

# Human factors, user requirements and user acceptance

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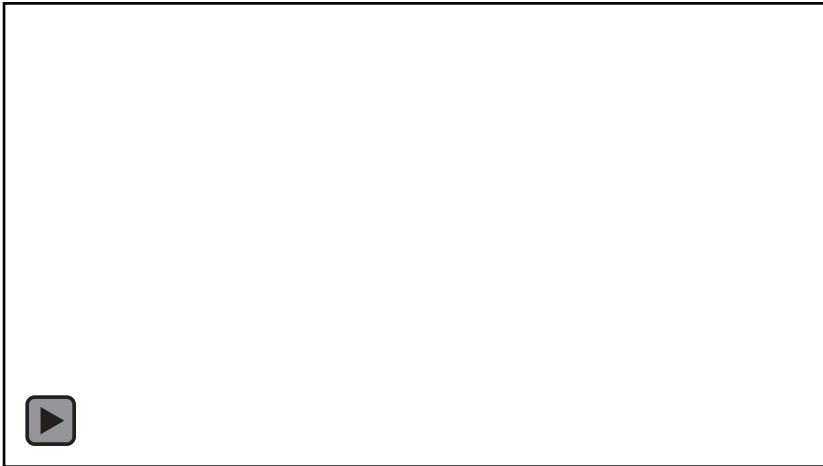
# Acknowledgements



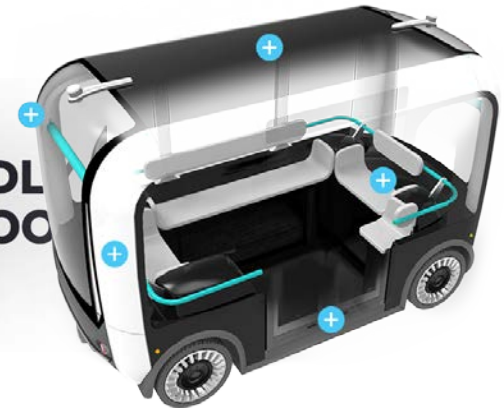
Ruth Madigan



Sina Nordhoff



**OLLI**  
**YOUR FRIENDLY**  
**NEIGHBORHOOD**  
**MOBILITY**  
**SOLUTION.**



[www.citymobil2.eu](http://www.citymobil2.eu)



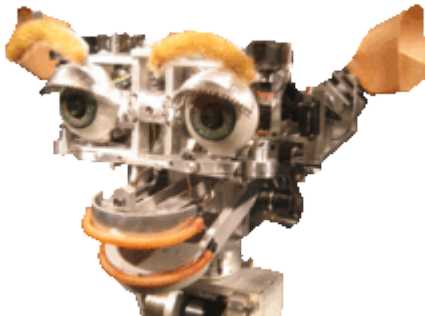
# Focus of paper

- Shared public AVs – SAE Level 4
- Social-psychological aspects: trust, acceptance, demographics, gender, social status, etc.
  - *user willingness to trust AV technology -- how to achieve adequate, but not excessive, trust?*
  - *user willingness to share a small unattended vehicle with strangers*
  - *interactions of AVs with pedestrians and bicyclists*
  - *realistic opportunities to serve mobility-impaired users (children, seniors, handicapped)*



# Resources

- Understanding user acceptance, etc. of *Conventional* car-sharing/pooling
- Large-scale surveys on AVs (mostly on-line)
- Real-world studies (limited)
- Interactions with automation/robots in other domains

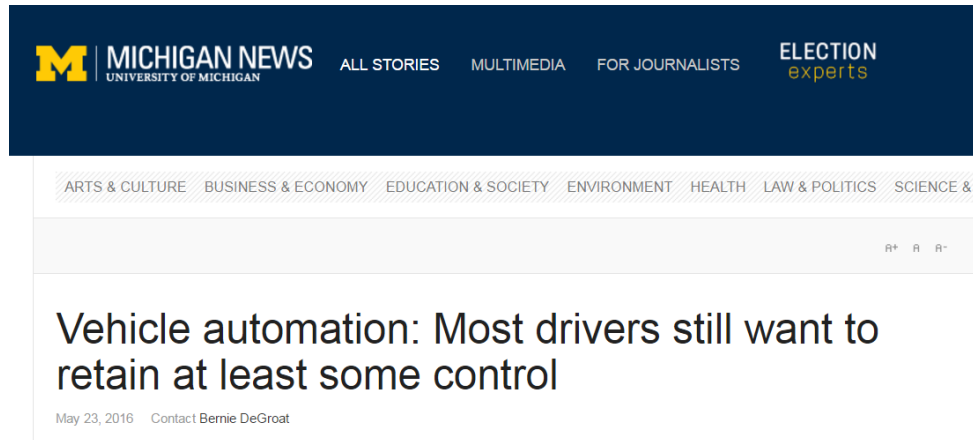


# Conventional car sharing

- Motivation: Very similar to AVs:
- Reduce:
  - Traffic volume, fuel use and any associated emissions; (IEA, 2005; Minett and Pearce, 2011)
  - The need for parking spaces, and;
  - The cost of travel for its users (TDM Encyclopaedia, 2012);
- provide a more convenient service than public transport (or an alternative for areas without such provisions);
- reduce driver fatigue (MAIF, 2009), which can then enhance productivity, and;
- improve social interaction (Agatz et al., 2012).
- Mixed views on typical users
- Mainly influenced by **time** and **cost**



# Web-based studies on AVs



Schoettle & Sivak

Kyriakidis et al., 2014

- 5000 responses from 109 countries
- Respondents “fascinated” by driverless cars, but “*most reported ...manual driving the most enjoyable mode*”



# Acceptability, Acceptance & Trust

- Acceptability: prospective, no need to experience
- Acceptance – post hoc and based on experience
- Technology Acceptance Model/Unified Theory of Acceptance and Use of Technology (UTAUT)



# Technology Acceptance Model/Unified Theory of Acceptance and Use of Technology (UTAUT)

| UTAUT Construct                | Definition   |
|--------------------------------|--|
| <b>Performance Expectancy</b>  | The degree to which using a system will provide benefits to consumers in their travel activities |
| <b>Effort Expectancy</b>       | The degree of ease associated with system use  |
| <b>Hedonic Motivation</b>      | The fun or pleasure derived from using the system  |
| <b>Facilitating Conditions</b> | Consumers' perceptions of the resources and support available to use the system                  |
| <b>Social Influence</b>        | The extent to which consumers perceive that important others would use the system                |
| <b>Price value</b>             | Value for Money  |
| <b>Habit</b>                   | The extent to which an individual believes a behaviour to be automatic                           |

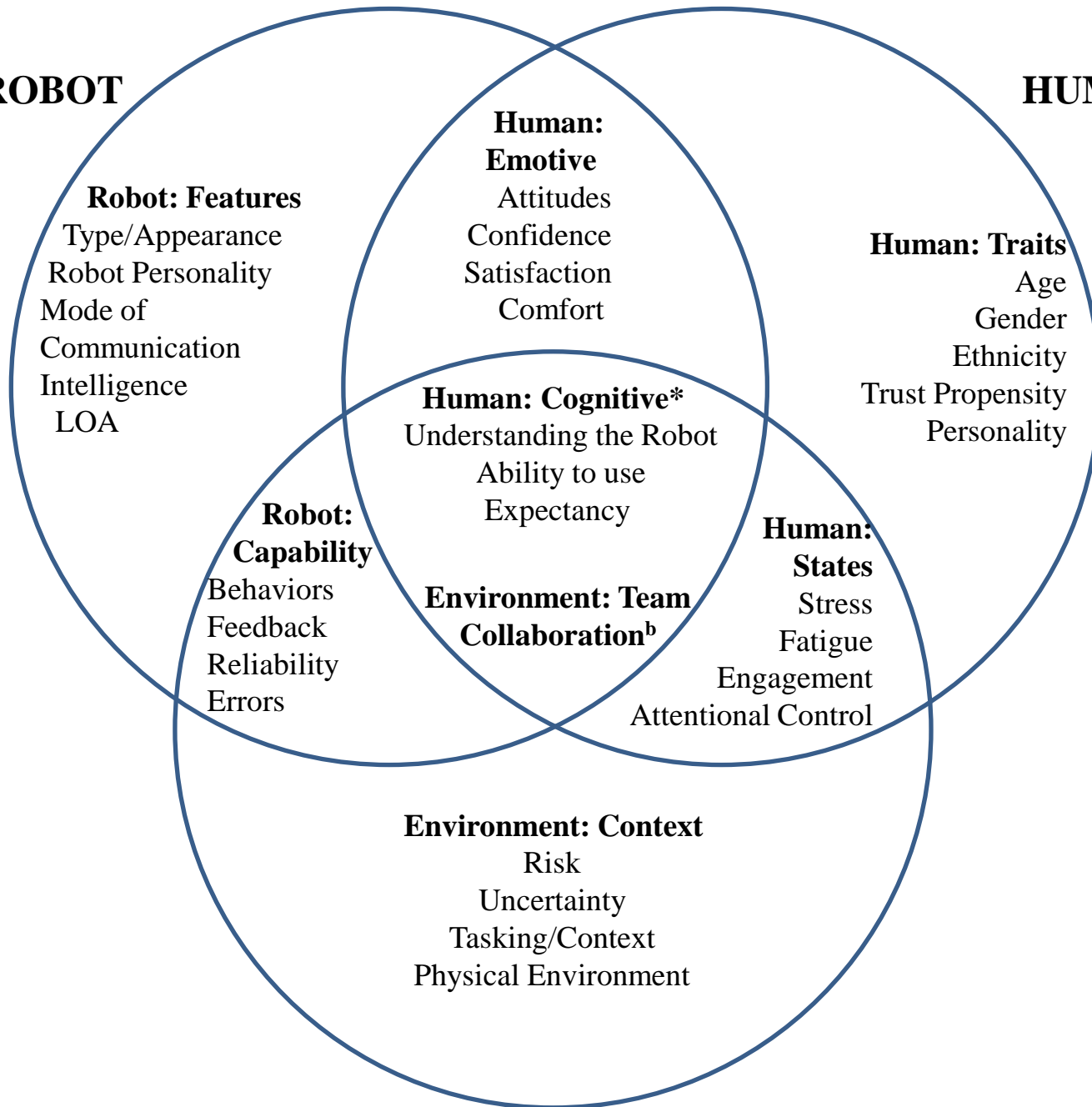
# From acceptance to trust

- UTAUT: adoption as a rational and goal directed behaviour
- What influences trust?



**ROBOT**

**HUMAN**



**ENVIRONMENT**

# Increasing trust

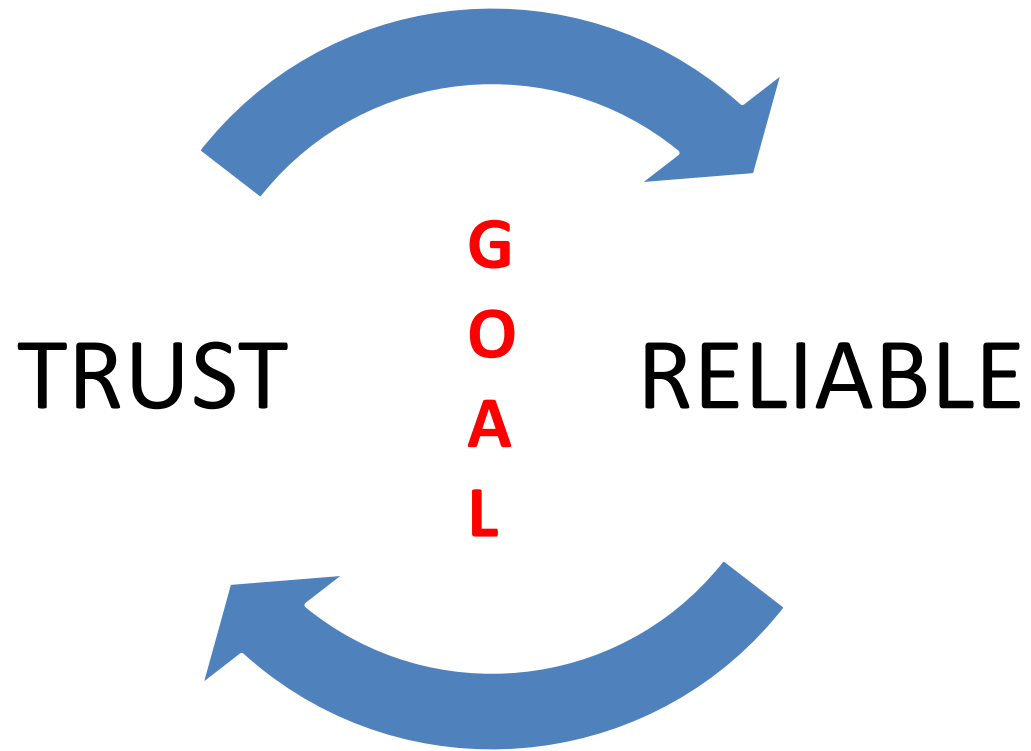
- **Usability** (Hoff & Bashir, 2015)
- Rapid drop if unanticipated action (Schaefer et al., 2014)
- Differences in age, gender, etc. **target user groups**
- Accurate and on-going **feedback** (Lee & Seppelt, 2007)
- **Anthropomorphism**
- **Appearance and communication style**



# ***Make automation trustable***

Lee & See (2004)

- Design for **appropriate trust**, not greater trust.
- Show the **past performance** of the automation.
- Show the **process and algorithms** of the automation by revealing intermediate results in a way that is **comprehensible** to the operators.
- **Simplify the algorithms** and operation of the automation to make it more understandable.
- Show the **purpose of the automation**, design basis, and range of applications in a way that relates to the **users' goals**.
- **Train operators** regarding its **expected reliability**, the mechanisms governing its behaviour, and its **intended use**.
- Carefully evaluate any **anthropomorphizing** of the automation, such as using speech to create a synthetic conversational partner, to ensure appropriate trust.



# Sharing unattended vehicle with strangers

- Improve 'privacy'
- Presence of operator
- CCTV and comms
- Familiarity with others
- Ensure SAFETY



# Opportunity to serve mobility-impaired

- No clear relationship between Age and acceptance
- Best for SAE 5
- Improve Facilitating conditions

# Interaction with other road users



Clamann, Aubert & Cummings, 2016



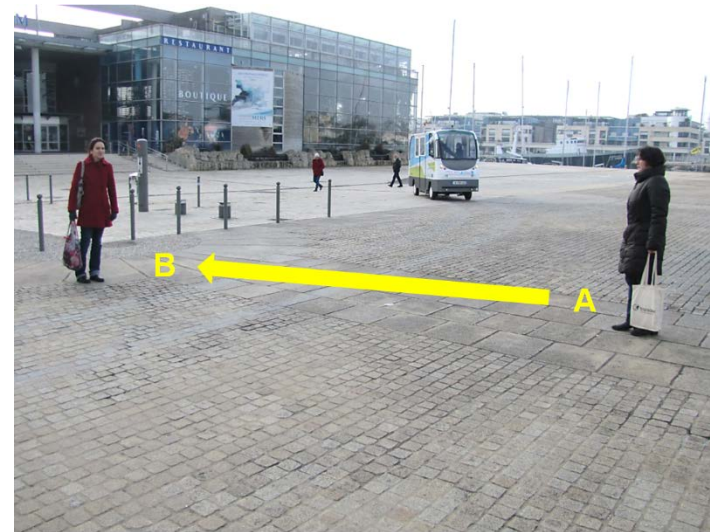
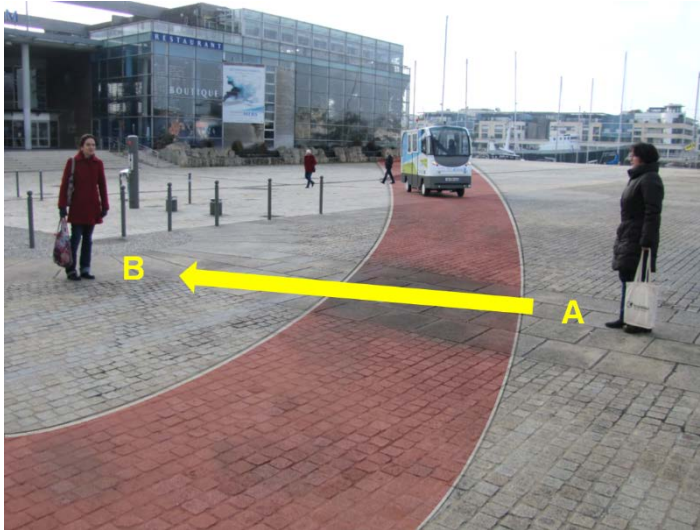
Fake it 'til you make it...

Right hand steered vehicle with fake steering wheel on the left side



Lagström & Lundgren , 2016

# Interaction with other road users



# Results from real-world studies

- Piao et al. (2016). AVs more acceptable than buses: lower prices (no driver), more space (no controls). Concerns about security, esp at night
- City Automated Transport Systems (CATS)
  - User friendly (92%), aesthetic (81%), functional (80%), easy to use (92%), safe (91%).
  - Lack of seating, quality (slopes)





# Using the User

## Related posts



February 23, 2016

How chatty are you in the car?



November 24, 2015

Take a BlaBlaCar to your next football games!



September 30, 2015

Save on travel costs by ridesharing to the Rugby World Cup!



| FACTOR                        | PRIVATE SEMI-AUTOMATED | SHARED AUTOMATED  |
|-------------------------------|------------------------|-------------------|
| <b>Availability</b>           |                        |                   |
| Anytime/Anywhere              | Developed              | Not Possible      |
| Up-to-date travel information | Needs Development      | Needs Development |
| Door to door solution         | Developed              | Not Possible      |
| Any weather                   | Developed              | Needs Development |
| <b>Facilities</b>             |                        |                   |
| High level of comfort         | Developed              | Needs Development |
| Clean/well-designed interior  | Developed              | Needs Development |
| Luggage storage               | Developed              | Needs Development |
| Caters for impairments        | Developed              | Needs Development |
| <b>Personal Preferences</b>   |                        |                   |
| Privacy                       | Developed              | Not Possible      |
| Status Symbol                 | Developed              | Not Possible      |
| <b>Societal Implications</b>  |                        |                   |
| Economical                    | Needs Development      | Developed         |
| Environmentally friendly      | Not Possible           | Developed         |
| Low emissions                 | Needs Development      | Developed         |
| <b>Use of travel time</b>     |                        |                   |
| Increased leisure time        | Not Possible           | Developed         |
| Increased productivity        | Not Possible           | Developed         |
| Social interactions           | Developed              | Developed         |

|                   |
|-------------------|
| Developed         |
| Needs Development |
| Not Possible      |

Thank you for your attention!

Lunch time!