

Free-floating Car-Sharing Mode Choice Model based on Simulated Non-Chosen Alternatives

H. Becker

Discrete Choice Modelling Workshop
Lausanne, April 2016

 Institut für Verkehrsplanung und Transportsysteme
Institute for Transport Planning and Systems

ETH

Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Car-Sharing Systems in Basel

mobility

car sharing



Fixed stations, round-trips only



Upon reservation



Fixed rental end time



Charged by km and hour

**catcha
car**
by mobility



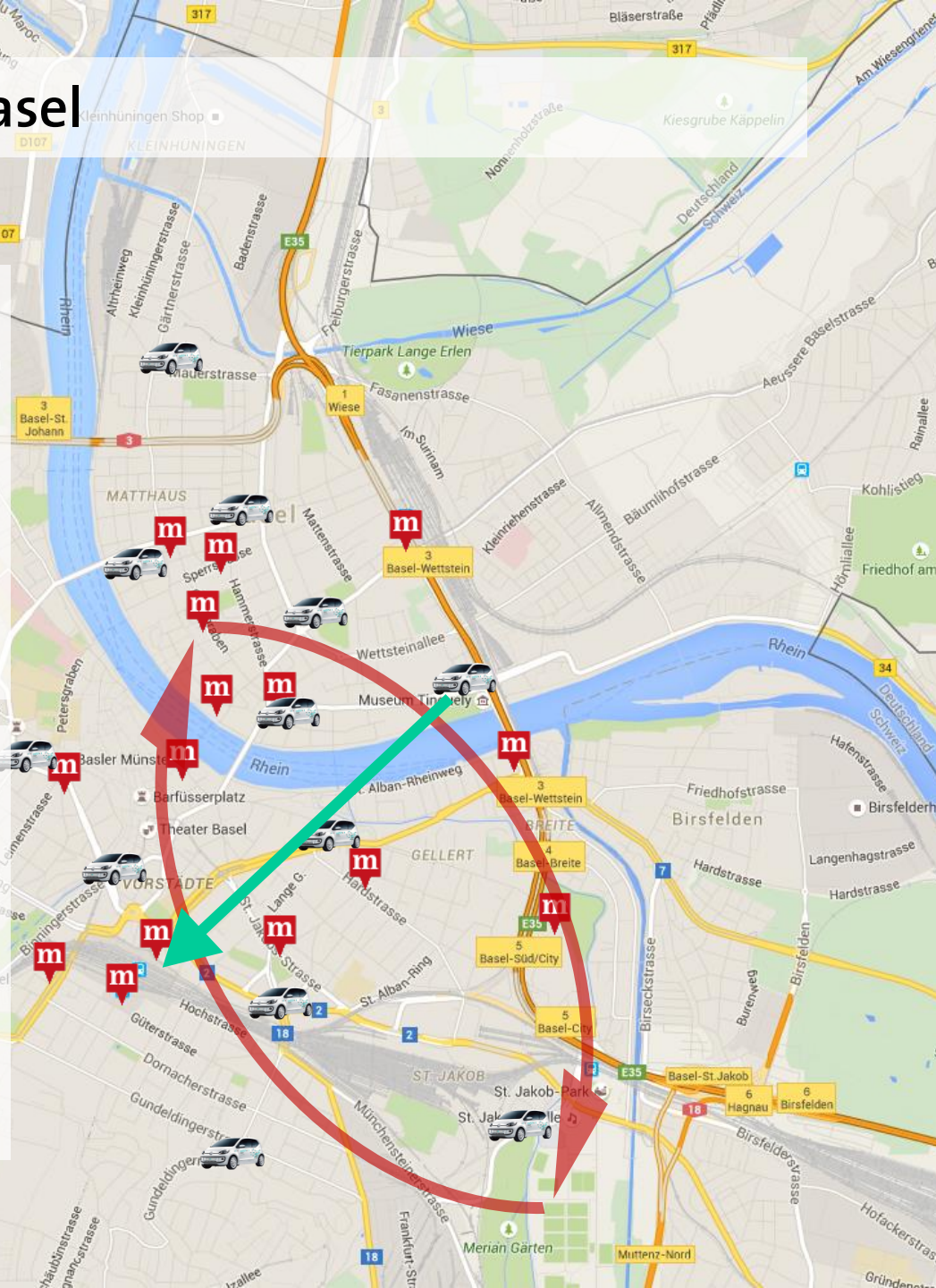
Locate a car via an app



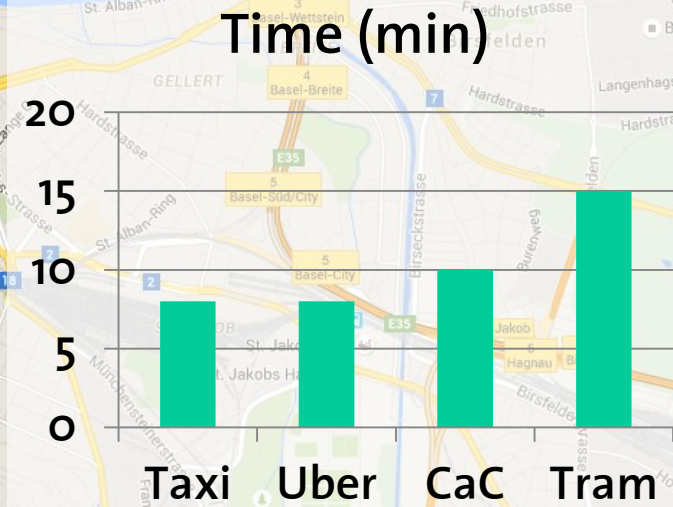
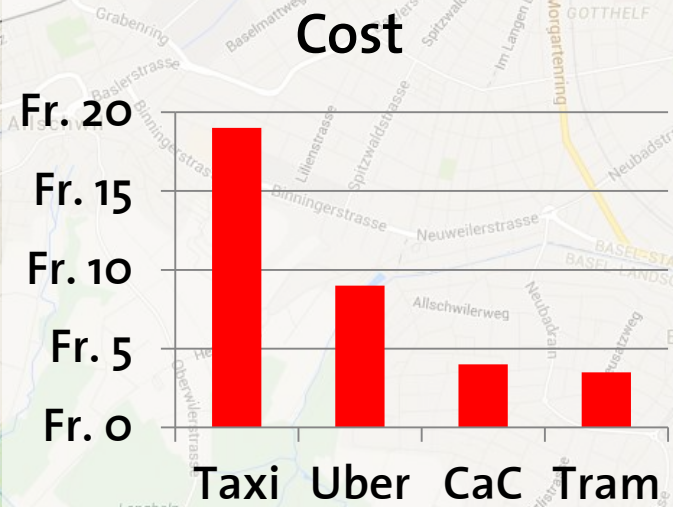
Leave the car anywhere



Charged by the minute



A cheaper taxi?



Idea

- Understand, in which situations people use free-floating car-sharing.

Applications:

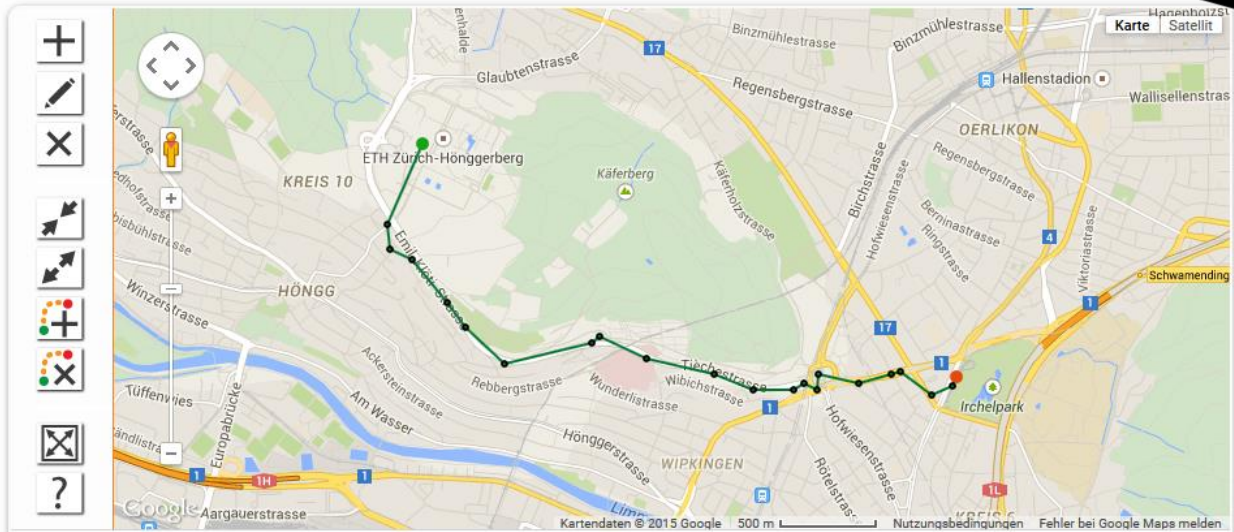
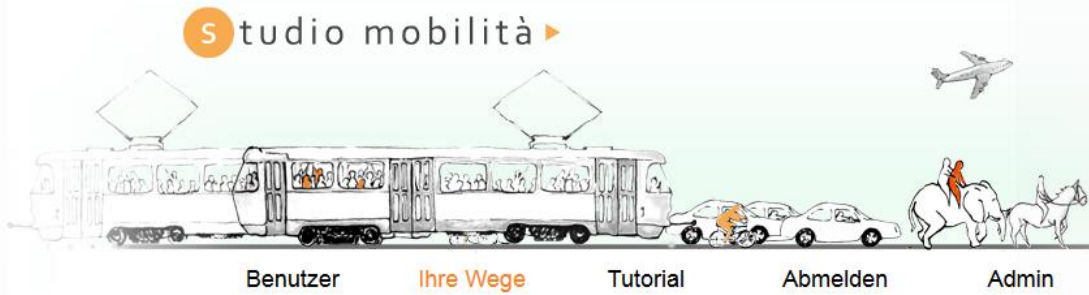
- System optimization
- Agent-based simulations (e.g. MATSim)
- ...

Data

Mobility Study

Booking Data

Mobility Study



	Beginn	Ende	Dauer	Distanz	Verkehrsmittel	Zweck	# Mitfahrende	Sperrige Objekte	Parkplatzkosten
<input type="checkbox"/>	?	?			?	?	?	?	?
<input checked="" type="checkbox"/>	15:14:57	16:13:31	58 min	3.9 km	Tram/Bus	Freizeit			
<input type="checkbox"/>	15:14:57	16:23:19	1 h	5.4 km					
<input type="checkbox"/>	16:13:31	16:23:19	9 min	1.1 km					
<input type="checkbox"/>	18:00:35	18:17:05	16 min	4.8 km					
<input type="checkbox"/>	18:00:35	18:17:05	16 min	4.8 km					

Trip Data

- Provided by the operator for three 3-months periods between October 2014 and March 2016
- **Booking Data**
 - Reservation start and end time
 - including anonymized User-ID
- **Insurance Data**
 - single trips: start- and end coordinates, travel time, distance
 - no information about user or reservation number
- Common identifier: license plate



Data

Mobility Study

~12'000 trips

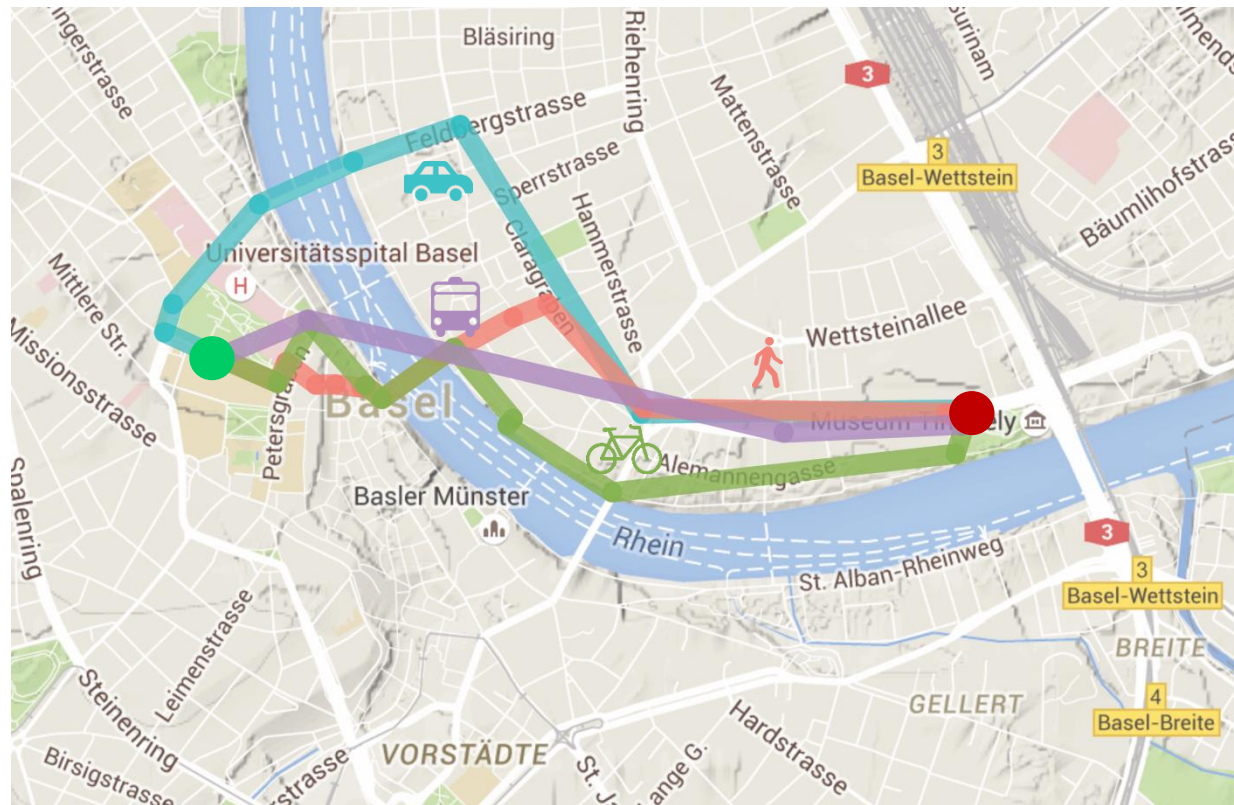
Booking Data

~15'000 trips

- Only considering trips with
 - Walk
 - Bike
 - Transit
 - Free-floating car-sharing
- Only considering one-stage trips
- Data contains only chosen alternatives.

Generate Non-Chosen Alternatives

- Enrich data with non-chosen alternatives using Google Maps API
- Generate car, walk, bike and transit routes for each OD pair
- Get travel time, distance, transfers, headway, elevation, ...



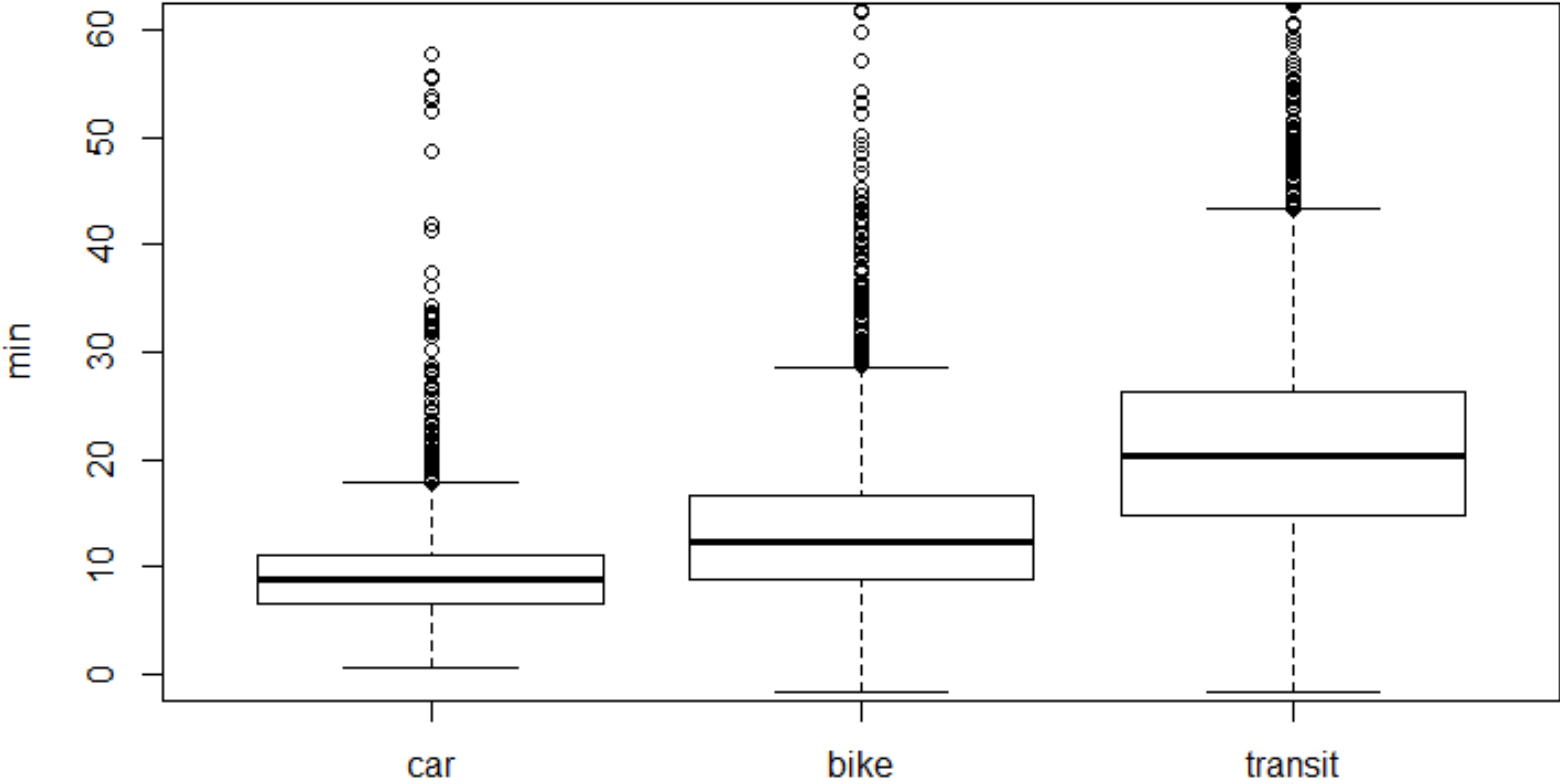
Generate Non-Chosen Alternatives

Main Issues

- For the booking data, the start point of the ride is not necessarily also the start point of the trip -> how to model access?
- Many of the car-sharers hold a season-ticket or GA. How to model the marginal cost of each trip for them?
- Parking search is not included in the routed car-trips.

Some descriptive statistics...

Travel Times for one-stage trips



Modelling Approach

- Use alternative-specific conditional logit model

$$\mathbf{X}_i^* = (\mathbf{X}_i, \mathbf{z}_i \otimes \mathbf{I}_J)$$

$$\boldsymbol{\beta}^* = \begin{pmatrix} \boldsymbol{\beta} \\ \text{vec}(\mathbf{A}') \end{pmatrix}$$

- Cluster error terms by respondent

«Intermediate» Results

```

Alternative-specific conditional logit      Number of obs   =   38,260
Case variable: id                        Number of cases  =   9565

Alternative variable: mode                Alts per case: min =    4
                                           avg =             4.0
                                           max =             4

                                           Wald chi2(11)   =   381.58
Log pseudolikelihood = -8508.8177        Prob > chi2     =   0.0000

```

(Std. Err. adjusted for 901 clusters in pers_id)

choice	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
mode						
cost	-.1918284	.0444565	-4.31	0.000	-.2789616	-.1046953
traveltime	-.1714747	.0129557	-13.24	0.000	-.1968673	-.1460821
bike						
night	-.4482149	.1932708	-2.32	0.020	-.8270188	-.069411
rainy	-.4025441	.3341025	-1.20	0.228	-1.057373	.2522847
cold	.3330567	.1754426	1.90	0.058	-.0108045	.6769178
_cons	-1.959115	.1866201	-10.50	0.000	-2.324883	-1.593346
car						
night	.3572248	.1677582	2.13	0.033	.0284248	.6860248
rainy	1.094191	.268098	4.08	0.000	.5687287	1.619653
cold	-2.16709	.2095535	-10.34	0.000	-2.577808	-1.756373
_cons	.1769049	.1915144	0.92	0.356	-.1984564	.5522661
transit						
night	-.0753861	.1548706	-0.49	0.626	-.3789269	.2281546
rainy	.2624464	.2334072	1.12	0.261	-.1950233	.7199161
cold	-.0593295	.1231858	-0.48	0.630	-.3007693	.1821102
_cons	-.6208585	.1474485	-4.21	0.000	-.9098523	-.3318647
walk	(base alternative)					

Next steps

- Include the full data set in the analysis.
- Include geographical information
 - Public transportation service level
 - Population density
 - Income Levels
 - ...
- Try GMNL model approach. [Fiebig et al., 2009]

Questions?
