E-Bikes in Transport Models: A Review of Current Practice and Literature

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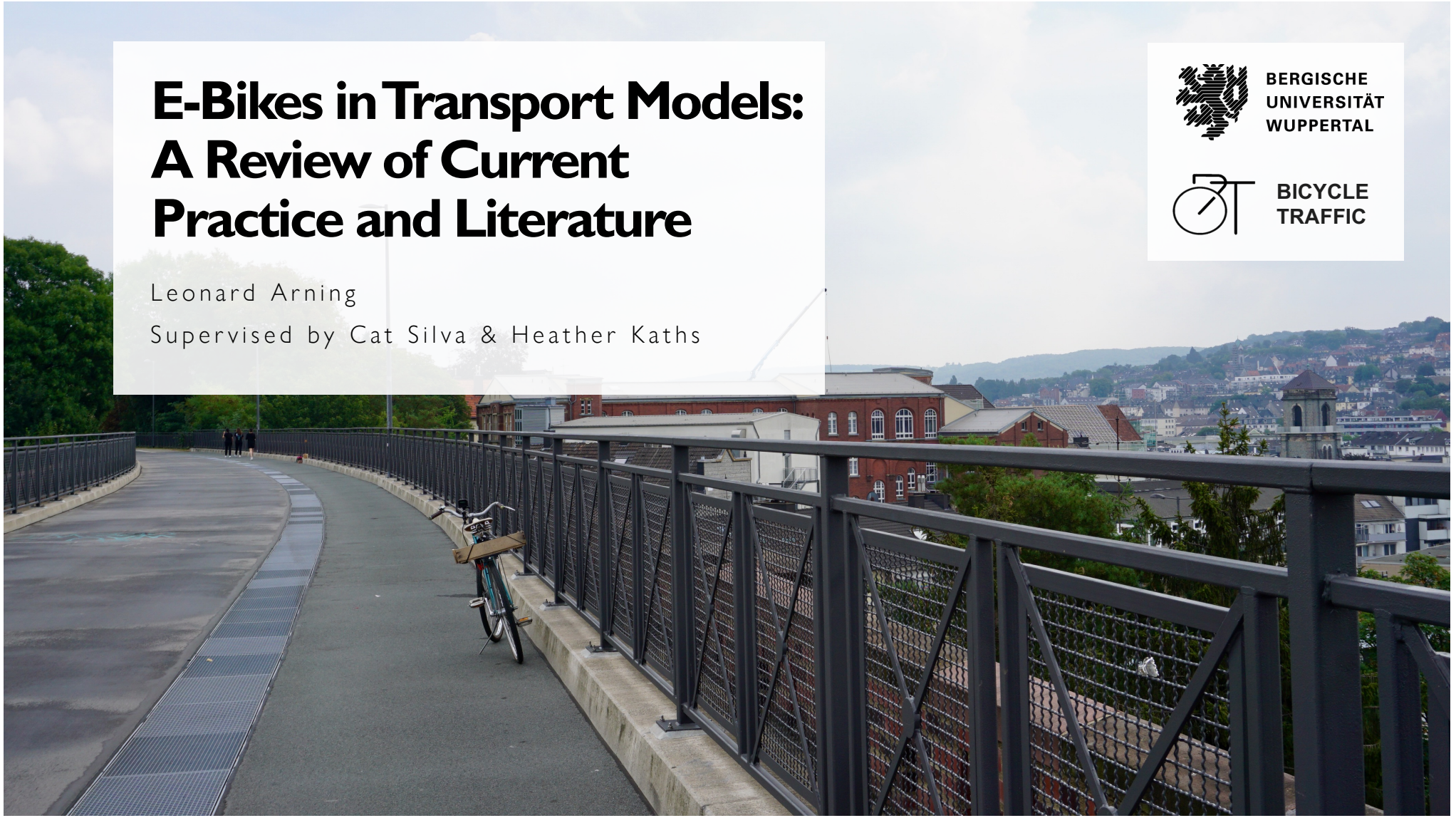
Supervised by Cat Silva & Heather Kaths



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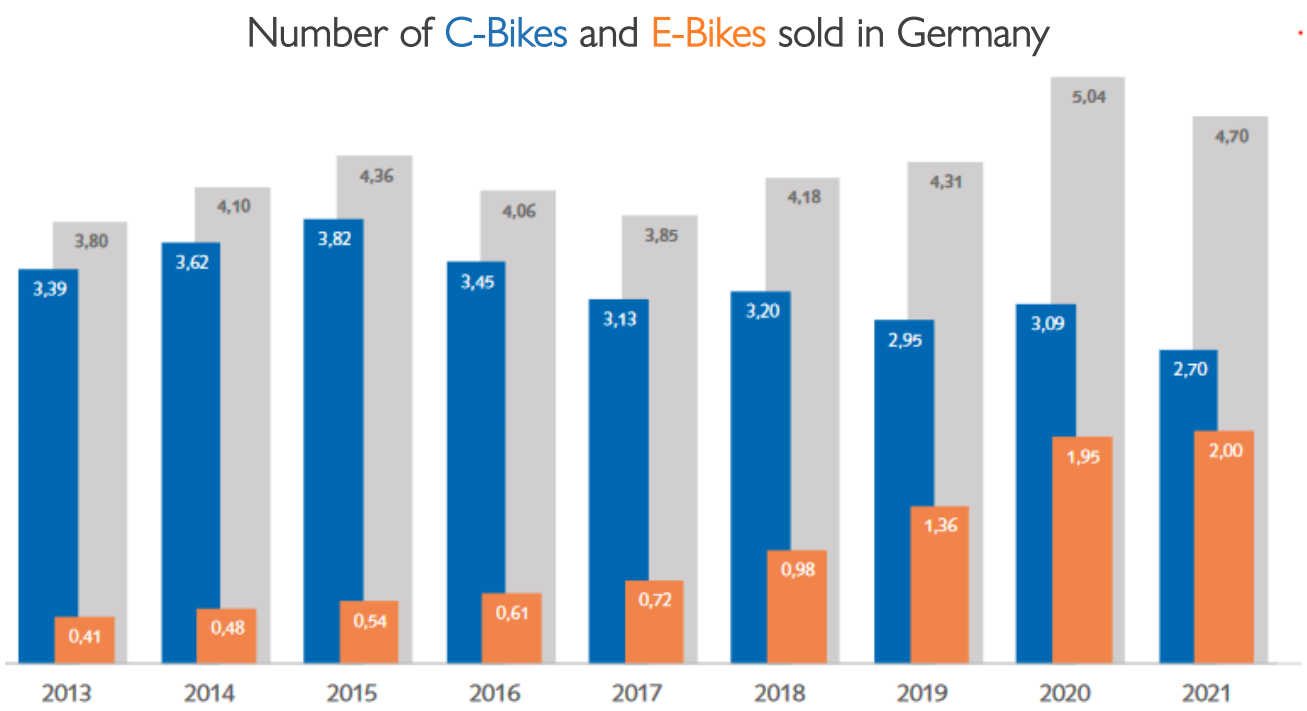
Motivation



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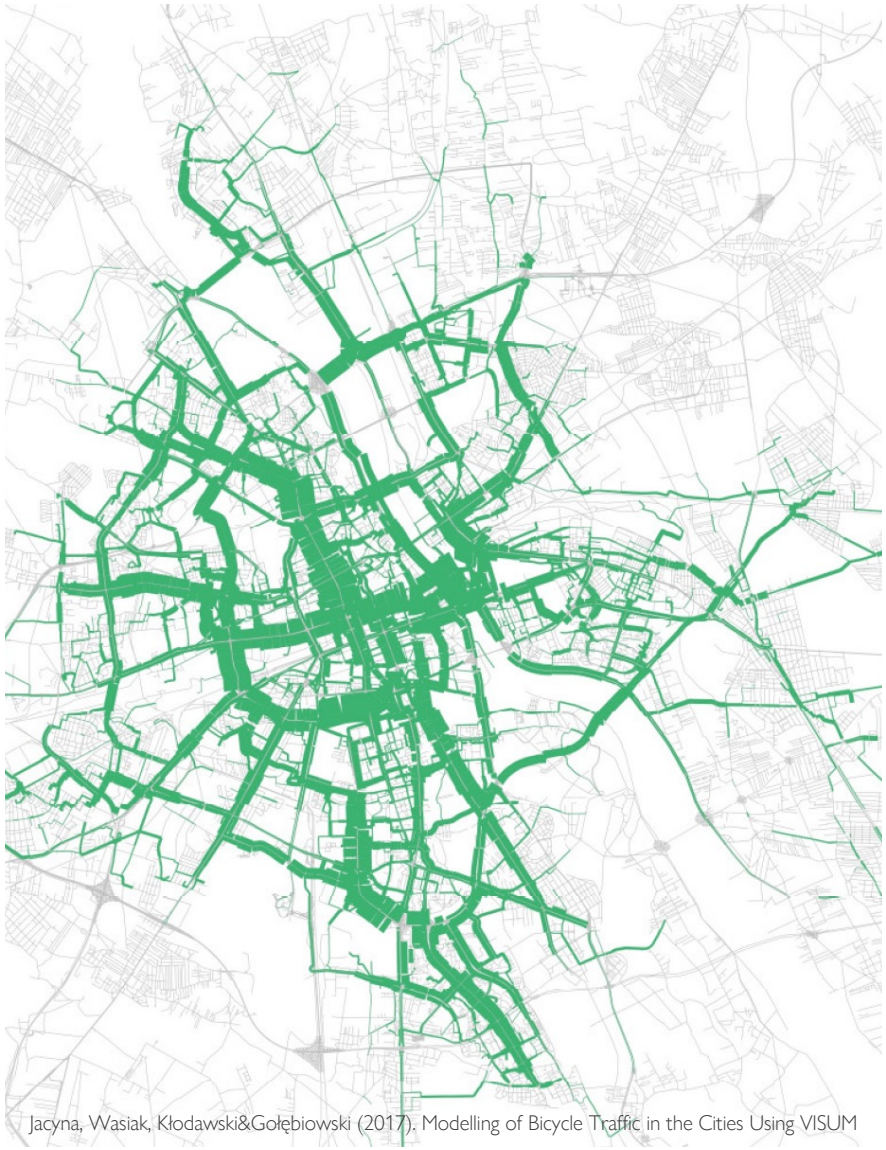

Jacyna, Wasiak, Kłodawski&Gołębiowski (2017). Modelling of Bicycle Traffic in the Cities Using VISUM

What is a macroscopic transport model?

- Simplified representation of real-world transportation system
- Four-Step-Model:
  - Trip generation
  - Trip distribution
  - Mode choice
  - Route choice
- Analysis, forecasting and policy evaluation

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Differences between e-bikes and c-bikes

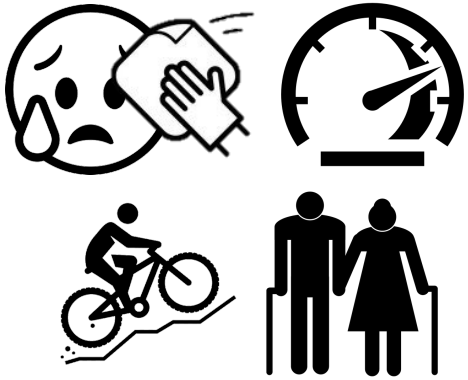

TABLE 1 Exemplary transport models and their considerations regarding e-bikes

Model	Area	Model specification
GM4	Netherlands	Distinct e-bike mode. E-bike LOS (travel time, distance) same as c-bike, but mode and route choice adjusted by separate estimation of travel time coefficient. Scenario-based e-bike ownership distinct by age group. Combined cycling-mode for transit access and egress journeys.
COMPASS (Under development)	Copenhagen	Explicit composite cycling-mode. Fraction of cycling trips that use e-bikes (f) and travel time reduction factor for e-bikes (15%) are manual inputs. Travel time is reduced across all cycling trips by multiplying with 1-(f-0,01)*0.15. No differentiation between c- and e-bikes in model output.
Verkehrsmodell Berlin 2030	Berlin	Combined cycling-mode
OTM 7	Copenhagen	Combined cycling-mode
Cynemon	London	Combined cycling-mode
NTM6/RTM	Norway	Combined cycling-mode
MODUS 3.1	Paris	Combined cycling-mode
LuTRANS	Stockholm County	Combined cycling-mode
NPVM	Switzerland	Combined cycling-mode
Landstrafikmodellen	Denmark	Combined cycling-mode, in trip assignment combined with walking
2016 City of Los Angeles Travel Demand Model	Los Angeles	Combined cycling-mode, no trip assignment
NYBPM	NYC	Combined cycling-mode, no trip assignment
Regional Travel Demand Model	Northeastern Illinois	No cycling-mode
VENOM	Amsterdam Metro Area	No cycling-mode (new regional models to be devolved from GM4)

Are there models that consider e-bikes?

- North America: cycling not considered at all
- Europe: cycling, but no differentiation between e- and c-bikes
- COMPASS and GM4: first attempts
- Both little practical and scientific work

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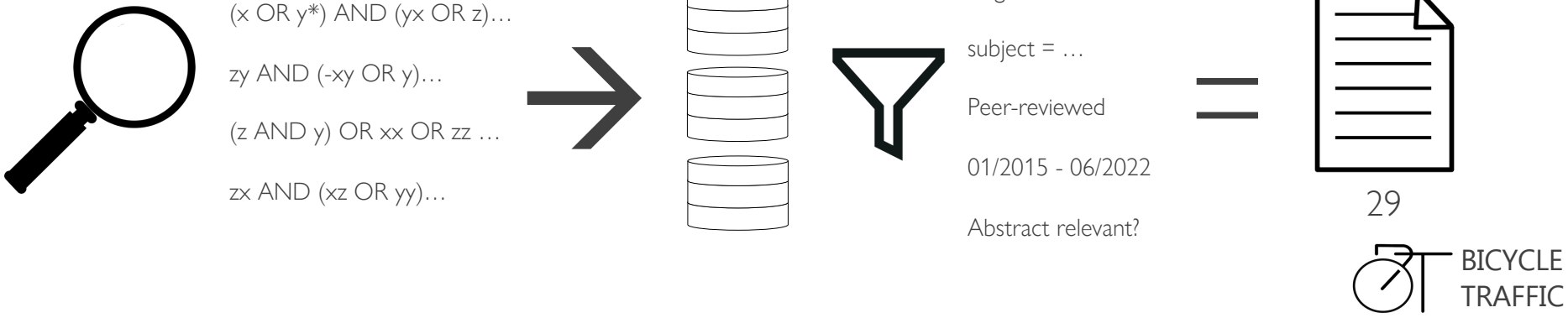
Research questions

What research exists explicitly regarding the macroscopic modelling of e-bike traffic?

What can we learn from adjacent fields of research about how to model e-bike traffic?

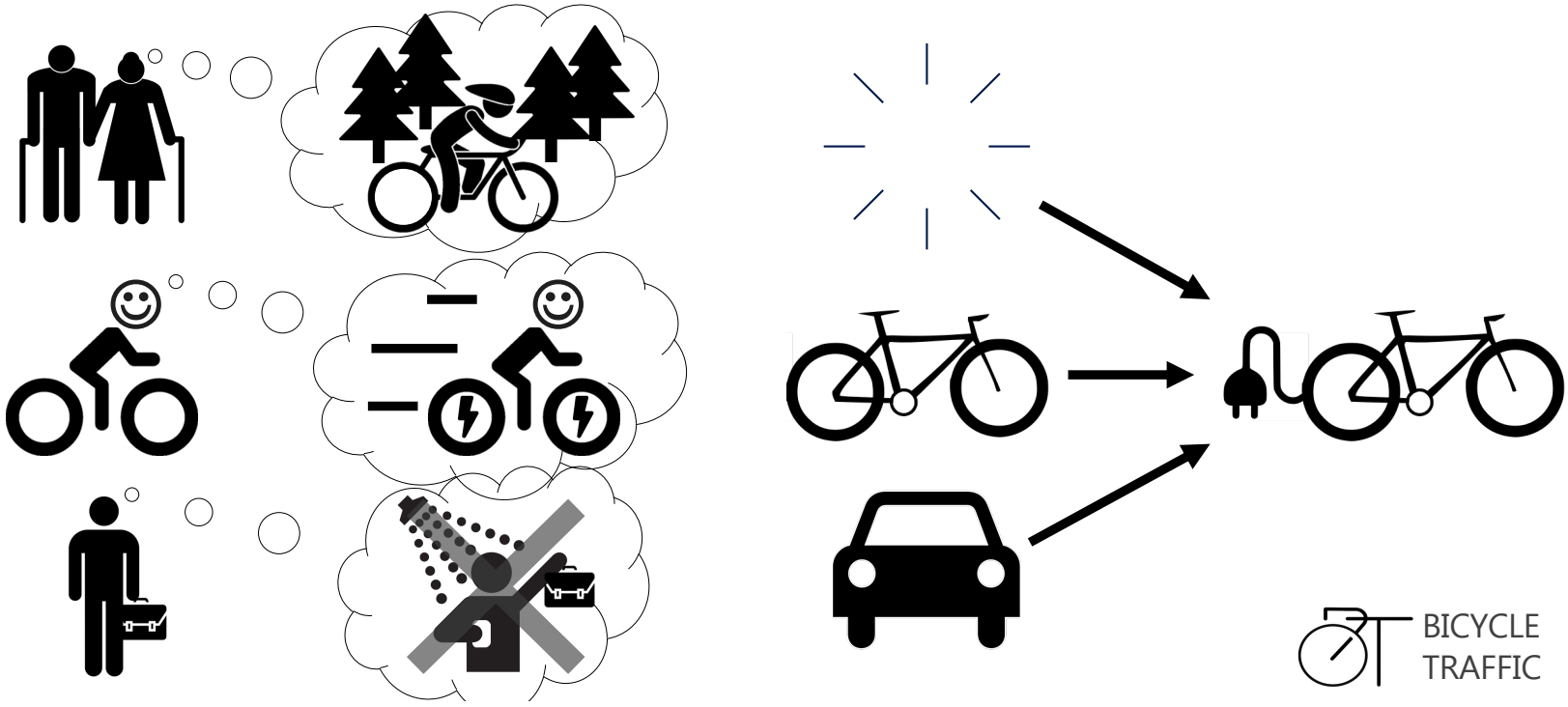
Method

- Four research fields with dedicated search strings:
    1. Impacts of infrastructure, topography and demographics on e-bike use
    2. Impacts of price on e-bike use
    3. Impacts of e-bikes on mode choice
    4. Impacts of e-bikes on route choice



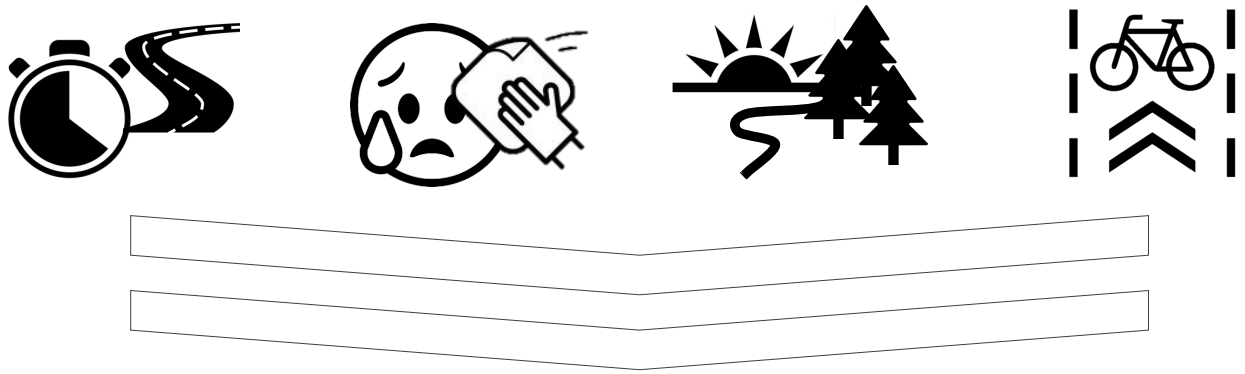
Key Learnings

1: E-bike ownership and usage characteristics must be differentiated by person groups



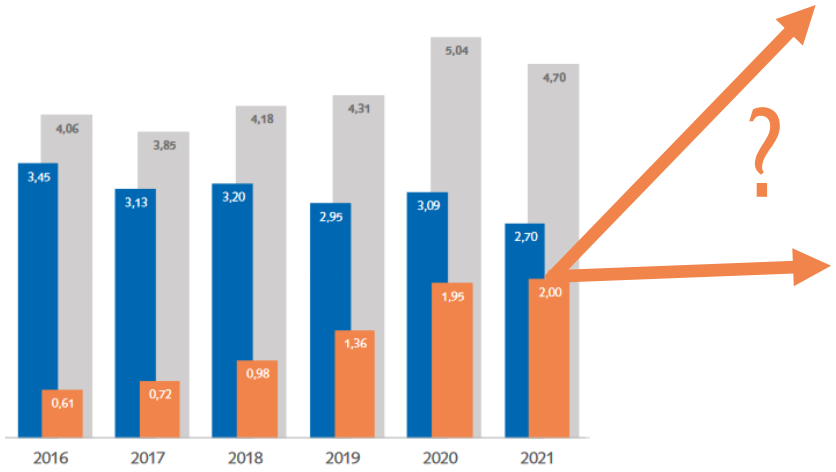
2: E-bike utility in mode and route choice must include more aspects than just travel time

Evidence from qualitative and quantitative research for relevance of:



$$C_{ijkr} = \beta_1 * S_{1ijk} + \beta_2 * S_{2ijk} + \beta_3 * S_{3ijk} + \beta_4 * S_{4ijk} + \cdots$$

3: Model must allow for scenario-setting regarding e-bike availability



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Societal factors and e-bike prices cannot be forecasted long-term

→future parameter values uncertain,
100 % dynamic modelling not reliable

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However: modelled e-bike use should be sensitive to measures!

→e-bike should not just be static share of overall cycling

Compromise as a solution:

- Total share of e-bike travel among cycling is static,
- but share of cycling overall and e-bike share on OD-pair-level is dynamic

Allows for

- scenario-setting regarding e-bike propagation at large,
- while retaining sensitivity on a local scale

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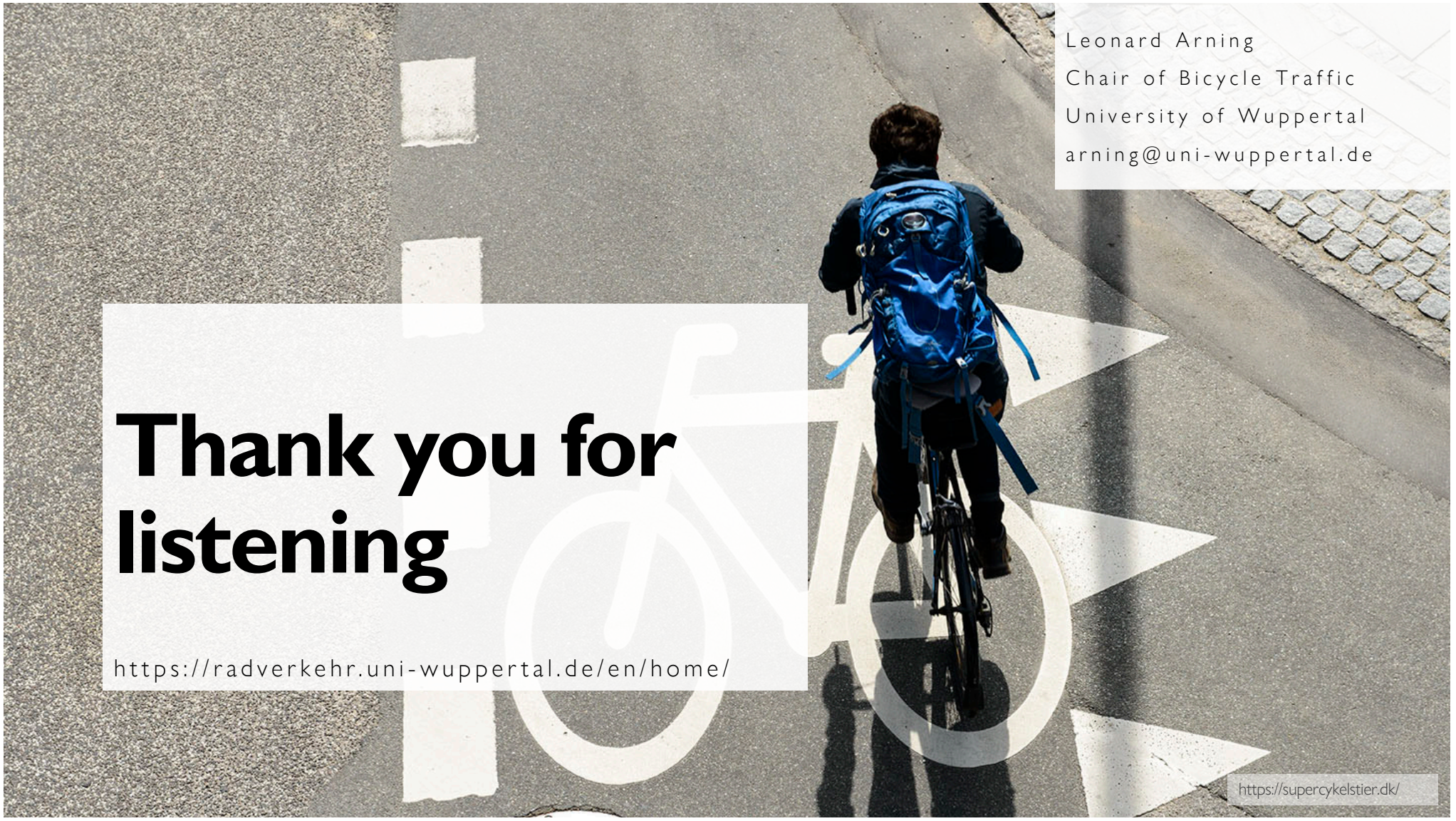
Outlook

Outline for a research project

- Estimating mode choice based on MiD mobility survey
- Estimating route choice based on Stadtradeln trajectory data
- Integration into three municipal transport models
- Application of enhanced municipal models to e-bike-specific use cases

→First project of its kind



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Thank you for listening

https://radverkehr.uni-wuppertal.de/en/home/

https://supercykelstier.dk/

Bonus slides

Shortcomings

- E-bike definition leads to exclusion of research carried out in China and India
- Search strings resulted in sources that were relevant not to this, but other research fields
  →might missed some relevant sources from the literature
- Exclusion of non-English sources
  →dominance of anglophone world, Nordic countries and the Netherlands
- E-bike sharing

TABLE 2 Setup and results of the systematic literature review

Source		Research field			
		1: Impacts of infrastructure, topography and demographics on e-bike use	**2: Impacts of price on e-bike use**	**3: Impacts of e-bikes on mode choice**	**4: Impacts of e-bikes on route choice**
Search String		(infrastructure OR locale OR topography OR demograph* OR "user groups") AND (e-bike OR "electric bicycle" OR pedelec) AND (ownership OR purchase OR acquisition)	(subsid* OR campaign OR incentive) AND (e-bike OR "electric bicycle" OR pedelec) AND (ownership OR purchase OR acquisition)	(e-bike OR "electric bicycle" OR pedelec) AND ("mode choice" OR modal)	(e-bike OR "electric bicycle" OR pedelec) AND ("route choice" OR path)
Web of Science	Filter			WOS categories: Transportation OR Transportation Science Technology	
	Results	16	8	35	20
	Useful results*	3	3	8	3
TRID	Filter			subject=pedestrians and cyclists	
	Results	15	8	65	18
	Useful results*	3 (+1 unavailable)	3	12	3 (+1 not available)
EBESCO	Filter	peer reviewed; subject=electric bicycles	peer reviewed	peer reviewed; subject=electric bicycles	
	Results	20	39	48	41
	Useful results*	3	3	7	3

E-Bike ≠ **E-Bike**

Fishman&Cherry (2016). E-Bikes in the Mainstream: Reviewing a Decade of Research