## User attitudes towards and the acceptance of automated vehicles

How prospective use cases make a difference

Rita Cyganski, Eva Fraedrich



## Agenda



### **Automated driving**

- General remarks on a technology in the making
- A user-centered look
- Potential use cases

### A use case driven survey on the perception and anticipated usage

- General results: level of awareness in the topic, interest
- Acceptance in general and in differentiation for specific use cases
- Perception and evaluation of possible benefits for specific use cases

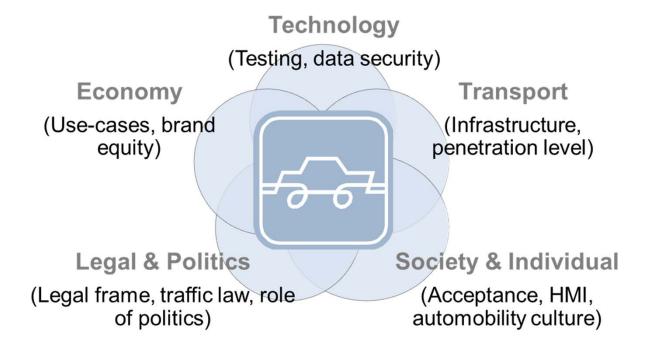
#### **Conclusions**





## Automated driving: Technology in the making

### Implementation context



The technology has to be considered in its context: a variety of factors influences the possible implementation (e.g. Fraedrich & Lenz 2014)





### A user-centered look at automated driving

- User-centered perspective includes topics like:
  - Perceived benefits
  - Context of use
  - Altered travel behavior
  - Alternative time use while traveling
  - Altered travel-time valuation
  - ...
- → Potential impact varies strongly depending on degree of automation and setting
- → Analyzing how automated driving may influence everyday mobility requires specification of use cases

### **FORTUNE**





### The end of driving (as we know it)

by Michal Lev-Ram

@mlevrar

JUNE 12, 2014, 7:17 AM E

"Instead of fighting traffic, erstwhile drivers could be working on their laptops, reading, even doing sit-ups in the back of a souped-up mobile gym."



© J. Lenz





### Potential use cases of automated driving (Wachenfeld et al. 2015)

(level 4 & 5 specifications following SAE 2014)



**Highway pilot:** *Driving task can be transferred to the vehicle on Interstates* 



Valet parking: The vehicle can drive independently to a parking space



**Fully automated vehicle:** On request, driving task can be transferred to the vehicle



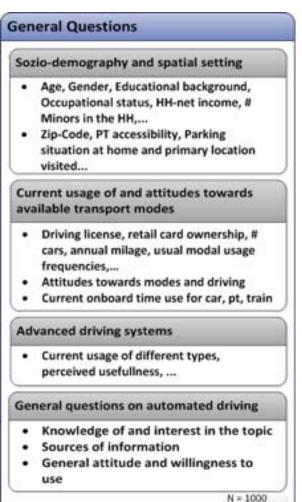
**Vehicle on Demand:** The vehicle is transporting its passengers without a driver





# A use-case-driven survey on the perception and anticipated usage of automated vehicles

- Germany-wide online survey collected April/May 2014
- Sample stratified by gender, age, income and education
- Combinable with German NHTS
- Frequent use of Likert-scaled response schemes
- Analysis based on 1000 interviews (for each use case 250)









## Low level of knowledge meets high interest...

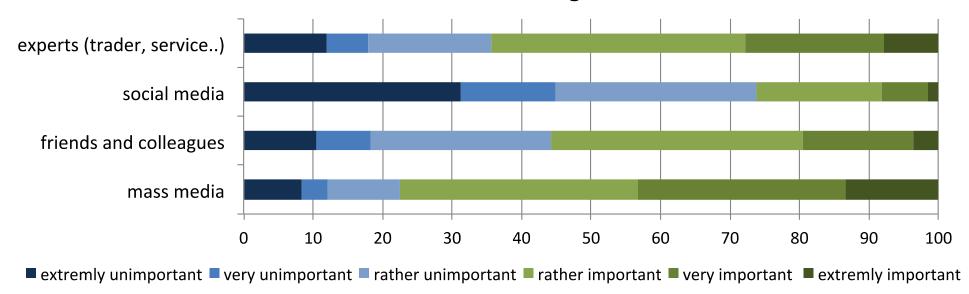
#### I am interested in the topic of How would you rate your personal "autonomous driving"? knowledge about "autonomous driving"? ■ I have no knowlege not at all true 3%\_1%\_1% predominantly not ■ I have heard of it 7% 17% true 16% 15% rather not true I have read some 7% articles on the net or in rather true iournals ■ Í am well acquainted with the topic 19% predominantly true 35% 36% ■ I am very knowledgeable in the absolutely true topic





## Mass media is the primary source of information on the topic.

### What information sources do you use for news on the topic 'autonomous driving'?

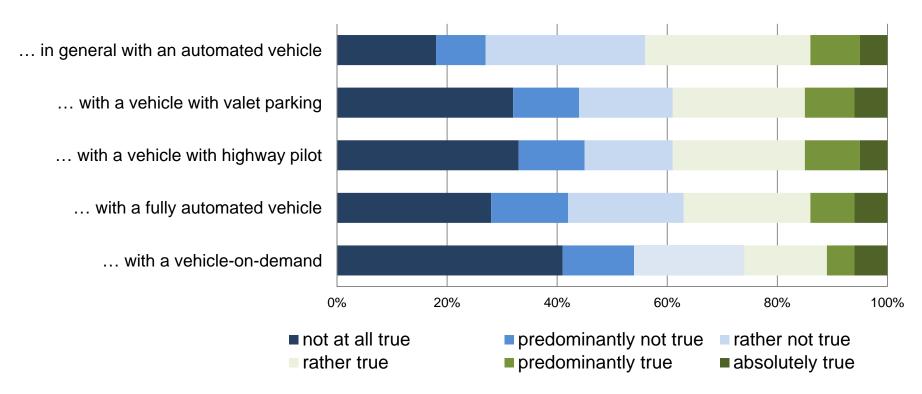






# Use cases matter: Generally, use case-based questions result in more determined, but also more negative answers.

## In principle, I can imagine replacing my preferred means of transport ...



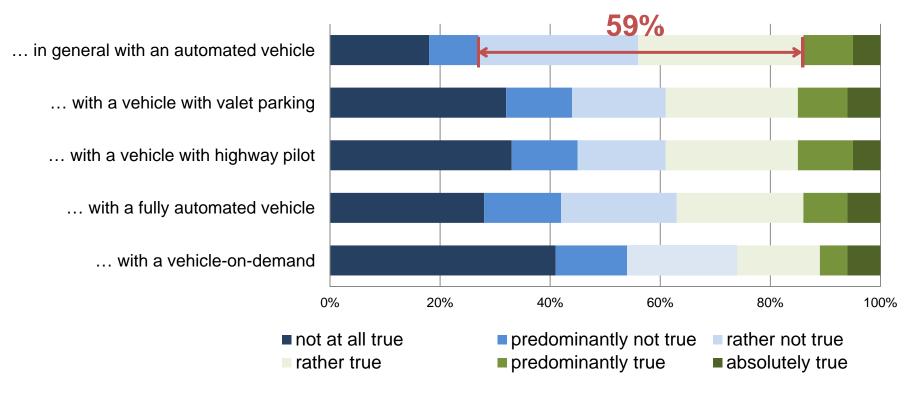




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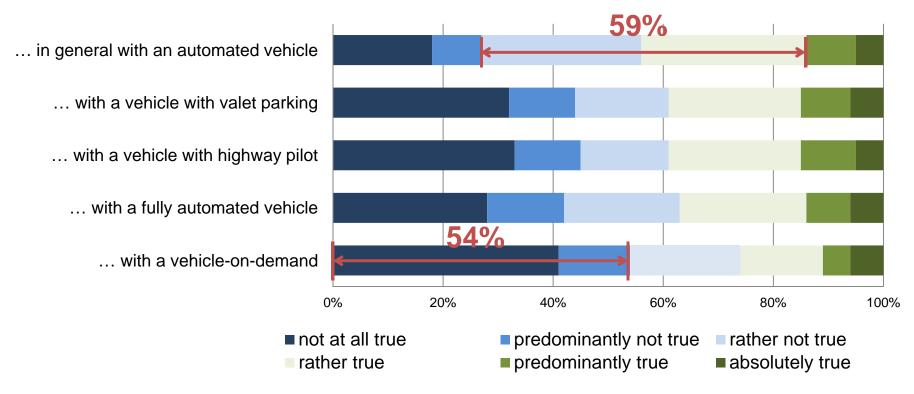




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# Use cases matter: Generally, use case-based questions result in more determined, but also more negative answers.

## In principle, I can imagine replacing my preferred means of transport ...







In general: N = 1.000, use cases: N = 250

- "I am interested in the subject of 'automated driving'..."
- "In principle, I can imagine replacing my preferred means of transport by such a vehicle ..."
- "In principle, I can imagine using such a vehicle ..."





			Interest	Replace	Use
Topic	Attribute(s)	Scale	ordinal	ordinal	ordinal
	gender	nominal	Χ	Χ	X
	age (grouped) / education / training level	ordinal	Χ	Χ	Χ
socio-demographics	occupation	nominal	Χ	Χ	Χ
	physical restrictions, children (y/n)	nominal	Χ	Χ	Χ
	net household income	ordinal	Χ	Χ	Χ
	driving licence	nominal	Χ	Χ	Χ
mobility bobayior	everyday car usage (b)	nominal	Χ	Χ	X
mobility behavior	frequency usage car driver/ passenger	ordinal	Χ	Χ	Χ
	annual vmt	ordinal	Χ	Χ	Χ
Interest/ Knowl. AD	interest in 'automated driving'	ordinal		Χ	X
	knowledge of 'automated driving'	ordinal	Χ	Χ	Χ
	regular ADAS-User	nominal	Χ	Χ	X
ADAS usage / wish for delegation of vehicle functions	speed adaption/ parking/ braking/ gear change/ veh. stabilization/ pedestrian recognition	ordinal	Х	Х	X
delegation of vehicle functions	steering	ordinal	Χ	Χ	X
	complete vehicle guidance	ordinal	Χ	Χ	Χ
car perception	driving is relaxing/ comfortable/ fun / save and protecting	ordinal	Χ	Χ	Χ
car perception	applying driving skills is fun	ordinal	Χ	Χ	Χ
importance needs for mode		ordinal	Х	Х	Х
choice	comfort/ stresslessness/ driving experience/ safety/ time	Olullidi	^	^	^

Test used

ordinal/ordinal: bivariate Correlation analysis (Pearson, Spearman und Kendall) nominal/ordinal: Phi-Coefficient, Cramers V-Coefficient, Kontigenz-Coefficient and Chi<sup>2</sup>-Test

In general: N = 1.000, use cases: N = 250

Significance indications

0 < r < 0,2 (and equivalent for negative signs)

0,2 < r < 0,4 (and equivalent for negative signs)

0,4 < r < 0,6 (and equivalent for negative signs)

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## Getting a hint on the perception of automated vehicles:

- Open answer analysis
  - 1 general definition item w.r.t. automated vehicles (N = 1000)
  - Up to 15 short answers w.r.t a specific use case for each respondent (N = 250)
  - Answers grouped by main statement and valuation

"Please try to to explain in a few words what ,automated driving' is".

"Fully automated vehicles are....

### Expensive

",Probably expensive cars" cars" unaffordable"

#### Comfortable

"probably convenient " comfort"





# Perception of uses cases of automation: Insights via an open answer analysis





© J. Len:

Valuations
Blue: positive
Red: negative
Black: ambivalent

Grey: without







Fully automated	vehicle		Vehicle on Demand		
valuation	#	%	valuation	#	%
positive	533	46	positive	428	34
negative	422	36	negative	493	40
ambivalent	106	9	ambivalent	97	8
without	102	9	without	218	18
total	1136	100	total	1236	100
Top 3 positive va	luations				
comfortable	90	17	useful	66	15
good	64	13	comfortable	59	14
safe	62	11	relaxing	59	14
Top 3 negative va	aluations				
not for me	68	16	not for me	82	16
expensive	65	15	technology-dependent	58	12
unnecessary	52	12	unnecessary	57	11
Top 3 ambivalent	valuations				
the future	51	48	the future	40	41
utopistic	24	23	utopistic	39	40
getting used to	23	22	getting used to	18	19







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- 1) High interest in the topic goes along with a perceived weak knowledge about automation.
  - Most important source of information is mass media.
  - Especially but not only the use case "Vehicle on Demand" showed high level of unacquaintance.
- 2) Prospective use cases make a difference!
  - Differences found in the adaption of specific use cases emphasize the importance of distinction.
  - Attitudes towards automation strongly depend on use case.
- 3) Interest, knowledge and willingness to hand over steering and complete vehicle control proved most significant for accepting attitude.
  - Only weak correlation with socio-demographics could be shown.
  - Neither driving attitudes nor experience with ADAS showed strong correlation.







## We are looking forward to questions and discussions!

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