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Technical Workshop

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21-22 APRIL 2016



Adapt!Ve

A photograph showing a blurred yellow vehicle, possibly a bus or truck, moving through a green, tree-lined area. The image is positioned at the top right of the slide.

*Automated Driving Applications and
Technologies for Intelligent Vehicles*

*Do we still need to consider Human Factors? -
The challenges regarding human-vehicle
interactions for automated vehicles*



// Overview

- How automation will change the human-vehicle interaction
- Do we still need to consider Human Factors?
- Challenges regarding the design of human-vehicle interaction for automated vehicles
 - Examples from EU projects Adaptive, HOLIDES, Citymobil2 and national projects
- Conclusions

// Automated and connected driving - Changes in the role of the driver

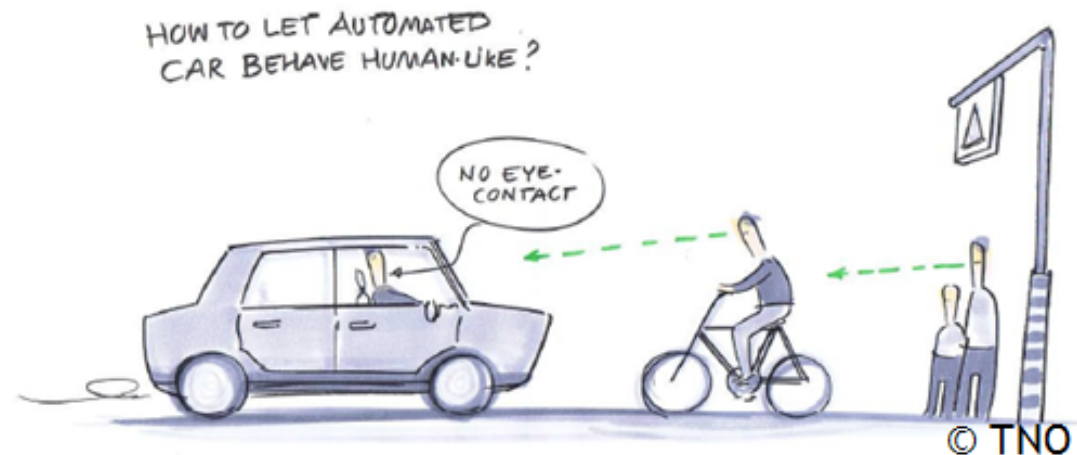


// Automated and connected driving - Changes in the interaction with other traffic participants



Version 1.0

SMART - 2010/0064
Definition of necessary vehicle and infrastructure systems for Automated Driving



// Do we still need to consider Human Factors?

YES - but why?

- Automated vehicles are to be implemented in mixed traffic environments where humans play a central role:
 - as drivers or passengers
 - as other road users (vehicle drivers or VRUs)
 - as operators
- Automation does not remove the human - it changes the way humans interact with vehicles
- *"[...] the irony that one is not by automating necessarily removing the difficulties, and also the possibility that resolving them will require even greater technological ingenuity than does classic automation."*
(Bainbridge, 1983)

// Do we still need to consider Human Factors?

- Human Factors can help:
 - to detect major effects of automated vehicles on human performance:
 - (short-& longterm) automation effects and implications for drivers
 - Driver workload, distraction, situation awareness
 - Trust, acceptance, fears, disuse and misuse
 - Performance and loss of skills
 - Differences in driver populations (e.g. age, intercultural aspects, experts - beginners - professional drivers)
 - (short-& longterm) automation effects and implications for other traffic participants
 - Trust, acceptance, fears
 - Information needs for safe interaction

// Do we still need to consider Human Factors?

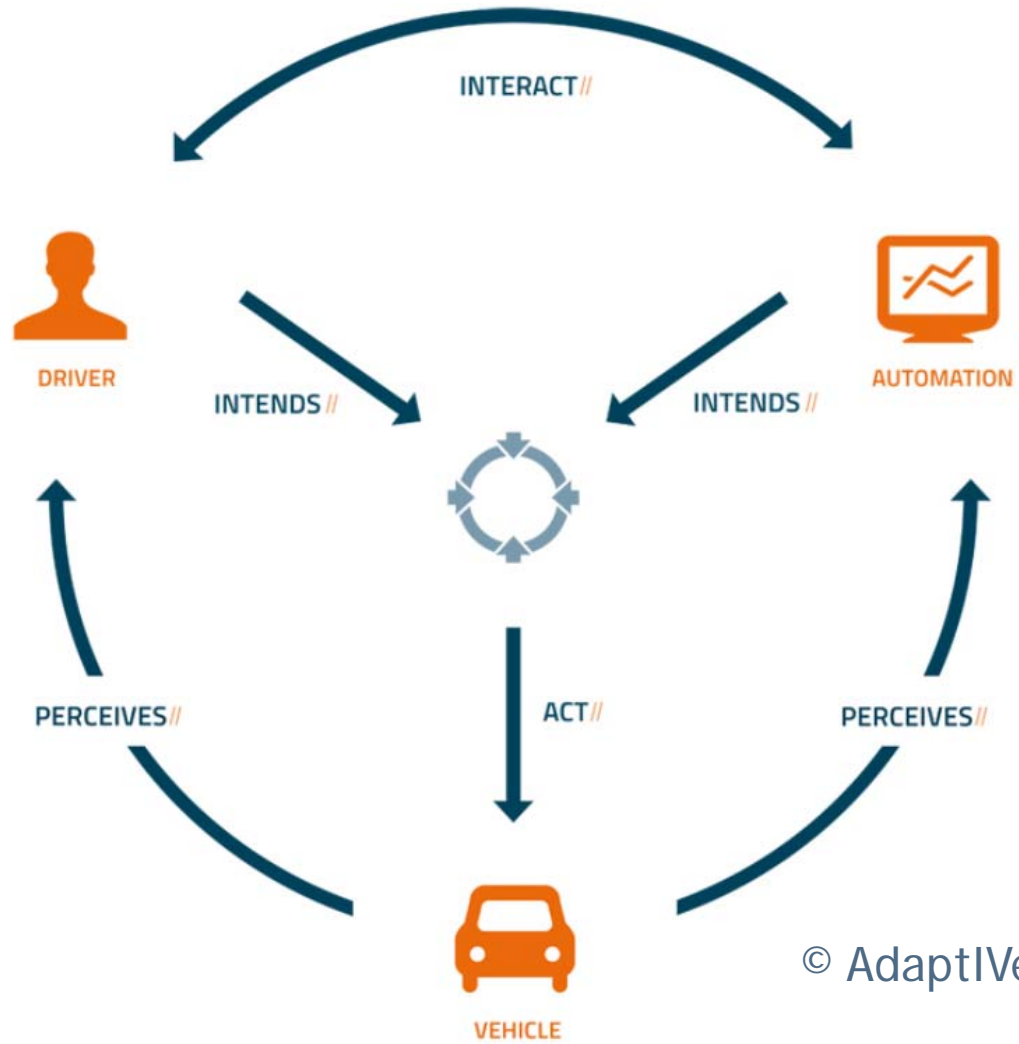
- Human Factors can help:
 - to improve the interaction design for human - vehicle interaction e.g.
 - Design of HMI and selection appropriate information and communication channels
 - Design of transitions of control
 - Selection of appropriate non-related driving tasks & definition of misuse
 - Design of automation behaviour
 - to design instruction strategies and trainings procedures
 - to define guidelines, rules and standards for HMI design

// Definition of the automation levels

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/Deceleration	Monitoring of Driving Environment	Fallback Performance of Dynamic Driving Task	System Capability (Driving Modes)
Human driver monitors the driving environment						
0	No Automation	the full-time performance by the <i>human driver</i> of all aspects of the <i>dynamic driving task</i> , even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	Driver Assistance	the <i>driving mode</i> -specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	Human driver and system	Human driver	Human driver	Some driving modes
2	Partial Automation	the <i>driving mode</i> -specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	System	Human driver	Human driver	Some driving modes
Automated driving system ("system") monitors the driving environment						
3	Conditional Automation	the <i>driving mode</i> -specific performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> with the expectation that the <i>human driver</i> will respond appropriately to a <i>request to intervene</i>	System	System	Human driver	Some driving modes
4	High Automation	the <i>driving mode</i> -specific performance by an automated driving system of all aspects of the <i>dynamic driving task</i> , even if a <i>human driver</i> does not respond appropriately to a <i>request to intervene</i>	System	System	System	Some driving modes
5	Full Automation	the full-time performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> under all roadway and environmental conditions that can be managed by a <i>human driver</i>	System	System	System	All driving modes

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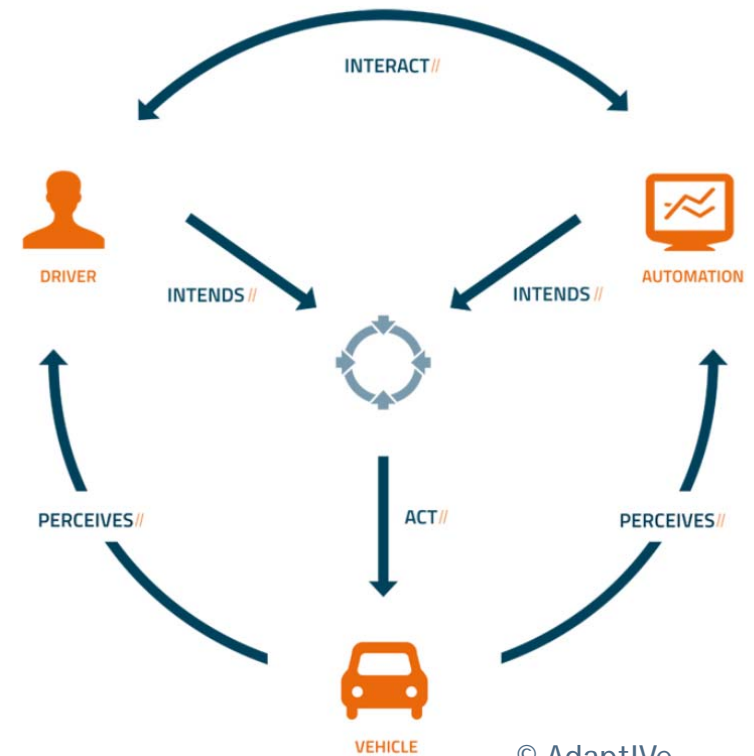
// Driver - vehicle interaction



© Adaptive

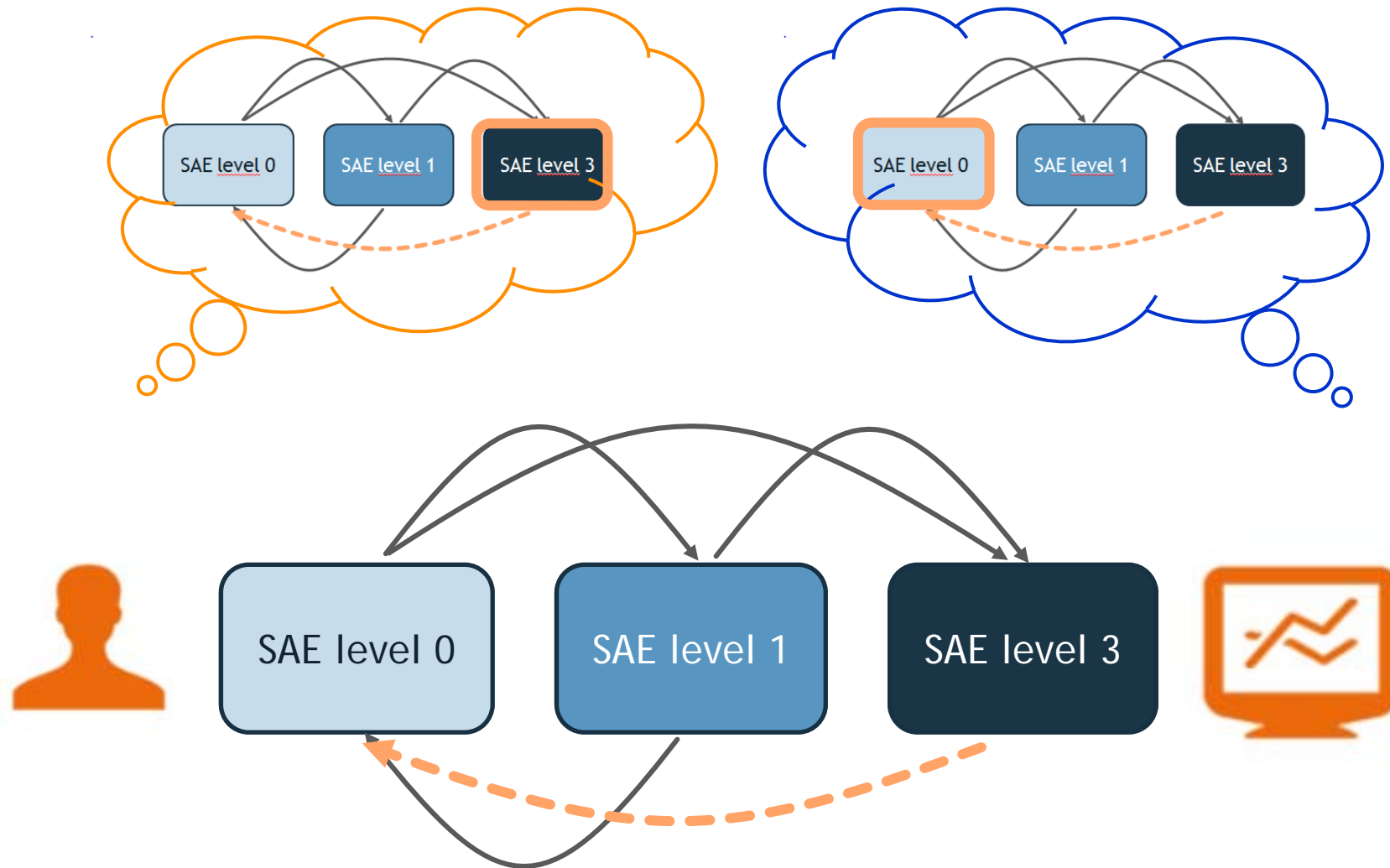
// Driver - vehicle interaction

- Examples for relevant interaction design issues:
 - Transitions of control between different levels of automation
 - Design for reasonable usage and avoidance of misuse
 - Adaptation of automation behaviour on driver state and driving style/driver preference



© AdaptIVe

// Driver - vehicle interaction: Transitions of control



© DLR

// Driver - vehicle interaction: Transition of control

- Risk of „control vacuum“ or „control surplus“
- Challenges for the interaction design:
 - Transitions need to be safe
 - Operation faults need to be avoided
 - Mode confusion should be avoided by presentation explicit information about available and activated automation level

// Driver - vehicle interaction: Transition of control

- Experimental evaluation of HMI design variants for the instrument cluster at VTEC



Manual



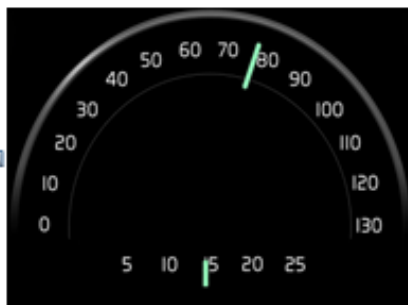
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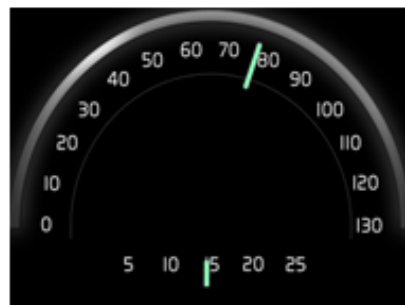
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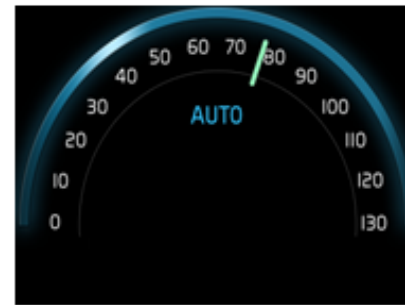
Auto mode



Manual



(Auto available)



Auto mode

// Driver - vehicle interaction: Transition of control



- Concept for integrating information of drivers driver assistance systems and automation levels in a holistic concept at DLR



// Design of reasonable usage/avoidance of misuse



- Challenges for the interaction design:
 - Take-over capability of the driver needs to be ensured, while allowing the driver to engage in non-driving related tasks
 - Misuse needs to be avoided
- Concept for integrating personal mobile devices in the overall vehicle system -> DLR project MOBIFAS

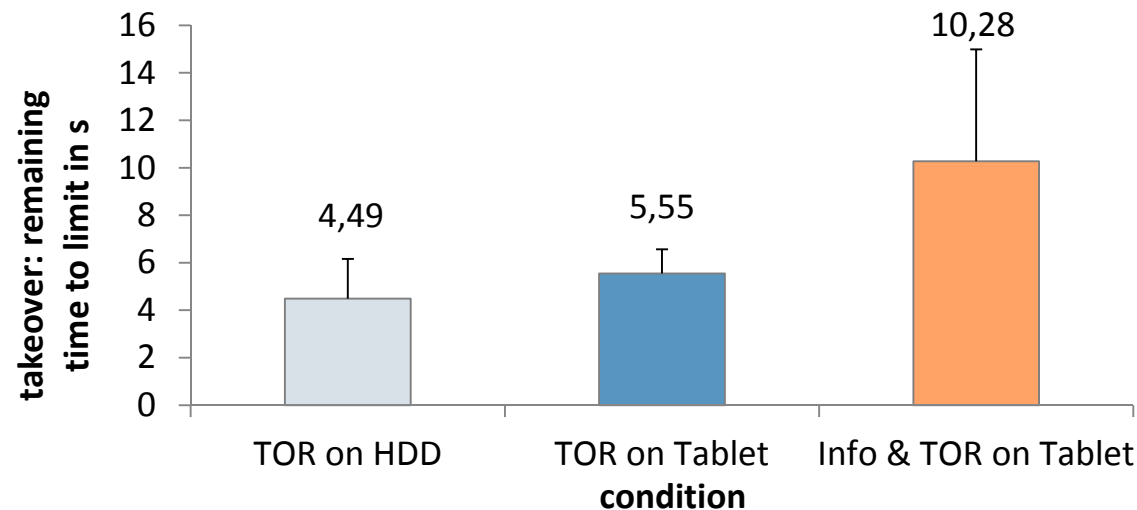


<https://www.youtube.com/watch?v=f53zJV1Zh0Q>

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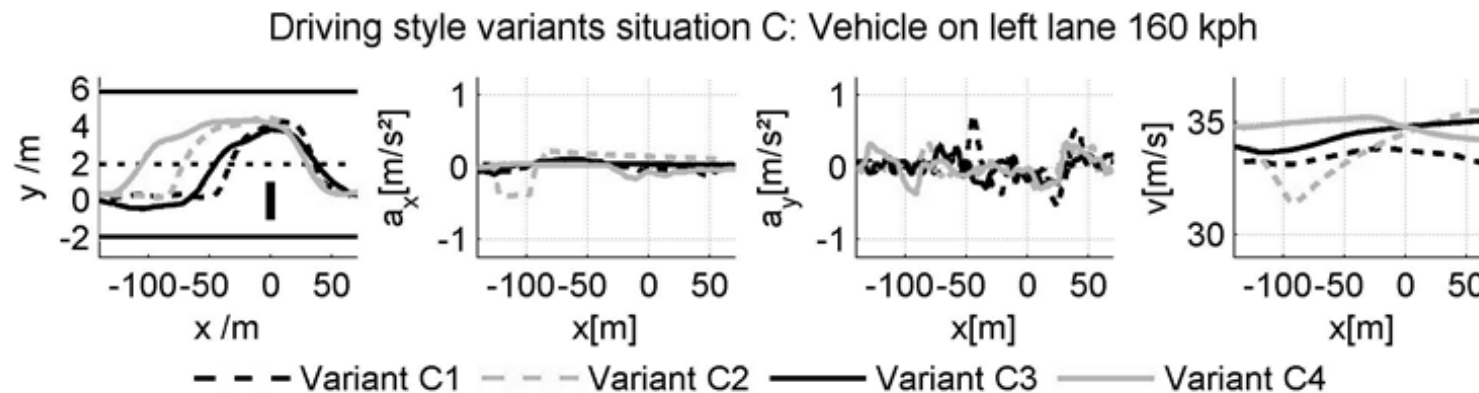
// Adaptation of automation behaviour

- Challenges for the interaction design:
 - Ensure comfortable driving
 - Support the driver in an optimal way
- Concept for adapting the automation behaviour with respect to driver preference/driving style and driver status

Driving style	Driver A: defensive	Driver B: offensive
Driver state	Driver C: attentive	Driver D: distracted

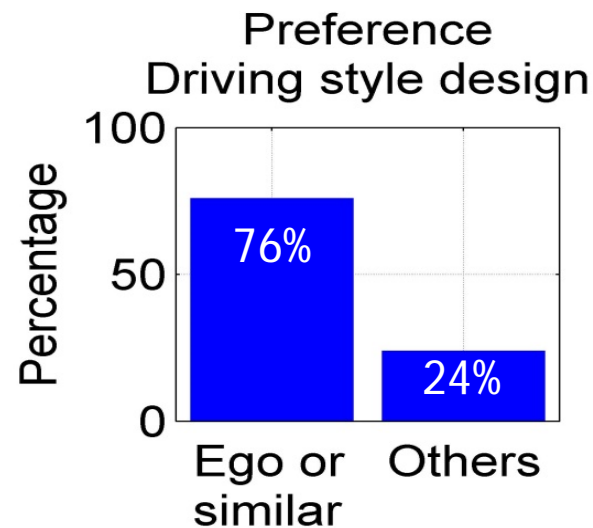
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// Interaction with other traffic participants

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// Interaction with other traffic participants

- Automated vehicles are to be implemented in mixed traffic environments where humans play a central role as other road users
 - Drivers of other vehicles
 - Vulnerable Road Users (VRUs)
- Various forms of interaction between drivers of conventional vehicles and other traffic participants
 - Eye contact, hand signals, gestures
- Challenges for the interaction design:
 - Safe and intuitive interaction with other traffic participants
 - Implicit and explicit communication
 - Human-like behaviour?



// Interaction with other traffic participants



- Focus groups, interviews, online survey by IST Leeds and DLR:
- Which kind of behaviour and interaction do people expect from driverless vehicles in shared environments?
- 99% of the participants expect that vehicles behave according to traffic rules
- About 50% would like to have additional visual and acoustic information about
 - Direction of movement
 - Detection of objects in the near field
 - Planned/next actions of the vehicle



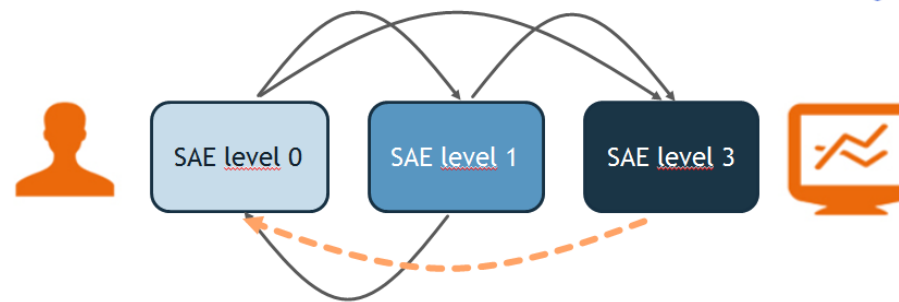
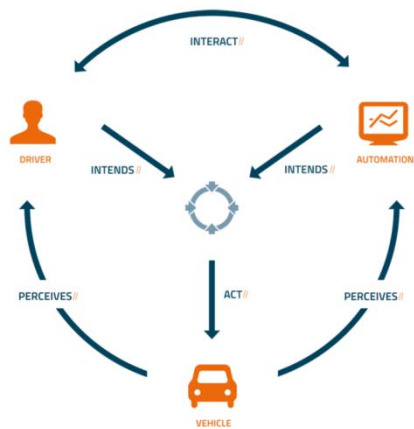
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// Conclusions

- Automation per se does not decrease Human Factors research needs
- The human stays a crucial part in the overall human - vehicle system
- Several Human Factors effects of automated vehicles have not been (fully) explored yet
- Vehicle automation will technically further develop - interaction design needs to keep pace
- Standardization of generic interaction concepts (not OEM specific HMI solutions) would help to significantly reduce critical interaction



// Interested in further information? - References

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AdaptIVe: <https://www.adaptive-ip.eu/>

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MobiFAS: http://www.dlr.de/dlr/desktopdefault.aspx/tabid-10081/151_read-14305/#/gallery/20054 & <https://www.youtube.com/watch?v=f53zJV1Zh0Q>

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Thank you.

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