Theory & Model Development for Active Modes

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Theory for active modes in urban environments

Modelling route and mode choice, and activity scheduling

Activity-travel choices

Choice sets

Theory and modelling of acquiring and storing spatial knowlegde

Wayfinding & Decision-Making in the City

Outline

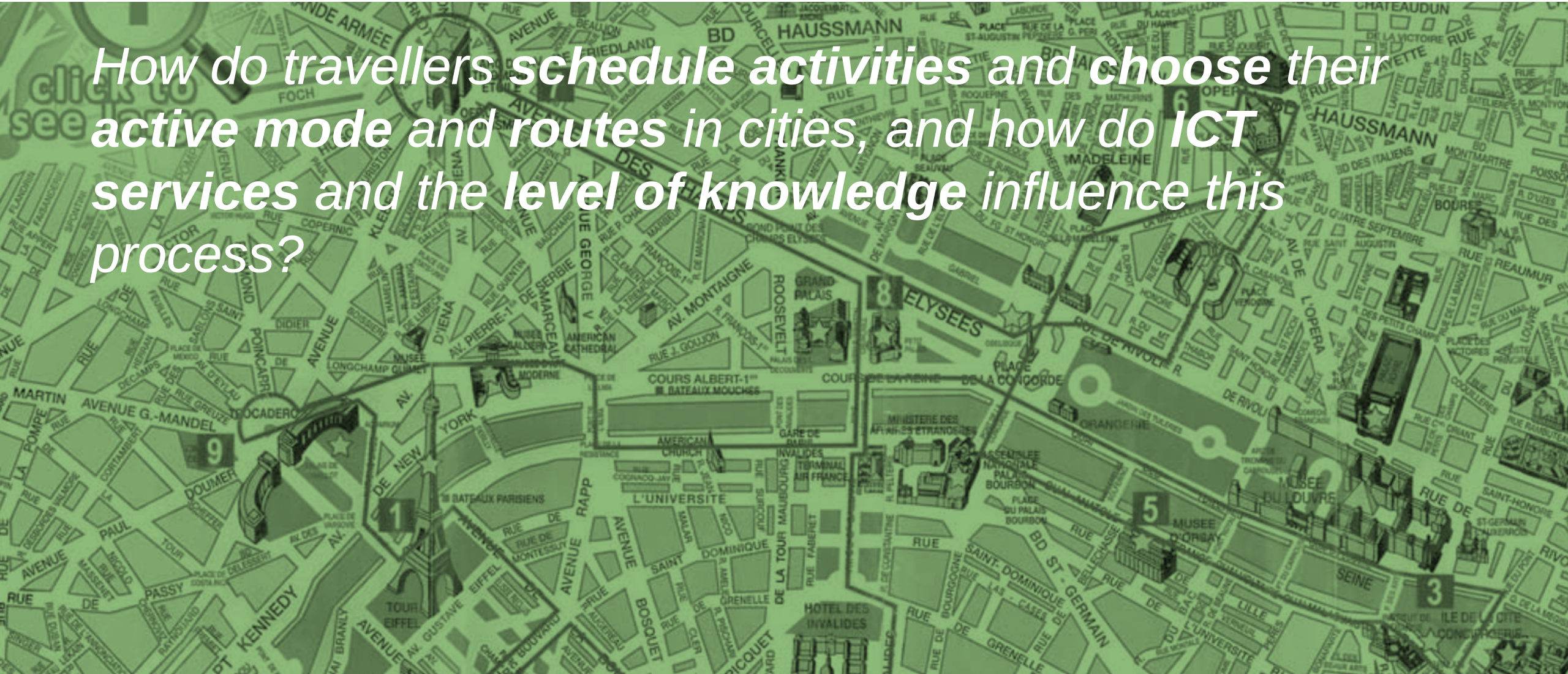
- Research Questions
- Problems
- Experiment
- Acquiring Spatial Knowledge
  - Conceptual Framework
  - Case Study Perceived Distances
  - Future
- Modelling Route & Mode Choice and Activity Scheduling
  - Conceptual Framework
  - Case Study Route Choice
  - Future
- Societal Relevance, Future and Now

Research Questions

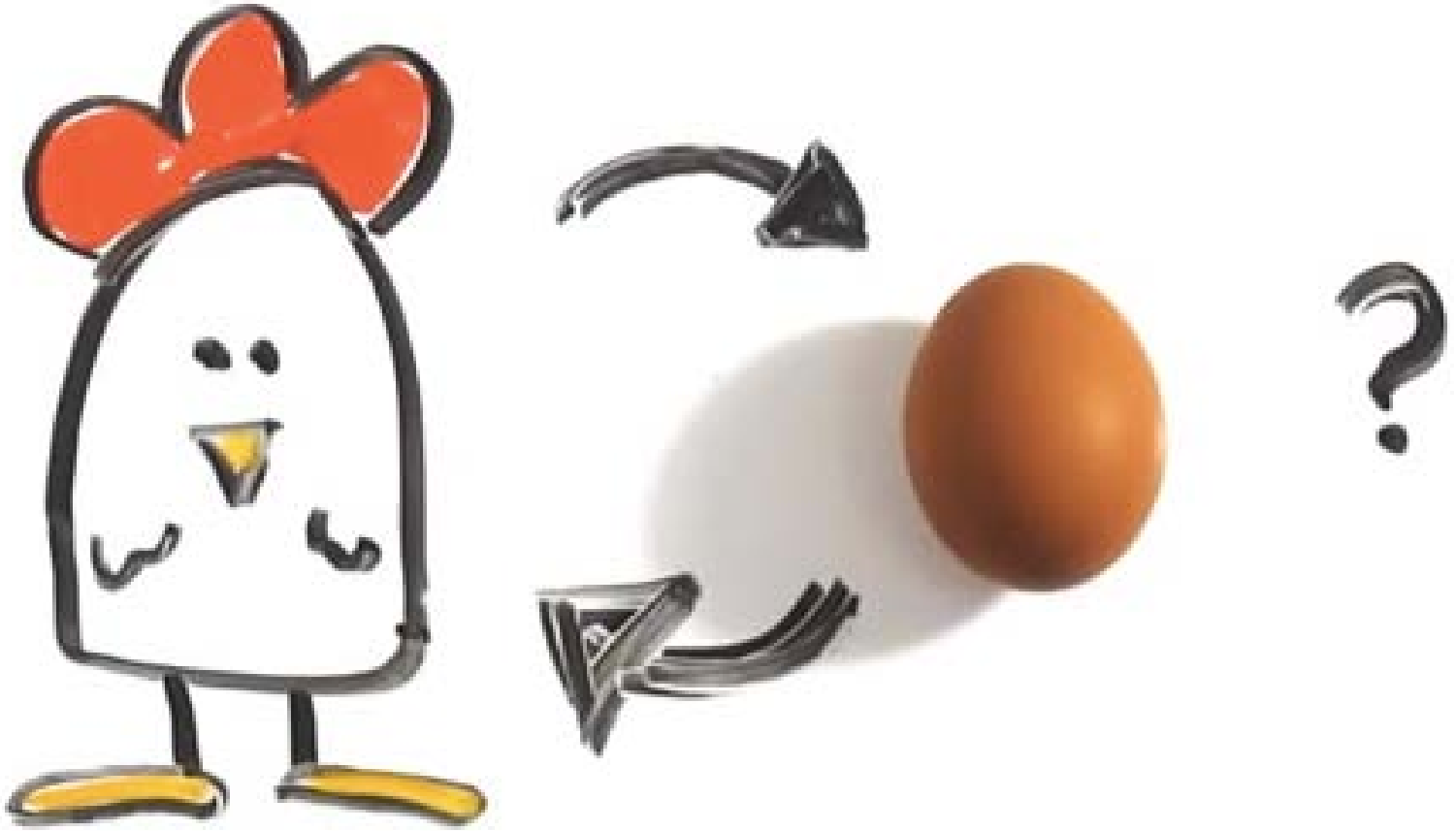
*How do active modes **acquire, memorize** and **utilize** **spatial knowledge** in cities & how do **ICT services** and **social interactions** impact this **urban wayfinding behaviour**?*

Was does the city in your mind look like?

Research Questions



Decision-Making Problem



Active Intermezzo

Option 1

Option 2

Imagine that we go for drinks to the Foodhallen after this presentation.

I am familiar with Amsterdam

I am not familiar with Amsterdam

I am familiar with the Foodhallen

I am not familiar with the Foodhallen

I will ask someone I know

To go together

I will go alone and see everybody

at the Foodhallen

I think it will be around 20 minutes

I think it will be around 5 km

I do not need any information

To find my way there

I will need information

I first explore (all) my options

I’ll see what I do when I stand outside

I first choose which mode I will take

I first choose which route I will take

The Westerkerk is North of the route

The Westerkerk in South of the route

The Answer to the Previous Question …

I didn’t know, I followed other people

I knew where the Westerkerk is located

I will take the tram

I will use an active mode

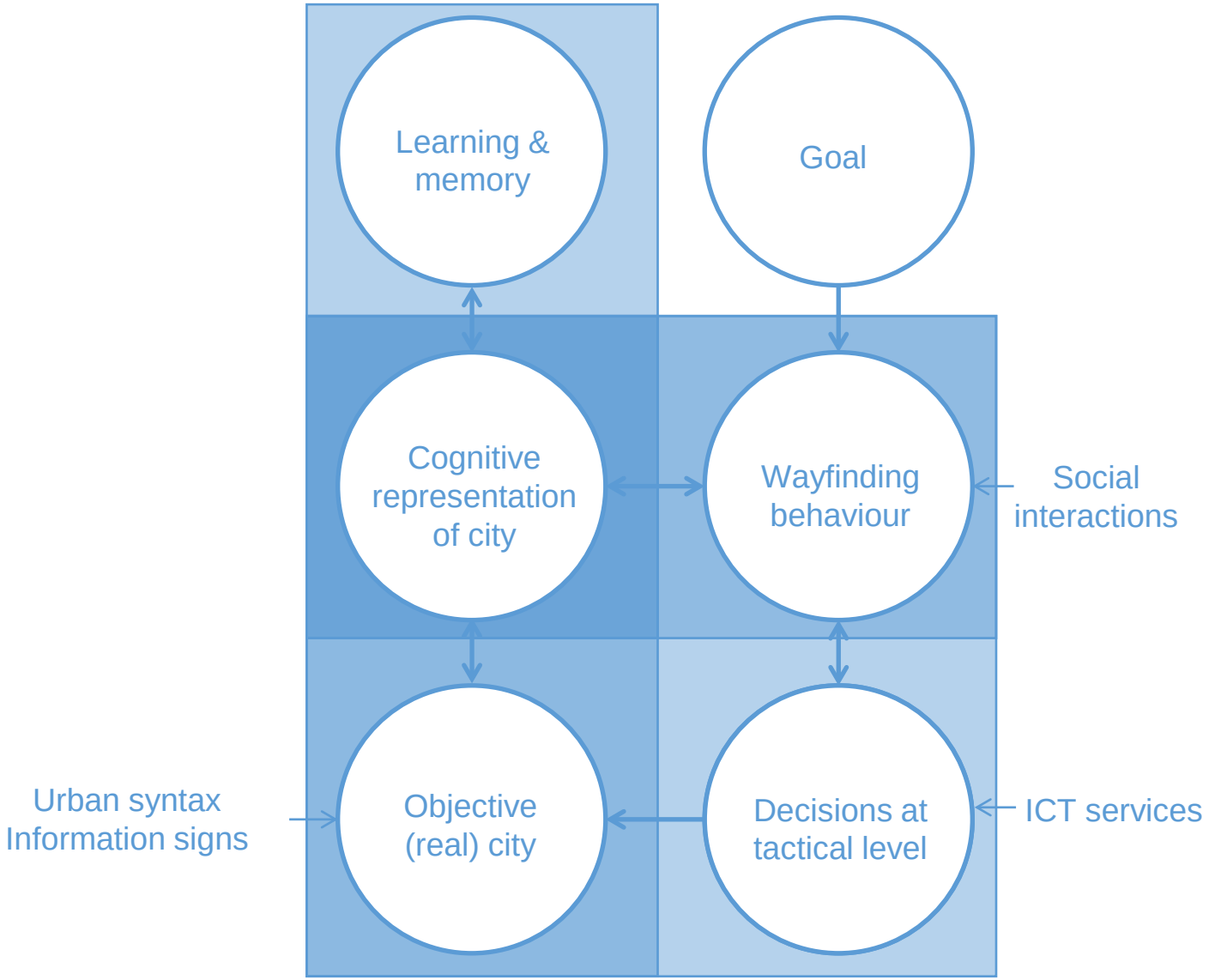
I will follow the canals

I will not pay attention to the canals

Discussion

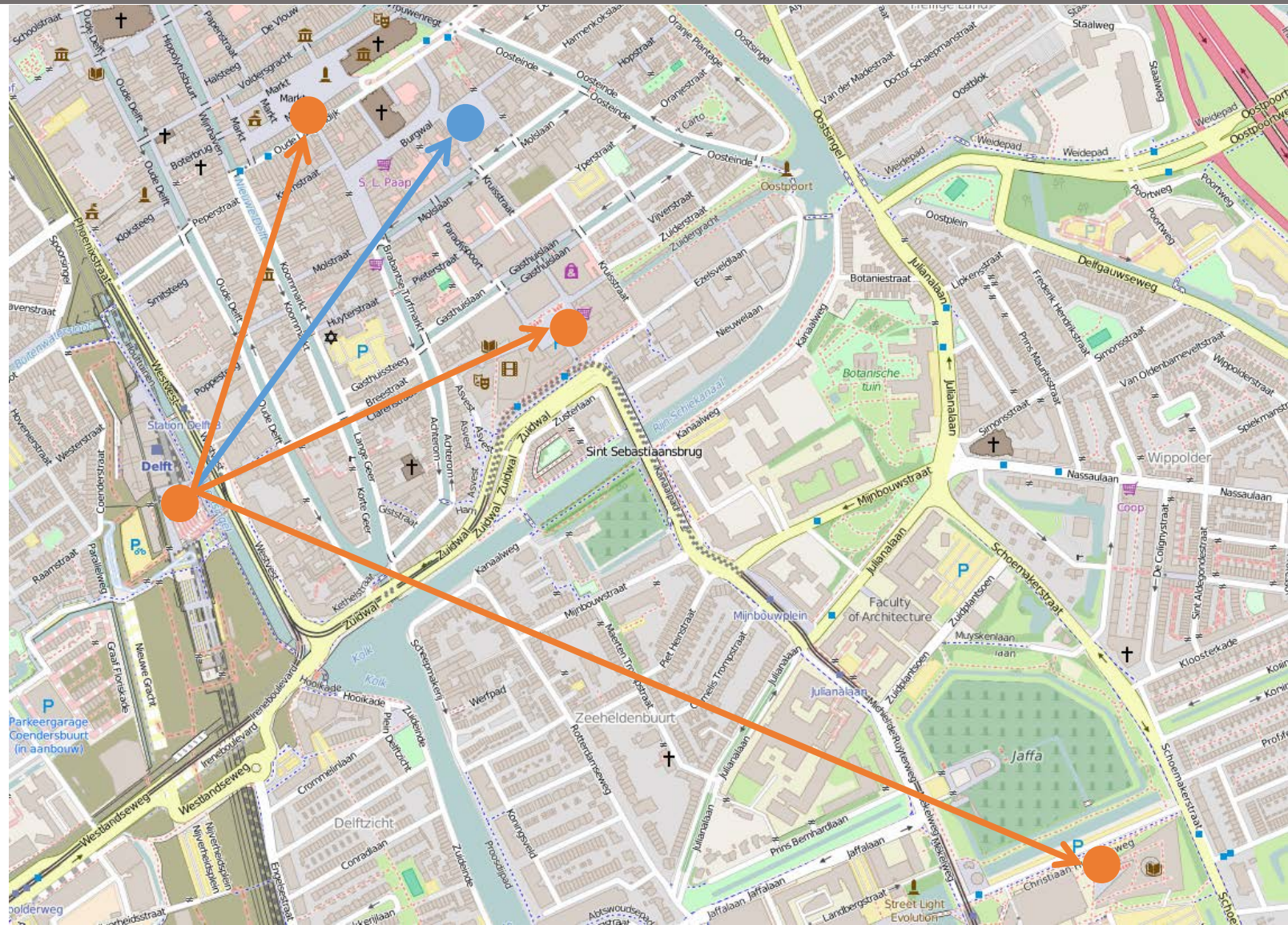
- Differences?
- Did you look to other people?
- What did you notice?

Conceptualized Theory on Strategic Level



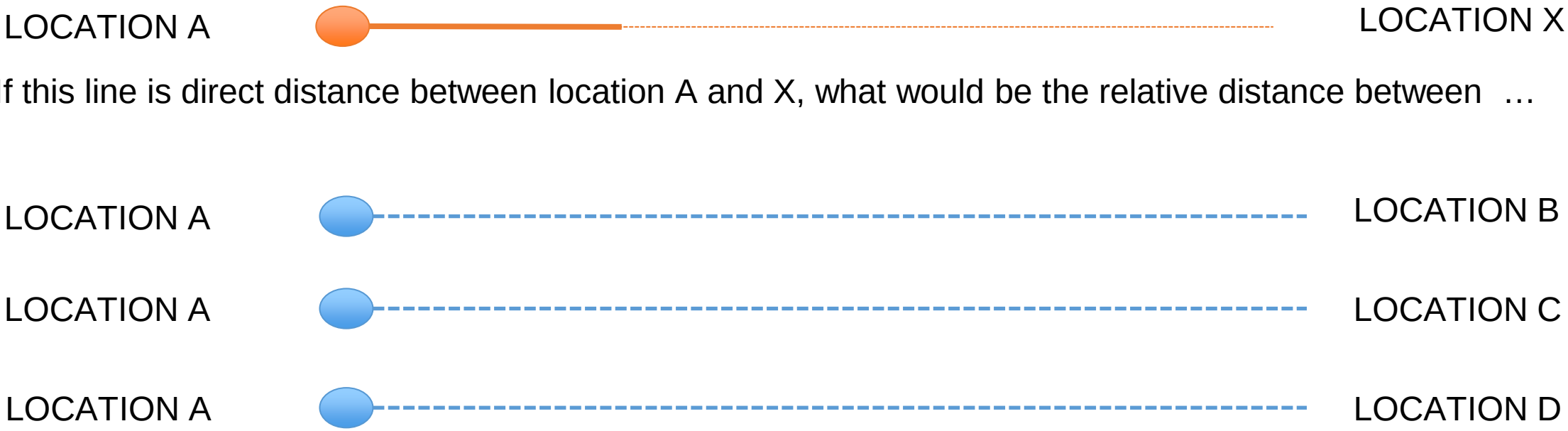
Experimental Case Study – Perceived Distances

- Locations of Interest
- Experimental Site
- Imagine yourself standing at a location of interest this is the distance (or direction) to the experimental site
- Estimate the distances (or directions) towards to other locations



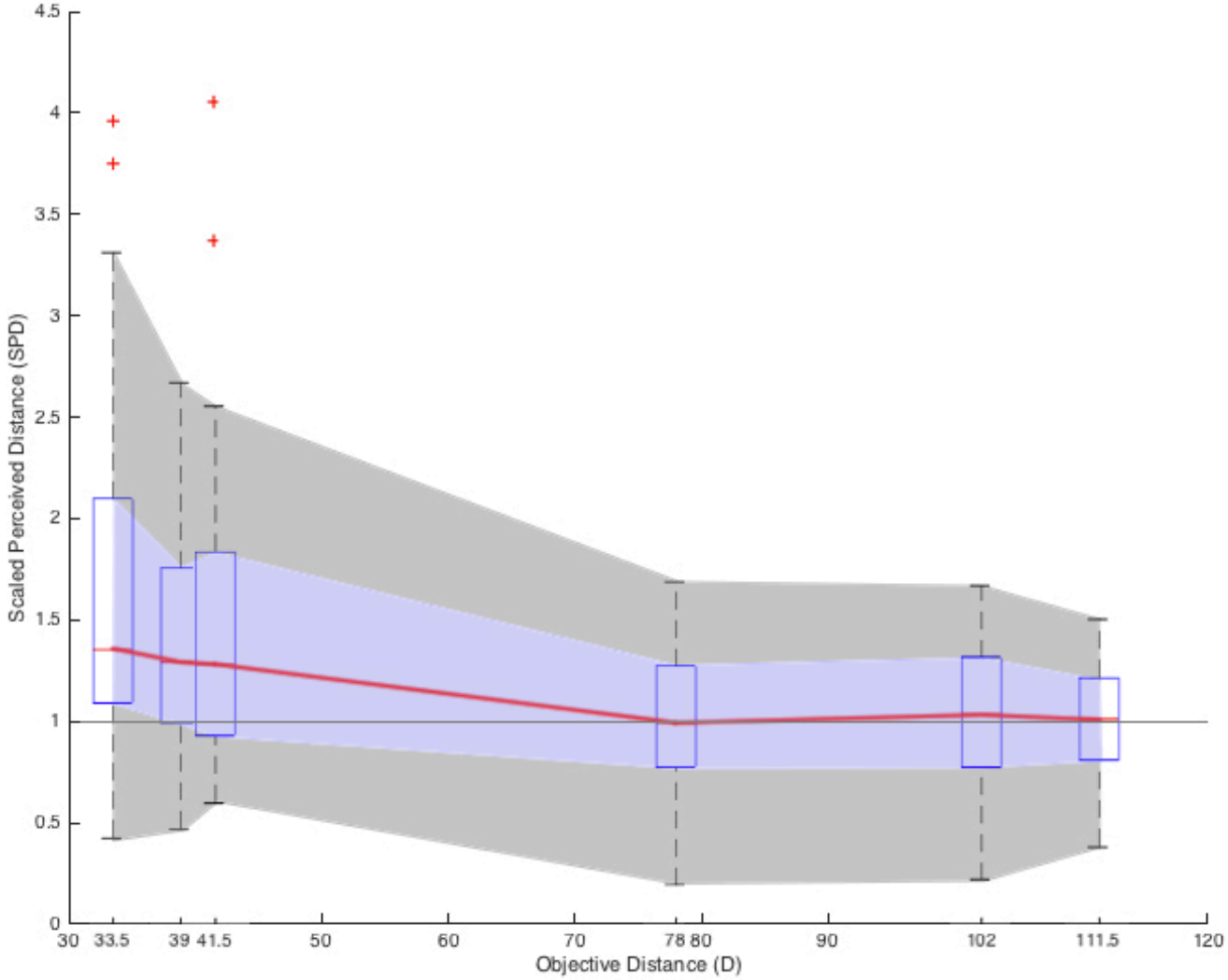
Experimental Case Study – Perceived Distances

Ratio Distance Estimations



(Lowrey 1973; Briggs 1973; Montello 1991)

Experimental Case Study – Results



Experimental Case Study - Conclusions

Variable	Effect on scaling factor
Intercept	General tendency to “overestimate” objective distances
Objective Distance	+ → -
Self-Assessment	+ → -
Bike	+ → -
Familiarity with Origin	+ → +
Frequency of travelling in Delft	+ → -
Order of estimations	+ → -
Experiment Version	+ → +

Relative Distance Distortion

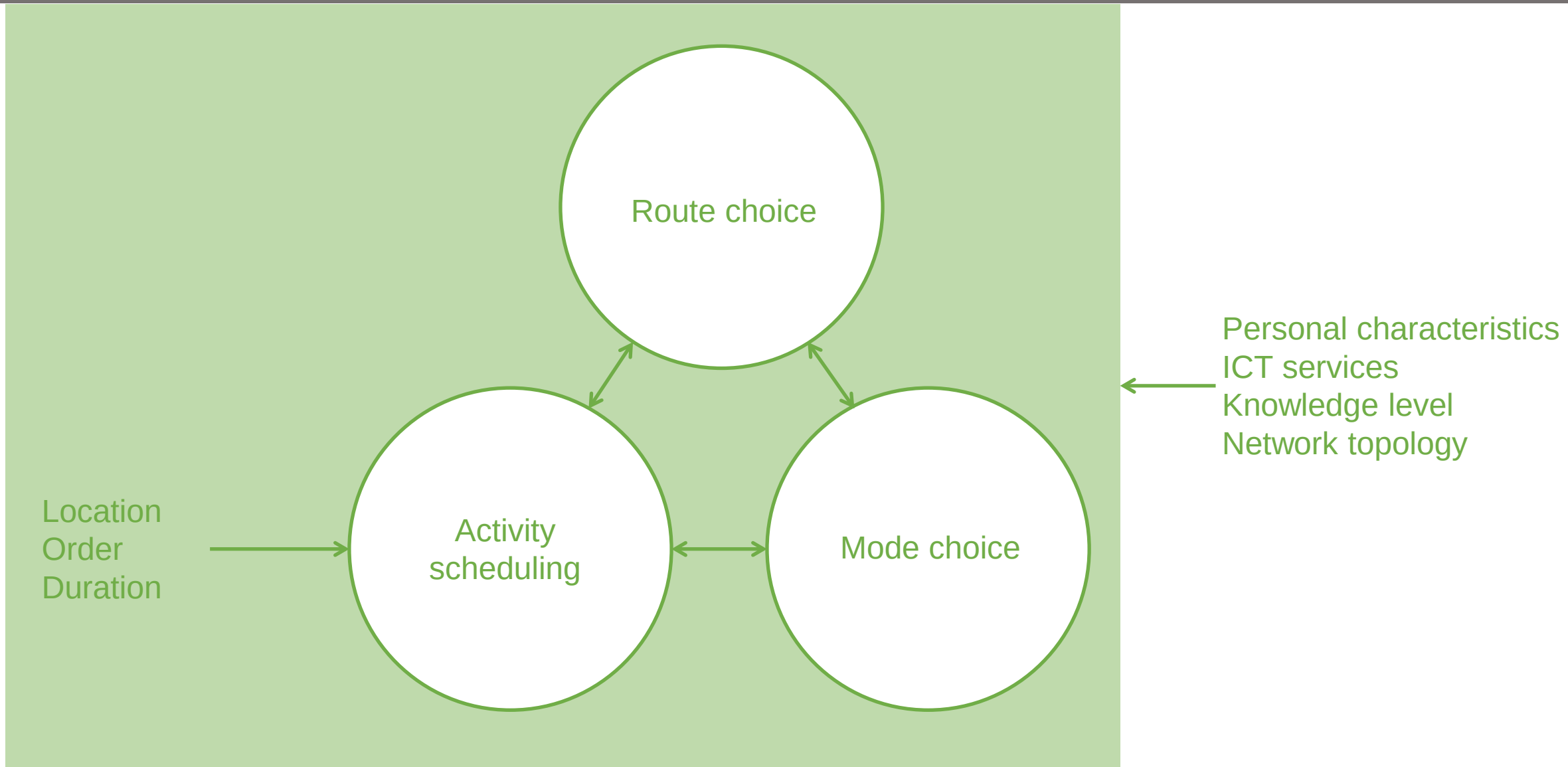
$W_{ij} = f_j(X_{ij})$

$W_{ij} = 1.761$ *– 0.008 * Obj. Distance – 0.506 * Self-Assessment – 0.219 * Familiarity with Origin + 0.307 * Bike_frequent + 0.303 * Experiment Version_Map-Estimations*

Future

- Include complexity of urban structure & compute distortion triangles
- Agent-based wayfinding simulation
  - Test wayfinding strategies and importance of landmarks
  - Estimate consideration choice set
  - Validate strategies with GPS trajectories
- Experiment: Infer spatial knowledge, and development using linguistic modelling
- Mathematical model of cognitive wayfinding behaviour
- Experimentation platform to test ICT services, urban syntax and social interactions

Conceptualized Theory on Tactical Level



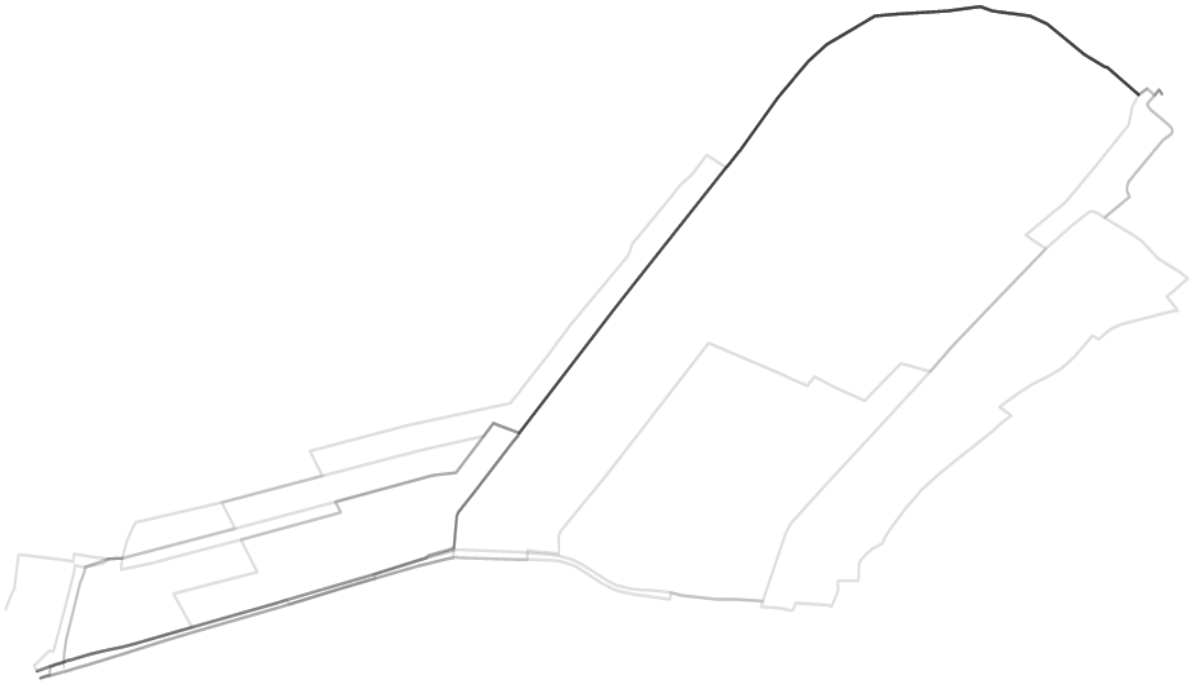
Data Driven Case Study – Route Choice

- Which factors determine how people cycle in Amsterdam?

- Fietstelweek data – 2015
- 3,045 GPS records
- Amsterdam Inner-City

- Discrete choice modelling
- Derive choice set from data

Data Driven Case Study – Route Choice



Data Driven Case Study – Route Choice

Factor	Influence	Positive/Negative
Distance	Yes	Negative
# Intersections / km	Yes	Negative
Separate cycle paths	No	
Overlap of routes	Yes	Positive
Rain	No	
Time of day	Yes (morning peak hour)	Negative effect on distance

$$U_i = -0{,}057 * \text{Distance} - 0{,}525 * \text{Distance} * \text{Morning Peak} - 0{,}029 * \text{Intersections/km} - 0{,}248 * \text{Ln (overlap)}$$

Future

- Choice set identification using the dense temporal and spatial GPS data
- Develop model for activity scheduling (specifically looking at the order, location and duration of activities)
- When to bike or to walk → active mode choice model
- Integration of route, active mode choice and activity scheduling in one model → dynamic for trip purpose
- Examine influence of ICT services and level of knowledge

Societal Relevance

Societal Relevance II

Societal Relevance III