evs 27

The 27th INTERNATIONAL ELECTRIC VEHICLE SYMPOSIUM & EXHIBITION.

Barcelona, Spain
17th-20th November 2013

Karlsruhe Institute of Technology

crome
cross-border mobility for EVs

Experiences of EV Users in the French-German context

Axel Ensslen, Patrick Jochem and Wolf Fichtner

FRENCH-GERMAN INSTITUTE FOR ENVIRONMENTAL RESEARCH (DFIU)
Chair of Energy Economics (Prof. Dr. W. Fichtner)

E-Mail: Axel.Ensslen@kit.edu

KIT – University of the State of Baden-Württemberg and
National Large-scale Research Center of the Helmholtz Association

www.kit.edu

Organized by Fira Barcelona avele

Hosted by AVERE mea Ajuntament de Barcelona

In collaboration with EVAAP EDTA

Supported by European Commission

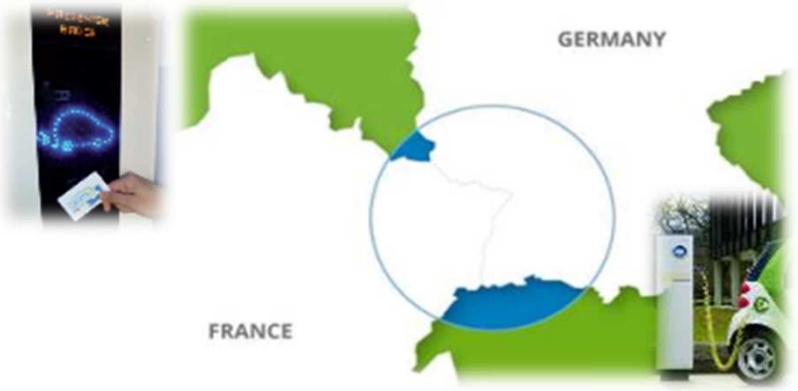
Agenda

- Cross-border Mobility for EVs (CROME)
- Fleet test sample description
- Hypotheses
- Methods
- Results
- Conclusion

Cross-border Mobility for EVs

- So far: No interoperability of charging infrastructure:
  - Hardware interoperability not fulfilled

  - Software (service) interoperability not fulfilled
    - Authentication
    - Roaming
    - Billing
- This makes cross-border activity with EV complicated.



EV models used

- Online survey of experienced EV users (French and German)
- N=161 respondents using 63 EV
- Data collection period: September 2012 – May 2013

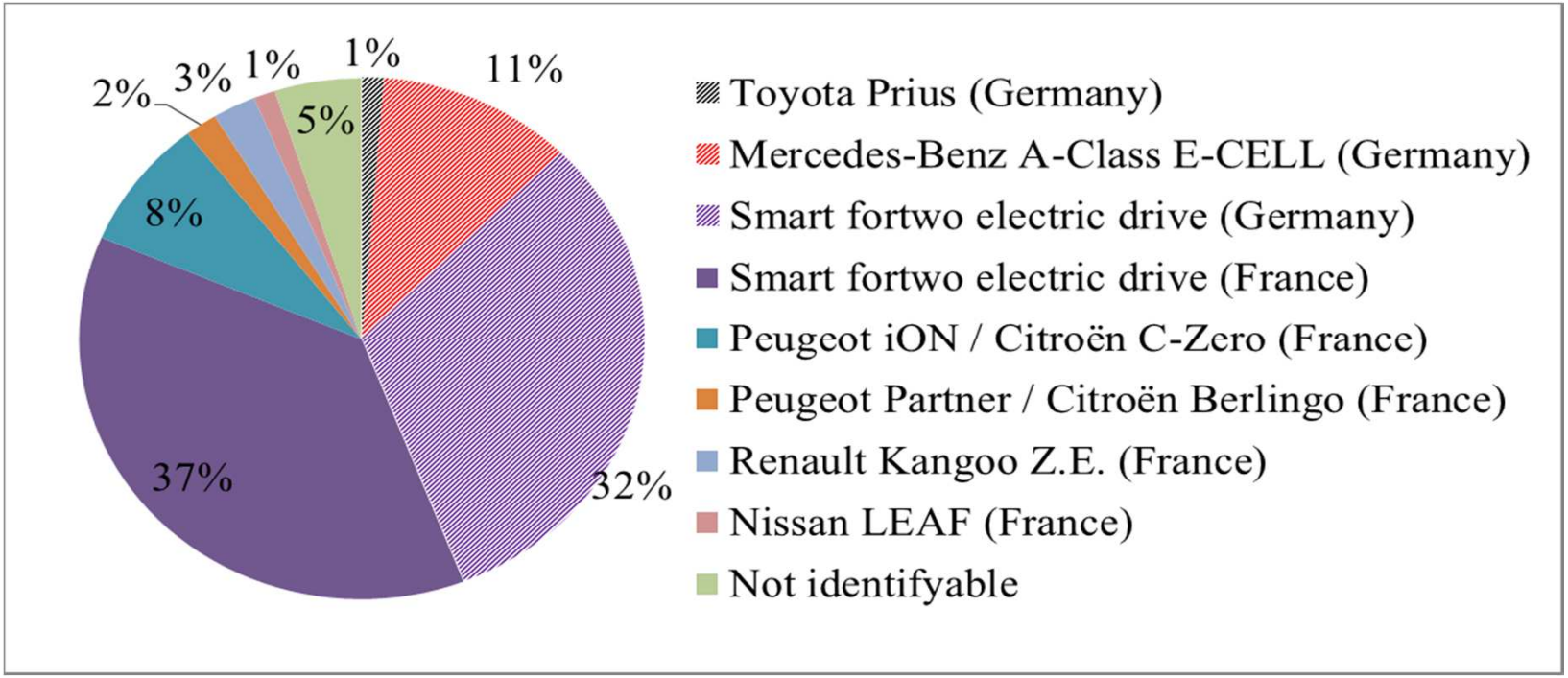


Figure 1: EV models the respondents have been using and their corresponding allocations

- Similar distribution of EV users using Smart ED and other EV.

EV users by country and sector

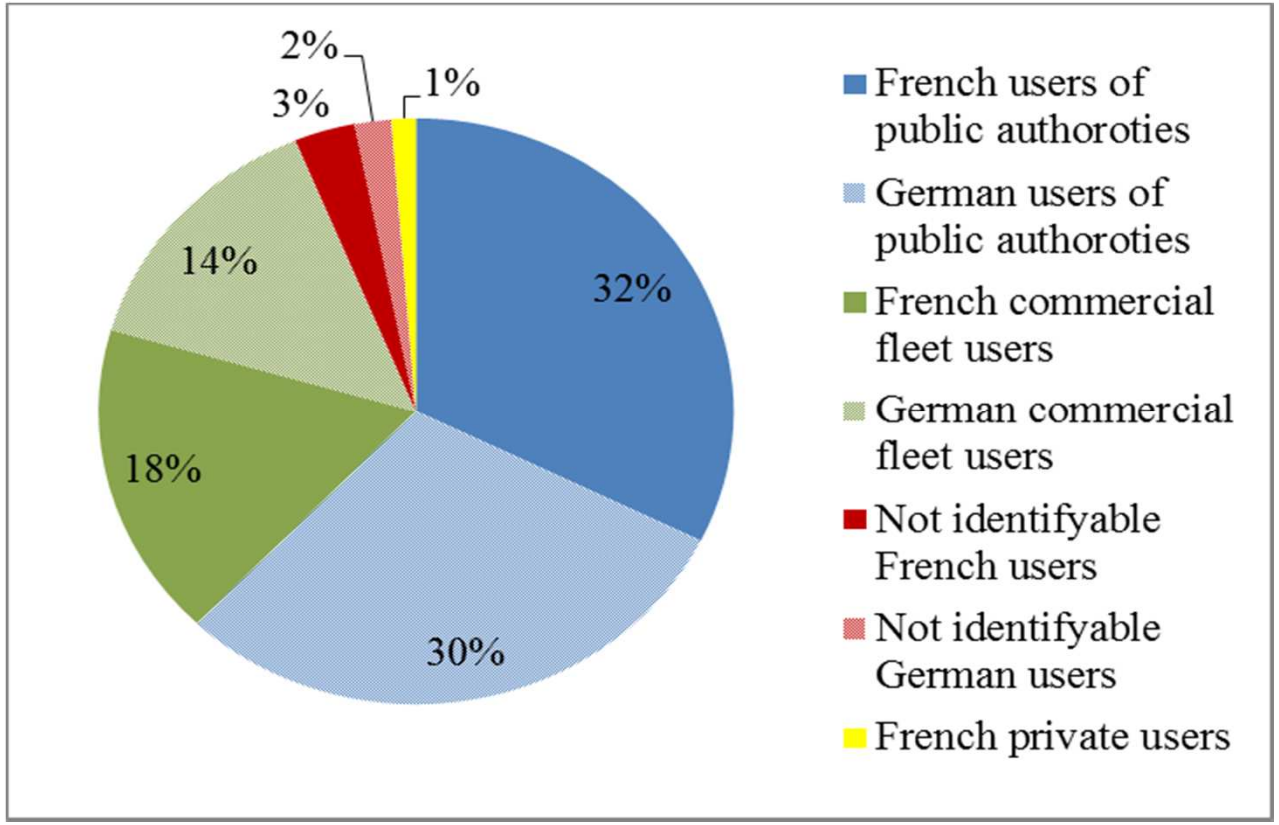


Figure 2: EV users by country and sector

- Similar sector- and country specific distribution of EV users participating in the survey.

Level of education

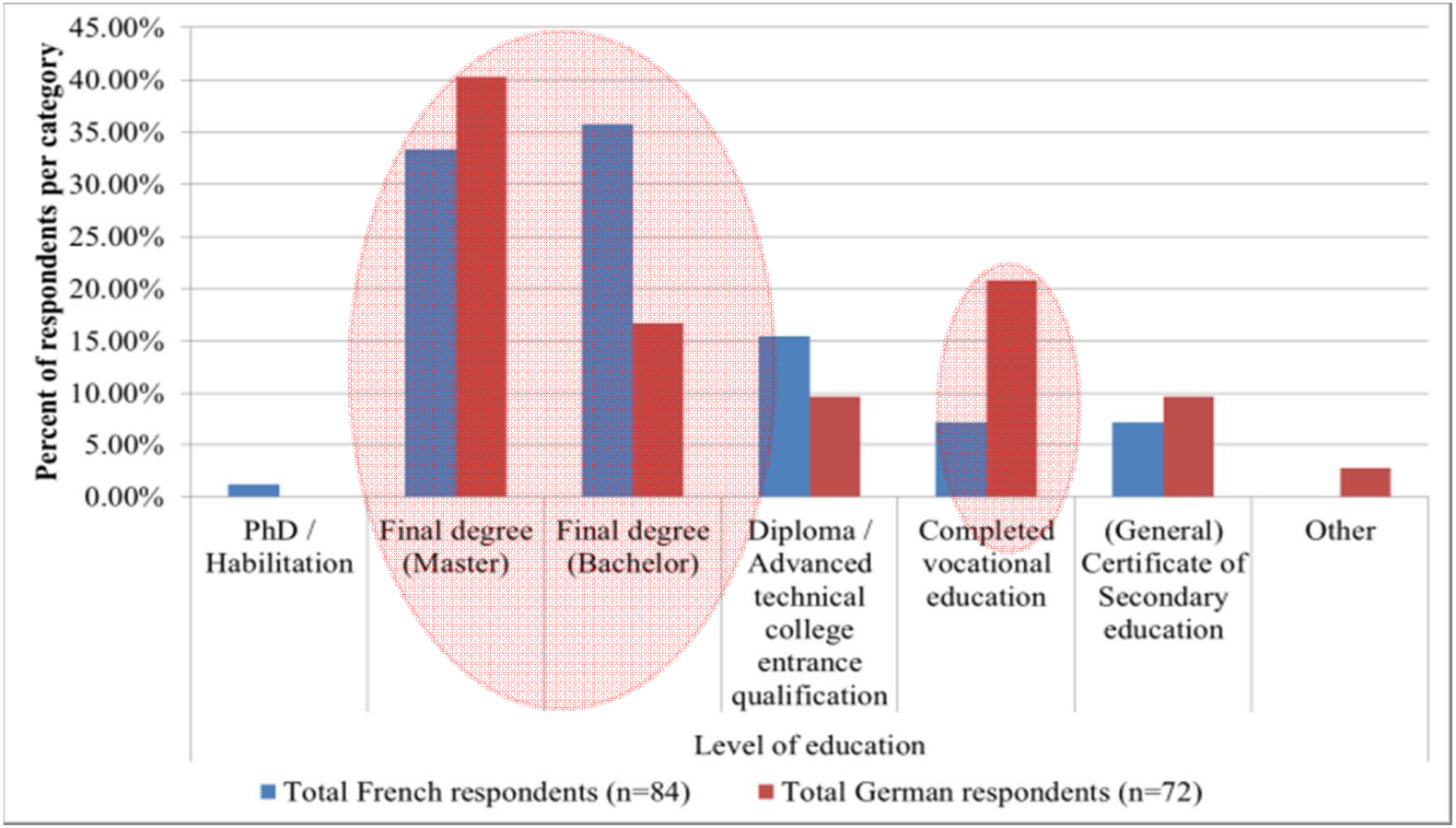


Figure 3: Respondents' level of education (n=156)

- French respondents: Higher share of Bachelor or Master degrees.
- German respondents: Higher share with completed vocational education.

Residential municipality size

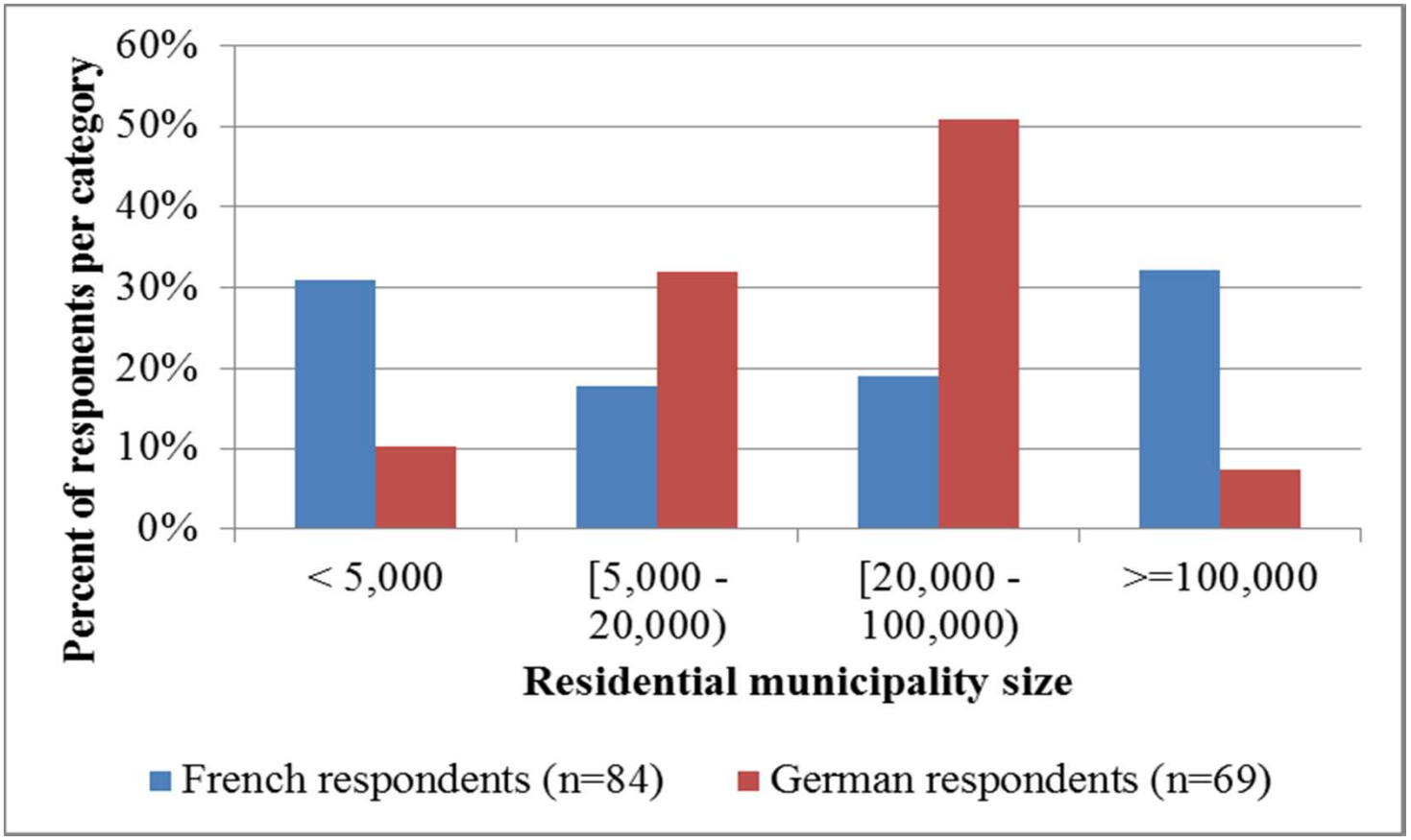


Figure 4: Respondents' residential municipality size by country (n=153)

- French respondents: Likely to live in big and small municipalities.
- German respondents: Likely to live in municipalities with 5,000 - 100,000 citizens.

Hypotheses

- Differences between respondents answers according to **country of origin** and **size of the home municipality** are observable, particularly concerning…

  a) … respondents' beliefs, attitudes and norms.

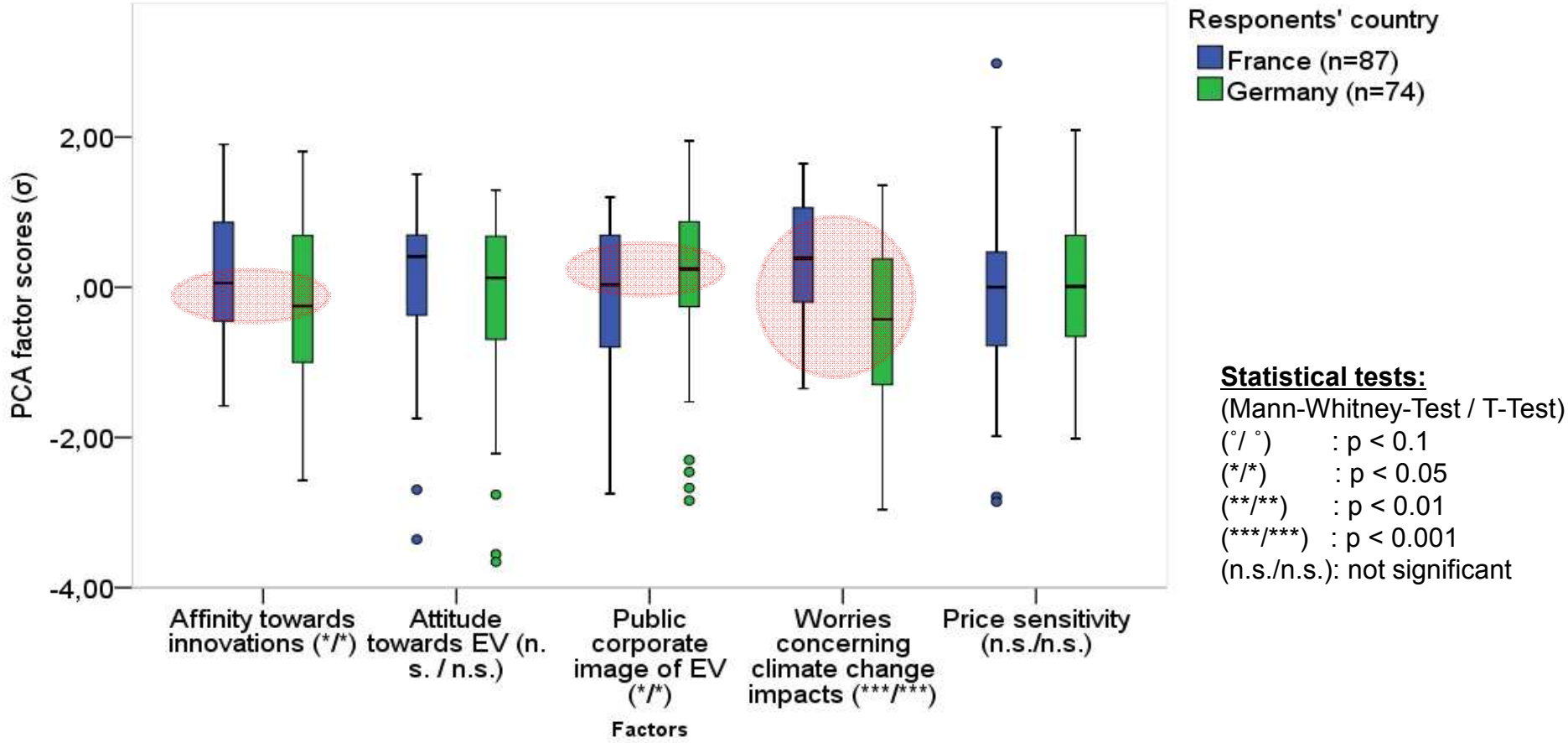
  b) … levels of satisfaction with EVs' different characteristics.

Methods

- In order to determine respondents' beliefs, attitudes and norms, 19 items have been answered.
- Principal component analysis determined the following dimensions (Cronbach's Alpha / Explained variance of factor)
  i. Affinity towards innovations (0.888 / 18.16%)
  ii. Attitude towards EV (0.832 / 15.29%)
  iii. Perceived public image of EV (0.793 / 14.79%)
  iv. Worries concerning climate change impacts (0.801 / 11.70%)
  i. Price sensitivity (0.506 / 7.60%)
- Differences in the samples have been determined with
  i. Nonparametric Mann-Whitney Tests
  ii. Independent-Samples T-Tests

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent
$0.7 \leq \alpha < 0.9$	Good
$0.6 \leq \alpha < 0.7$	Acceptable
$0.5 \leq \alpha < 0.6$	Poor
$\alpha < 0.5$	Unacceptable

Attitudes / beliefs / norms (country)



Statistical tests:
(Mann-Whitney-Test / T-Test)
(˚/ ˚) : $p < 0.1$
(*/*) : $p < 0.05$
(**/**) : $p < 0.01$
(***/***) : $p < 0.001$
(n.s./n.s.): not significant

Figure 5: Respondents' attitudes according to their country (n=161)

- French respondents have comparably more worries about climate change impacts and a higher affinity towards innovations.
- German respondents' perceived public corporate image of EV is higher.

Attitudes / beliefs / norms (municipality size)

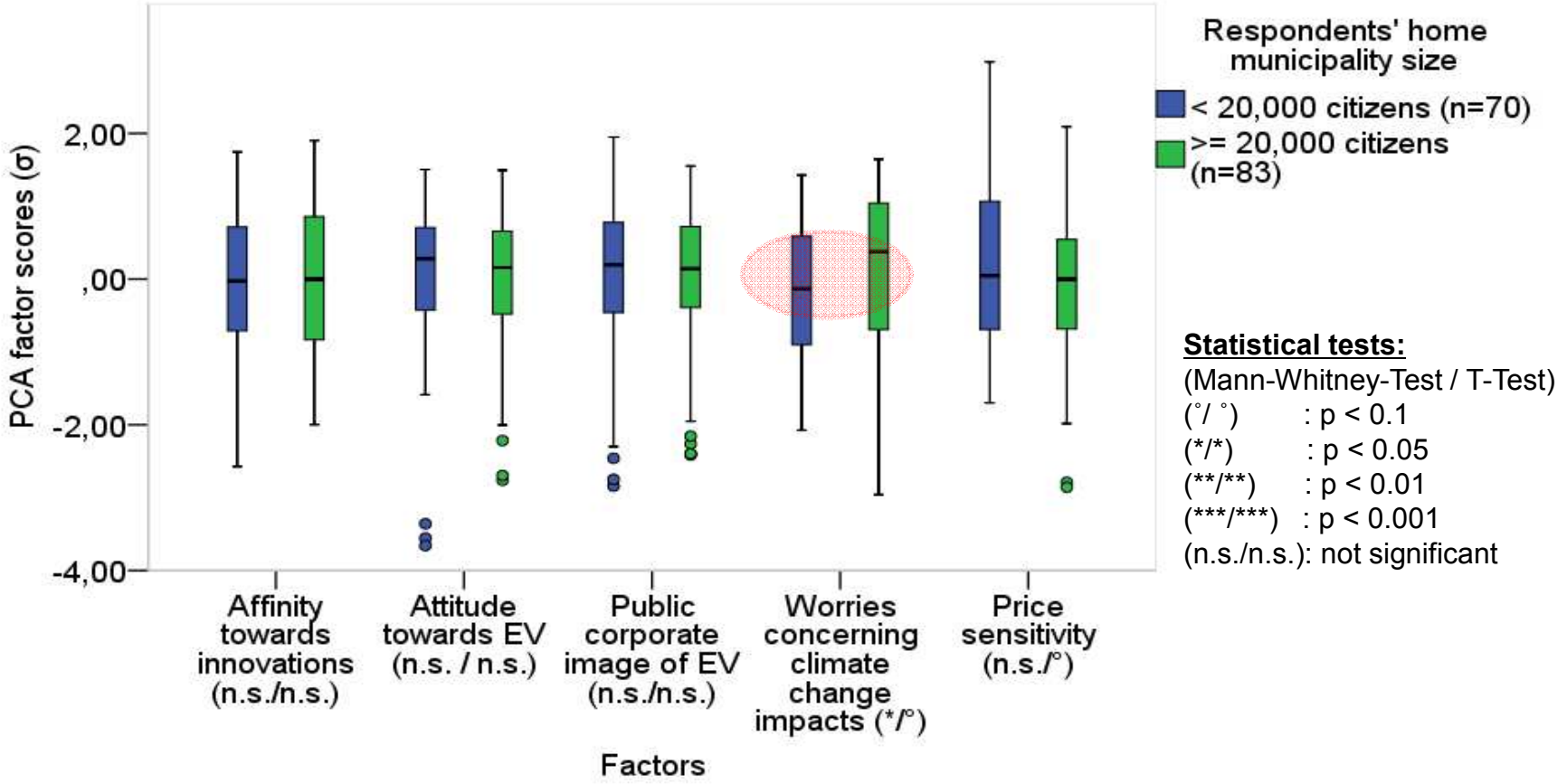
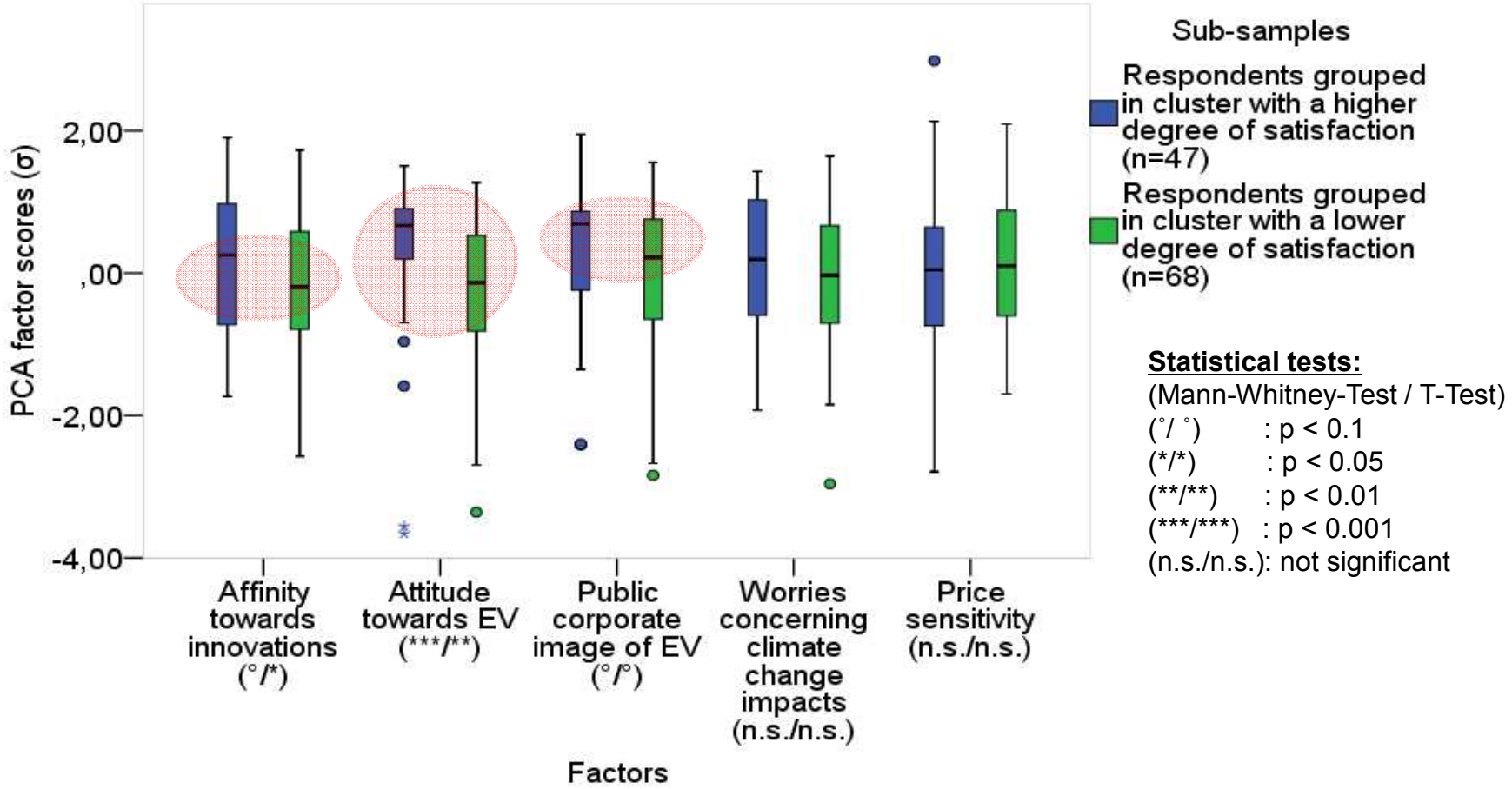


Figure 6: Respondents' attitudes according to the size of their home municipality (n=153)

- Respondents living in municipalities with more than 20,000 citizens have comparably more worries about climate change impacts.

Attitudes / beliefs / norms (satisfaction)



Statistical tests:
(Mann-Whitney-Test / T-Test)
(˚/ ˚) : p < 0.1
(*/*) : p < 0.05
(**/**) : p < 0.01
(***/***) : p < 0.001
(n.s./n.s.): not significant

Figure 7: Respondents' attitudes according EV specific satisfaction levels (n=115)

- Respondents grouped in cluster with a higher degree of satisfaction with EVs' characteristics show higher scores concerning attitude towards EV.

Satisfaction according to country

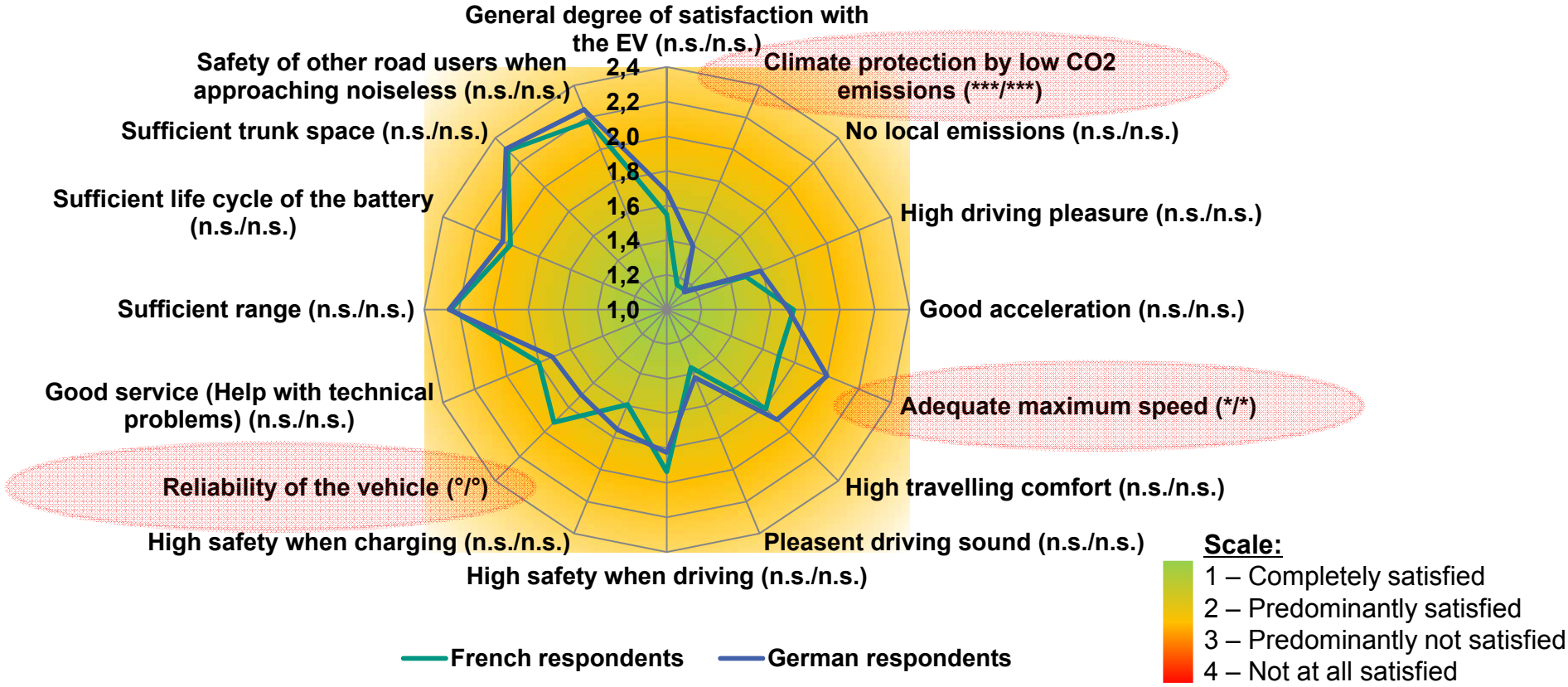


Figure 8: Arithmetic means of respondents' degree of satisfaction with different characteristics of the EV according to their country (n=146)

- High degree of satisfaction with EVs' environmental characteristics.
- Medium degree of satisfaction with EVs' range and trunk space.

Satisfaction according to municipality size

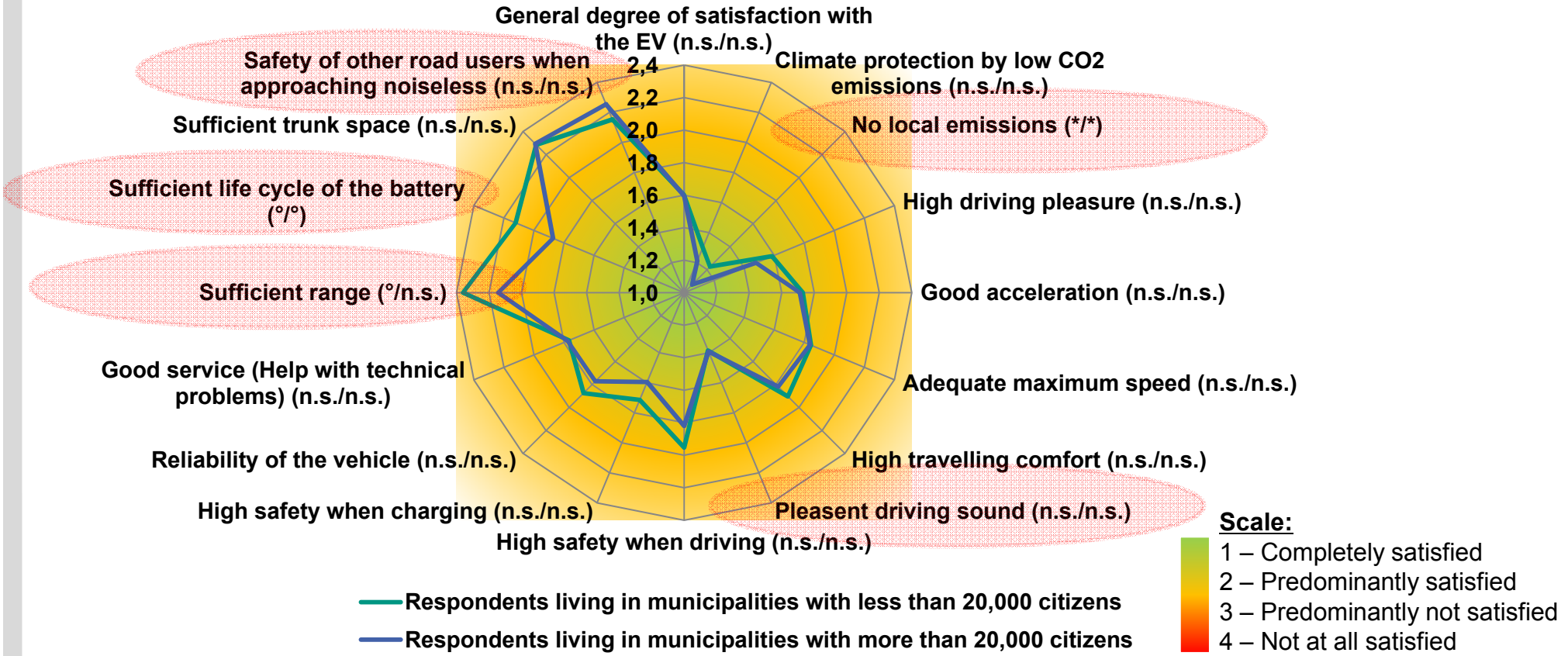


Figure 9: Arithmetic means of respondents' degree of satisfaction with different characteristics of the EV according to the size of their home municipality (n=139)

- Ambiguous evaluations concerning EVs' sound characteristics.
  - Road safety vs. pleasant driving sound.

Conclusion

- Convincing people to use EV in rather urban areas could be easier.
- But: In cities ...
  - the parking situation is more restrictive.
  - households are less likely to have a second or third car.
  - car dependency and mileage is lower → Unfavorable TCO.

- Recommendations:
  - Further development of E-car-sharing concepts in urban areas.
  - Necessity of a 'system backbone' managing communication between market participants (e.g. users, carsharing providers, charging service providers) in order to integrate different service providers' systems and to offer user friendly interoperable solutions.

- crome emonstrates that interoperability of charging infrastructure is possible, even in the cross-border context.

Thank you.

evs 27

The 27th INTERNATIONAL ELECTRIC VEHICLE SYMPOSIUM & EXHIBITION.

Barcelona, Spain
17th-20th November 2013

Karlsruhe Institute of Technology

crome
cross-border mobility for EVs

Experiences of EV Users in the French-German context

Axel Ensslen, Patrick Jochem and Wolf Fichtner

FRENCH-GERMAN INSTITUTE FOR ENVIRONMENTAL RESEARCH (DFIU)
Chair of Energy Economics (Prof. Dr. W. Fichtner)

E-Mail: Axel.Ensslen@kit.edu

KIT – University of the State of Baden-Württemberg and
National Large-scale Research Center of the Helmholtz Association

www.kit.edu

Organized by Fira Barcelona avele

Hosted by AVERE mea Ajuntament de Barcelona

In collaboration with EVAAP EDTA

Supported by European Commission

Backup

Results of principal component analysis

	Rotated Component Matrix[a]					Commu-nalities	Measures of sampling adequacy (MSA)
	Component						
	1[b]	2[c]	3[d]	4[e]	5[f]		
It worries me when I think about the environmental conditions under which our children and grandchildren will probably have to live.	0.14	0.11	0.16	**0.80**	0.11	0.71	0.78
If we continue with business as usual, we are heading towards an environmental catastrophe.	0.01	0.05	0.04	**0.87**	0.01	0.75	0.73
The citizens can make significant contributions to climate protection by environmentally conscious everyday behavior.	0.06	0.17	0.11	**0.81**	0.05	0.71	0.74
I am very excited about technologies	**0.71**	0.28	0.08	0.02	0.11	0.61	0.83
I constantly do research on new technical developments.	**0.81**	0.24	0.06	0.11	0.12	0.75	0.86
I like to try new products and technical innovations, even if they are not yet as widespread.	**0.82**	0.20	0.14	0.13	0.00	0.74	0.86
I often look for information about new products and brands.	**0.87**	0.01	0.17	0.10	0.09	0.80	0.82
I am often one of the first persons in my circle of friends and acquaintances, who is getting new technologies as soon as they appear on the market.	**0.81**	-0.02	0.12	-0.05	0.01	0.67	0.78
When I purchase products I compare them first and then buy the cheapest.	0.08	-0.09	0.07	0.00	**0.84**	0.73	0.50
When I buy a product I always try to buy the maximum quality at the lowest possible price.	0.12	0.19	-0.05	0.15	**0.72**	0.60	0.71
Using the electric car is easy	0.13	**0.75**	0.12	0.21	0.03	0.63	0.81
The electric car is useful in everyday life.	0.09	**0.86**	0.15	0.09	-0.02	0.78	0.78
The electric car is environmentally friendly.	0.12	0.28	**0.52**	0.14	0.23	0.43	0.85
The electric car excites me.	0.18	**0.80**	0.24	0.05	0.00	0.73	0.77
I prefer driving an electric car to driving a conventional car.	0.17	**0.74**	0.19	0.06	0.12	0.63	0.78
The use of electric car is good for the company's image.	0.07	0.11	**0.79**	0.06	0.23	0.71	0.81
My colleagues / employees think it is good, that we use electric cars.	0.07	0.17	**0.68**	0.05	-0.18	0.54	0.79
By using electric cars our company adopts a pioneering role.	0.12	0.14	**0.81**	0.02	-0.01	0.70	0.84
Our company is interested in that innovations like the electric car establish themselves on the market.	0.19	0.12	**0.73**	0.17	-0.10	0.62	0.81
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.							
a. Rotation converged in 5 iterations. | b. Factor 1: Affinity towards innovations | c. Factor 2: Attitude towards EV | d. Factor 3: Public image of the EV | e. Factor 4: Worries concerning climate change impacts | f. Factor 5: Price sensitivity							

Outlook

- User specific cross-analysis between objectively measured trip data originating from data loggers and subjective data originating from surveys.

- Evaluation of respondents' willingness to further adopt EV (future usage as well as private purchase intention) after a longer period of using EV.