Social Acceptance of Automated Driving in Germany and Japan

Conceptual Issues and Empirical Insights

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Comparative Analysis in JP and GER on Social Acceptance of Autonomous Vehicles

Part A: Conceptual Issues

■ Torsten Fleischer, Jens Schippl, Yukari Yamasaki
Karlsruhe Institute of Technology

Why 'Social Acceptance' of CAD? (1)

- Technology projects are also social programs.
- CAD linked to "societal promises". Usually four:
  - improve traffic safety
  - increase transportation efficiency
  - different (productive) time use while travelling
  - provide individual mobility options for currently excluded groups (elderly, people with impairments, …)

- Social Acceptance as a prerequisite for the adoption / diffusion of CAD technologies and services in order to fulfill these promises and have an impact.

Why 'Social Acceptance' of CAD? (2)

- **Public policy perspective:** achieve related policy goals and avoid (potential, anticipated, …) societal conflicts

- **Business perspective:** achieve economic goals (new products and services, profits, avoid sunk cost, SLO/CSR,…)

- **Ethics perspective:** SA a metaphor for dealing with moral issues, value conflicts and acceptability

- **Research perspective:** Understanding all of the above (and more) and providing knowledge for orientation and action: structures and dynamics of sociotechnical change, conceptual and numerical models, empirical access,…

Who accepts? (Subjects of Acceptance)

- an individual ("isolated", in social context(s) (e.g. household, family, peers), in professional role (engineer, driver, city official,…))

- an organization (company, research institute, NGO/CSO, regulatory authority, …)

- a "small" network of actors (e.g. local community, national government, …)

- a "large" network of actors: (national, technological, regional,…) innovation system

- actors may form actor networks that may act like single actors in certain contexts (e.g. a family buying a car, national governments in international organizations) → "networks of networks"

- their relations and interactions are regulated by sets of common habits, routines or established practices which are rooted in both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct), and formal rules (constitutions, laws, rights) ("institutions")

Innovations and institutionalization

- Innovations that create new institutions, or substantially reorganize existing institutional arrangements, are often called radical or transformative.

- Innovation actor networks may need to modify existing or „create" new institutions in order to enable new technologies to diffuse. They may fail to do so, even if the technology itself might be functionally (and/or economically) superior.

- Robust institutional configurations („regimes") are a reason for technology lock-ins (and lock-outs).

- The ability of innovation actor networks to modify existing or create new institutions (largely) uncontested should be seen as an element of social acceptance.
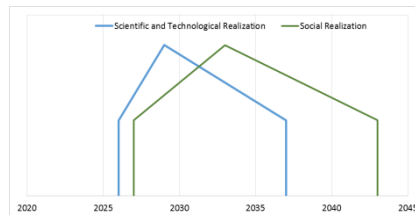
NISTEP S&T Foresight Delphi 2019

Transportation service by level 4 automated driving in urban areas (the system does all the driving, but the driver responds appropriately to system intervention requests, etc.)
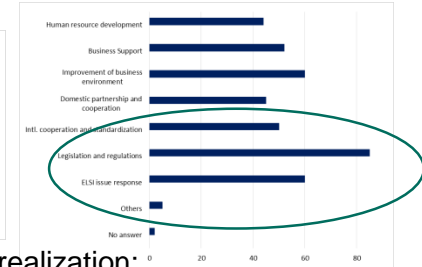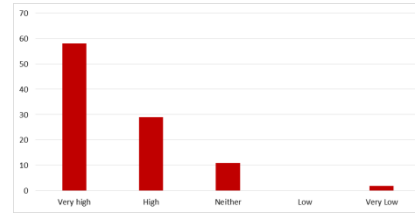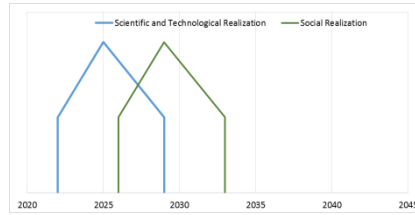
Level 5 automated driving (the system operates everything without limitations of location)

Policy measures for social realization:
Legislation and regulation
ELSI issue response
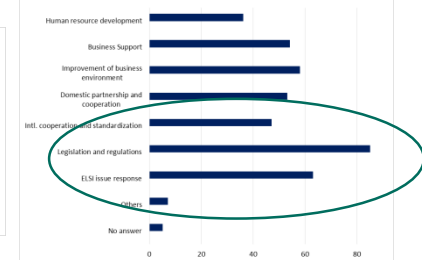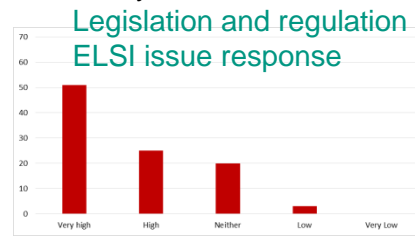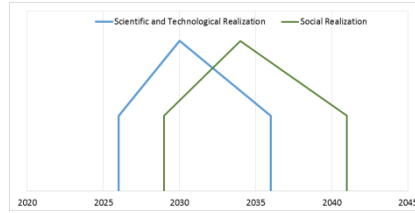
'Flying cars and drones' that can transport people in urban areas
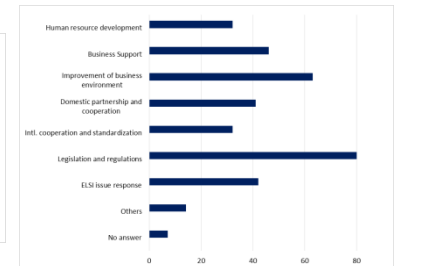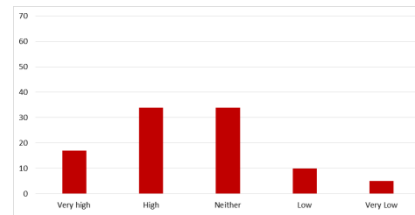
Data: NISTEP Science & Technology Foresight Delphi 2019

Predicted Time

Importance

What to accept? (Objects of Acceptance)

- an automated driving function

- a vehicle (of what type?) with automated driving functions (which?)

- a mobility service based on vehicles with automated driving functions

- the fact that (and the way how) automated vehicles interact with me as a (current) non-user in road traffic

- the set of rules that determines the behaviour of automated vehicles in the event of a collision (and regulates any consequences)

- new, automated mobility services operated by public institutions or private companies

- changed daily routines due to changing mobility services and tools

- a transformed mobility system (or my imagination thereof)

- (…)

Audi AG

Senatsverwaltung UVK Berlin

Daimler AG

Bosch

Objects of Acceptance (Eurobarometer 2020)

QB4: I am going to show you three pictures. For each of them, please tell me to what extent this picture corresponds to your idea of automated vehicles.

Dimensions of Social Acceptance

Subjects of Acceptance

Types of Relationship
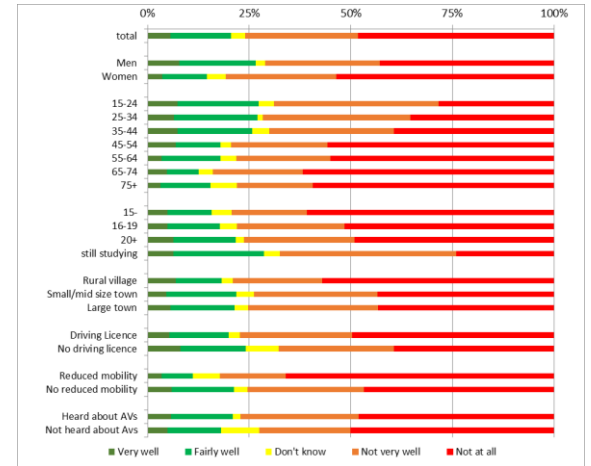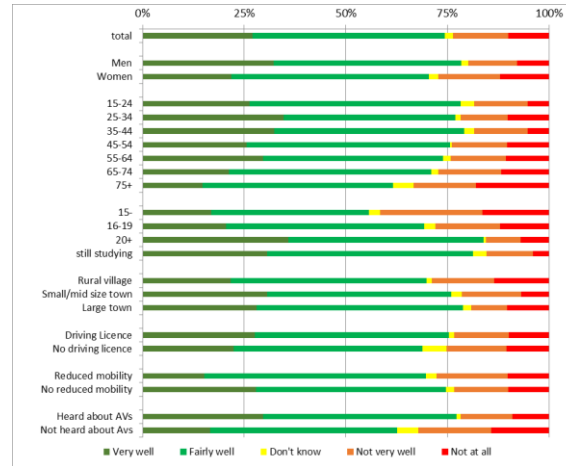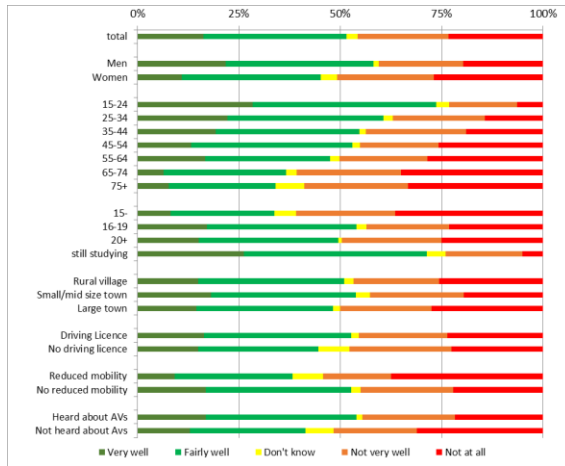
Objects of Acceptance

Individuals
("isolated")
In their social context(s)
In their professional role

Organizations as Actors
Regulators, Legislators
Companies, Utilities
Assurances
NGOs / CSOs

Actor Networks as Actors
Communities, Regions, Nation States
etc.

Attitude-oriented (passive):
Ignorance
Indifference
Tolerance
Approval
(Endorsement?) (Trust?)

Preference-oriented (hypothetical):
Willingness-to-adopt (…use, buy, pay,…)
Willingness-to-adapt

Action-oriented (active, observable):
protest – participate, adopt – not adopt,
change – maintain, permit – reject,
(legitimize – de-legitimize)

Concrete Characteristics: e.g. "being driven by an automation (on a highway)"

Products and services (e.g. automated vehicles, robo-shuttles, L3 personal cars)

Impacts of systemic change: less or more traffic, safer traffic, suburbanisation etc.

Sociotechnical configurations (mobility futures)

Access to xy, participation in xy: cost, mobility for disabled p.

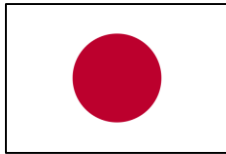**Privacy, Cybersecurity:** data provision, centralised control

A working definition of Social Acceptance

Social acceptance of a technology can be defined as

a favourable or positive response (like attitude, stated preference or action) by a given actor group or actor network (e.g. nation state, region, local community, organization),

relating to a proposed or emerging technology or an imaginary of a socio-technical regime or socio-technical system modified by this technology,

and the reasonable expectation to find explicit or tacit approval of the related processes of its institutionalization.

Comparative Analysis in JP and GER on Social Acceptance of Autonomous Vehicles

Part B: Empirical Insights

Prof. Ayako Taniguchi
University of Tsukuba

Dimensions of Social Acceptance

Subjects of Acceptance

Types of Relation

...of Acceptance

As a first step in our joint research, we focused on the orange part of this diagram

Individuals
(„isolated")
In their social context(s)
In their professional role

Organizations as Actors
Regulators, Legislators
Companies, Utilities
Assurances
NGOs / CSOs

Actor Networks as Actors
Communities, Regions, Nation States
etc.

Attitude-oriented (passive):
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Preference-oriented (hypothetical):
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Action-oriented (active, observable):
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Concrete Characteristics: e.g. "being driven by an automation (on a highway)"

Products and services (e.g. automated vehicles, robo-shuttles, L3 personal cars)

Impacts of systemic change: less or more traffic, safer traffic, suburbanisation etc.

Sociotechnical configurations (mobility futures)

Access to xy, participation in xy: cost, mobility for disabled p.

Privacy, Cybersecurity: data provision, centralised control

Online questionnaire survey overview

- Survey methods

Date: 5th – 14th May 2020

Target：General public of Japan/Germany

Answer method：Online questionnaire survey

　Age(20-60), gender and residential area are equally allocated

Japan

Germany

NOTE!
The data is not representative
of both countries,
We focused on specific region;
capital area and highly motorized area

Target：Japan citizens
500 samples
(**Tokyo**250・**Aichi**250)

Target：Germany citizens
500 samples
(**Berlin**250・**Nordrhein-Westfalen**250)

Agreement of AVs

Question: Please tell us how much you agree with the following statements about Level 3 to 5.

I agree with the idea of creating a "society realizing an autonomous vehicle system".
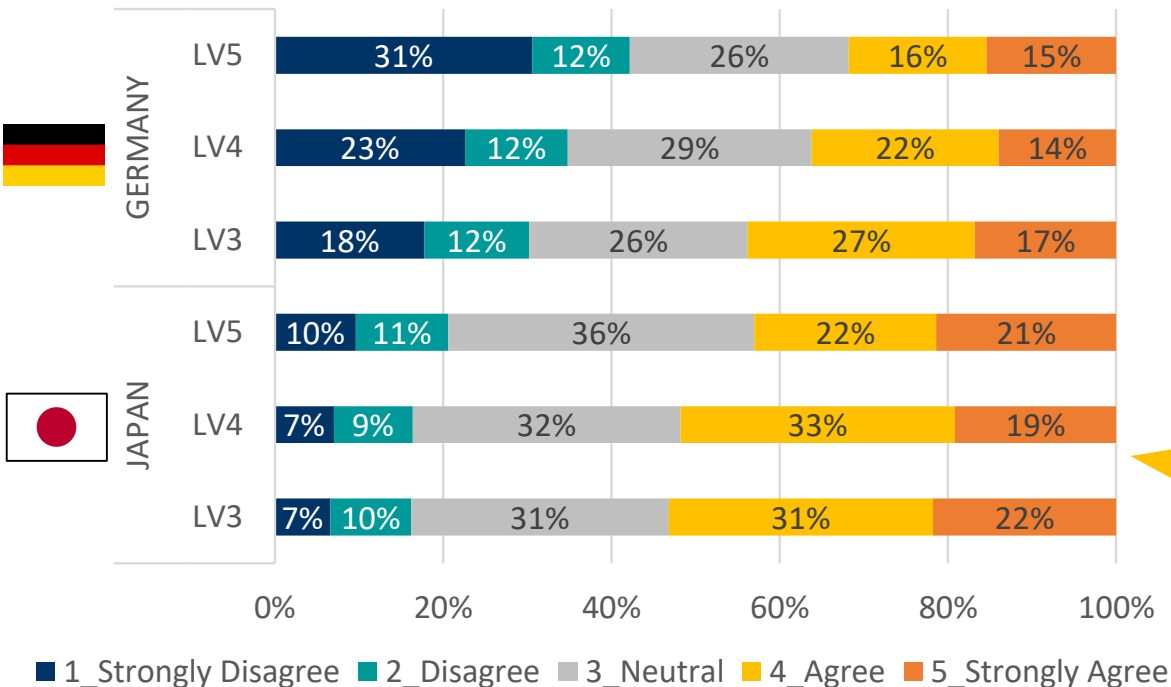
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Tones of Argument Over AVs

■Dr. Satoshi Nakao
Kyoto University

14 Tones given as a reason for the introduction of AVs

Question: The following is a discussion of the Autonomous Driving System(AVs). Do you agree with each tone?

Tone1: For the purpose of **reducing the number of traffic accidents between road vehicles**, the safety of cars should be improved through automated driving systems.

Tone2: For the purpose of **reducing the number of traffic accidents in which pedestrians are the victims**, the safety of cars should be improved through automated driving systems.

Tone3: AVs should be introduced to **alleviate traffic congestion**.

Tone4: AVs should be introduced to **support the elderly going out**.

Tone5: AVs should be introduced to **reduce CO2 emissions** by making the entire transport system more efficient.

Tone6: AVs should be introduced to **support the vulnerable** in depopulated areas.

Tone7: AVs should be introduced for **effective use of travel time**.

Tone8: AVs should be introduced to **reduce the cost of transport services** such as buses, taxis and trucks.

Tone9: AVs should be introduced to **solve the shortage of drivers of transport services** such as buses, taxis and trucks.

Tone10: Progress should be made in the social implementation of AV technology to **revitalise the domestic economy**.

Tone11: Progress should be made in the social implementation of AV technology so that the domestic automobile industry does **not lose to international competition**.

Tone12: The government of our country **should invest** to support the social implementation of AV technology.

Tone13: In order to implement AV technology, the government of our country should **relax road traffic regulations on safety**.

Tone14: In order to implement AV technology, the government of our country should **conduct AV trials on public roads** as soon as possible.

JP vs. GER: All Tones

	Strongly Disagree
	Disagree
	Neutral
	Agree
	Strongly Agree

The length of the bar shows the percentage of people who chose that option.

The higher the mean-value, the higher the agreement with tone.

Japanese more likely than Germans to agree with all tones.

Japanese tend to answer "neutral".

Germans tend to answer "Strongly Disagree".

We'll focus on 5 types of tones..

Comparing the each distribution..

Country		JP	GER		JP	GER		JP	GER
Sample size		500	500		500	500		500	500
Tone1	Mean	3.72	3.32	**Tone6**	3.65	3.22	**Tone11**	3.35	3.03
	Standard Deviation	1.01	1.29		1.02	1.28		1.00	1.26
reduce traffic accidents (vehicles)	1_Strongly Disagree	4%	15%	support the vulnerable	4%	16%	not lose to international competition	5%	19%
	2_Disagree	5%	8%		6%	8%		9%	10%
	3_Neutral	30%	25%		32%	33%		45%	31%
	4_Agree	37%	33%		35%	26%		27%	29%
	5_Strongly Agree	24%	18%		22%	18%		14%	11%
Tone2	Mean	3.71	3.38	**Tone7**	3.36	3.09	**Tone12**	3.19	2.78
	Standard Deviation	1.05	1.33		1.03	1.28		1.04	1.28
reduce traffic accidents (pedestrians)	1_Strongly Disagree	4%	15%	effective use of travel time	5%	18%	government should invest in AVs	7%	23%
	2_Disagree	6%	8%		10%	9%		13%	16%
	3_Neutral	31%	25%		44%	31%		45%	30%
	4_Agree	33%	28%		25%	28%		23%	21%
	5_Strongly Agree	26%	24%		15%	14%		12%	9%
Tone3	Mean	3.59	3.35	**Tone8**	3.31	2.99	**Tone13**	2.99	2.21
	Standard Deviation	1.00	1.27		1.02	1.27		1.08	1.22
alleviate traffic congestion	1_Strongly Disagree	4%	15%	reduce the cost of transportation services	6%	19%	government should relax road traffic regulations on safety for AVs	11%	41%
	2_Disagree	8%	7%		9%	12%		17%	18%
	3_Neutral	35%	27%		47%	31%		43%	24%
	4_Agree	34%	33%		24%	26%		20%	13%
	5_Strongly Agree	20%	19%		14%	12%		9%	4%
Tone4	Mean	3.64	3.21	**Tone9**	3.43	2.82	**Tone14**	3.24	2.87
	Standard Deviation	1.06	1.27		1.00	1.27		1.01	1.28
support the elderly going out	1_Strongly Disagree	4%	16%	solve the shortage of bus and truck drivers	5%	22%	government should conduct AVs trials on public roads	6%	22%
	2_Disagree	8%	9%		8%	15%		13%	14%
	3_Neutral	32%	30%		43%	32%		44%	30%
	4_Agree	31%	30%		28%	21%		25%	25%
	5_Strongly Agree	24%	16%		16%	10%		12%	10%
Tone5	Mean	3.47	3.38	**Tone10**	3.4	2.8			
	Standard Deviation	1.00	1.28		0.97	1.23			
reduce CO2 emissions	1_Strongly Disagree	4%	14%	revitalize the domestic economy	5%	22%			
	2_Disagree	8%	8%		8%	13%			
	3_Neutral	42%	25%		42%	35%			
	4_Agree	30%	33%		33%	22%			
	5_Strongly Agree	17%	20%		12%	8%			

JP vs. GER: Tone1, tone2, tone4, tone6

Tone1: For the purpose of **reducing the number of traffic accidents between road vehicles**, the safety of cars should be improved through automated driving systems.

Tone2: For the purpose of **reducing the number of traffic accidents in which pedestrians are the victims**, the safety of cars should be improved through automated driving systems.

Tone4: AVs should be introduced to **support the elderly going out**.

Tone6: AVs should be introduced to **support the vulnerable** in depopulated areas.

Both Germans and Japanese have high mean for these four tones.

In Germany, is AVs considered not to be the right tool and not a good solution? Technology may prevent accidents, but it brings other.

Country		JP	GER		JP	GER
	Sample size	500	500		500	500
Tone1	Mean	3.72	3.32	**Tone4**	3.64	3.22
	Standard Deviation	1.01	1.29		1.06	1.28
reduce traffic accidents (vehicles)	1_Strongly Disagree	4%	15%	support the elderly going out	4%	16%
	2_Disagree	5%	8%		8%	9%
	3_Neutral	30%	25%		32%	30%
	4_Agree	37%	33%		31%	30%
	5_Strongly Agree	24%	18%		24%	16%
Tone2	Mean	3.71	3.38	**Tone6**	3.65	3.22
	Standard Deviation	1.05	1.33		1.02	1.28
reduce traffic accidents (pedestrians)	1_Strongly Disagree	4%	15%	support the vulnerable	4%	16%
	2_Disagree	6%	8%		6%	8%
	3_Neutral	31%	25%		32%	33%
	4_Agree	33%	28%		35%	26%
	5_Strongly Agree	26%	24%		22%	18%

KIT Karlsruhe Institute of Technology | ITAS Institute for Technology Assessment and Systems Analysis | 筑波大学 University of Tsukuba | KYOTO UNIVERSITY FOUNDED 1897 | TOKYO UNIVERSITY OF SCIENCE

JP vs. GER: Tone5

Tone5: AVs should be introduced to **reduce CO2 emissions** by making the entire transport system more efficient.

In Germany, the mean-value of tone5, as well as tone 2 is the highest.
In Japan, mean-value of tone5 is not as high as one of the other tones.

The percentage of "Agree" and "Strongly Agree" is higher for Germans than for Japanese

Germans are more concerned about the environment.
"**Climate Change**" would be a *power word* in Germany.

	Country	JP	GER
	Sample size	500	500
Tone5	Mean	3.47	3.38
	Standard Deviation	1.00	1.28
reduce CO2 emissions	1_Strongly Disagree	4%	14%
	2_Disagree	8%	8%
	3_Neutral	42%	25%
	4_Agree	30%	33%
	5_Strongly Agree	17%	20%

JP vs. GER: Tone7

Tone7: AVs should be introduced for **effective use of travel time**.

We thought the public expected effective use of travel time, however, the mean-value of tone7 is not high in both countries.

Country		JP	GER
Sample size		500	500
Tone7	Mean	3.36	3.09
	Standard Deviation	1.03	1.28
effective use of travel time	1_Strongly Disagree	5%	18%
	2_Disagree	10%	9%
	3_Neutral	44%	31%
	4_Agree	25%	28%
	5_Strongly Agree	15%	14%

JP vs. GER: Tone9

Tone9: AVs should be introduced to **solve the shortage of drivers of transport services** such as buses, taxis and trucks.

The mean-value of Tone9 is much higher in Japan than in Germany.

The results show that while the driver shortage is a social problem in Japan, this is not the case in Germany.

	Country	JP 🇯🇵	GER 🇩🇪
	Sample size	500	500
Tone9	Mean	3.43	2.82
	Standard Deviation	1.00	1.27
solve the shortage of bus and truck drivers	1_Strongly Disagree	5%	22%
	2_Disagree	8%	15%
	3_Neutral	43%	32%
	4_Agree	28%	26%
	5_Strongly Agree	16%	12%

JP vs. GER: Tone13

: In order to implement AV technology, the government of our country should **relax road traffic regulations on safety**.

The Germans are more likely to strongly disagree with Tone13, but Japanese does not disagree so much.

The Japanese see deregulation as a good thing, regardless of automated-driving.

"**Deregulation**" would be a ***power word*** in Japan.

	Country	JP 🇯🇵	GER 🇩🇪
	Sample size	500	500
Tone13	Mean	2.99	2.21
government should relax road traffic regulations on safety for AVs	Standard Deviation	1.08	1.22
	1_Strongly Disagree	11%	43%
	2_Disagree	17%	18%
	3_Neutral	43%	24%
	4_Agree	20%	13%
	5_Strongly Agree	9%	4%

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NIMBY of AVs

Does this city need a landfill ?

Yes!

but…

So where do we build it ?

Not
In
My
Back
Yard

■Dr. Kosuke Tanaka
Tokyo University of Science

NIMBY: AVs Society Realization vs. Your Child Ride Alone

AVs Society: I agree with the idea of creating a "society realising an autonomous vehicle system"
Your Child Ride Alone: I have no reservations about allowing my children to ride alone

5 point scale

Your Child Ride Alone (Japan)

Disagree → Agree

AVs Society — Disagree / Agree

46	0	2	0	0
28	19	8	0	0
60	17	98	3	4
30	21	35	19	3
30	14	16	12	35

Your Child Ride Alone (Germany)

Disagree → Agree

AVs Society — Disagree / Agree

139	6	6	1	1
33	16	8	1	0
47	22	55	6	0

JP: 1.2% / 64.6% / 34.2%
GER: 1.8% / 75.6% / 22.6%
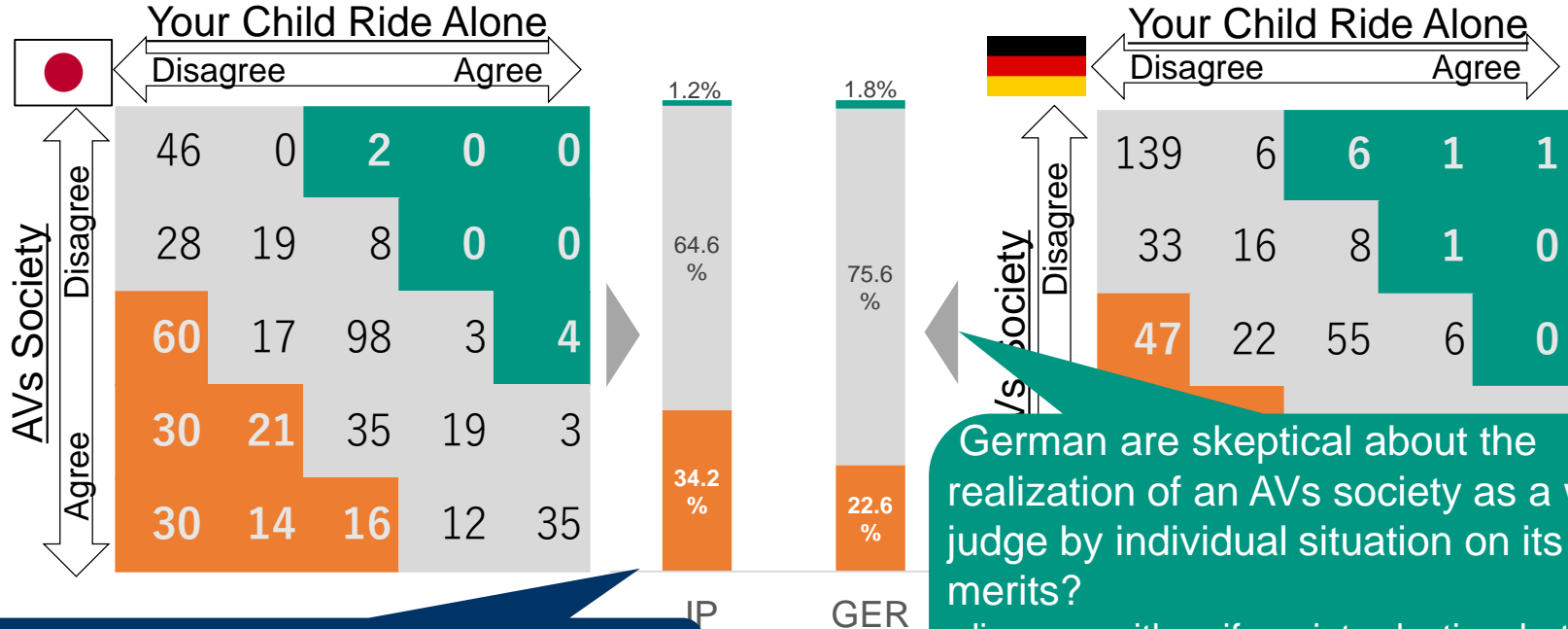
When it comes to children, the responses become More NIMBY-like in both countries

German are skeptical about the realization of an AVs society as a whole, judge by individual situation on its own merits?
-disagree with uniform introduction, but it is OK to test in front of home: 10.4%.
-disagree with uniform introduction, but it is OK to allow children to ride alone: 1.8%.

26

What causes NIMBY? ~analyzed by regression model~

Dependent Variable = Difference between
"**Agreement of LV5 AVs**" & "**Agreement of your child ride LV5**"

** : 1% , * : 5% significant

	JP	GE
Age	-0.13 **	
Male dummy		
Living with Child under 12 (dammy)		-0.092 *
Car ownership dummy		
Number of driving movements		
Experience with AVs		0.134 **
Trust in Technology		0.335 **
Trust in Government		
Trust in companies like insurance		
Trust in AVs development companies	0.188 **	
Capital city dummy		
Fear of LV5 AVs	0.191 **	
Knowledge about LV5 AVs	-0.166 **	-0.186 **
Adjusted R2	0.099	0.124

It is thought that families with children would be resistant to riding alone…
they are not NIMBY, but actually "YIMBY".
Is it the effect of age?

Trust in companies in Japan and trust in technology in Germany raises expectations for the realization of AVs Society

NIMBY is caused by **unknown** and **fear**

Comparative Analysis in JP and GER on Social Acceptance of Autonomous Vehicles

PRIVACY: Provision of Personal Information

■Dr. Kosuke Tanaka
Tokyo University of Science

Provision for Personal Information

Country		Japan	Germany
Sample size		500	500
Location Info.	Mean	2.92	2.46
	Standard Deviation	1.10	1.30
	1_Strongly Disagree	12%	32%
	2_Disagree	23%	21%
	3_Neutral	34%	21%
	4_Agree	25%	18%
	5_Strongly Agree	7%	7%
Images **outside** AVs	Mean	3.21	2.77
	Standard Deviation	1.08	1.31
	1_Strongly Disagree	8%	25%
	2_Disagree	14%	16%
	3_Neutral	37%	25%
	4_Agree	29%	26%
	5_Strongly Agree	11%	8%
Images **inside** AVs	Mean	2.86	2.35
	Standard Deviation	1.07	1.27
	1_Strongly Disagree	12%	37%
	2_Disagree	22%	18%
	3_Neutral	39%	25%
	4_Agree	21%	15%
	5_Strongly Agree	6%	6%

Question: Do you agree with providing personal information such as **location information** and **images inside** and **outside the vehicle** when using an AV driving system? (* Recorded image data similar to current driving recorders)

The Germans are negative about providing location information, which is essential for system optimization, despite their strong interest in reducing CO_2 emissions.

The Japanese are less polarized and relatively unconcerned about privacy.

The Germans have a strong interest in privacy.

Conclusion & Future Challenges

■ Conceptual issues
- ✓ Current research focused on attitudes of (private) individuals
- ✓ Important to better understand roles of professional actors, organizations, actor networks and institutional change
- ✓ Dynamics (knowledge, familiarity, adaptation) difficult to assess

■ Empirical study
- ✓ There seems to be a certain solid layer of skepticism in Germany.
- ✓ Don't be tricked by the power words (**climate change** in Germany, **deregulation** in Japan)!
- ✓ The Japanese may be more likely to be in a NIMBY situation where they are officially in agreement with AVs but are actually against them.
- ✓ Germans are more sensitive to privacy issues than the Japanese.

■Policy Implication
- ✓ NIMBYs are more likely to occur in people with high FEAR and UNKNOWN of AVs.
- ✓ Important to provide balanced information on pros and cons of AV rather than just emphasizing the advantages

It is necessary to **continue joint research** between Japan and Germany in the future

Comparative Analysis in JP and GER on Social Acceptance of Autonomous Vehicles

Thank you for your attention!