

CHALMERS UNIVERSITY OF TECHNOLOGY				
Adoption and use of technical systems users' needs and requirements for technical systems use and meaning of technical products and systems prerequisites for users' adoption of new technologies	Energy s	Urban n		
Human- machine systems (incl HMI) • interplay between human and "machine" – from simple products to complex socio-technical systems • performance, safety	ystems and	nobility and	Well-being	
Sustainability and everyday life • design for sustainable behaviour • understanding behaviour and change	resource e	transport sy	and health	
User experience • sensing, perceiving and react to products and events • aesthetics • product identity and meaning	fficiency	/stems		





Expert Systems

- Professional Training
- High degree of system understanding
- Time for Consideration
- Team work



Automated Vehicles (AVs)

- Novice users
 - Little training
 - Low system understanding

Adoption/Acceptance

- Choice to adopt
- Trust highly important



Implications

- Mistrust
 - Using the system in an unintended way
 - Accidents

• Distrust

• Not adopting the system













Automated Vehicle Research

- Graphical User Interfaces
- Not much focus on implicit cues
 - AV driving behavior
 - Acceleration/Deceleration
 - Lane positioning

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Experimental Study

- Does a Automated vehicle's driving behavior affect trust?
- Comparing two simulated AV driving behaviors at AstaZero with a Wizard-of-Oz-car
 - No graphical user interface
 - No secondary task

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	Defensive	Aggressive
Starting & stopping behaviour	Keep the vehicle rolling (avoid standstill)	Start & stop (come to full stop)
Acc./Retardation pattern	Avoid heavy acc/deacc.	Heavy acc/deacc.
Lane positioning	Early indicate right or left turn (through positioning in lane)	Indicate late right or left turn (through positioning in lane)
Distance to object	Keep longer distance (lateral & longitudinal) to other objects	Keep shorter distance (lateral & longitudinal) to other objects



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Results Questionnaire – Aggressive vs. Defensive

I understood how the self-driving car operated	Def. Agg.		
I had full confidence in the competence of the self- driving car	Def. Agg.		
I thought the self-driving car was safe to ride	Def. Agg.		
I could trust the self-driving car	Def. Agg.	0000000	
I believe the car did what was best for me	Def. Agg.		
thought the car's driving behaviour felt predictable	Def. Agg.		
If my car worked like this, I would let it drive by itself	Def. Agg.		
If my car drove by itself, the experience would be better than driving on my own	Def. Agg.		



Perception of the AV behaviour

- Vehicle capacity (Performance)
 - Planned decisions
 - Clearly showing position in lane
 - No sudden actions
 - Smooth turns (without perceived continuous compensation)
- User's understanding of the AV's upcoming actions (Process)
 - · Gentle actions but distinct lane placement before situation
 - Coming to full stop (when giving way for VRU)
- Respect towards VRU (Purpose)
 - Placement (lateral, direction of car, and in time)
 - Speed
 - Coming to full stop (when giving way for VRU)

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Perception of the AV behaviour

- The perceived intelligence of the automation depended on the situations
 - In critical situations, Defensive mode was preferred since it more clearly communicated the intention of the car
 - e.g. early slow down for pedestrian
 - In none critical situation, Aggresive mode was preferred since it was perceived as more effective
 - e.g. narrow turn in roundabout

Discussion

- To communicate the intention of the car emerged as an important factor
 - The driving behavior communicates the intention is the car aware of the surroundings?
 - Can the behavior of the car be used intentionally to communicate the intention of the car?
 - HMI
- How to match the driving behavior to the graphical user interface?
 - How to sync cues from driving behavior with cues graphical in user interface?
 - Difference between a "Defensive" interface and a "Aggressive" interface?

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Conclusions

- The participants related the driving behavior to car having intelligence/agency
- The driving behavior affected the trust of the participants
- People experienced the automated car as a whole
- The vehicle dynamics and driving pattern need to be seen an essential part of user interface of the car to create trust
- The whole autonomous car is the user interface to the driver/passenger

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