

8th METRANS International Urban Freight Conference, October 16-18, 2019, Long Beach, CA

Factors Explaining the Use of Cargo Bikes and Cars in Urban Logistics: Results from a Stated Preference Experiment in Germany

Johannes Gruber, Lars Thoma, Felix Steck

German Aerospace Center (DLR)
Institute of Transport Research
Berlin, Germany

Telephone: +49 30 67055 200

Email: johannes.gruber@dlr.de

A large, curved image of the Earth from space occupies the right half of the slide. It shows a blue horizon, white clouds, and green landmasses. The text "Knowledge for Tomorrow" is overlaid on the bottom right of this image.

Knowledge for Tomorrow

Agenda

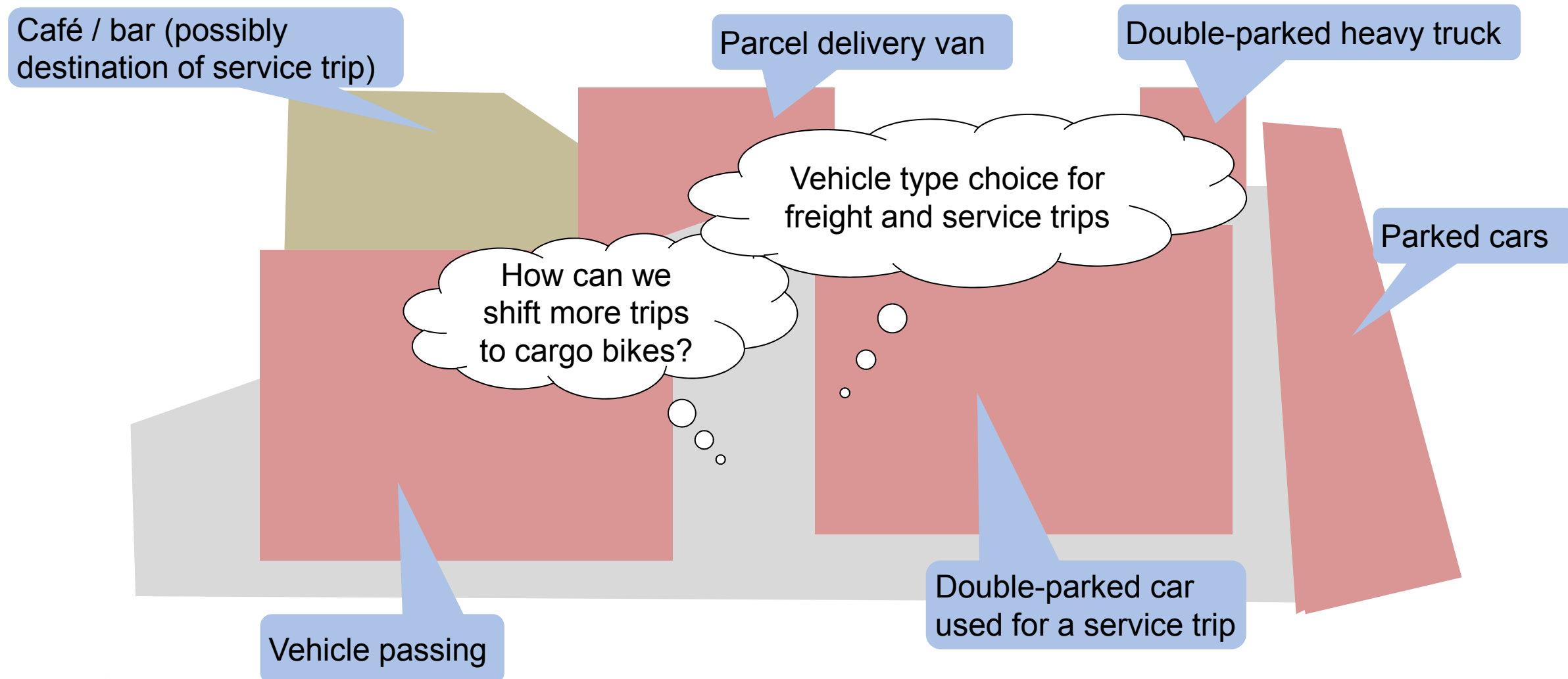
Factors Explaining the Use of Cargo Bikes and Cars in Urban Logistics: Results from a Stated Preference Experiment in Germany

- Motivation
- Project background:
cargo bike (CB) trial
- Stated preference (SP)
experiment design
- Model results
- Conclusions



Note: Background picture removed due to copyright

Just a “boring” German street scene...?



Research question and context

Research question:

Which factors explain the use of cargo bikes (CB) and cars in urban logistics?

**CARGO
BIKE (CB)**

CAR

Research context and method:

- Organizations willing to change from car (or van) use to CB
- SP choice experiment at the end of a CB trial phase
- Additional RP data
- Mixed logit to model vehicle type choice



Project background: Germany-wide CB trial “*Taking the load off cities*” (German title “Ich entlaste Städte”)

Large-scale CB trial...

- 152 vehicles
- 2 years of testing in total
- 3 months for each participant

...for a diverse target group...

- Companies of all industries
- Public institutions
- NGOs, initiatives
- Freelancers, self-employed

... with similarities

- All are willing to downshift
- All gained operational CB experience



Supported by:



Federal Ministry for the
Environment, Nature Conservation,
Building and Nuclear Safety



NATIONAL
CLIMATE
INITIATIVE

based on a decision of the German Bundestag

Some examples of the CB trial participants



Brewery

Beer deliveries to local supermarkets



Toy repair service

Transport of toys



Beekeepers

Transport of beehives



Movie production

Transport of equipment to film location



Church community

Helping priests for on-site visits



Real estate firm

Trips to viewing appointments



Electrical engineering

Customer support trips



Caramel factory

Delivery of sweets

CB trial fleet: 5 main types of construction, 23 different models, 152 vehicles



Pizza delivery bike



Tricycle, front load



Heavy load tricycle



Long John bike








"Specialist" CB



Longtail bike

Sample descriptive statistics: Vehicle use

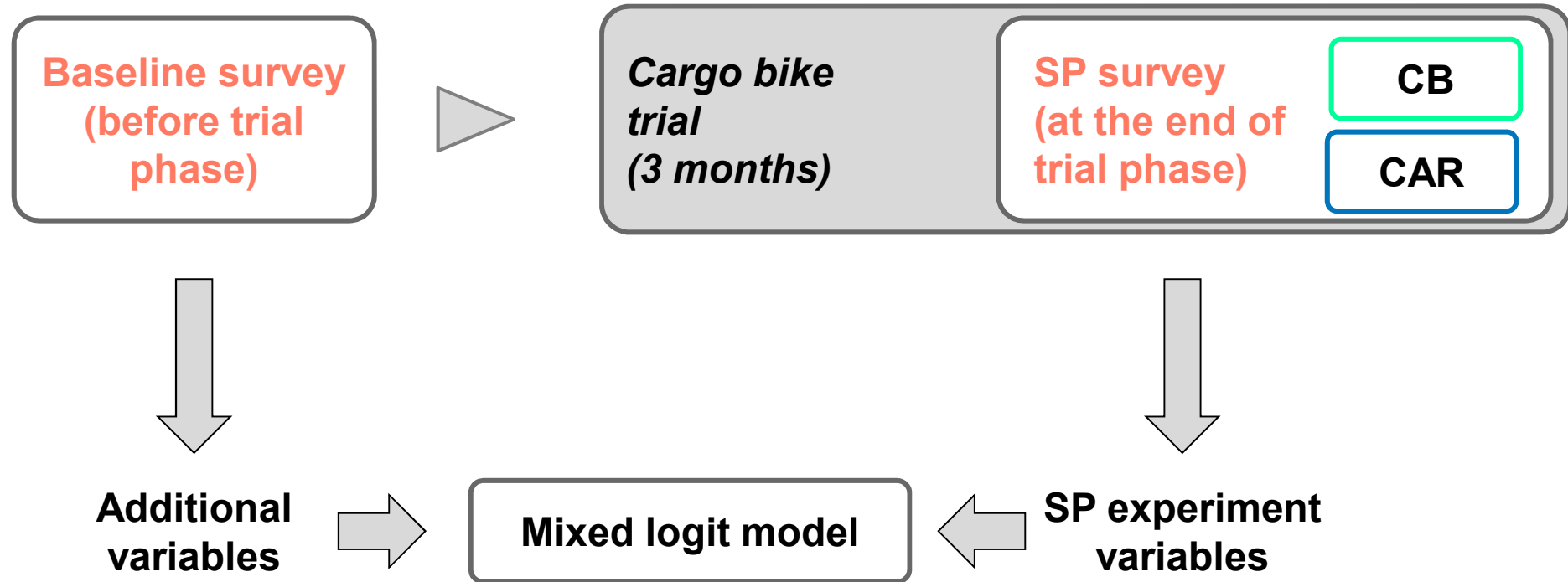
No. of wheels	Construction type	Typical model	No. of models	No. of participants in sample
2	Pizza delivery bike		1	26
	Long John bike		10	206
	Longtail bike		2	9
3	Tricycle, front load		6	84
	Heavy-load tricycle		4	14

Sum=339
(sample size)

Distance parameter	Value	Data basis
Mean daily mileage	12.1 km 7.5 mi	5,002 GPS-tracked days
Mean single trip distance	5.1 km 3.2 mi	11,736 GPS-tracked trips




















Main operational purpose	Share of CB trial participants
Delivery of goods	21%
Pick-up / procurement of goods	13%
Provision of services	38%
Other business-related errands	25%
Private errands	3%

Study design: Overview













Study design: Example of a SP choice experiment

SP survey question: *Which vehicle would you choose for a trip under the following conditions?*

INDEPENDENT ATTRIBUTES	{	TRIP DISTANCE (ROUNDTrip) 5 km (3.1 mi)		TEMPERATURE 18 °C (64 °F)
				PRECIPITATION YES 
ALTERNATIVE-SPECIFIC ATTRIBUTES		<input type="checkbox"/> CARGO BIKE		<input type="checkbox"/> CAR
 PARKING		 At point of destination	 Parking available	
 INFRASTRUCTURE		 Safe bike path	 Street	
 TRAVEL TIME		 13 min	 18 min	
 TOTAL COST OF TRIP		 € 5	 € 6	
 RISK OF DAMAGING GOODS		 15 %	 0 %	
 RISK OF DELAY		 15 %	 0 %	
		<input type="checkbox"/> TRIP WOULD NOT BE CARRIED OUT UNDER THESE CIRCUMSTANCES		

Study design: Attributes of SP experiments

INDEPENDENT ATTRIBUTES		2 SETS OF CARDS FOR TRIP DISTANCE (ROUNDTrip) 5 km (3.1 mi) 12 km (7.5 mi)	
		 TEMPERATURE -3 °C (27 °F) 5 °C (41 °F) 18 °C (64 °F)	
		PRECIPITATION Yes   No 	
ALTERNATIVE-SPECIFIC ATTRIBUTES		<input checked="" type="checkbox"/> CARGO BIKE	<input type="checkbox"/> CAR
 PARKING		At point of destination	No stopping zone Parking available
 INFRASTRUCTURE		Safe bike path Mixed use street	Street
 TRAVEL TIME		13 21 30 min 32 51 72 min	10 12 18 min 25 30 45 min
 TOTAL COST OF TRIP		€ 3.5 € 5 € 7.5 € 8.4 € 12 € 18	€ 6 € 8.5 € 12.5 € 14.4 € 20.4 € 30
 RISK OF DAMAGING GOODS		0 % 5 % 15 %	0 % 5 % 15 %
 RISK OF DELAY		0 % 5 % 15 %	0 % 5 % 15 %
		<input type="checkbox"/> TRIP WOULD NOT BE CARRIED OUT UNDER THESE CIRCUMSTANCES	

Results overview: Actual choice of alternatives

Sample size: 3,051 choices by 339 respondents

☐ **CARGO BIKE**

n=1,815 (59%)

☐ **CAR**

n=1,088 (36%)

☐ **NON-CHOICE**

n=148 (5%)



Results overview: Factors explaining the use of cargo bikes and cars

SP EXPERIMENT VARIABLES



• TEMPERATURE ✓



• PRECIPITATION ✓



• PARKING ✓



• ROAD INFRASTRUCTURE ✓



• TRAVEL TIME ✓



• TOTAL COST OF TRIP ✓



• RISK OF DAMAGING GOODS ✓



• RISK OF DELAY ✗

ADDITIONAL VARIABLES

ORGANIZATIONAL FACTORS

- Main operational purpose ✓
- Change in fleet management during CB trial ✓
- Suitability of CB for transport tasks ✓
- Type of organization ✗
- Number of employees ✗
- Fleet configuration prior to CB trial ✗
- Time-critical transports ✗

INDIVIDUAL FACTORS

- Operative use of CB by respondent during trial ✓
- Age ✗
- Sex ✗

CONTEXTUAL FACTORS

- Population density at trial site ✗
- CB trial was conducted in winter ✗

✓ **significant** ✗ **non-significant**

Results of a Mixed Logit Model: SP experiment variables

Car Cargo Bike Non-Choice Generic








Moderate temperatures increase the intention to use CB...

... but rain is among the strongest factors to avoid cycling.

Lack of parking prevents car use.

Good bike infrastructure has a noticeable effect.

Longer travel times reduce willingness to use CB to a greater extent than for cars.

Variable	Value	Base	Choice Ref.	Est. value	t-value
 TEMPERATURE	5 °C (41 °F)	-3 °C (27 °F)	CAR	-0.39	-2.76
			NC	-1.14	-3.84
	18 °C (64 °F)	-3 °C (27 °F)	CAR	-0.97	-7.52
			NC	-1.78	-5.91
 PRECIPITATION	Yes	No	CAR	2.58	20.31
			NC	3.06	11.64
 PARKING	No stopping zone	Parking available	CAR	-0.52	-4.69
 ROAD INFRASTRUCTURE	Safe bike path	Road with mixed traffic	CB	0.34	3.39
 TRAVEL TIME			CAR	-0.01	-2.15
			CB	-0.06	-16.53
 TOTAL COST OF TRIP	Total cost of trip and risk of damaging goods show expected sign		GEN	-0.04	-5.83
 RISK OF DAMAGING GOODS			GEN	-0.02	-4.24



Model results: Additional variables

Car Cargo Bike Non-Choice Generic

CB were rather chosen for the provision of services or other business-related errands than for goods delivery.

Positive effects during trial phase push decisions towards CB.

Individual experience of vehicle use increases CB choice.

Sigmas (normally distributed) take account for the panel effect.

Variable	Value	Base	Choice Ref.	Est. value	t-value
MAIN OPERATIONAL PURPOSE	Delivery of goods	All other purposes	CAR	0.47	2.53
CHANGE IN FLEET MGMT DURING CB TRIAL	Positive change	No or negative change	CAR	-0.48	-2.88
SUITABILITY OF CB FOR TRANSPORT TASKS	High suitability	Low suitability	CAR	-0.93	-5.80
OPERATIVE USE OF CB BY RESPONDENT DURING TRIAL	Respondent is only CB user	Respondents and others, only others are users	CAR	-0.50	-3.29
ALTERNATIVE-SPECIFIC CONSTANTS			CAR	-1.92	-8.49
			NC	-7.99	-16.45
SIGMA			CAR	1.00	12.11
			CB	-0.04	-0.15
			NC	-2.30	-8.42



Conclusions and outlook

- Contribution reveals factors leading to vehicle type choice in an unusual segment of urban logistics with...
 - smaller vehicles involved,
 - short trip distances,
 - service trips and freight trips of non-logisticians.
- Findings are (rather) valid for organizations that are already willing to downshift.
- Service providers might be a better target group for CB deployment than delivery companies.
- Good bicycle infrastructure and reduction of car parking show substantial effects.
- Trial programs can remove reservations and obstacles.
- Rain is much more deterrent than cold temperatures.



One out of the 23 tested CB models was equipped with rain protection.

Thank you! Questions?

Johannes Gruber

German Aerospace Center (DLR)
Institute of Transport Research
Berlin, Germany

Telephone: +49 30 67055 200

Email: johannes.gruber@dlr.de



Knowledge for Tomorrow

