Individual Mobility, Mode Choice and the Effects of Public Transport Subsidies: Evidence from a Randomized Controlled Trial

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Motiviation

- Car traffic still dominates the traffic volume in Germany, and the only sector where CO2 emissions have not decreased since 1990 is the transport sector (BMU, 2019)
- One possible solution is a transition away from car traffic to public transport
- For this purpose we investigate the effect of free one-month public transport ticket on uptake and habit formation
- A number of studies have already investigated similar questions (Fujii and Kitamura, 2003 and Thøgersen, 2009), but we are the first to use a smartphone app to record actual mobility for three months

Overview

- Randomized Controlled Trial that uses an app to track individuals' mobility over three months
- The participants in the treatment group receive a one-month public transport ticket for the 2nd month
- Main research questions:
  1. Does a free public transport ticket for one month increase public transport among car drivers?
  2. Do the participants exhibit habit formation in the month after they receive the free ticket?

Field Experiment Timeline

February 2018 Screening of people, who are potentially willing to participate in the App-Tracking

May 2018 Start of experimental period: Baseline Month

End of May 2018 Sending out of one month ticket for June to randomly assigned treatment group

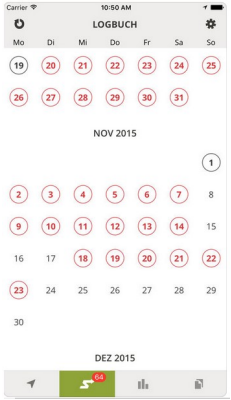
- Every participant (both control and treatment) received a letter with some information about the app
- The treatment group additionally received the ticket for their city/region as well as some general information on the public transport in the region and the validity of the ticket

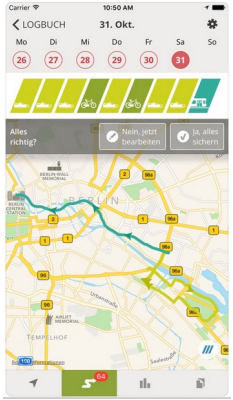
June 2018 Treatment month

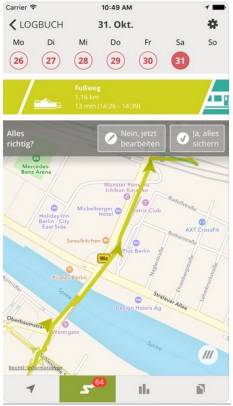
July 2018 Habit formation month

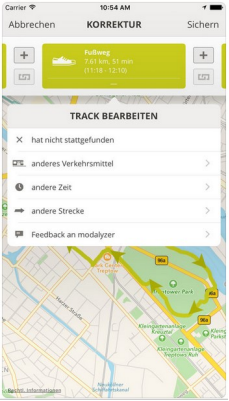
App-Tracking

- App provides us with observations for every trip taken by the participants
- Information on used mode, start and finish time, distance, and speed







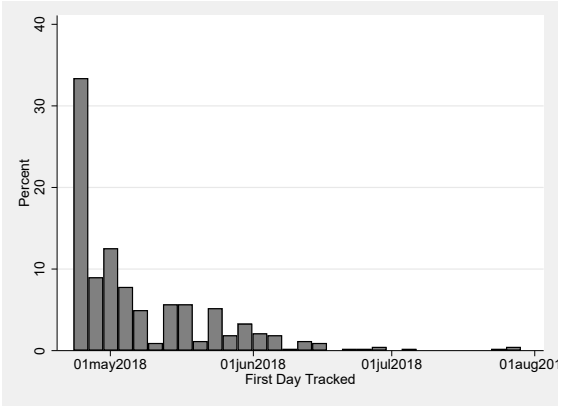


Data

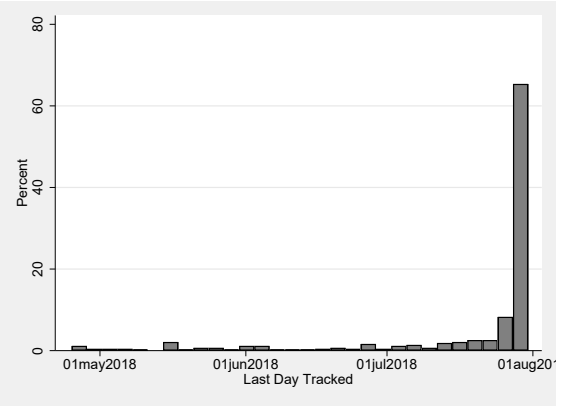
- We collapse the data on the day-level, which gives us the number of trips and kilometers per day for each day and each participant
- The data provides us with a lot of different modes, like car, bus, light rail, long-distance train, ferry,...
- For the calculation of the public transport variable we add up all modes of public transport
  $\Rightarrow$ We check this calculation against different specifications to make sure this does not drive our results
- One particular challenge was that after turning their phones off and on again, they had to open the App again to get the tracking going again

Number of participants per day | Validation with survey data

First and last day reported for all experiment participants



(a) First day reported



(b) Last day reported

Descriptives & Baseline Travel Behavior (April/May) of Treatment and Control Group

Variable	Total	Control Group	Treatment Group
Age	49.6	50.2	49.1
Female	0.33	0.34	0.31
Children	1.41	1.53	1.28
College Degree	0.64	0.64	0.64
Full-time Employed	0.81	0.77	0.84
Average car trips per day	2.17	2.16	2.18
Average public transport & train trips per day	0.22	0.24	0.20
Average car km per day	34.72	32.65	36.97
Average public transport km per day	4.70	6.58	2.67
Number of participants	422	209	213
Number of observations (in April/May)	6,441	3,094	3,347
Number of observations (Overall)	20,414	10,117	10,297

Mobility behavior for the different months

Methodology

- Baseline estimation equation that we estimate with individual fixed effects:

$$Y_{it} = \beta_0 + \beta_1 treat_{it} + \beta_2 habit_{it} + \epsilon_{it}, \quad (1)$$

- Y_{it} can be a number of different dependent variables: car trips, car km, public transport trips, etc.
- $treat_{it}$ is an indicator whether participant i received the treatment for day t
- $habit_{it}$ indicates if participant i was treated but day t is after the treatment period

- Furthermore, we are currently working on an estimation with inverse probability weights, to check whether panel attrition is stronger for the control group and if this affects our results

Results (Daily use of mode as the dependent variables)

	PT & train trips	Car trips	Walking trips	Bike trips
Treatment received in given day	0.126***	-0.034	0.176***	0.021
	(0.020)	(0.048)	(0.060)	(0.030)
Habit formation	0.003	-0.067	-0.057	-0.046
	(0.021)	(0.050)	(0.062)	(0.031)
Constant	0.233***	2.202***	2.566***	0.709***
	(0.009)	(0.020)	(0.025)	(0.013)
Observations	20,414	20,414	20,414	20,414

Robust standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Results (Daily covered kilometers per mode used as the dependent variable)

	PT & train km	Car km	Walking km	Bike km
Treatment received in given day	3.773***	-0.042	-0.009	0.040
	(0.898)	(1.743)	(0.047)	(0.151)
Habit formation	1.080	2.431	-0.027	-0.179
	(0.925)	(1.796)	(0.049)	(0.156)
Constant	4.496***	35.189***	1.302***	2.166***
	(0.376)	(0.731)	(0.020)	(0.063)
Observations	20,414	20,414	20,414	20,414

Robust standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Different specification for public transport | Specfication for participants that tracked a minimum number of days per month

Summary

- This study provides evidence on the effect of the provision of a free public transport ticket to car drivers
- Usage of public transport significantly increases for the treated month
- Car travel does not seem to be affected by the treatment
- We do not observe any sign of habit formation

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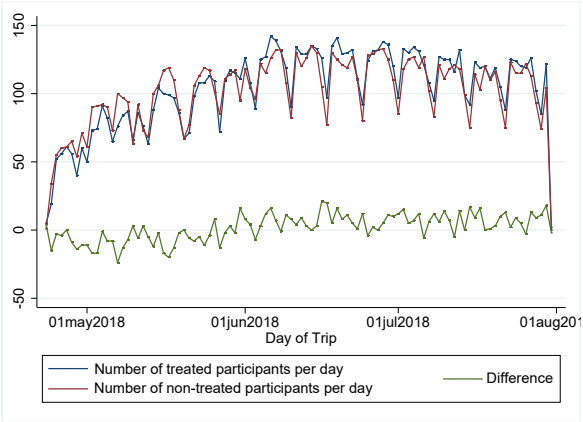
Appendix

Number of participants who tracked a given day



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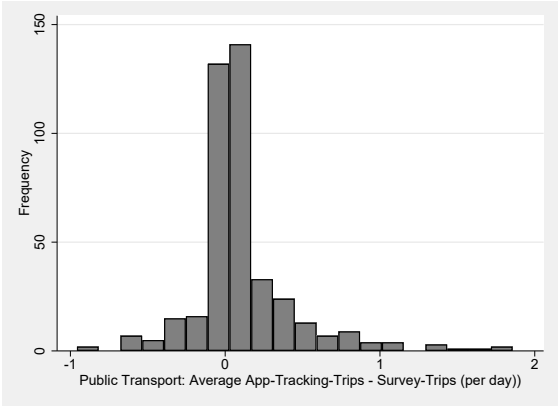
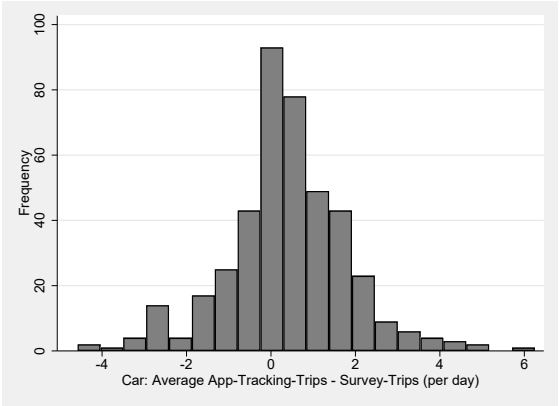
Difference between number of trips tracked per day and self reported per day

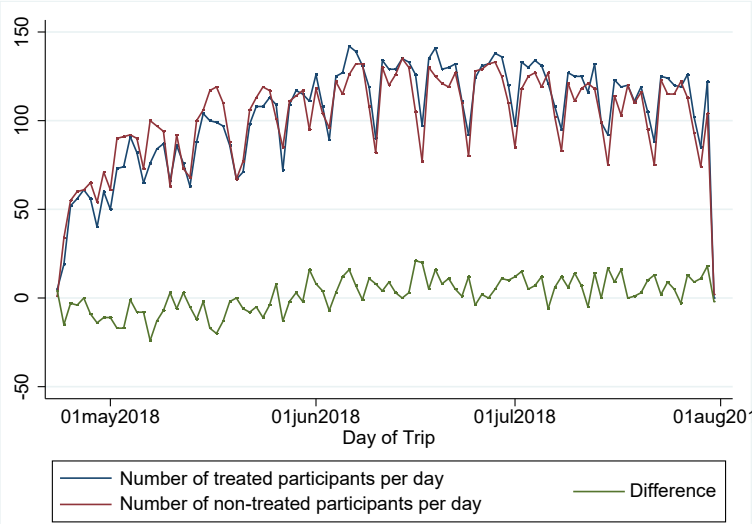


(a) Public transport trips



(b) Car trips

Figure: Number of participants who tracked a given day



Descriptives: Participants in the experiment

Feature	In total	May	June	July
Users	421	394	365	363
Observations	20.414	7.043	7151	6.612
Share of female users	33.02%	32.27%	33.69%	33.88%
Share in the treatmentgroup	49.64%	49.33%	51.51%	51.57%

Mobility behavior (per day) during the experimental period

	Average	Average in April/May	Average in June	Average in July
Public transport & train trips	0.26	0.22	0.31	0.24
Car trips	2.18	2.17	2.21	2.17
Walking trips	2.59	2.51	2.68	2.56
Bike trips	0.70	0.68	0.74	0.69
Distance covered by public transport an train	5.37 km	4.70 km	6.88 km	4.38 km
Distance covered by car trips	35.60 km	34.72 km	34.28 km	37.85 km
Distance covered by walking	1.30 km	1.27 km	1.32 km	1.30 km
Distance covered by bike	2.14 km	2.23 km	2.18 km	2.02 km

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Fixed Effects Regression only for public transport and for public transport and train trips below 100 km

	PT trips	PT km	PT & train trips (with $<$ 100km)	PT & train km (with $<$ 100km)
Treatment received in given week	0.114***	1.279***	0.102***	0.470***
	(0.019)	(0.416)	(0.017)	(0.162)
Habit formation	-0.008	-0.038	-0.009	-0.212
	(0.020)	(0.429)	(0.018)	(0.166)
Constant	0.218***	2.488***	0.182***	1.150***
	(0.008)	(0.175)	(0.007)	(0.068)
Observations	20,414	20,414	20,118	20,118

Robust standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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Fixed Effects Regression: Daily use as the dependent variable (only with participants that tracked for at least three days per month

	PT & train trips	Car trips	Walking trips	Bike trips
Treatment received in given week	0.129***	-0.059	0.158**	0.021
	(0.022)	(0.053)	(0.066)	(0.034)
Habit formation	0.021	-0.055	0.012	-0.054
	(0.023)	(0.055)	(0.068)	(0.035)
Constant	0.222***	2.256***	2.577***	0.721***
	(0.009)	(0.022)	(0.027)	(0.014)
Observations	17,313	17,313	17,313	17,313

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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