Fachhochschule Nordwestschweiz
Hochschule für Architektur, Bau und Geomatik

How relevant is the aggregation bias with regards to mode choice in aggregated transport demand models?

Swiss Transport Research Conference 2023
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PROBLEM STATEMENT

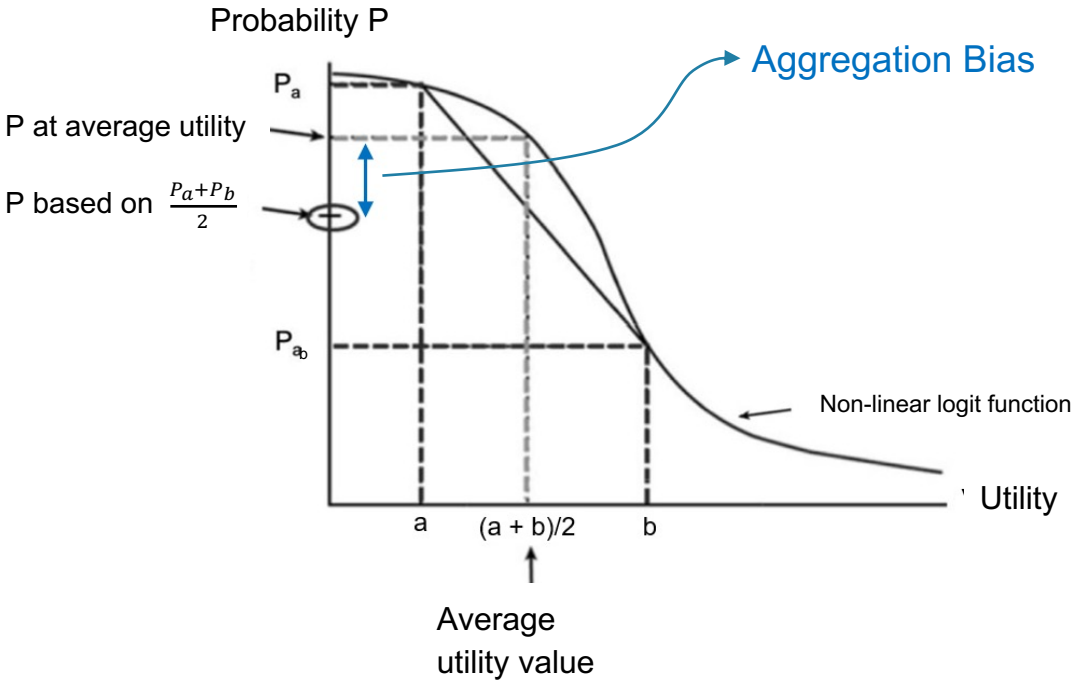
Starting point

- **Activity-based transport demand models (ABM)** are considered **«best practice»** in research and in practice
- **Aggregated models** still prevail in **«real practice»,** also in Switzerland
- Differences in **model sensitivity** with regards to **mode choice** due to:
  - Aggregation Bias
  - Tour vs. trip-based mode choice

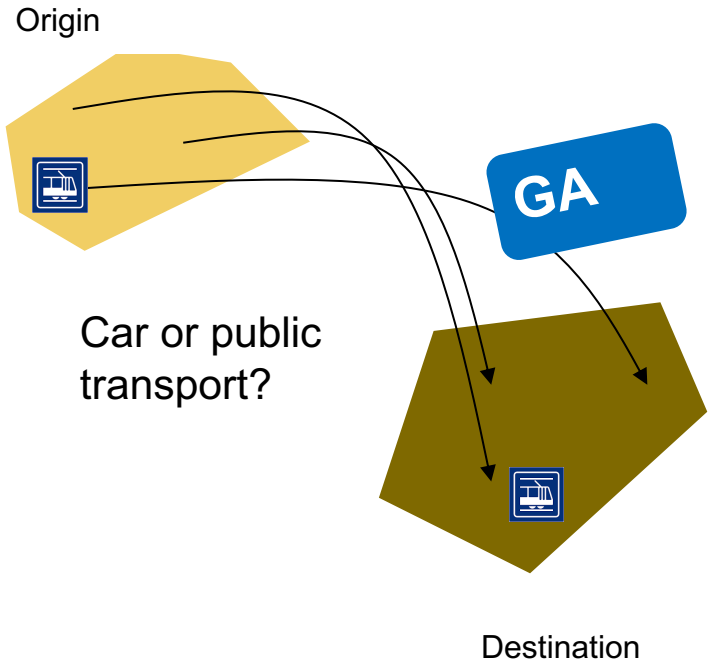
Research questions

- **How big** is the impact for typical model applications?
- Which **implications** can we derive **for the transition** from aggregated models to ABM?

AGGREGATION BIAS



MODE CHOICE BETWEEN TWO ZONES



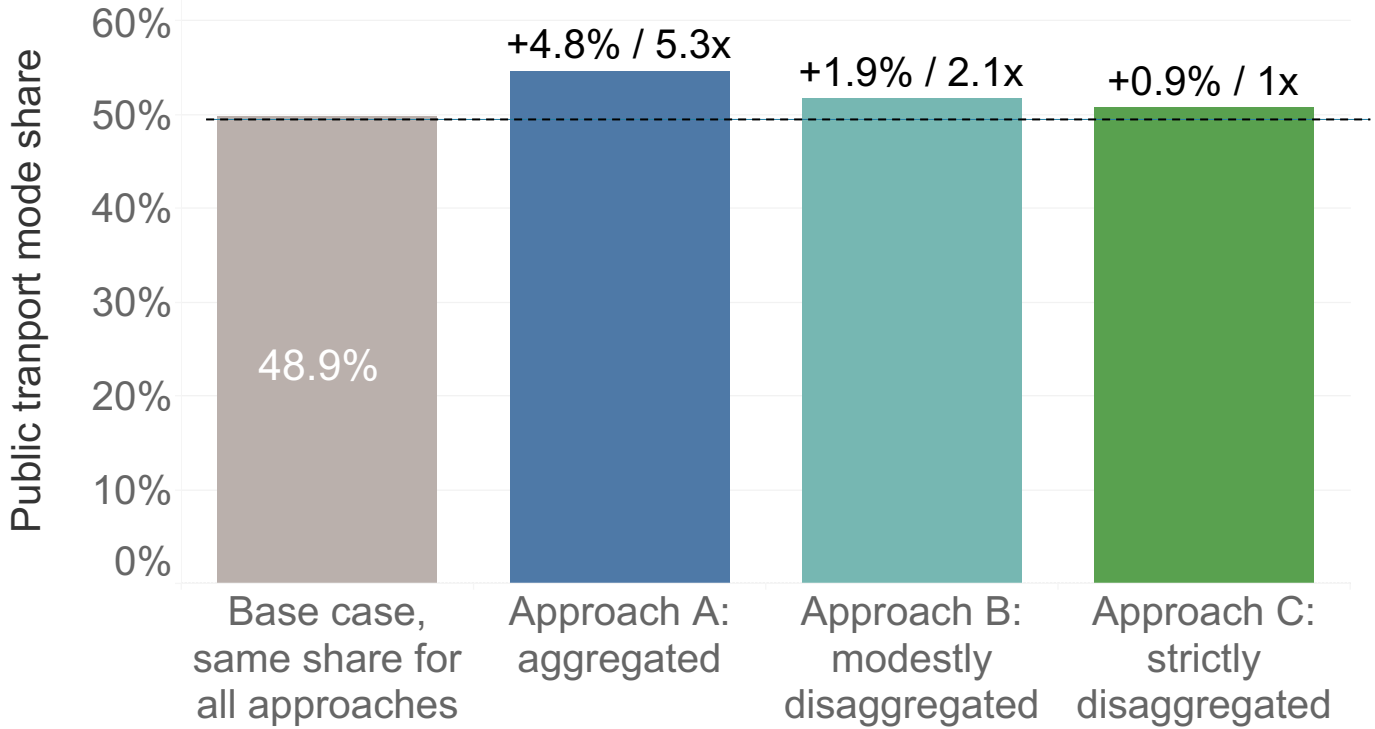
Variable	Attribute
Travel time by car	mean: 12.0 min stdev: 2 min
Travel time by public transport	mean: 14.4 min stdev: 2 min
Distance	6 km
Mobility tools	
Car available	44%
Travelcard for public transport	26%
Car and travelcard	14%
None	16%

Mode choice and cost parameters based on Swiss national transport model

STUDY SETUP

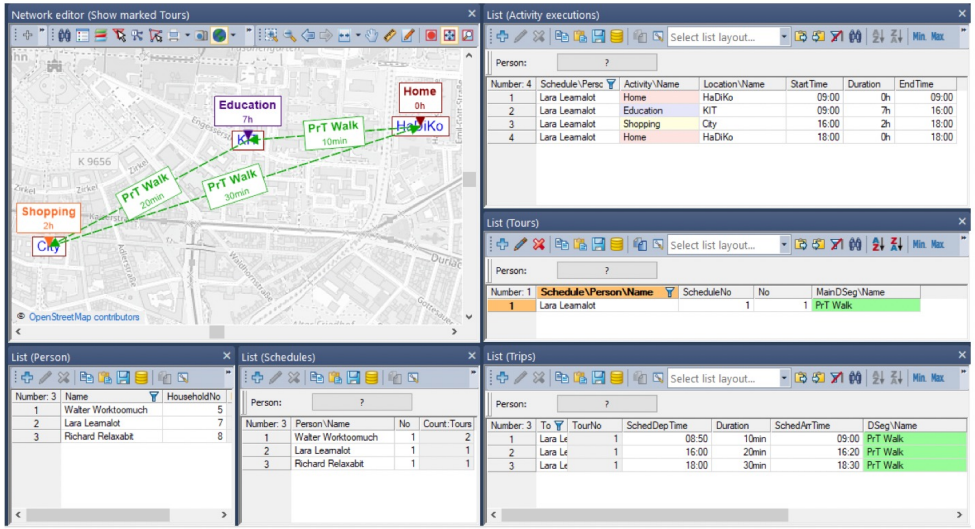
	Approach A: „Aggregated“	Approach B: „modestly disaggregated“	Approach C: „strictly disaggregated
Mode choice parameters	Same parameters for all approaches		
Availability of car and travelcard	Shares; additional utility	**Disaggregated; additional utility, if available**	**Disaggregated; defines availability of alternative**
Public transport travel cost	Same for all (average cost)	**Zero cost, if travelcard is available**	**Zero cost, if travelcard is available**
Travel time	Average between zones	**Random draw from normal distribution**	**Random draw from normal distribution**
Why?	Common practice	Practical compromise	How choice model has been estimated

IMPACT OF 30% FASTER PUBLIC TRANSPORT ON MODE SHARE



OVERVIEW

Starting point



Quelle: PTV Visum Handbuch (2022)

ABM-based PTV Visum model available for Halle (including Python code)

Setup

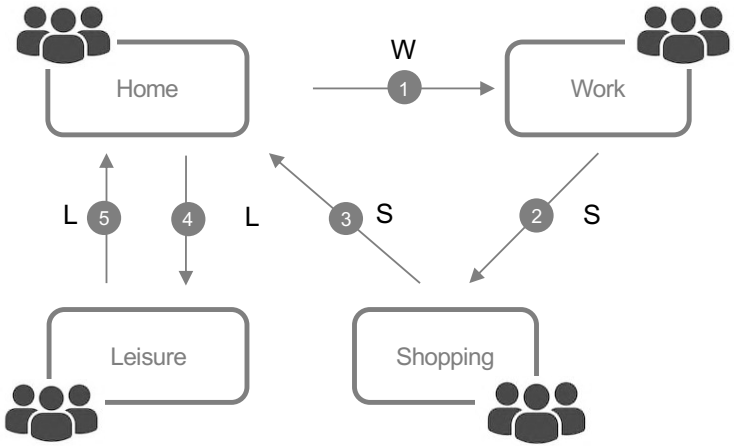
- **Derive aggregated demand matrices from ABM** travel demand model → “aggregated model”
- Both models share the **same network and travel demand**, but follow **different mode choice** approach
- **No heterogeneity of travel times** between zones

Key idea

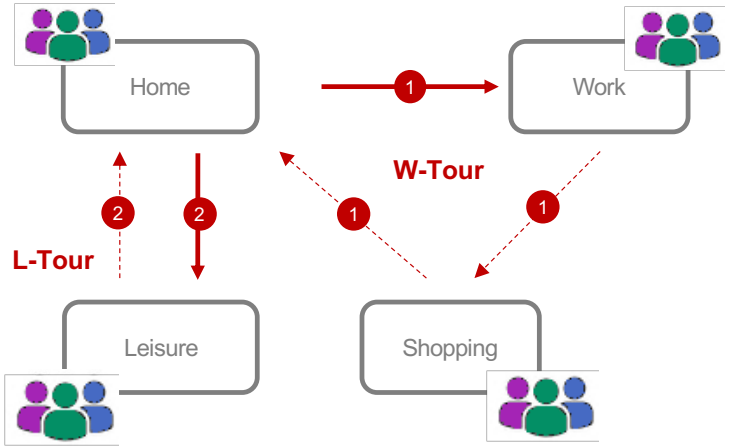
- Compare **impact of various transport measures on mode choice** using both models:
  - **Aggregation bias** due to **mobility tool ownership**
  - **Trip- vs. tour-based** mode choice approach

KEY DIFFERENCES IN MODE CHOICE IMPLEMENTATION

Aggregated mode choice



Disaggregated, tour-based mode choice



Tour-based mode choice

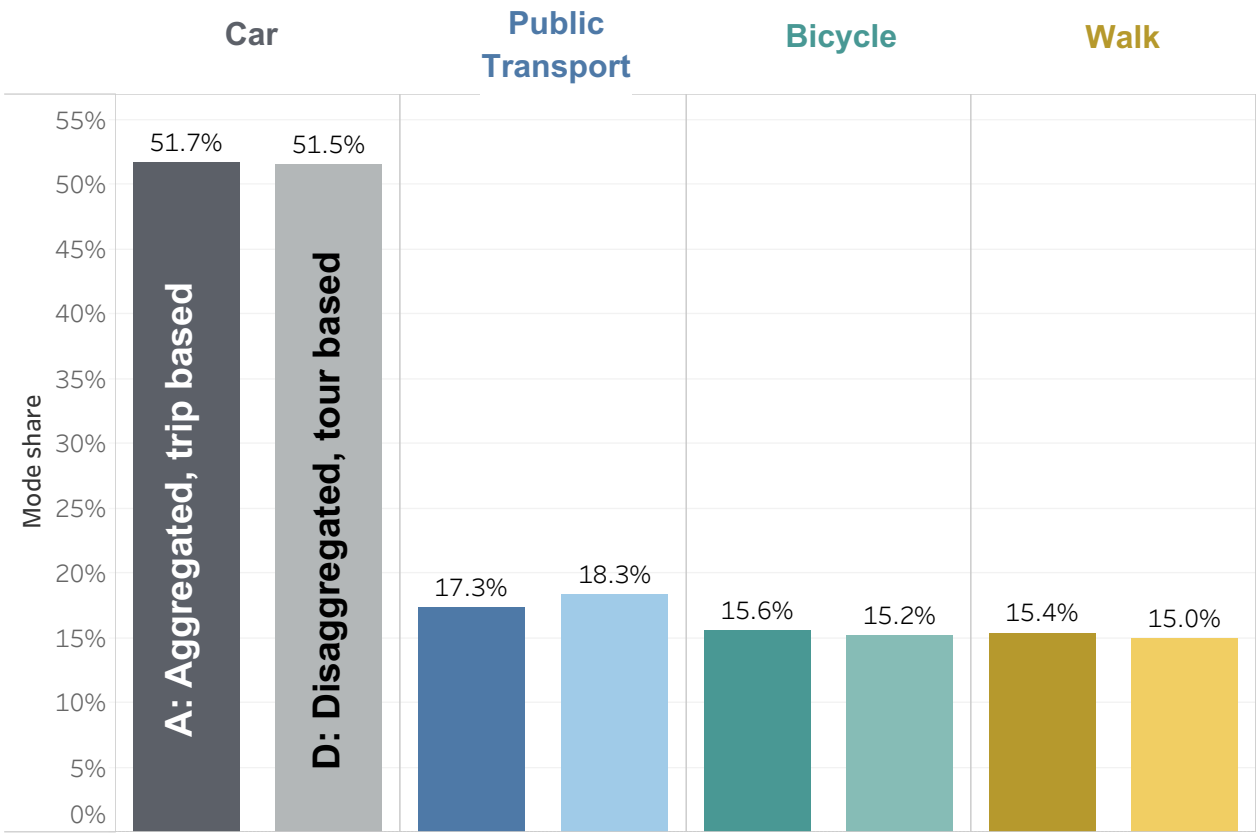
Trip information considered

Trip information **not** considered

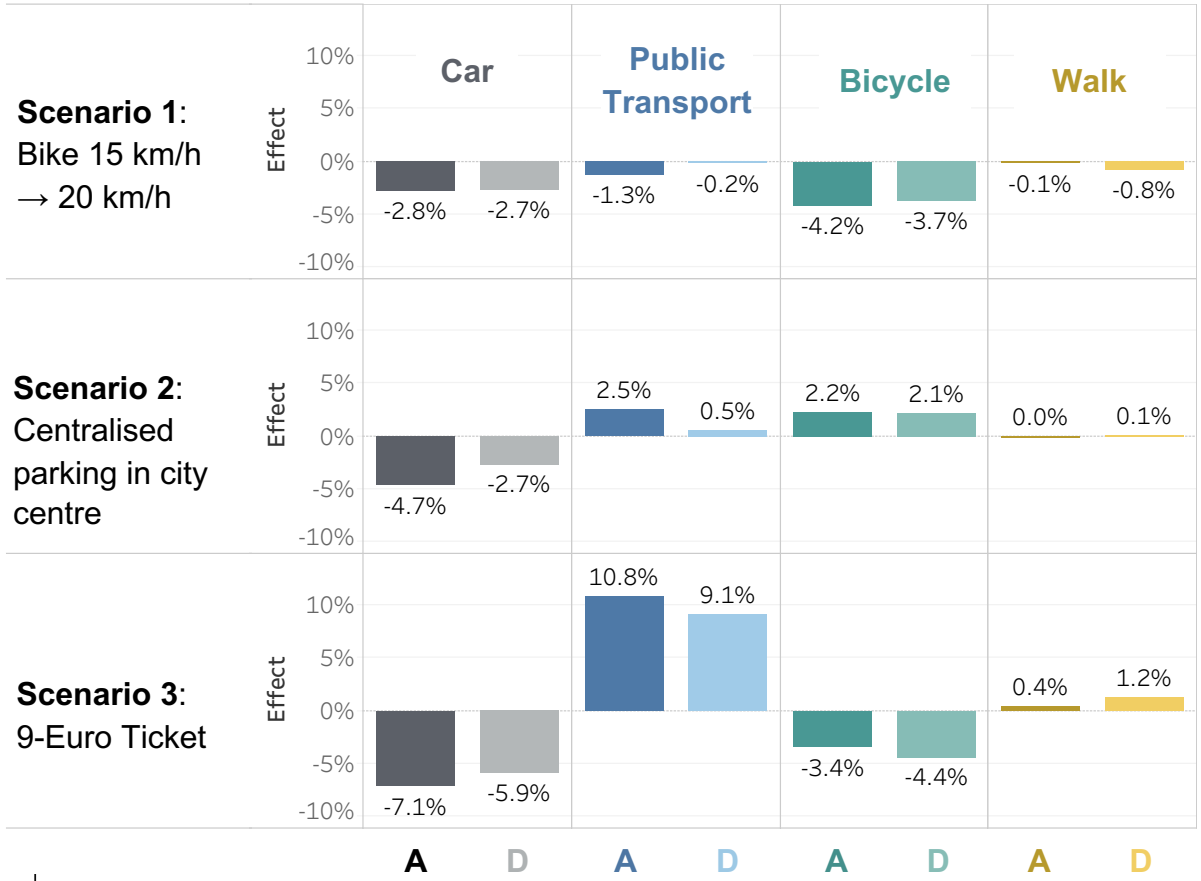
SCENARIOS

	Scenario 1: Faster bicycles	Scenario 2: Centralised parking in city centre	Scenario 3: 9-Euro Ticket
Implementation	• Increased speed on all bike links: 15 km/h → 20 km/h	• Parking in city centre cost the equivalent of 10 minutes egress walk	• 40% of the population with travelcard • Probability-based assignment of new travelcards
Aggregation bias implications	• Indirect through mobility tool ownership	• Direct through car availability • Persons without a car are not affected	• Direct through season card availability • Only holders of travelcards are affected: no cost
Trip vs. tour-based implications	• None	• ”Lag” on further trips in tour-based model	• Multimodal tours: effects on walking

BASE CASE: CALIBRATED MODE SHARES



EFFECTS



Disaggregated model leads to…

- Lower impact on pt mode share: differentiation for travelcard availability
- Lower impact on car mode share: differentiation for car availability
- Lower impact on car and pt shares: differentiation for travelcard and car availability
- Lower impact on walking: multimodal tours
- Higher impact on cycling: more direct effect for new travelcard holders

SYNTHESIS

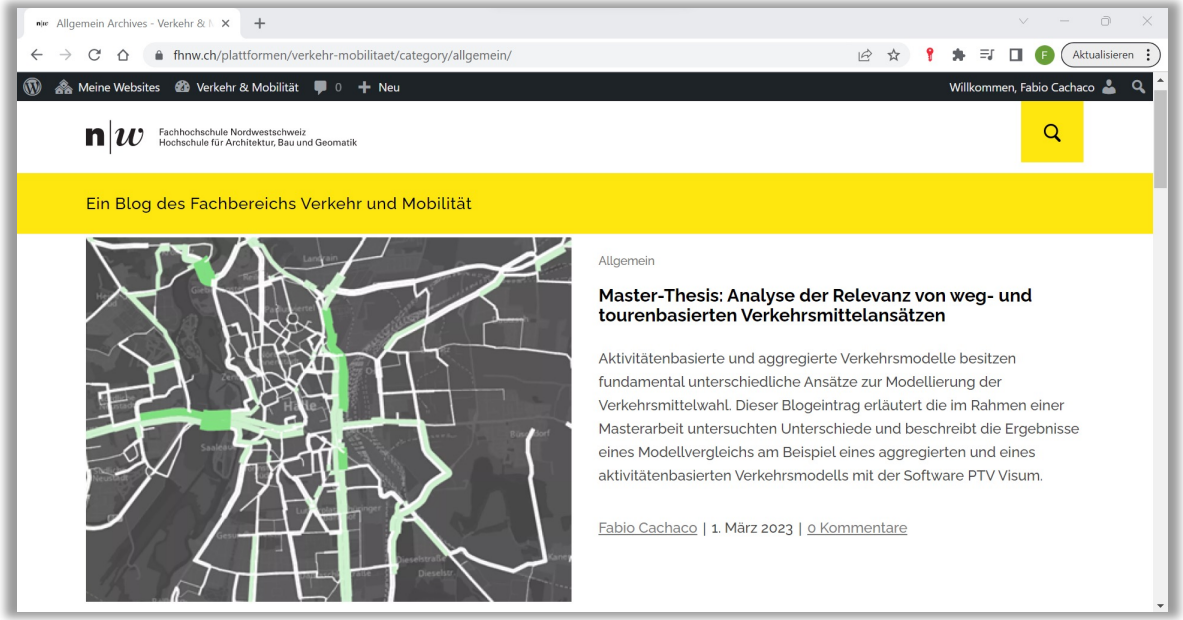
Key insights

- Aggregation bias causes the **disaggregated model generally to be less sensitive** with regards to changes that impact mode choice
- Using the **Halle case study** and realistic transport measures, the methodology related differences **amount to 0.5% to 2% mode share**
- Between certain OD-pairs the mode choice bias can cause the model to be **6x less sensitive** than an aggregated model

Recommendations for practice

- Ensure **consistency between** mode choice model **estimation and** its **application** in travel demand models
- If you switch to an ABM: formulate, estimate and apply mode choice
  - **based on tours, not trips**
  - **for behaviourally homogenous groups**, e.g. public transport season card holders, car holders, **not (just) trip purpose**

MORE INFORMATION

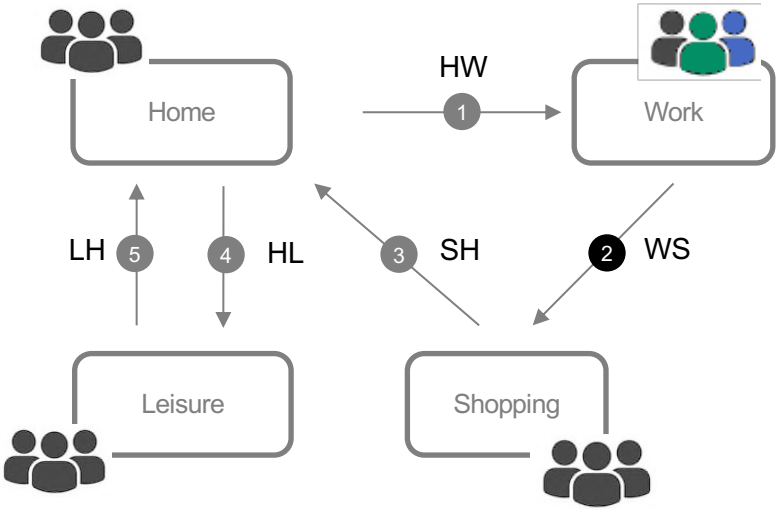


More information online

- Blogpost
- MSc thesis
- STRC Paper

APPENDIX

AGGREGATED, TRIP-BASED VS ACTIVITY BASED MODELLING APPROACH



Limitations of aggregated approach

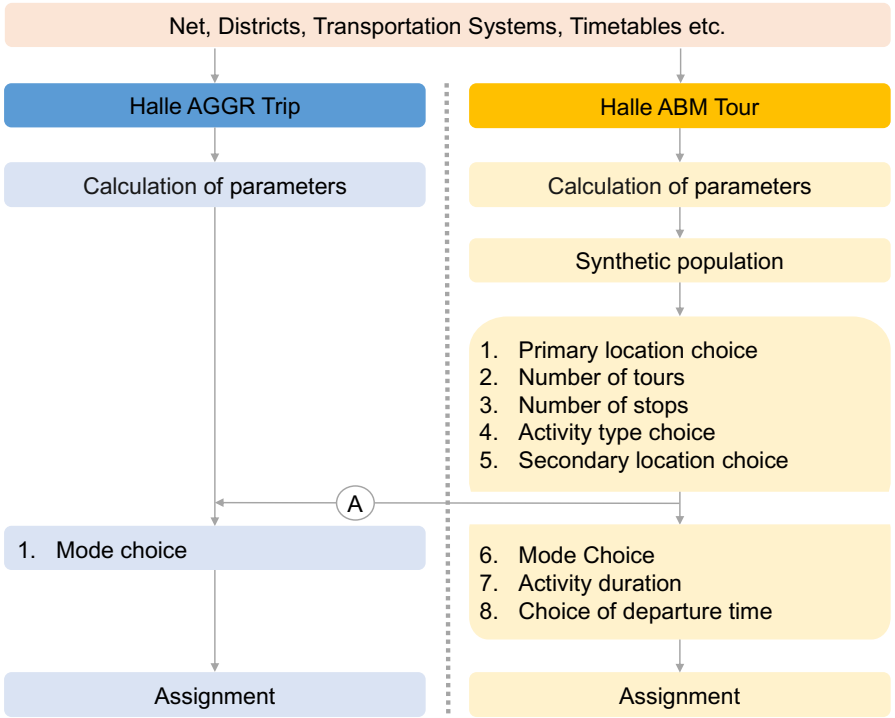
- (aggregate) socio-demographic information is only available for home-based ●, but no other trips ●
- Mode choice is subject to aggregation bias
- Mode choice on the level of trips, but not tours
- Activity chains remain fixed
- Limited sensitivity with regards to activity and trip timing

Scope of this work

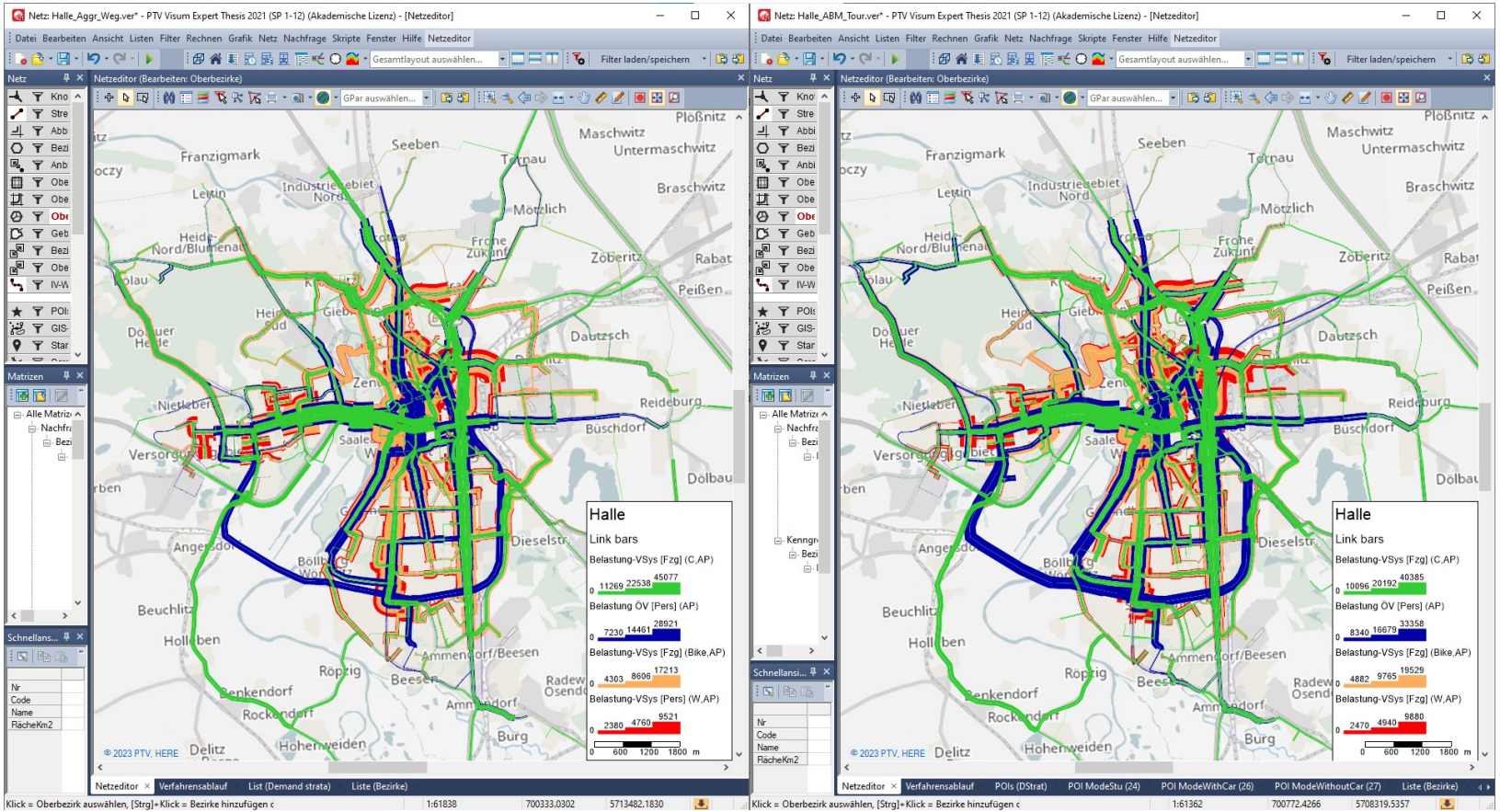
MODEL SETUP

Approach

1. Derive trip-purpose specific, aggregated travel demand matrices from ABM
2. ABM model: extend tour-based mode choice model to consider mobility tool ownership
3. Calibration of both models: consistent modal split
4. Application of both models to analyse impact on transport measures on mode choice



MODELLE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Netz: Halle_ABM_Tour.ver* - PTV Visum Expert Thesis 2021 (SP 1-12) (Akademische Lizenz) - [Netzeditor]
Halle
Link bars
Belastung-VSys [Fzg] (C,AP)
Belastung ÖV [Pers] (AP)
Belastung-VSys [Fzg] (Bike,AP)
Belastung-VSys [Pers] (W,AP)
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