

# The Mobilität.Leben study:

A year-long tracking panel study to observe two natural transport pricing experiments

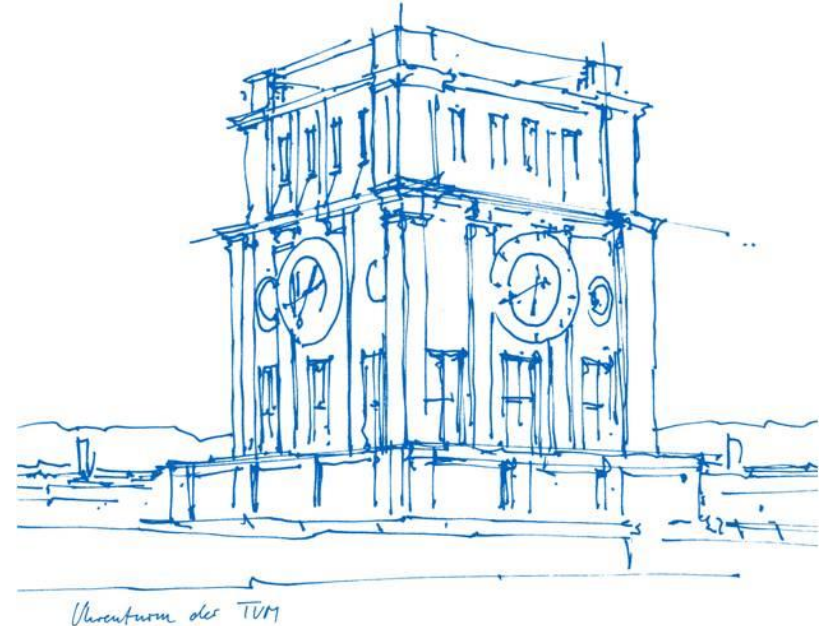
Prof. Dr.-Ing. Klaus Bogenberger

Technical University of Munich

TUM School of Engineering and Design

Chair of Traffic Engineering and Control

Zürich, 05.09.2023



**TUM THINK TANK**



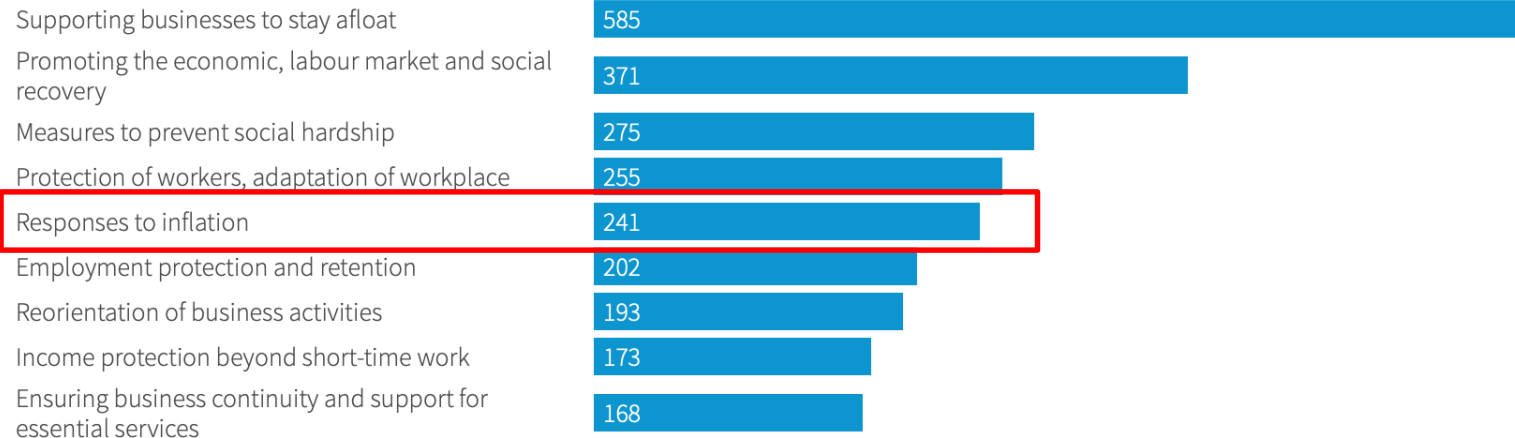
Landeshauptstadt  
München



# Policy Responses in Times of Crises

Multiple challenges: COVID-19 crisis, war in Ukraine and rising inflation

## Categories



Source: EU PolicyWatch

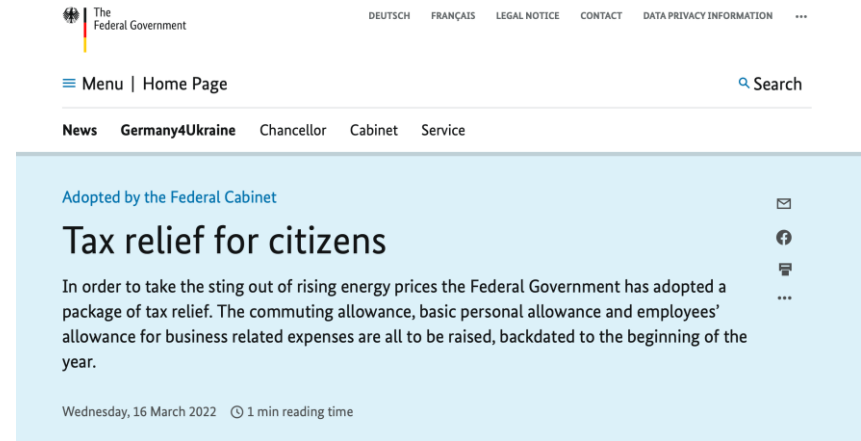
# Germany's Policy Measures



Fuel Tax Cut from June to August 2022



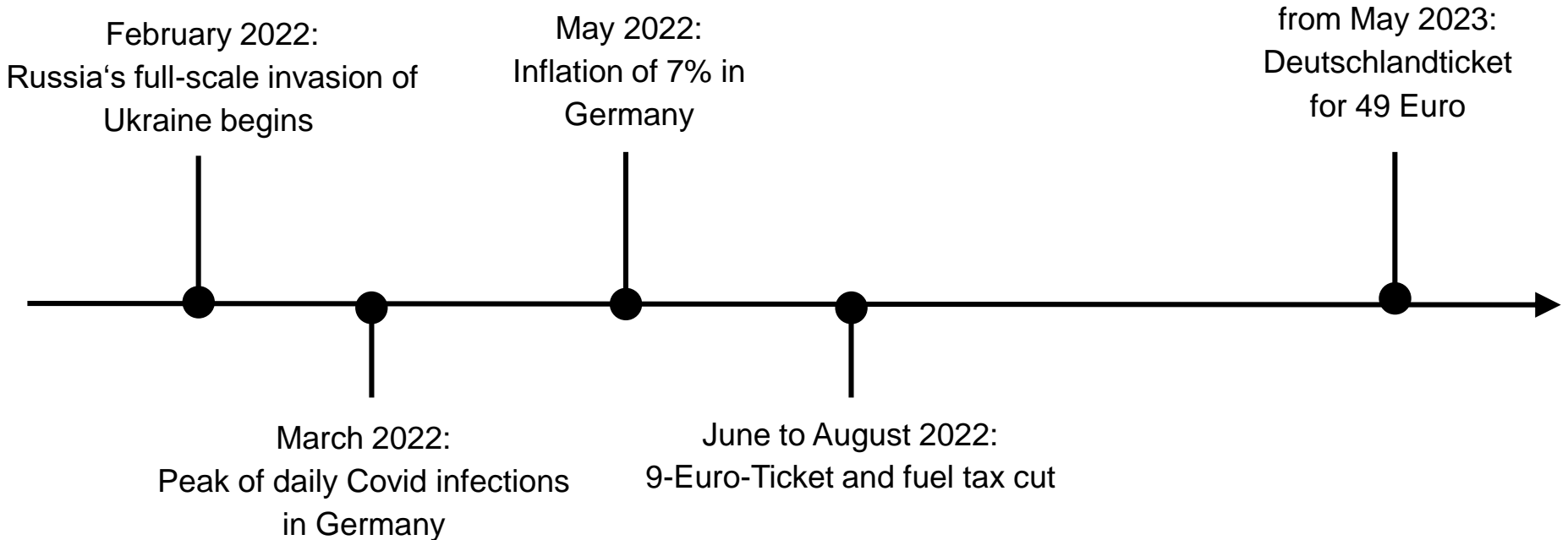
9-Euro-Ticket from June to August 2022  
Deutschlandticket from May 2023



The screenshot shows the top navigation bar of the German Federal Government website. It includes the logo 'The Federal Government' and links for 'DEUTSCH', 'FRANÇAIS', 'LEGAL NOTICE', 'CONTACT', and 'DATA PRIVACY INFORMATION'. Below the navigation bar, there is a 'Menu | Home Page' link and a search bar. The main content area features a news article titled 'Tax relief for citizens' with a sub-header 'Adopted by the Federal Cabinet'. The article text states: 'In order to take the sting out of rising energy prices the Federal Government has adopted a package of tax relief. The commuting allowance, basic personal allowance and employees' allowance for business related expenses are all to be raised, backdated to the beginning of the year.' The article is dated 'Wednesday, 16 March 2022' and has a '1 min reading time'.

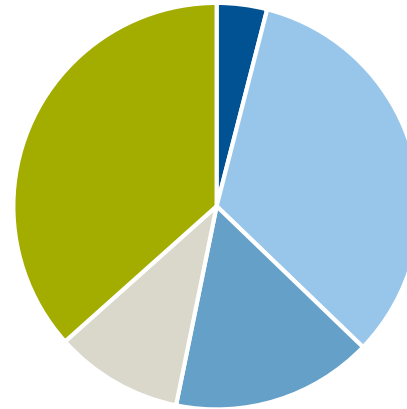
Other measures on heating, electricity, financial support for students...

# Timeline 2022 - 2023



# Fuel Tax Cut

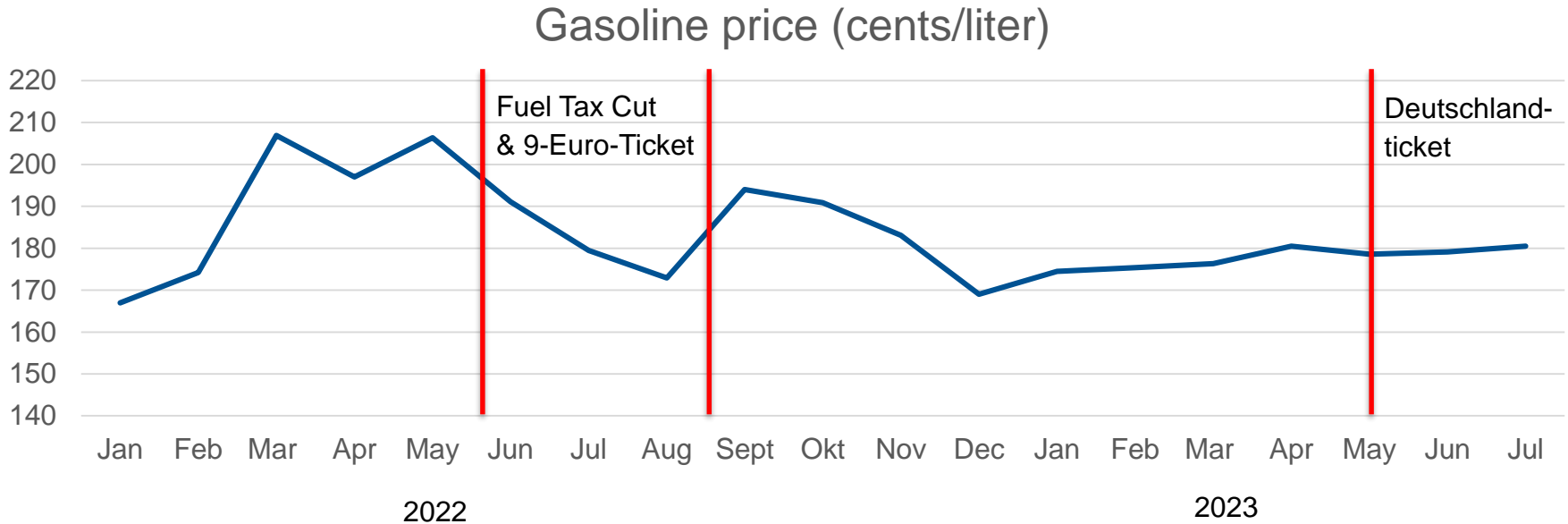
- Gasoline by 29.55 cents per liter
- Diesel by 14.04 cents per liter
- Natural gas (CNG/LNG) by 6.16 cents per kilogram
- Liquefied petroleum gas (LPG) by 12.66 cents per liter



- CO2 price
- product price
- VAT
- contribution margin
- fuel tax

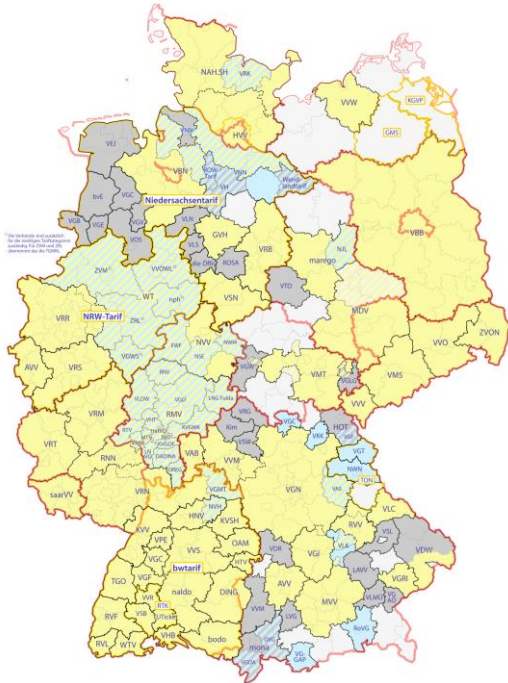
Composition of the gasoline price in the first quarter of 2022:  
in total around 206 cent/liter  
diesel: around 203 cent/liter

# Fuel Tax Cut



# The 9-Euro-Ticket & the Deutschlandticket

Karte der Landkreise: TUBS, CC BY-SA 3.0/Verkehrsverbünde: Maximilian Dörbecker (Chumwa), NJ Giggie, CC BY-SA 4.0, CC BY-SA 2.5, via Wikimedia Commons



70 transit districts with >  
400 companies and  
thousands of fares



1 single district with 1  
fare! (excluding long  
distance express trains)



# Drastic Price Cut: 9 Euro per Month



- The average cost for a travel pass is around 50 Euro/month, but only valid in one transit district
- A single day for 44 Euro for Germany, but only after 9 AM
- BC100: 4,400 Euro per year for Germany, but not all services (~15% of median net income)



KlimaTicket (all services)

- 1,095€ p.a.
- ~ 4.5% of median net income



Generalabonnement (all services)

- 4,000 CHF p.a.
- ~ 6.3% of median net income



# The 9-Euro-Ticket is Almost Fare-free Public Transport



Tallinn, Estonia

- Increased passenger demand of 1.2%



Cascais, Portugal

- Increased passenger demand of 10%, funded by parking fees



Santiago, Chile

- Randomly assigned fare-free travel passes for two weeks
- Increased demand by 10% but no evidence for mode substitution

# Huge Popularity: More than 50 Millionen Tickets sold

*The New York Times*

## ***Germany's €9 Monthly Train Pass Has Proved Popular (and a Pleasant Surprise)***

To help offset inflation, Germany's government has subsidized cheap train passes this summer. While many feared chaos and overcrowding on an overburdened system, it has been a relatively smooth ride.

<https://www.nytimes.com/2022/08/15/world/europe/germanys-trains-9euro-pass.html>

Way to go: why Germany's €9 travel pass is a big step in the right direction

*Melissa Bruntlett and Chris Bruntlett*



Cheap fares alone are not enough. Dutch-style investment, together with price cuts, could be the real game changer



<https://www.theguardian.com/world/2022/jul/14/germany-9-euro-travel-pass-cheap-fares>

# Successor Ticket: Deutschlandticket (49 Euros/month)

- Successor to the 9-Euro-ticket, start date May 1, 2023
- Subscription model (digital-only)
- initially limited until 2025
- federal and state governments contribute € 1.5 bln p.a. each as loss compensation
- Ongoing debate about further funding and price development



# Hypotheses



The changes in travel costs of car and public transport relatively to each other are expected to **change travelers' mode choice**.



Second, the reduction in car traffic and public transport costs is further expected to **increase overall individual mobility**.

# Our Study



# Study Mobilität.Leben

## Core Team

- Chair of Traffic Engineering and Control
- Chair of Vehicle Technology
- Professorship of Economics
- Professorship of Policy Analysis
- TUM Think Tank

Sponsor: **TUM THINK TANK**



# Dissemination

- 8+ working papers, 1 journal paper
- 4+ conference contributions
- 3+ Ph.D. theses
- 8+ student theses
- Multiple webinars and keynotes

Project homepage



# Study Design Mobilität.Leben



## Smartphone App

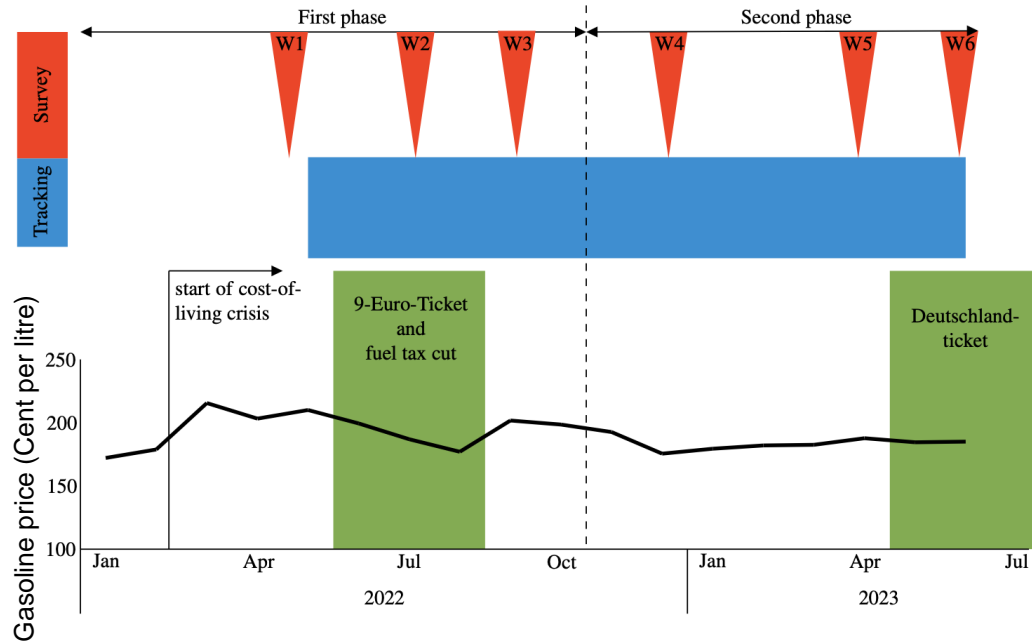
- Smartphone tracking app with a semi-passive travel diary

## Survey

- 6 questionnaires (10 to 15 minutes)
- socio-demographic questions, questions on mobility tool ownership, transport- and energy-related attitudes, travel behavior (changes), impact of the cost-of-living crisis

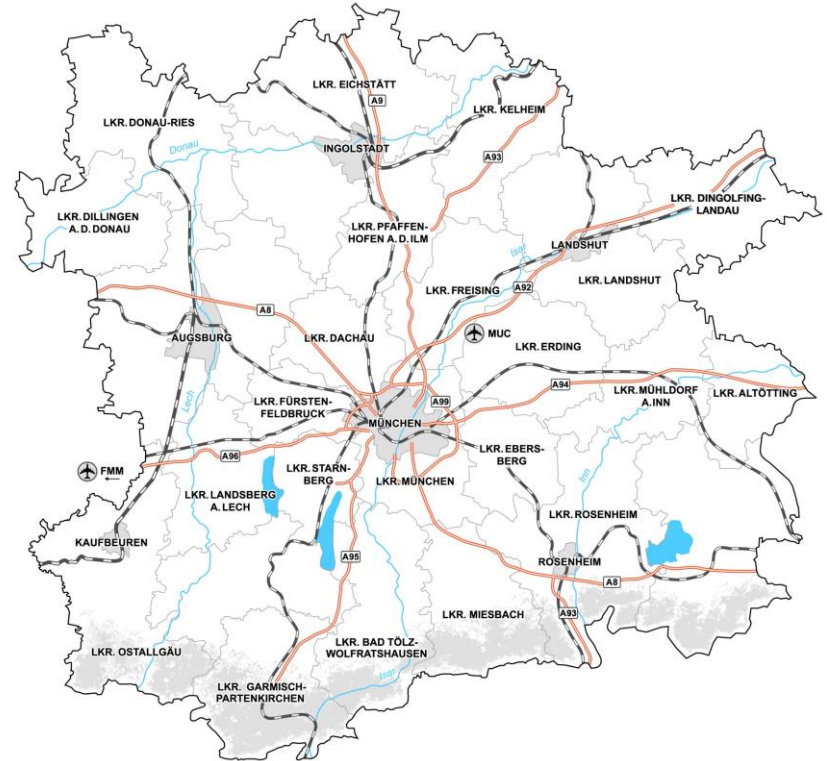


# Study Mobilität.Leben: Timeline



# Recruiting of the Participants

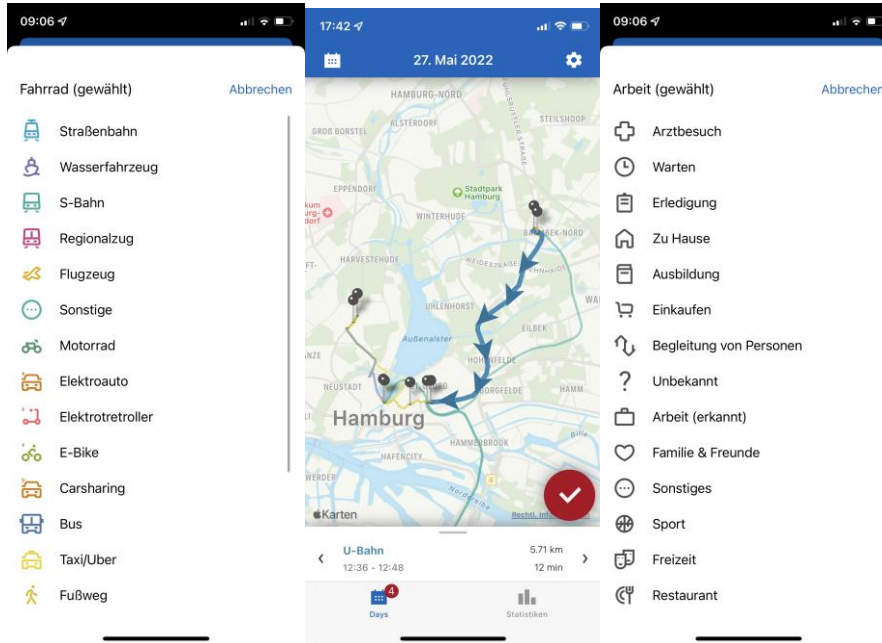
- Media campaign in focus area Munich
- Panel agency as backup
- In total, 3,080 participants of which
  - ~ 1,706 from the media campaign
  - ~ 1,374 from the agency (only survey)



# Rewards



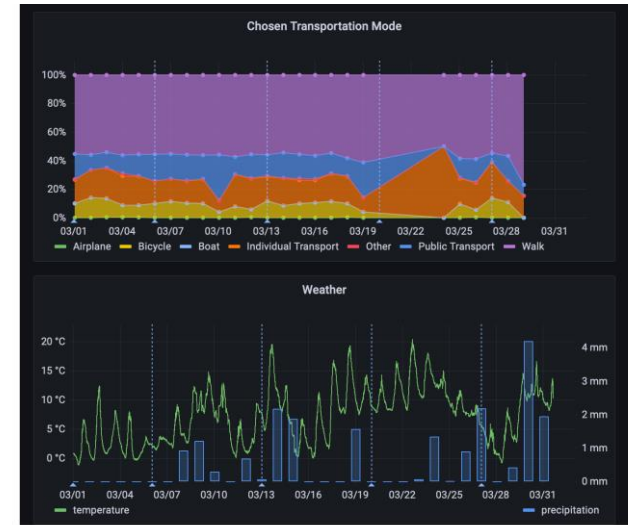
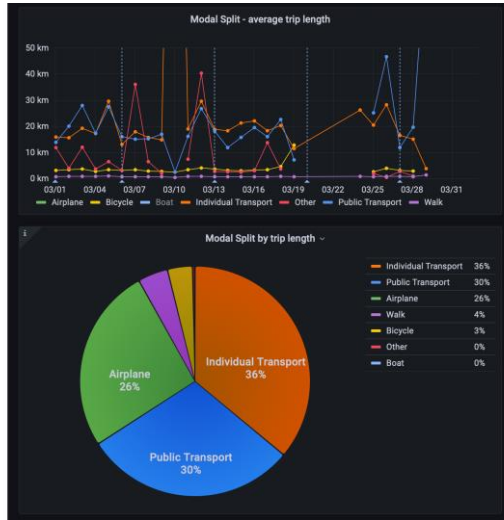
# Tracking-App



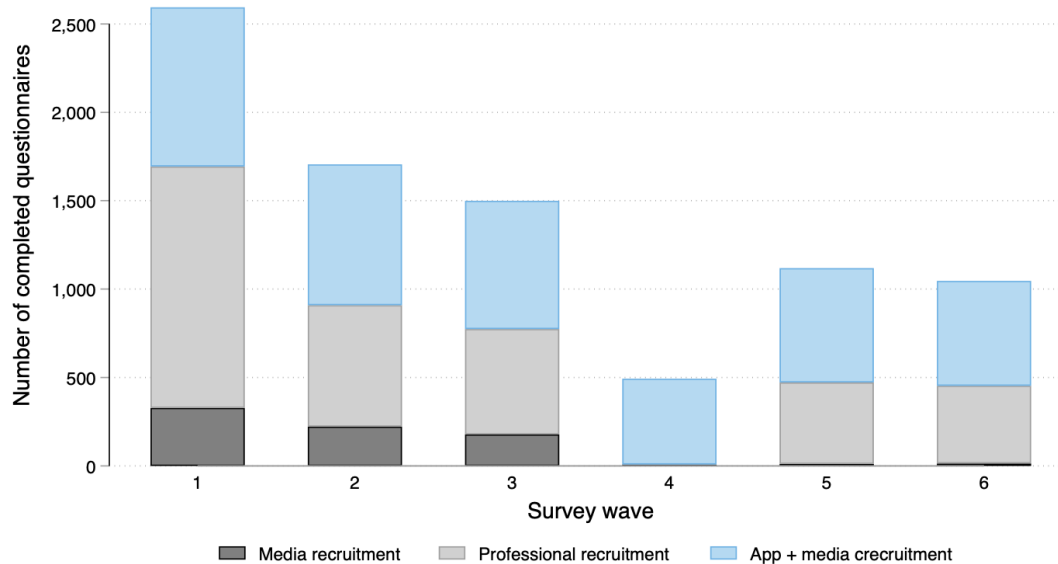
4,8 million km of PT trips and  
5,4 million km of car trips  
tracked!

Extensive data enhancement:  
outlier removal, track merging,  
trip detection

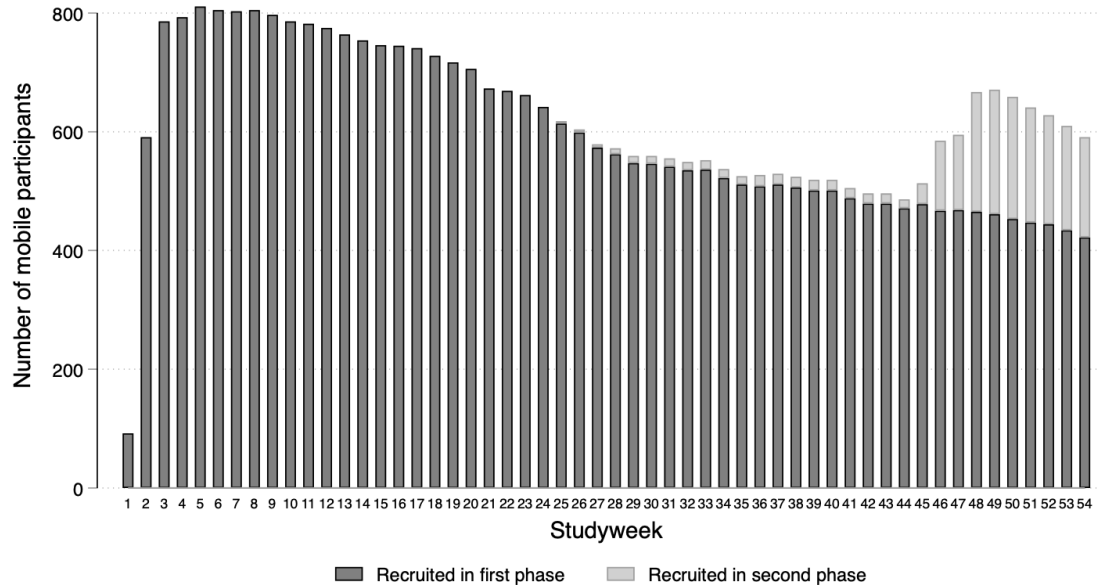
# Dashboard



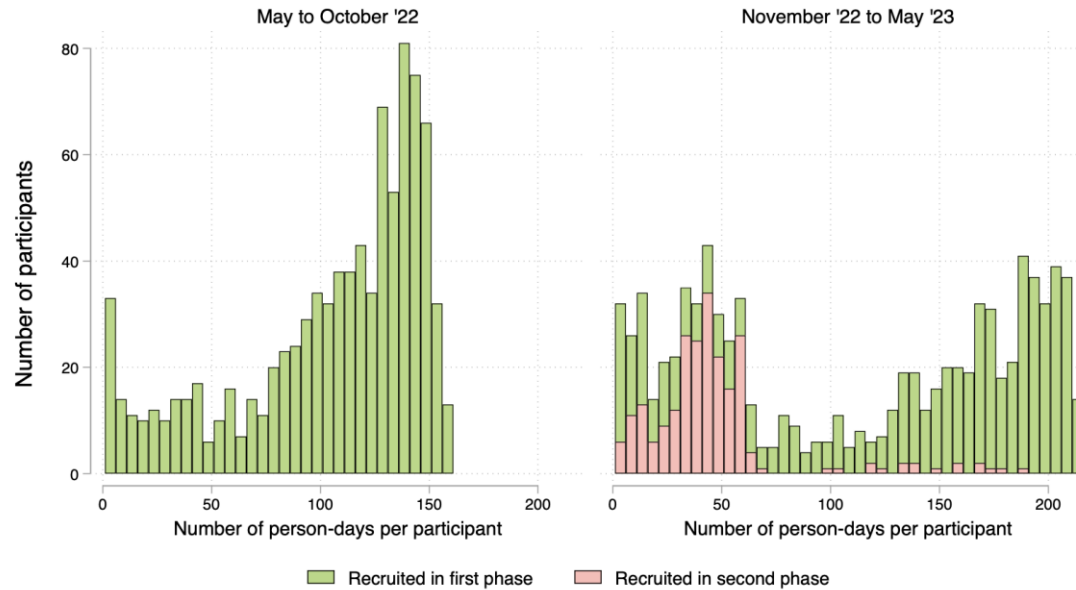
# Study Participation: Survey



# Study Participation: App



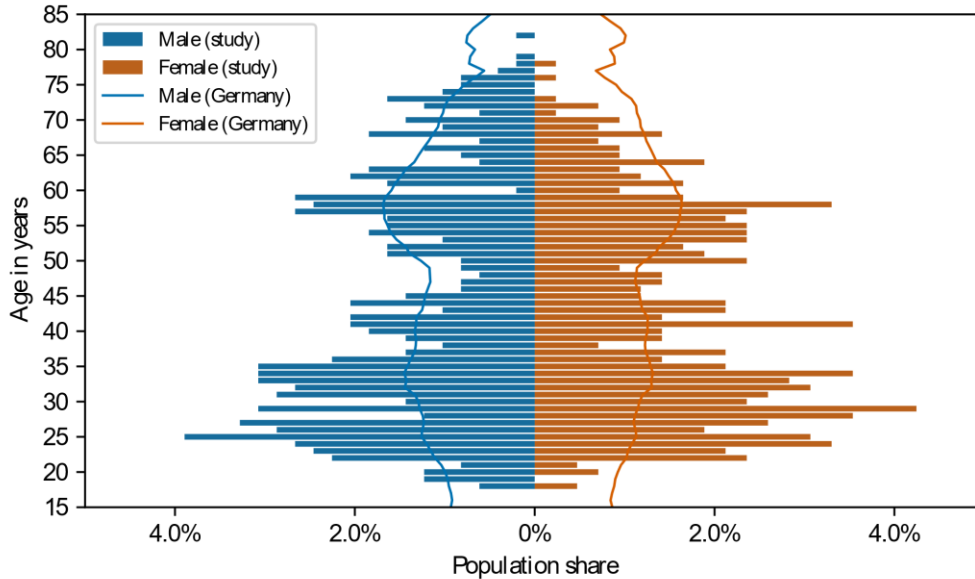
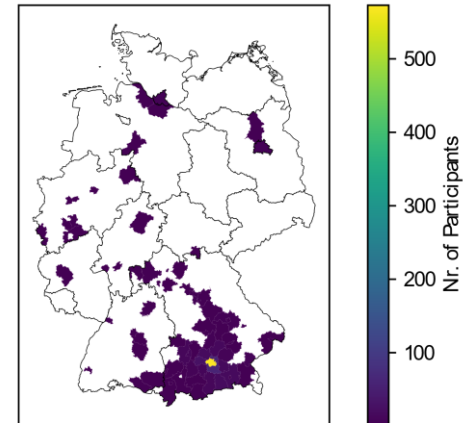
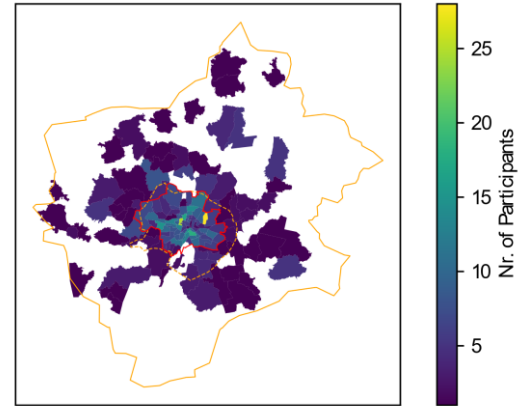
# Study Participation: App





# Sample: App

- MVV zone M
- MVV service area
- Administrative boundaries of Munich



# Overall success



80% success rate in activating the smartphone app



Attrition rate of 1% per week (participants with incentive) / 4% (without incentive)



25% of the invited participants completed the tracking and questionnaires from June 2022 to May 2023

# Implications and Learnings



**Short time** between announcement of the ticket and its start: did **not** allow for a **conventional recruiting** strategy, e.g., using direct mail to reach a representative sample of households



**Panel management** resources are necessary to answer participants' requests  
(e.g. technical problems)



First phase with a **higher compensation led to lower attrition** rates



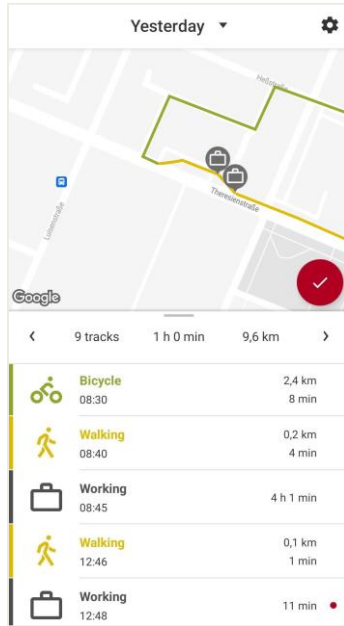
**Complex data structure** with heterogeneous data quality

Data processing of the tracking data  
Excluding „speeders“ from the survey panel

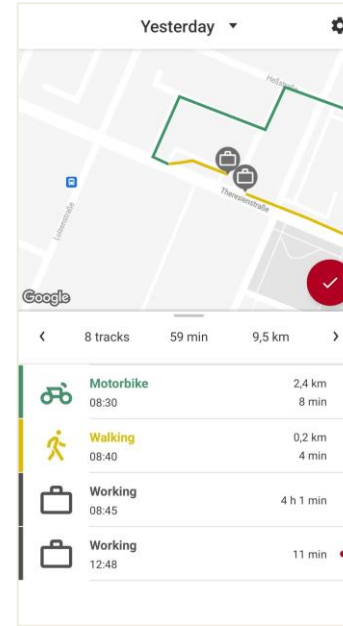
# Data Processing: Pipeline



# Mobility Tracking App with User Validation

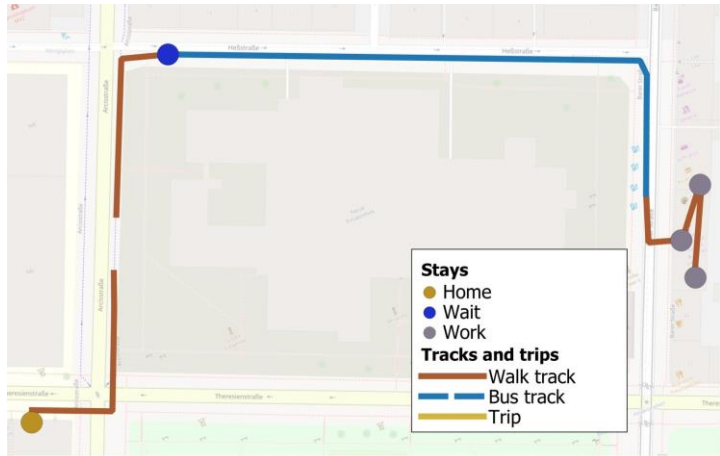


Automatically detected activities  
(fully-passive travel diary)



Activities after validation and correction  
by users (semi-passive travel diary)

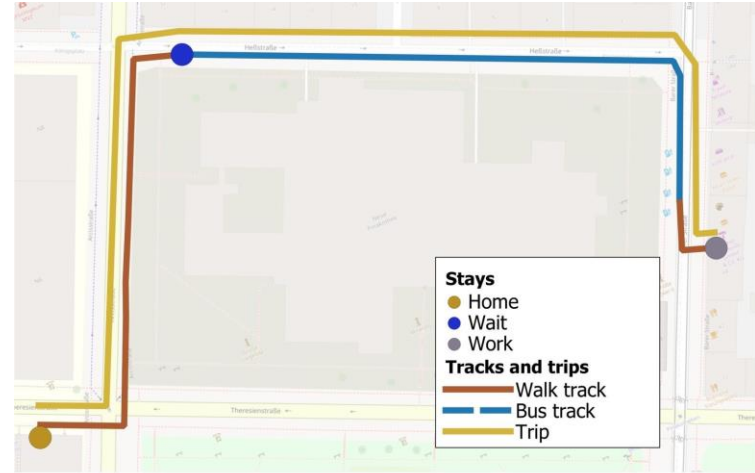
# Data Quality Enhancement I



time



Raw data



time



Improved data

# Data Quality Enhancement II

Map matching



Weather



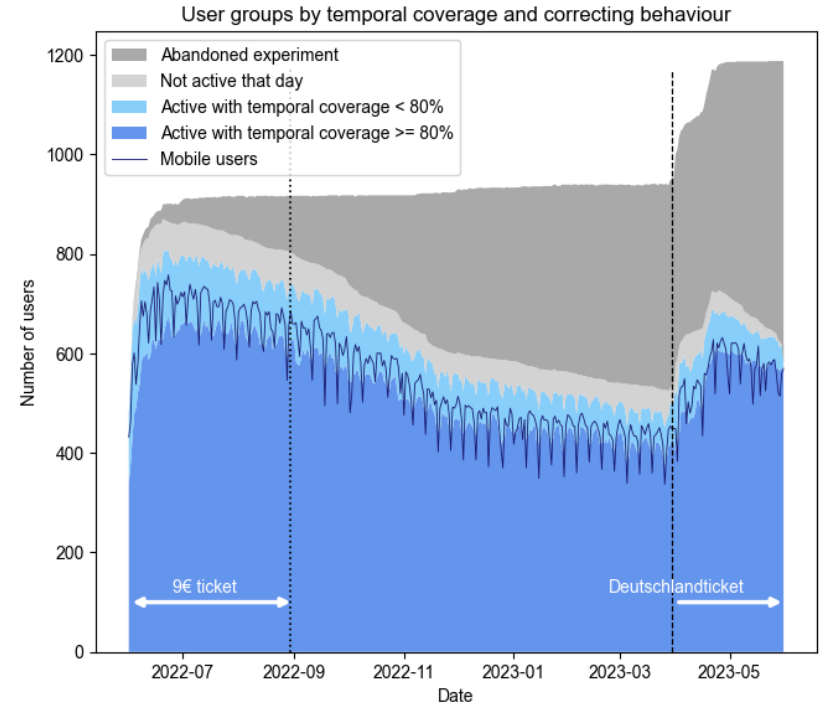
Travel times



Sociodemographic data

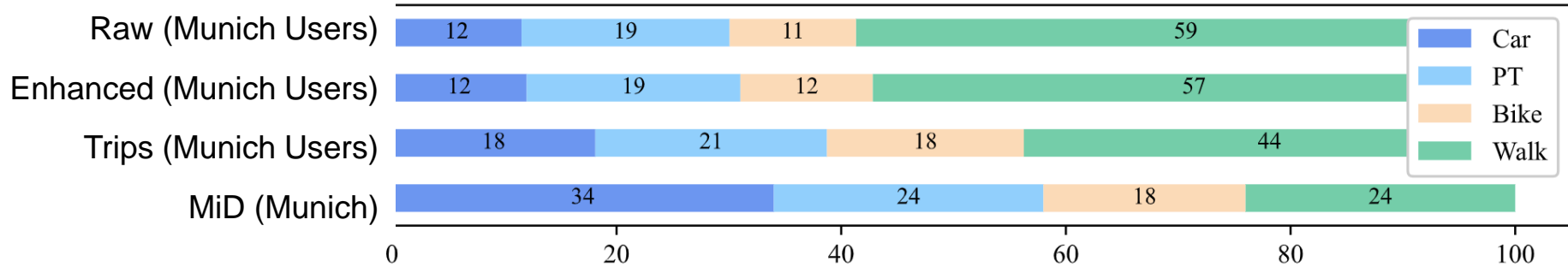


Tracking quality metrics



# Modal Split After Quality Enhancement

## Mode split by frequency

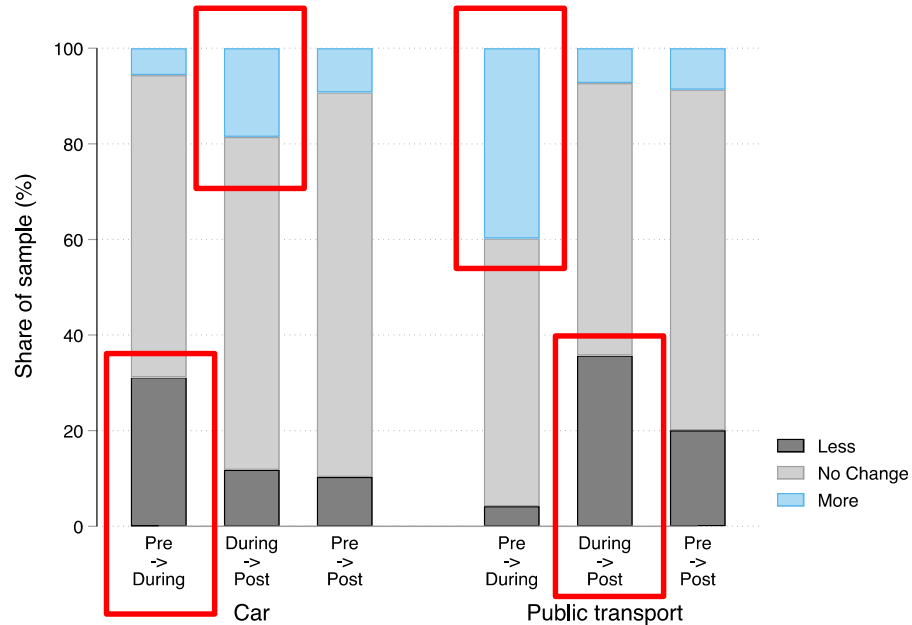




# Results: 9-Euro-Ticket

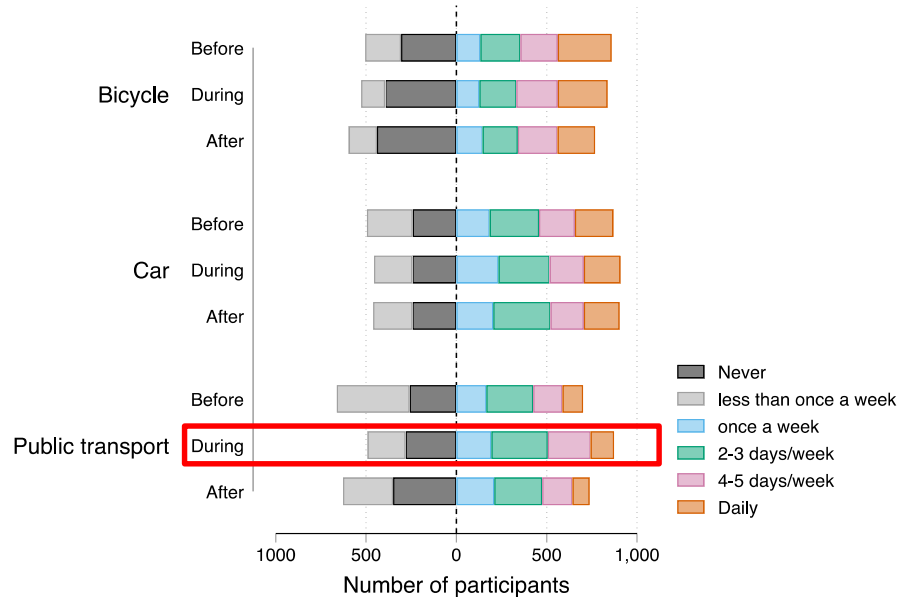


# Did They Change Their Behavior?



Survey

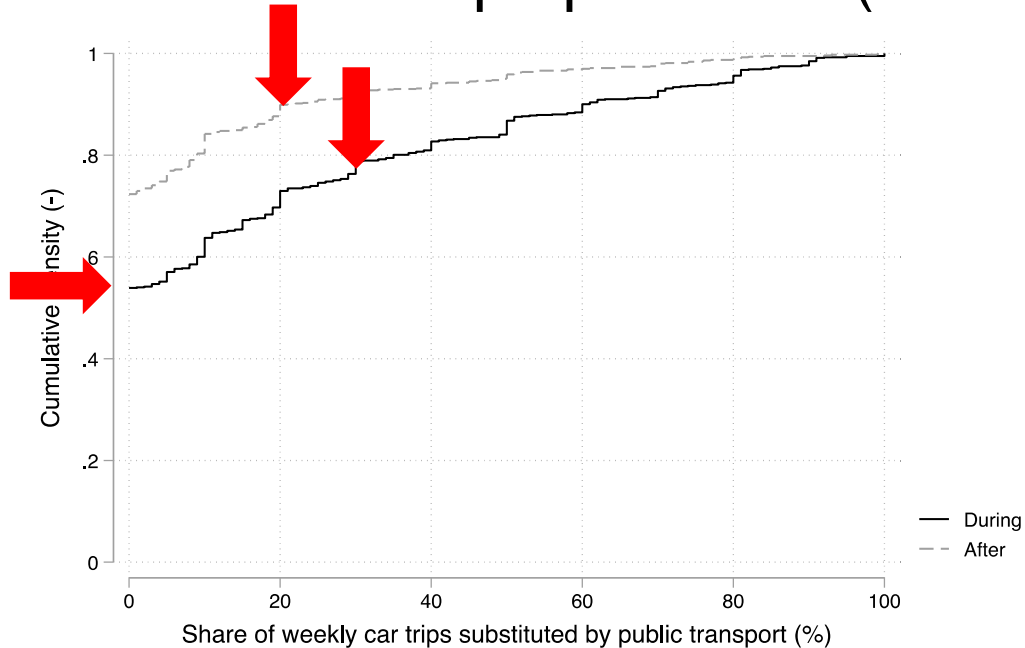
# No Substantial Changes in Car Use Frequencies



Survey

N=1,402

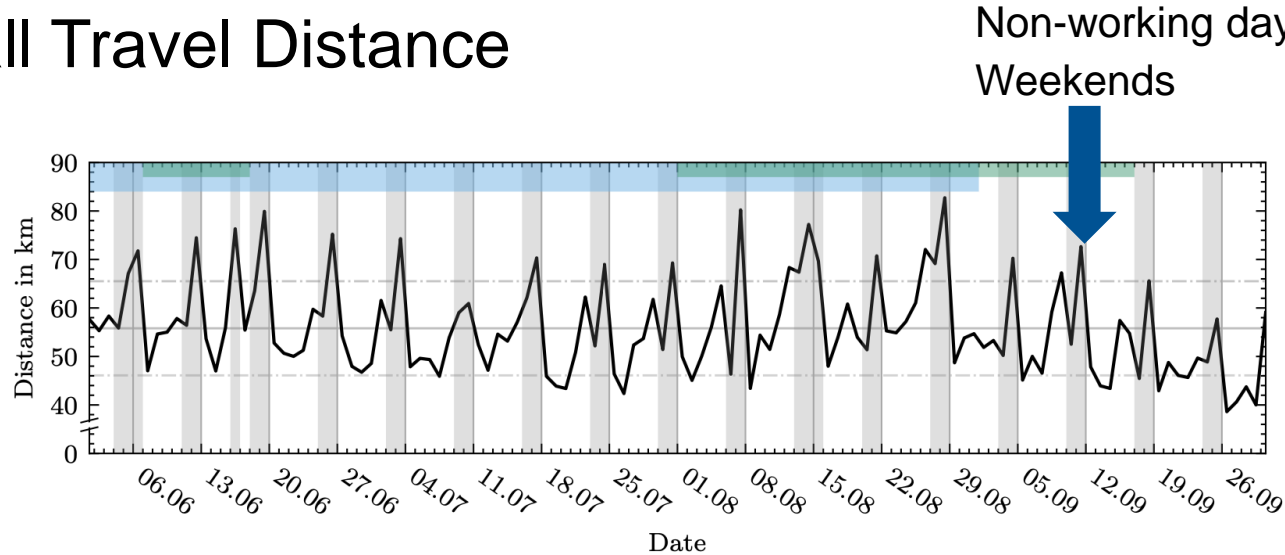
# Share of substituted Car-Trips per week (self reported)



Data shows only 57.27% of the sample who used the car at least once per week before the 9-Euro-Ticket period.

Survey

# Overall Travel Distance



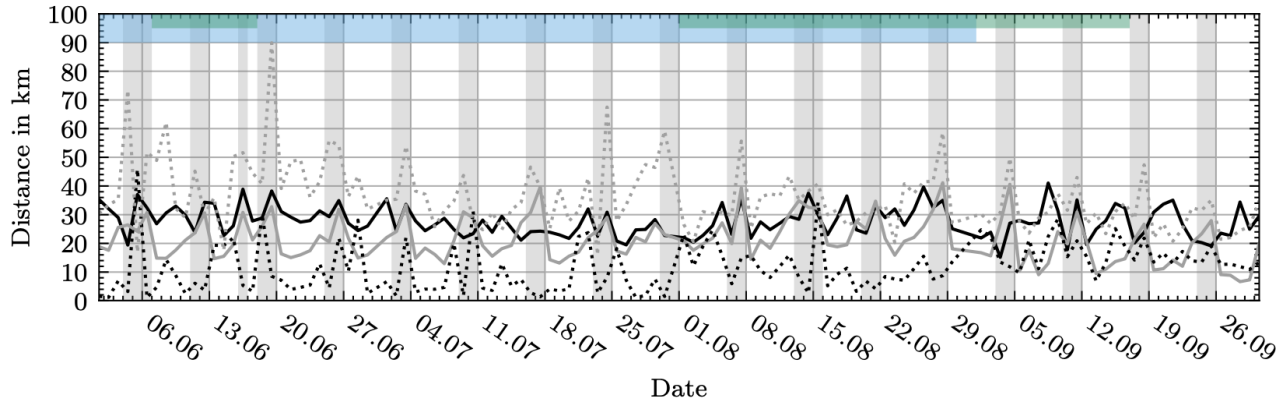
APP

- Daily Avg. Travel Distance
- - - Standard Deviation
- Mean Travel Distance
- Weekends & Public Holidays
- 9EUR-Ticket
- School Holidays

# Travel Distance by Means of Transport and PT Ticket Ownership

## (TH=Ticket Holder)

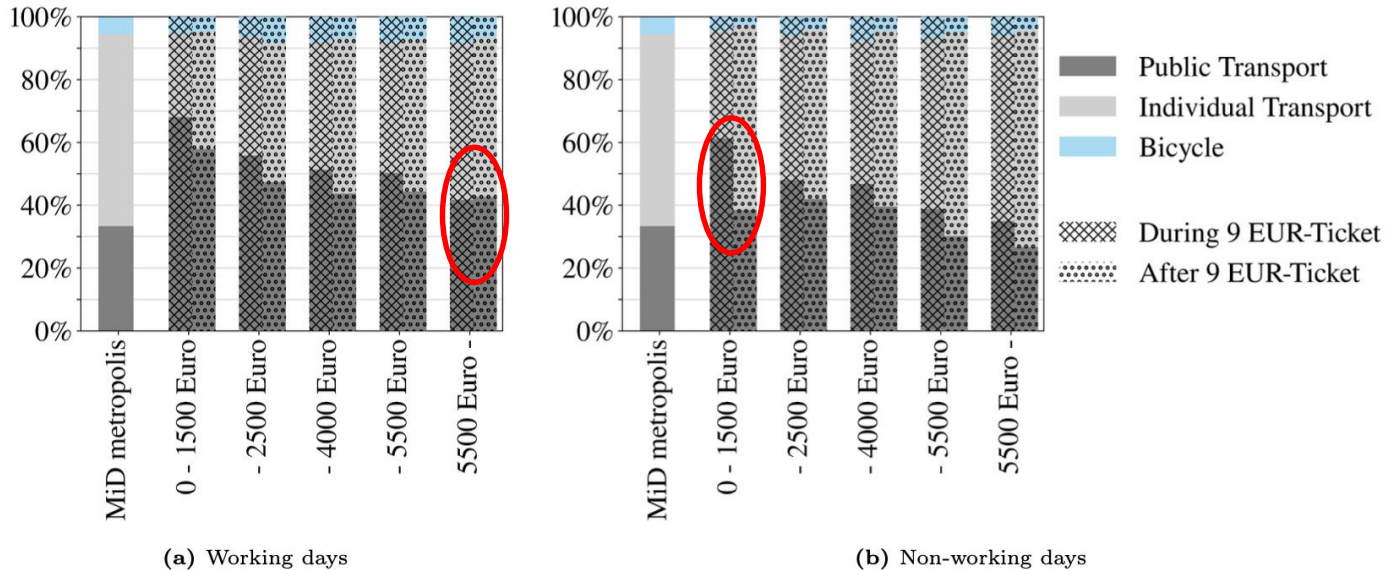
During the ticket phase, in which the usage of public transport is almost free, the NTH hardly travel using public transport. Instead, most travel distance is done by means of individual transport.



APP

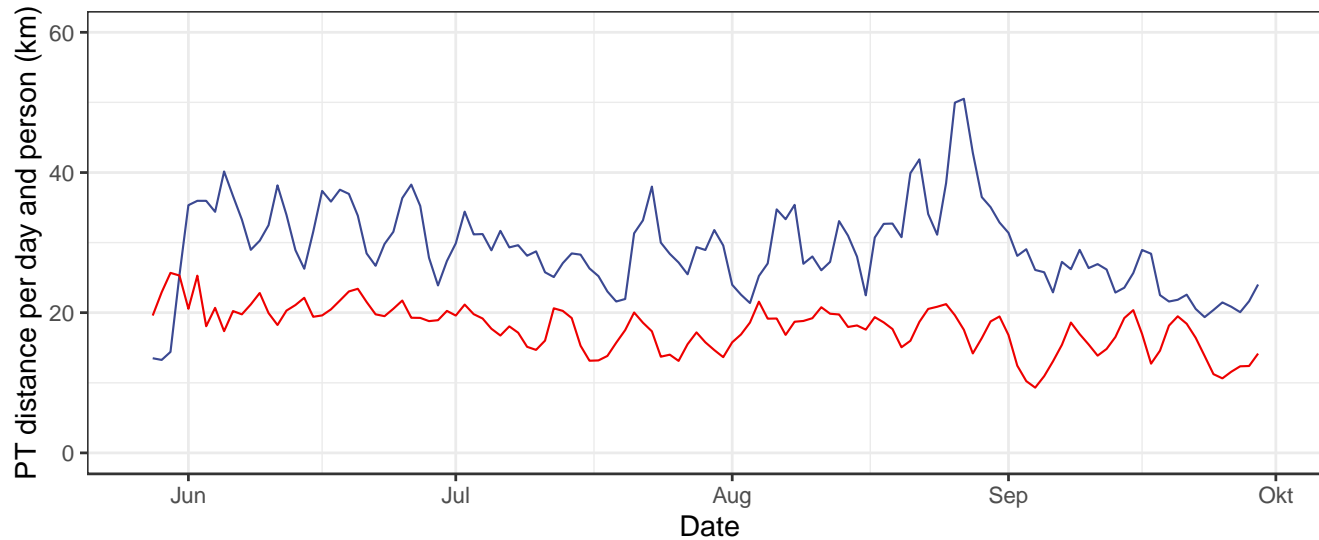
- Public Transport (TH)
- Individual Transport (TH)
- ..... Public Transport (NTH)
- ..... Individual Transport (NTH)
- Weekends & Public Holidays
- 9EUR-Ticket
- School Holidays

# Observed Modal Splits By Income Groups



APP

# By Car Ownership

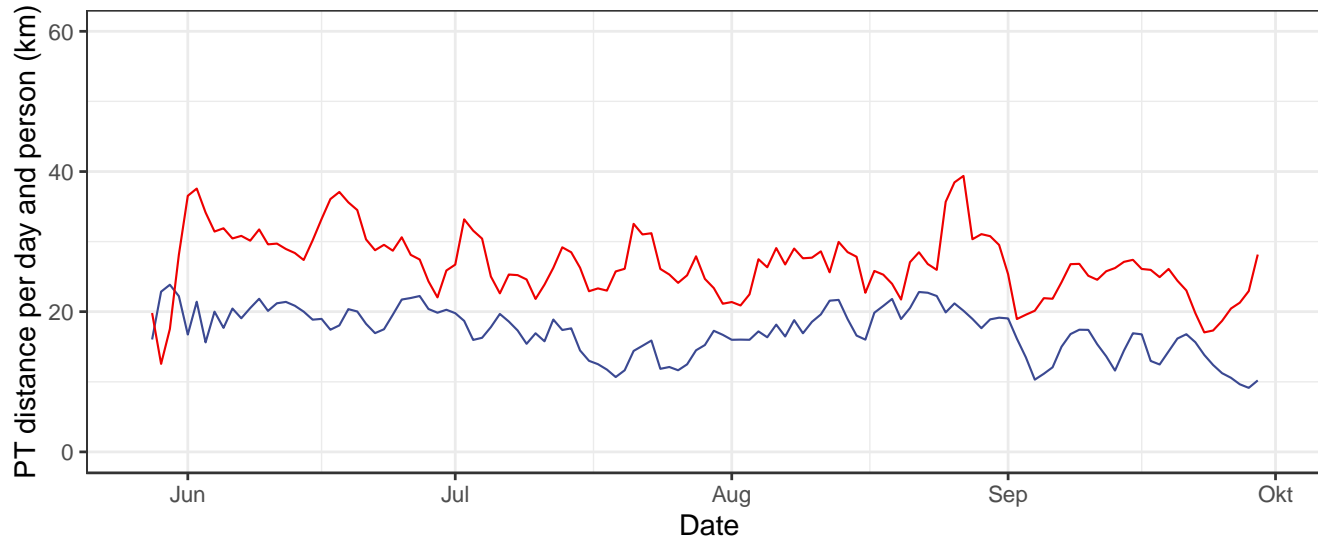


APP

Had a car pre 9-Euro-Ticket — No — Yes



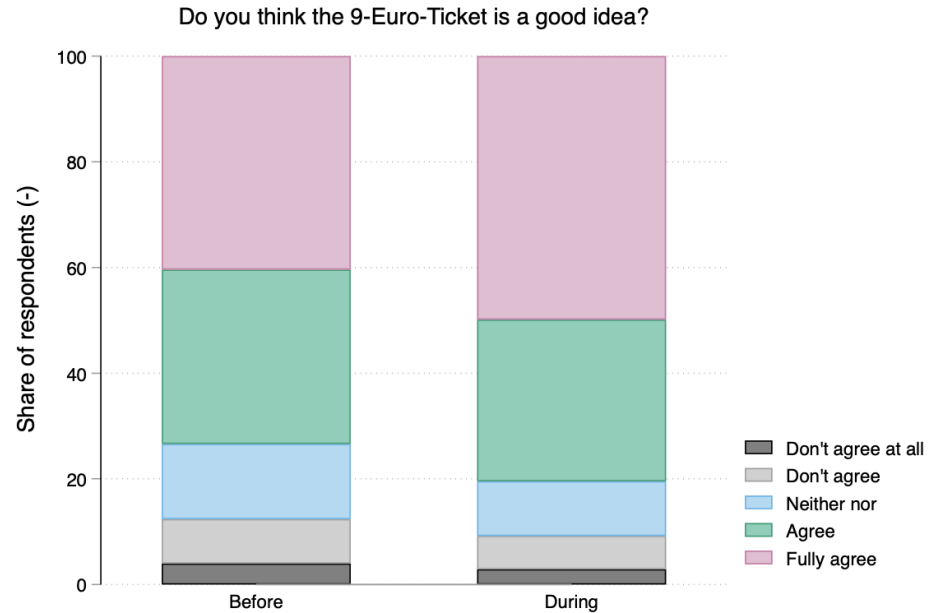
# By Travel Pass Ownership



APP

Had a travel pass pre 9-Euro-Ticket — No — Yes

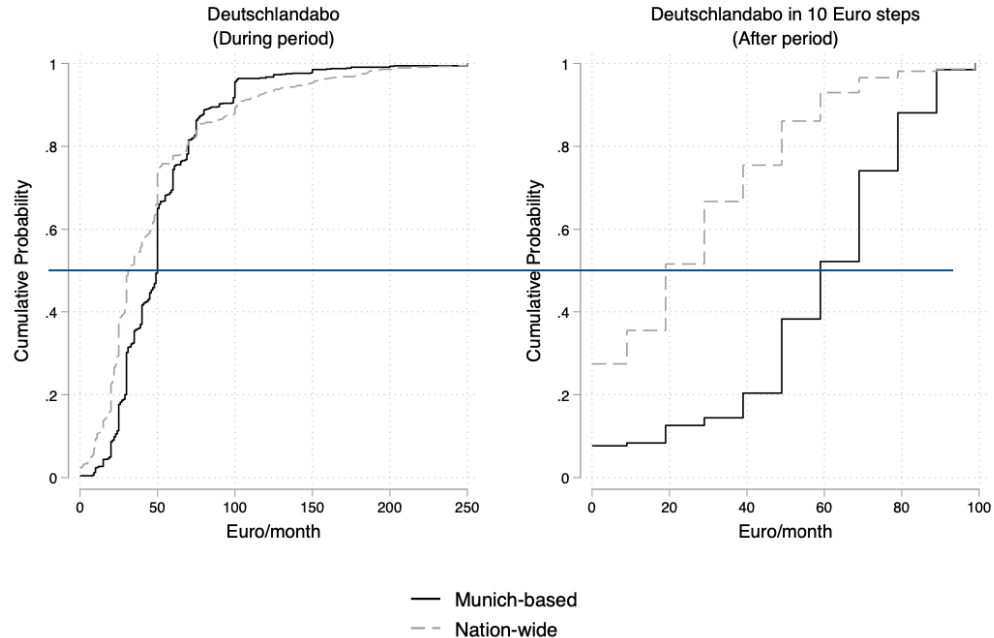
# Public Support



Survey

# Willingness-to-Pay for a nation-wide travel pass for all local PT services

Survey



# Willingness-to-Pay for a nation-wide travel pass for all local PT services

Survey

Price:  
50 Euro per month

	During the 9-Euro-Ticket	Post 9-Euro-Ticket
Munich-based panel	~51%	~80%
Nation-wide panel	~36%	~25%

# How did the 9-Euro-Ticket affect different social groups?

- Method: Propensity Score Matching, ATT on those without prior public transport subscription (N = 827)
- Findings



**All groups increased public transport** use with the 9-Euro-Ticket, especially economically marginalized individuals.



After the ticket validity period, all groups except for economically marginalized individuals reduced the probability of never using public transport, and all groups except for women and economically marginalized individuals increased the probability of purchasing a travel pass.



**Women and economically marginalized individuals** used the ticket mostly for **errands**, while men and **economically privileged individuals** used it more for **leisure.**

Survey

# The 9-Euro-Ticket as a Climate Policy?

Preliminary findings suggest only small effects on CO<sub>2</sub> emissions of app. 300,000 tonnes CO<sub>2</sub> over the three months

Survey & App

CO<sub>2</sub> Emissions from Private Transport in Germany



# Results of Other Studies

## Fuel Tax Cut

- The **fuel tax cut was not an effective** measure to provide **financial relief** (RWI)
- No study on the impact on driving is known ...

## 9-Euro-Ticket

- **20 % new customers**, 10% of trips have been shifted from the car to public transport (VDV)
- **11% of all trips shifted from other modes** of transport, while **6% of all trips were induced** (Krämer et al.)
- **No change in daily mobility** but instead **increased leisure travel** at the beginning and the end of the ticket's validity period (DIW... a similar study with tracking and survey, N~1000 participants)

# Results: Deutschlandticket





# Deutschlandticket Ownership: Probit Model

A person living in a rural area, being **older than 30 years**, having **no automobile** in their household, but **using public transport 1-3 days** per week has a probability of becoming a **new customer of around 43%**

Contrary, people younger than 30 years and living in a metropolitan center, using public transport 1-3 days per week, and having no automobile have only a probability of 13% of becoming a new customer.

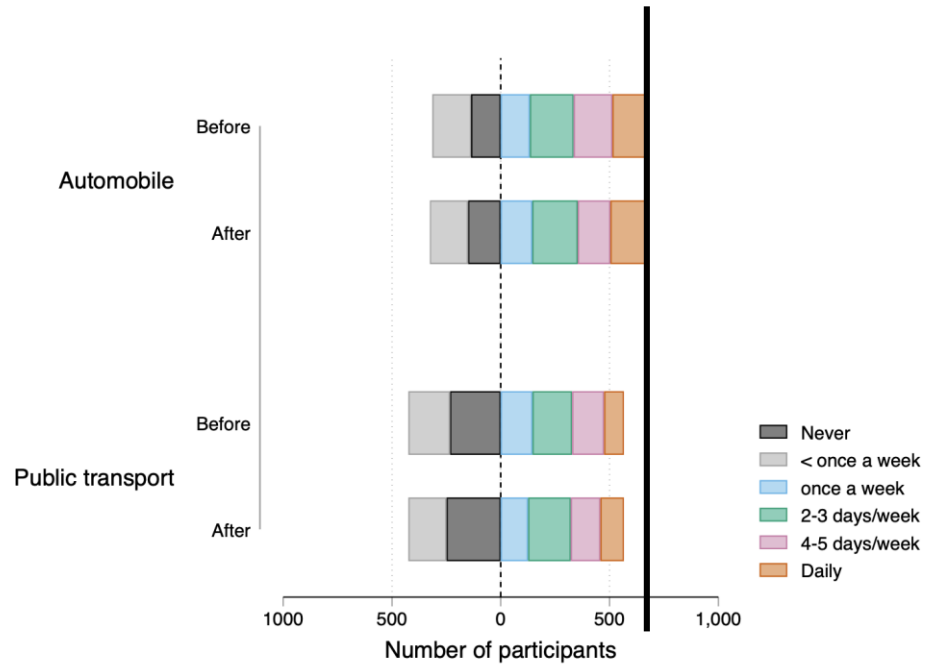
TABLE 2 : Model estimates of a Probit choice model of becoming a new season-ticket customer.

	Dependent variable:	
	<i>new season-ticket customer</i>	
Age category		
Younger than 30 years (base)	-	(-)
30-50 years	0.416*	(1.95)
Older than 50 years	0.464**	(2.21)
Gender		
Non-male (base)	-	(-)
Male	0.0442	(0.34)
Net household income		
1499 Euro per month or less (base)	-	(-)
1500-2499 Euro per month	0.260	(1.07)
2500-3999 Euro per month	-0.0628	(-0.26)
4000 per month or more	-0.196	(-0.82)
Household automobile ownership		
Has no automobile	0.430**	(2.56)
Has at least one automobile (base)	-	(-)
Regional statistical spatial typology at household location		
Rural region	0.477**	(2.55)
Regiopolis, urbanized areas	0.412***	(2.64)
Metropolitan center (base)	-	(-)
Public transport mode usage frequency in April 2023		
Less than once per week (base)	-	(-)
One to three days per week	0.669***	(4.53)
More than four days per week	0.0253	(0.11)
Recruited through professional agency	-1.041***	(-6.90)
Constant	-1.610***	(-5.16)
Observations	717	
Pseudo R <sup>2</sup>	0.171	
Log-likelihood at convergence	-257.7	
Log-likelihood constant only model	-309	

*t* statistics in parentheses

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

# Mode Choice



Survey

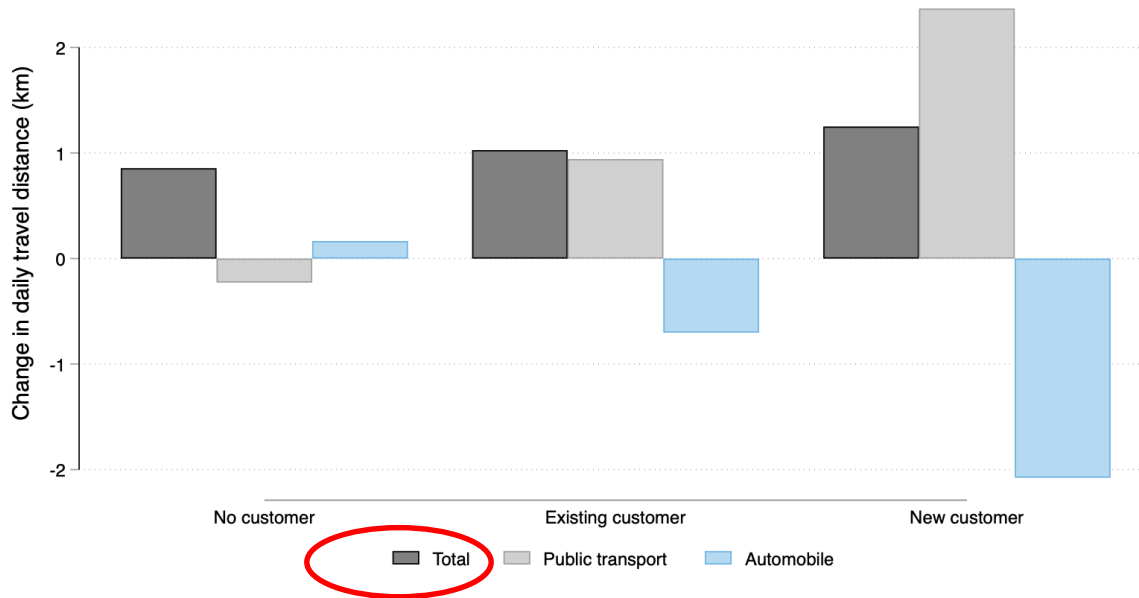
# Stated Travel Behavior Changes

Behavioral change	Season-ticket customer		
	No	Existing	New
Not more public transport, not less automobile	68.81%	50.99%	34.48%
Not more public transport, less automobile	16.56%	20.16%	13.79%
More public transport, not less automobile	11.90%	21.74%	31.90%
More public transport, less automobile	2.73%	7.11%	19.83%

Small reported decrease in automobile use!

Survey

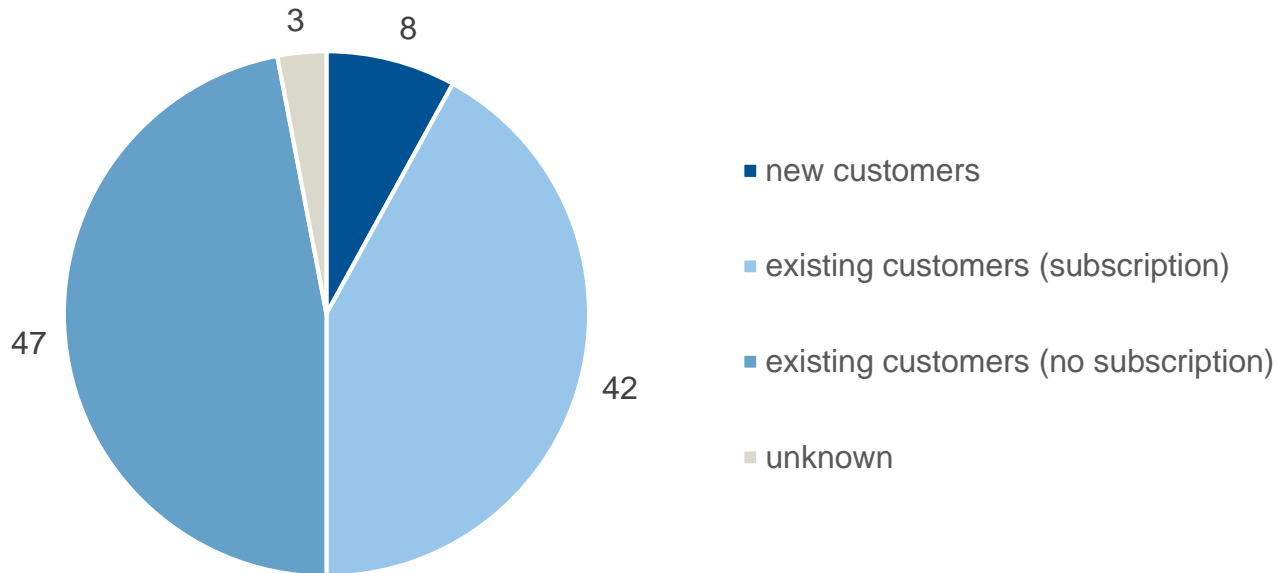
# Measured Travel Behavior Changes



APP

N = 506

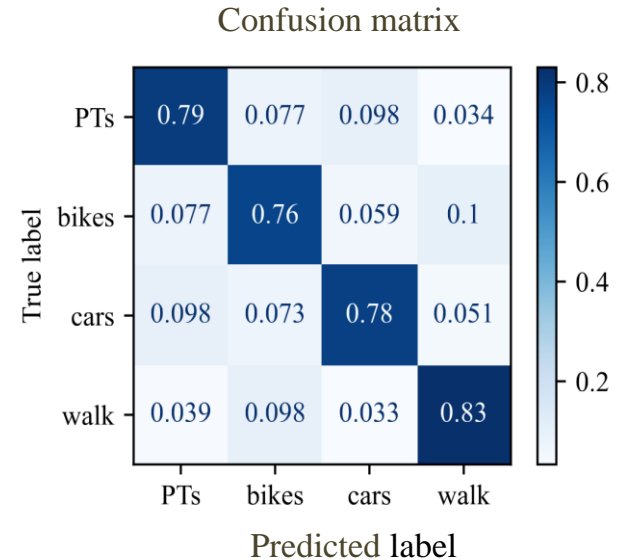
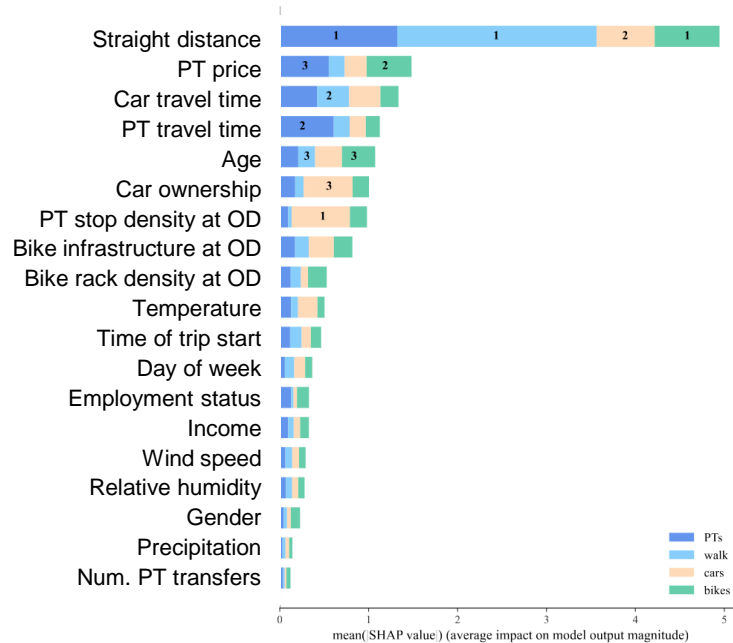
# Results from the VDV market research



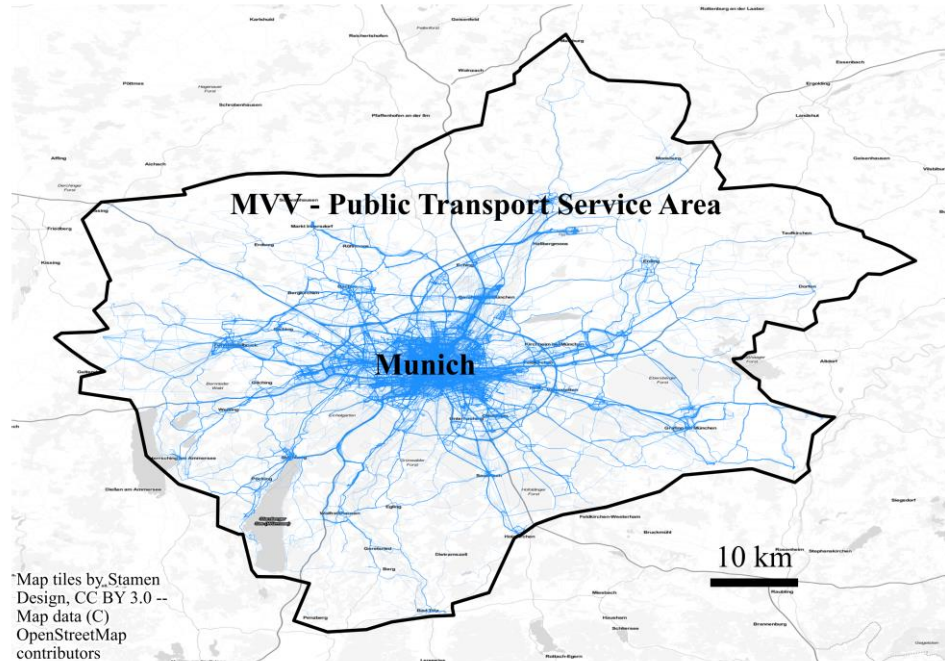
# Other Research with the Data



# NEW MODEL: XGBoost mode choice model



# Analyses: Cycling tracks

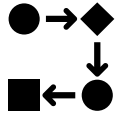




# Outlook on Future Research



- **Codebook** and **survey metadata** for the entire Mobilität.Leben study
- Develop/Automation **methods for data processing, enrichment, and analysis** of semi-passive travel diaries



- Estimate **elasticities**
- Estimate **value of time**
- **Cost-benefit-analyses** of the 9-Euro-Ticket and Deutschlandticket

Thank you!

