

How popular will ride hailing and ride pooling be with autonomous vehicles?

European Transport Conference 2024

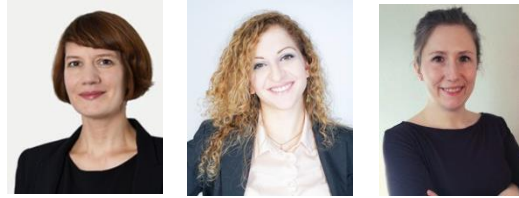
Alex Erath, **Michael van Eggermond** and Reto Tanner



HOW AUTONOMOUS VEHICLES WILL AFFECT THE SWISS TRANSPORT SYSTEM

RESEARCH TEAM

n|w University of Applied Sciences and Arts Northwestern Switzerland
School of Applied Psychology



Understanding people's hopes and concerns

n|w University of Applied Sciences and Arts Northwestern Switzerland
School of Architecture, Civil Engineering and Geomatics



Sketching, planning, designing, implementing, conducting and analysing stated preference survey

ETH zürich



Contributing MATSim features, setting-up & calibrating simulations and running policy scenarios



Initiating, supporting, advising, questioning, guiding, checking, trusting.

n|w University of Applied Sciences and Arts Northwestern Switzerland
School of Architecture, Civil Engineering and Geomatics

INTRODUCTION

A NEW SET OF MODES

Autonomous ridehailing (aRH)



Source: Daimler

Autonomous ridepooling (aRP)



Source: Rinspeed

Service type

Door-to-door

Between pick-up points

As feeder to public transport

Cost

Competitive to car

Competitive to public transport

Travel time elements

Response time

Travel time

Response time

Travel time

Access / Egress time

Travel time uncertainty

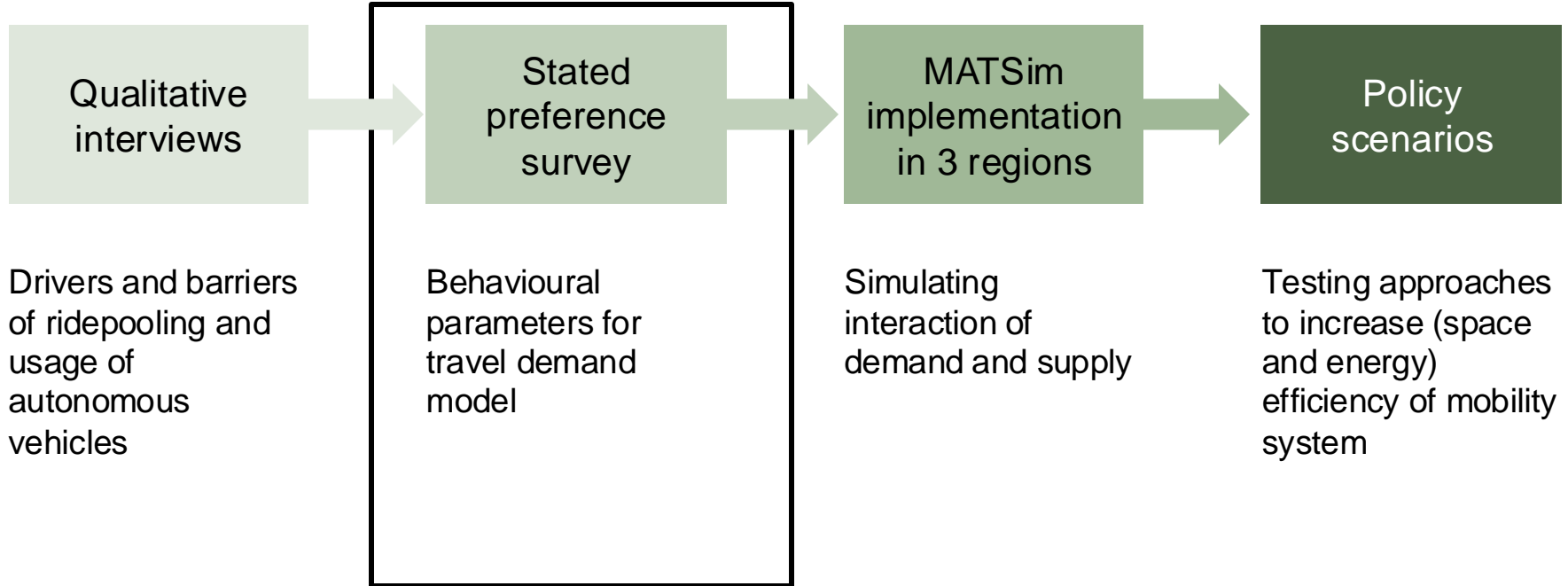
Due to traffic

Due to traffic and other passengers

INTRODUCTION

OUR STUDY AS PART OF THE RESEARCH PROJECT

Today



Sponsor: Swiss Federal Roads Office FEDRO
Project ID: MB4 20 01A 01

Krueger *et al.* (2016), Australia

- 3 alternatives: chosen mode, aRH, aRP
- “Prezi” slide show to explain aRH and aRP
- Classification of respondents according to their modality
- Travel time and cost: aRP >> aRH
- Waiting time: aRP and aRH >> public transport
- High a priori preference for aRH compared to aRP

Bansal and Daziano (2018)

- 3 alternatives: reported mode, aRH, aRP
- Information on (a)RH and (a)RP based on text and illustration
- Waiting and access time perceived 3x as much as in vehicle time

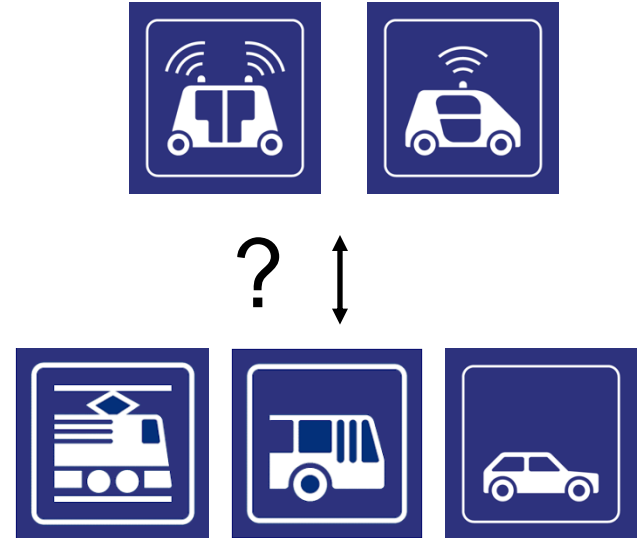
Becker *et al.* (2019) and Hörl *et al.* (2021)

- 6 alternatives, including aRP, aRH and aRH+PT
- 5159 choices from 453 respondents (Zurich area)
- Perception of travel time:
aRH-Feeder >> aRP / aRH > car > public transport
- Some key parameters not significant at 5% level

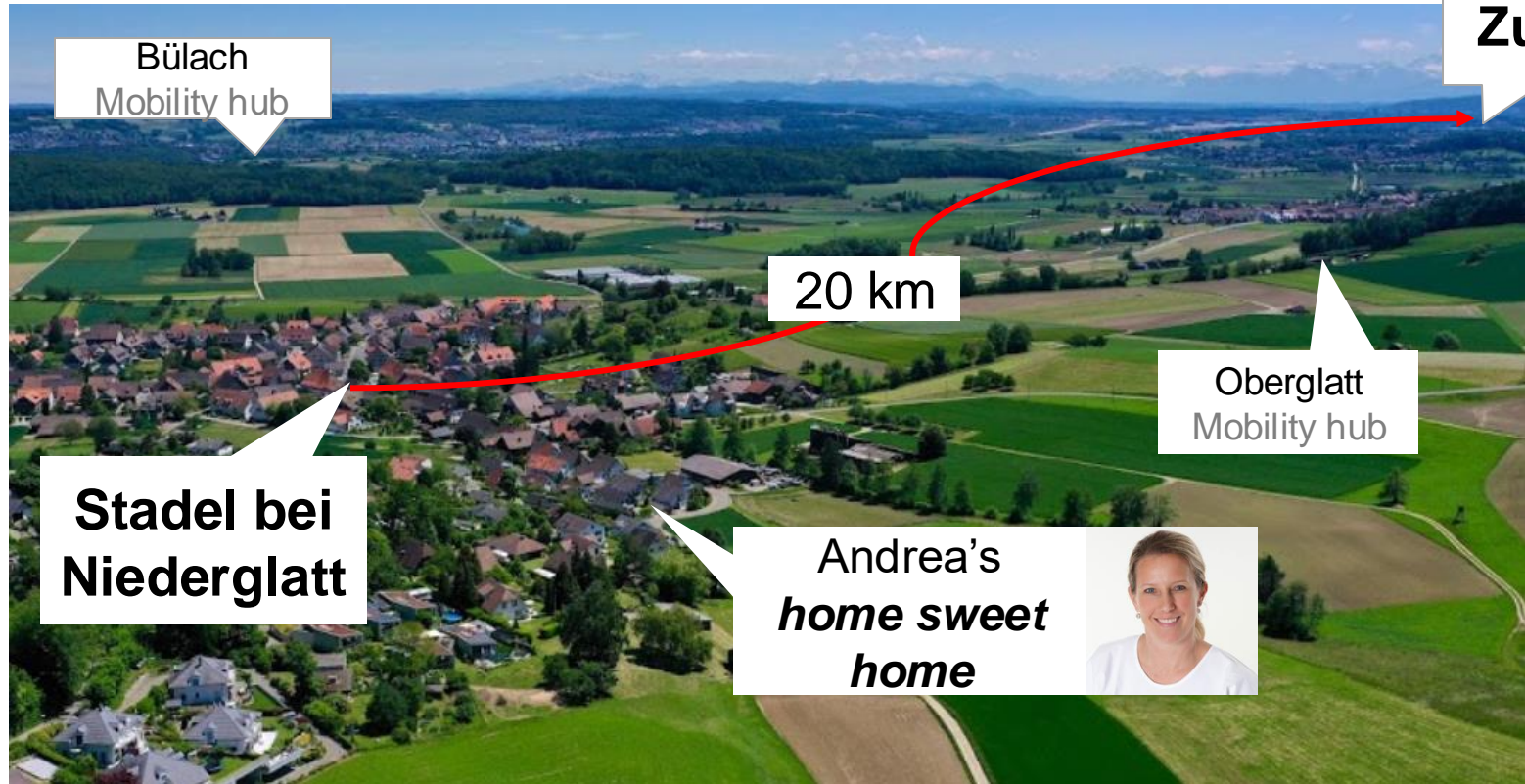
INTRODUCTION

RESEARCH QUESTIONS

- How do behavioural parameters for ridehailing (aRH) and ridepooling (aRP) **compare to parameters of existing modes?**
- Which **additional parameters** for aRH and aRP **can we reliably quantify** with a nationwide stated preference survey?
- How do the new modes **impact car ownership?**
- Is there a **market for ridepooling travel cards?**

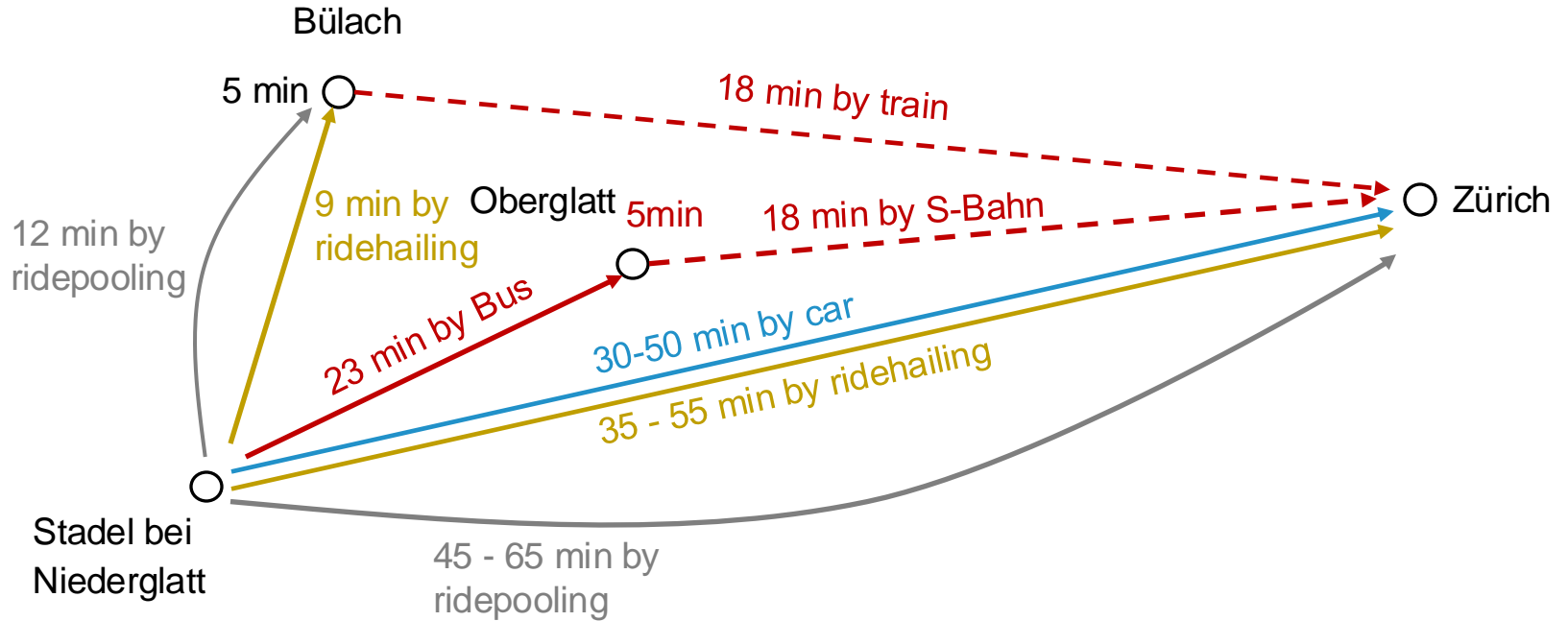


INTRODUCTION
STADEL BEI NIEDERGLATT









INTRODUCTION

OUR CASE STUDY: A 25KM TRIP TO THE CITY ON A THURSDAY EVENING



METHODOLOGY

OUR CASE STUDY AS A CHOICE EXPERIMENT

						
Your choice:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Car	Public transport	aRH (direct)	aRH + PT (intermodal)	aRP (direct)	aRP + PT (intermodal)
	30-50 min	53 min	32 min	35- 55 min	35 min	45-65 min
	CHF 15	CHF 5	CHF 12	CHF 20	CHF 9	CHF 12
	-	1 transfer	1 transfer	-	1 transfer	-

Introduction

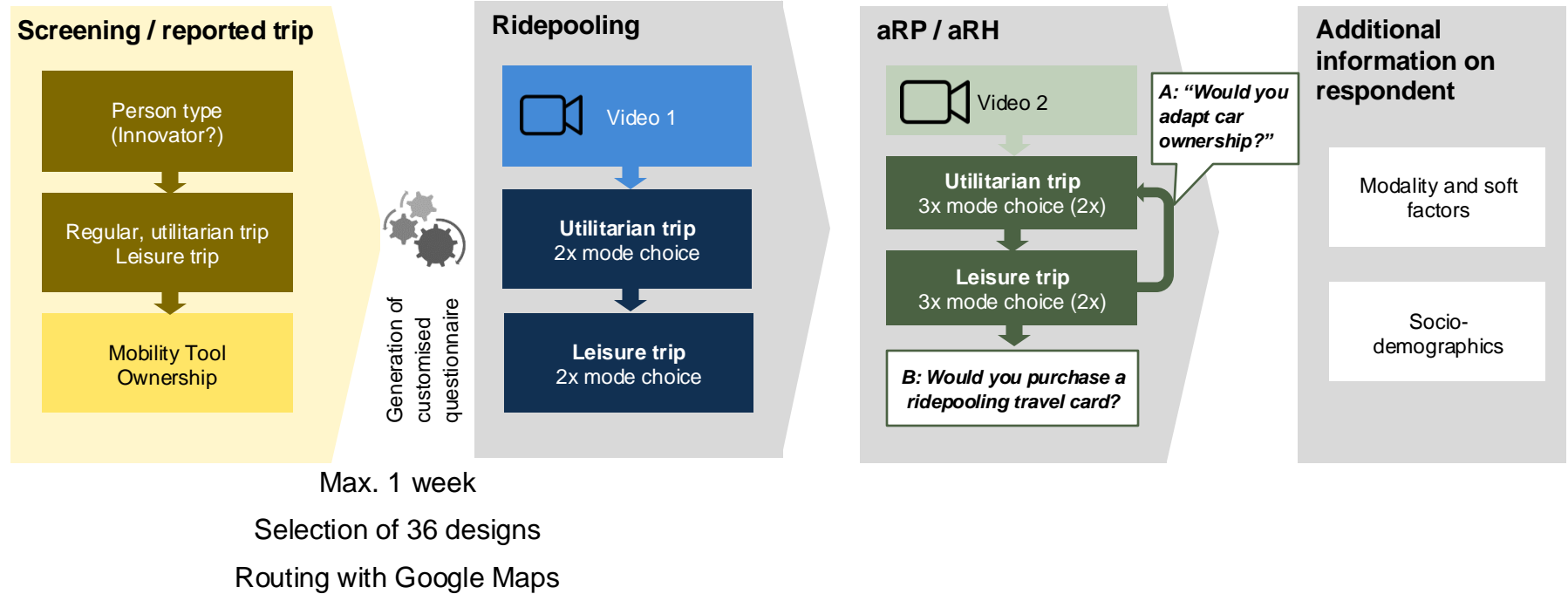
Methodology & Data

Results

Conclusion

METHODOLOGY

SURVEY



Questionnaire 1

Questionnaire 2

Objectives:

- Ensure consistent information among all respondents
- Address concerns raised in exploratory interviews
- Easy to understand and watch

Addressed topics in video 2:

- AV technology
- Traffic safety
- **Vehicle types and new services**
- **Fare and travel cards**
- **Personal safety**



Fachhochschule Nordwestschweiz
Hochschule für Architektur, Bau und Geomatik

Wie funktionieren selbstfahrende Fahrzeuge?

Video in [German](#) / [French](#)

METHODOLOGY

ADAPTIVE PIVOT POINT EXPERIMENT DESIGN

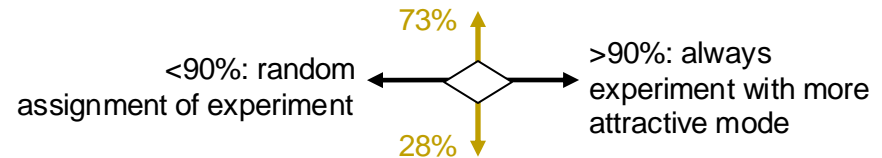
Goal

- Simple, realistic and efficient choice sets
- Can be implemented in a web-based questionnaire

Approach

- Choice set with 3 labelled alternatives
- Pivot random design based on reported trips
- Prices ranges for aRH and aRP based on Bösch et al. (2018)
- Attribute levels adaptive to **trip length** and **spatial type** of origin and destination
- **Selection of alternatives** based on attractiveness of aRP as direct mode vs. feeder mode (utility-based)

Choice set 1:	Public transport	aRH (direct)	aRP (direct)
Direct modes	53 min	32 min	35 min
	CHF 5	CHF 12	CHF 9
	1 transfer	1 transfer	1 transfer
	○	○	○



Choice set 2:	Public transport	aRH + PT (intermodal)	aRP + PT (intermodal)
With transfer	53 min	35- 55 min	60-70 min
	CHF 5	CHF 20	CHF 12
	1 transfer	-	-
	○	○	○

Desktop Browser

	Auto	Selbstfahrendes Taxi	Selbstfahrendes Ridepooling
Reisedauer	18 - 22 Min.	15 - 19 Min.	19 Min.
im Fahrzeug	18 - 22 Min.	15 - 19 Min.	13 Min.
Zu Fuss	0 Min.	keine Fusswege	6 Min.
Kosten inkl. Parkplatz	6 CHF (inkl. Parkplatz)	9 CHF	7 CHF
Wartezeit	-	10 Min.	2 Min.
Zusteigeort	-	Haustür	ÖV Haltestelle
Mitfahrende	-	keine Mitfahrenden	2 - 3 Pers.
Vorbestellung möglich	-	Ja	Nein
Entscheidung	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Mobile Browser

Kosten	16 CHF
Anzahl Umsteigen	-1
Auslastung im ÖV / Mitfahrende	mittel
Takt	Fährt alle 60 Min
Zusteigeort	Haltestelle
Vorbestellung möglich	-
Ihre Wahl	<input type="radio"/>
	Ridepooling
Reisedauer	42 Min.
im Fahrzeug	40 Min.
Fusswege zu/von Haltep.	2 Min.
Umsteigen	-
Kosten	72 CHF
Anzahl Umsteigen	Fährt direkt
Auslastung im ÖV / Mitfahrende	2 - 3 Pers.
Takt	4 Min.
Zusteigeort	Virtueller Haltepunkt
Vorbestellung möglich	Ja
Ihre Wahl	<input type="radio"/>

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SAMPLING AND SAMPLE

intervista Webpanel

- 110k residents
- Stratified sample for spatial type of residence, innovation diffusion and various quotas

Deviation from national shares smaller than 5%

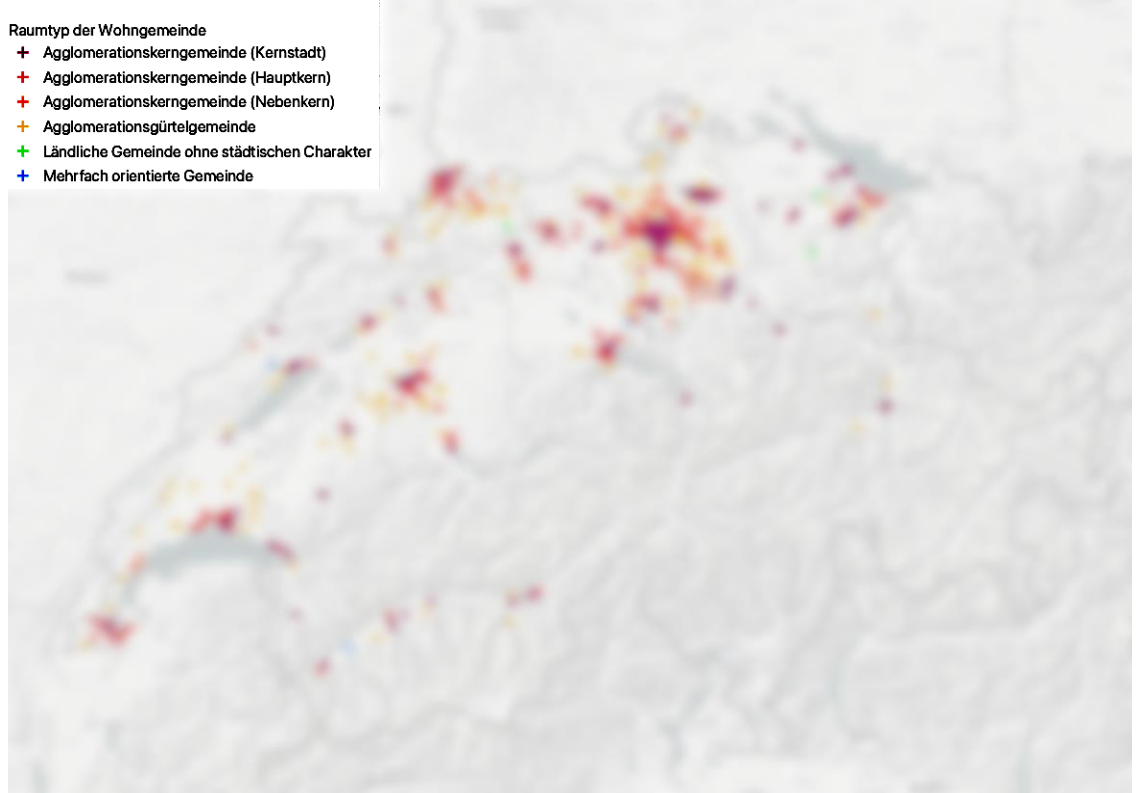
- Age groups
- Car availability
- Language (German and French)
- Spatial type of residence municipality

Slightly overrepresented groups

- GA and regional travel card (34% vs 20%) due to restrictions WRT trip distance
- 20% higher income than for reference population

Raumtyp der Wohngemeinde

- + Agglomerationskerngemeinde (Kernstadt)
- + Agglomerationskerngemeinde (Hauptkern)
- + Agglomerationskerngemeinde (Nebenkern)
- + Agglomerationsgürtelgemeinde
- + Ländliche Gemeinde ohne städtischen Charakter
- + Mehrfach orientierte Gemeinde



Introduction

Methodology & Data

Results

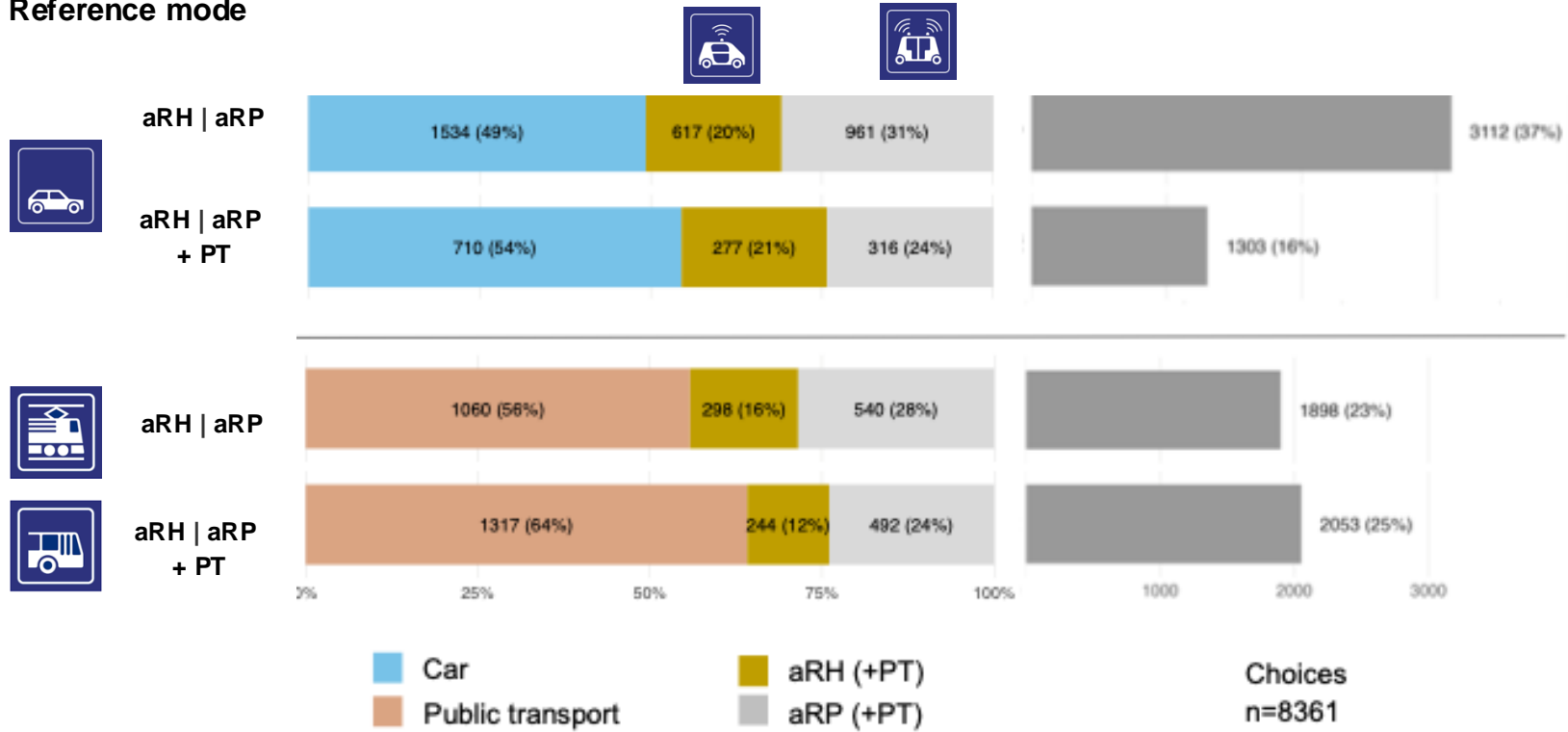
Conclusion

RESULTS: CHOICE EXPERIMENTS

MARKET SHARES

Chosen modes

Reference mode

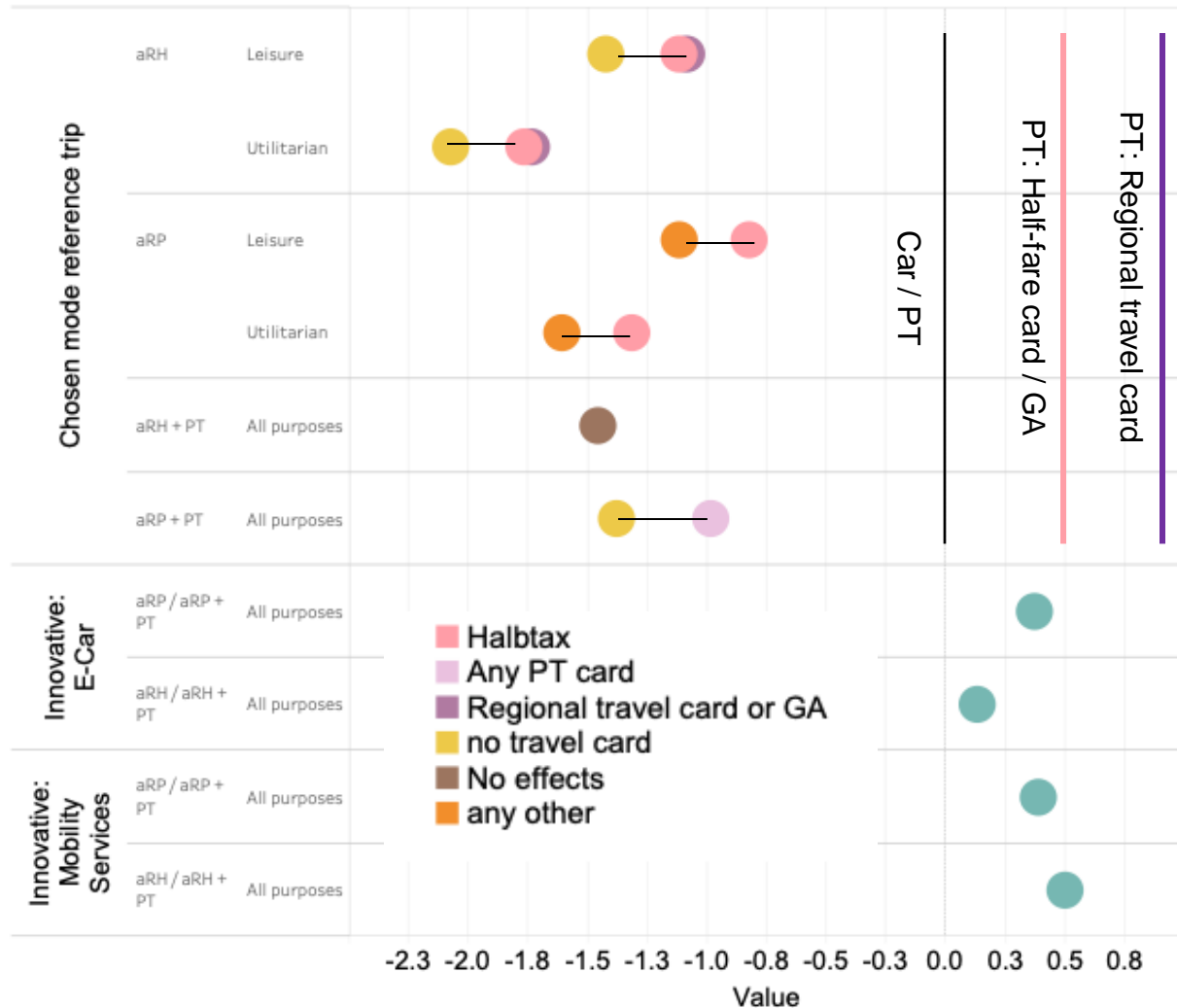


RESULTS: CHOICE EXPERIMENTS

MODEL CONSTANTS

Insights:

- Respondents are rather hesitant to choose the new modes
- Car trips are more likely to be replaced by aRH or aRP
- No a priori preference for aRH
- Car users with travel cards are more likely to use aRH or aRP
- PT users with travel cards are less likely to use aRH or aRP
- “Innovative” persons are more likely to use aRH or aRP



RESULTS: CHOICE EXPERIMENTS

PARAMETER RATIOS - TRIP PURPOSE: WORK

	Car	PT	aRH	aRH +PT	aRP	aRP + PT
Access time vs. in-vehicle time	146%	156%	-	-	160%	
Response time vs. in-vehicle time	-	-	30%		61%	
Bookable	-	-	xx CHF	insign.	xx CHF	insign.
Travel time at high occupancy	-	+20%	-	-	insign.	insign.
Uncertainty: +/- 1 Min vs. in vehicle time	21%	-	insign.	insign.	44%	insign.
Headway vs. in vehicle time	-	26%	-	-	-	-
5 min transfer as in- vehicle time	-	10 min	-	insign.	-	7 min (additional PT transfer)

RESULTS: CHOICE EXPERIMENTS

SOME OTHER RESULTS

Public transport quality

- A decrease in public transport quality at the residence increases the likelihood of using aRP or aRH

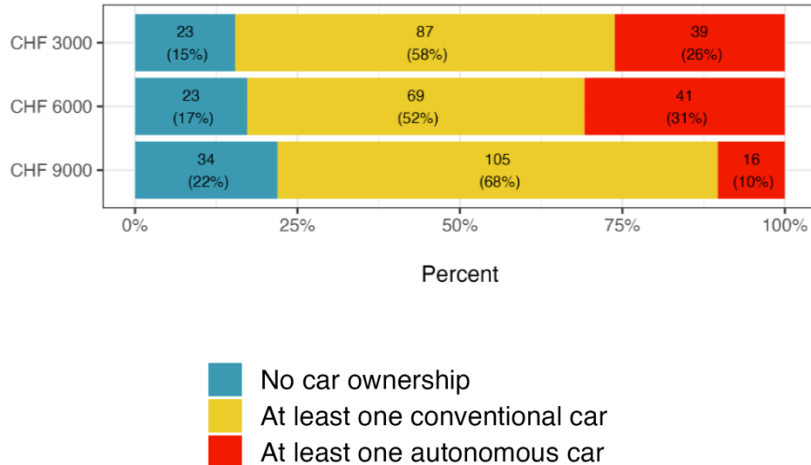
Not significant service characteristics

- Occupancy aRP:
 - Number of passengers in ridepooling vehicles
 - Type of pick-up point:
 - Home (aRH) / Virtual stop / PT stop
- Travel time uncertainty for aRH / aRP
- Income interaction with travel costs

RESULTS: MOBILITY TOOLS

UPDATE VEHICLE OWNERSHIP

Update in car ownership as function of presented price



Factors that explain...

... to give up a car

- ++ Generalabo
- + Public transport used for reported trip
- + Residence with highest public transport connection quality
- + Half fare card
- + Female
- + Being innovative

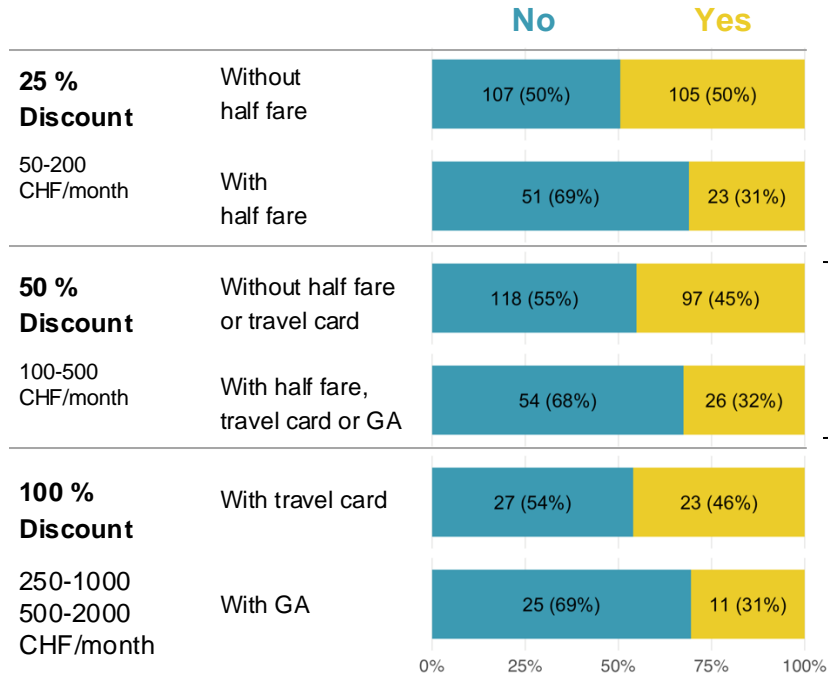
... to purchase of AV?

- + Being innovative
- + No driver's license
- Half fare card

RESULTS: MOBILITY TOOLS

RIDEPOOLING SUBSCRIPTION: DESCRIPTIVE ANALYSIS

Would you buy a ridepooling discount card for CHF / month?



Factors that explain buying a 50% discount card

- ++ Medium/low public transport connection quality ("C")
- + Being innovative
- + Half fare card
- - - CHF 500 / month
- - CHF 300 / month
- Inner suburb (spatial type "Hauptkern")

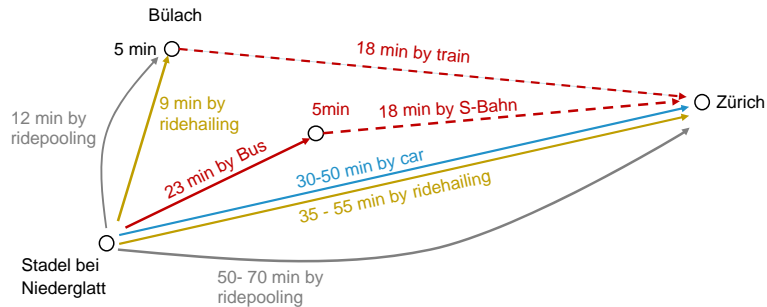
RESULTS

OUR CASE STUDY: 25KM TRIP TO THE CITY



Andrea

- Lives in Stadel bei Niederglatt
- Still owns a (old) car
- Has half fare card including aRP trips up to 10km



	Today
Car	74%
Public transport	26%
aRH	-
aRH + PT	-
aRP	-
aRP + PT	-
Veh-km on road	18.6
Pkm in public transport & aRP	7.1

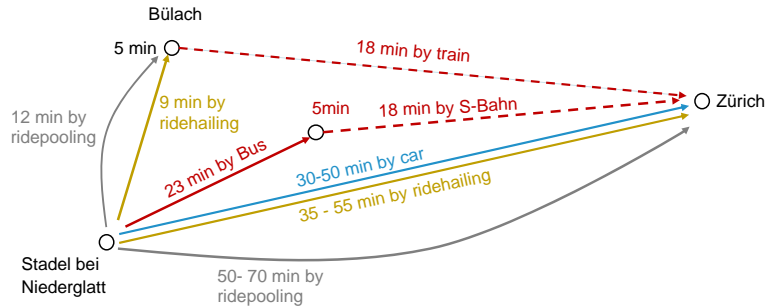
RESULTS

OUR CASE STUDY: 25KM TRIP TO THE CITY



Andrea

- Lives in Stadel bei Niederglatt
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	Today	Today's view of the future
Car	74%	50%
Public transport	26%	17%
aRH	-	9%
aRH + PT	-	4%
aRP	-	5%
aRP + PT	-	14%
Veh-km on road	18.6	17.5
Pkm in public transport & aRP	7.1	8.7

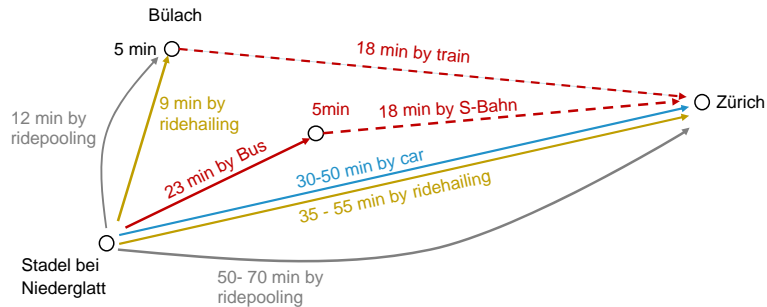
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OUR CASE STUDY: 25KM TRIP TO THE CITY



Andrea

- Lives in Stadel bei Niederglatt
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- Has half fare card including aRP trips up to 10km



	Today	Today's view of the future	A less hesitant future
Car	74%	50%	28%
Public transport	26%	17%	10%
aRH	-	9%	21%
aRH + PT	-	4%	10%
aRP	-	5%	11%
aRP + PT	-	14%	20%
Veh-km on road	18.6	17.5	17.8
Pkm in public transport & aRP	7.1	8.7	9.0

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HOW POPULAR WILL RIDE HAILING AND RIDE POOLING BE

DISCUSSION

Credible results

- Confirms insights from existing aRH/aRP-studies
- Adds new insights with regards to travel behaviour with aRH and aRH as direct and feeder mode

(Non-)confirmation of earlier findings

- Confirmation of earlier study by Becker / Hörl *et al.*
 - Hesitance to use aRP as compared to aRH identified by Krueger *et al.* cannot be confirmed: Switzerland as a “multimodal” nation?

New modes fill a gap

- For people who are neither public transport addicts nor petrol heads
- For areas with low public transport service quality

Limitations

- Influence of the number of additional passengers on willingness to pool could not be quantified.
- No nested structures tested (yet)
- No consideration of trips in groups (highly relevant for pricing of aRH and aRP)
- Competition with cycling not examined.
- Should participants be presented with simpler experiments?

HOW POPULAR WILL RIDE HAILING AND RIDE POOLING BE

CONCLUSION AND OUTLOOK

Insights

- aRH and aRP can supplement existing modes and can lead to a more sustainable transport system
- Pricing seems very effective to shift people from aRH to aRP
- aRP has limited potential as feeder service due to highly negative constant

Contribution:

- New type of an adaptive pivot design choice experiment
- Wide set of credible and stat. sign. estimated behavioural parameters for aRH and aRP.

Outlook

- Implementation of choice model parameters in MATSim models – submitted to TRB AM
- Simulating where, when, and where the demand potential can be served with aRH and aRP supply.

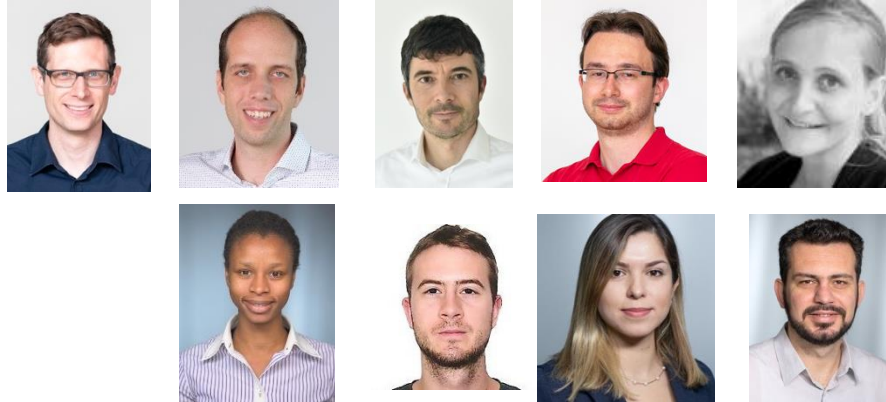
Open (research) questions

- By how much will the hesitance towards the new modes will decrease as they become better known?
- How should we shape the Swiss transport system to leverage on shared autonomous vehicles and which role should aRP have?

HOW POPULAR WILL RIDE HAILING AND RIDE POOLING BE THANK YOU!



Understanding people's hopes
and concerns



Sketching, planning, designing,
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HOW POPULAR WILL RIDE HAILING AND RIDE POOLING BE

QUESTIONS AND CONTACT



Alexander Erath

alexander.erath@fhnw.ch

<https://www.fhnw.ch/verkehr-und-mobilitaet>

Michael van Eggermond

michael.vaneggermond@fhnw.ch

<https://www.fhnw.ch/verkehr-und-mobilitaet>

HOW AUTONOMOUS VEHICLES WILL AFFECT THE SWISS TRANSPORT SYSTEM

LITERATURE

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