Dirk Wisselmann, Project Leader Highly Automated Driving.

TAKE-OVER CONCEPTS FOR HIGHLY AUTOMATED DRIVING.

ITS-Workshop on Automated Driving.
Tokio, Nov. 17-18, 2014.

BMW GROUP

AUTOMATED DRIVING WILL INCREASE SAFETY, COMFORT AND EFFICIENCY BOTH FOR THE DRIVER AND THE TRAFFIC SYSTEM.

IMPROVED TRAFFIC AND DRIVING SAFETY.

Always safe (also without automation by an optimized perception).

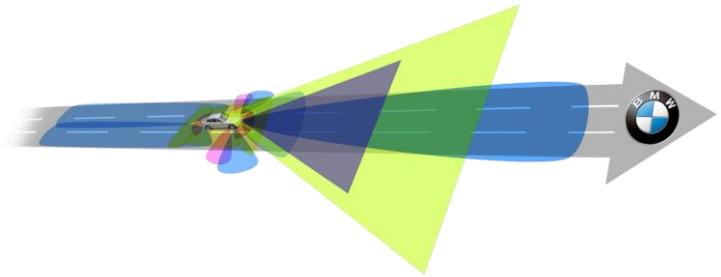
INCREASED DRIVING COMFORT.

Gaining valuable time by delegation.

IMPROVED DRIVING EFFICIENCY.

Time and fuel savings through optimized driving strategy.

WITH THE AUTOMATION THE CUSTOMER HAS TO DEVELOP AND ACCEPT A NEW ROLE MODEL.



Self driving:
Well experienced.
Underdemanding in longlasting, boring situations.

Delegation

Re-Delegation

Automated Driving:
New experience of relaxation in boring situations.

HMI - HIGHLY AUTOMATED DRIVING.

Take-Over-Process:

Task 1

Non-Driving Task
„Out of the Loop“

Shift of
Attention

Situational
Awareness
Desicion

Action
Manoveur

$t_{Take\text{-}Over}$ = time, driver starts a manoveur

Transition / „Task Switch“

Take-over Request (TOR)

Task 2

Manual Driving
„In the Loop“

HMI - HIGHLY AUTOMATED DRIVING.

1. HMI Challenges | **2. Simulator Studies** | 3. Requirements for Take-Over Concepts

AnalyzingTake-over Behavior

- 7x studies in the BMW dynamic driving simulator
- about 400 partipicants (BMW employees)
- Level 3 Automation 120 km/h on Highway with 3 Lanes

…. what did we measure:

- Timing aspects of take-over process
  - gaze reaction time
  - hands on time
  - take-over time
- Quality aspects of take-over process
  - number of glances at Mirrors, etc.
  - accelerations & trajectories
  - number of collisions

HMI - HIGHLY AUTOMATED DRIVING.

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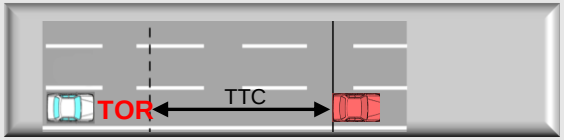
Overview:

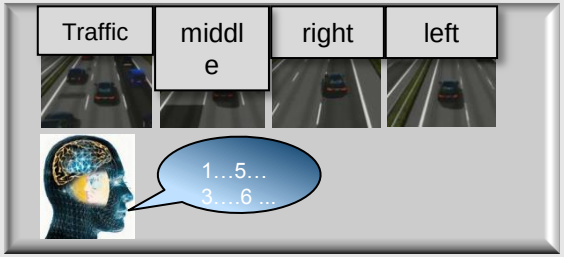
Take over! How long does it take to get the driver back into the loop
Gold, C; Damböck, D; Lorenz, L; Bengler, K. (Hfes, San Diego, 2013)



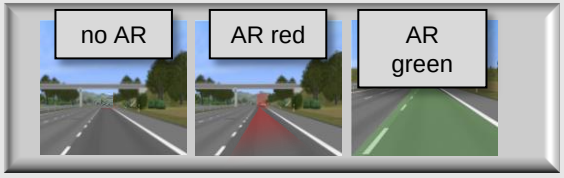
Partially Automated Driving as a Fallback Lavel of High Automation
Gold, C; Lorenz, L; Bengler, K. (6. Tagung Fahrerassistenz Munich, 2013)

Influence of Automated Brake Application on Take-over Situations
Gold, C; Lorenz, L; Bengler, K. (FISITA, Maastricht 2014)

How Traffic Situations and Non-Driving-Related-Tasks Affect The Take Over Quality in Highly Automated Driving
Radlmayer, J.; Gold, C; Lorenz, L; Bengler, K. (Hfes, Chicago, 2014)



Designing take over scenarios for automated driving: How does augmented reality support the driver to get back into the loop?
Lorenz, L; Kerschbaum P.; Schumann, J. (Hfes, Chicago, 2014)



HMI - HIGHLY AUTOMATED DRIVING.

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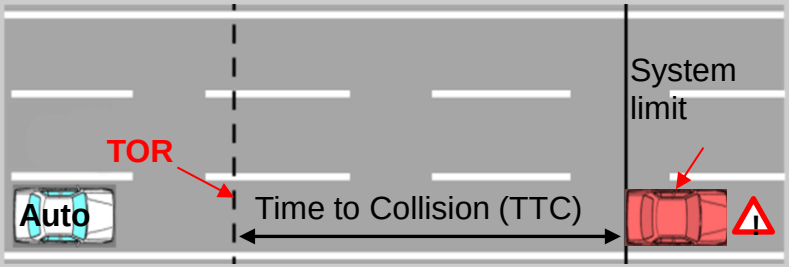
Influence of Time-Budget:

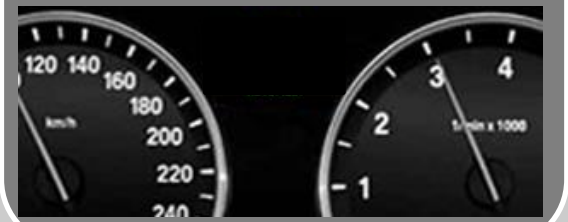


Independent Variable:

- Time-Budget: TTC 5 Sec. vs. 7 Sec.
- Sample: N = 32; M = 33.2 years (SD = 11.2)

TOR

Manual Driving
Level 0



Highly Automated Drving
Level 3

HMI - HIGHLY AUTOMATED DRIVING.

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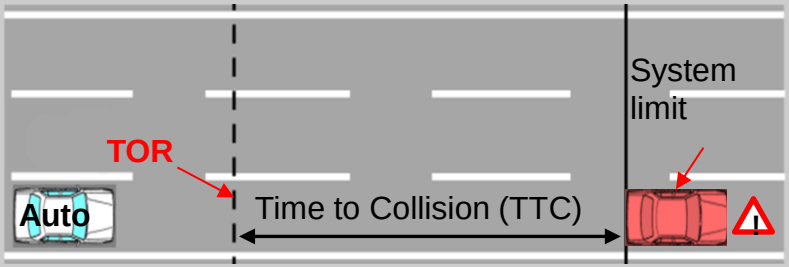

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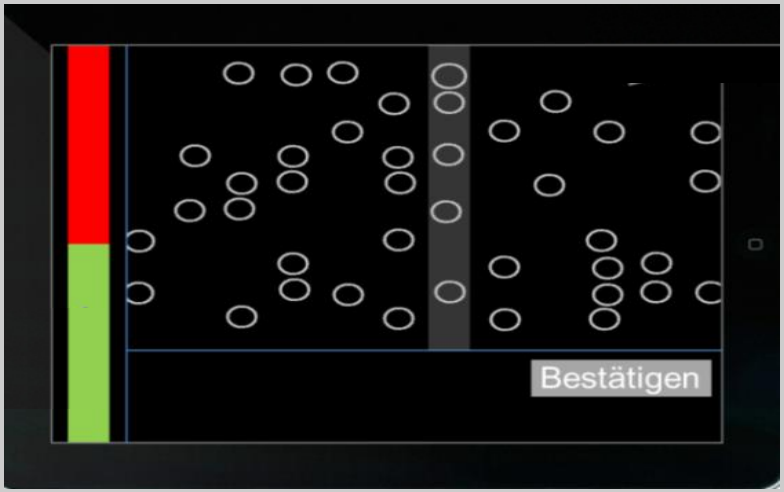

Modified Surrogate Reference Task (SuRT) (ISO14198):

- Select the biggest circle!

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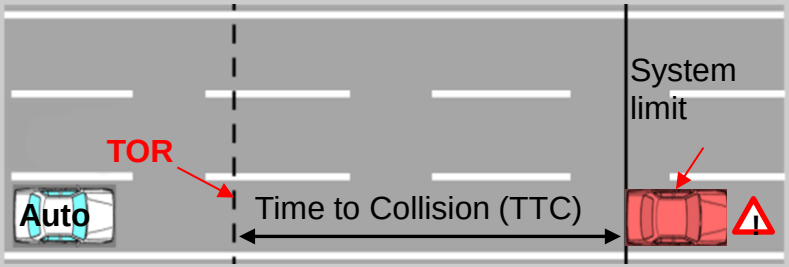
Influence of Time-Budget:



Independent Variable:

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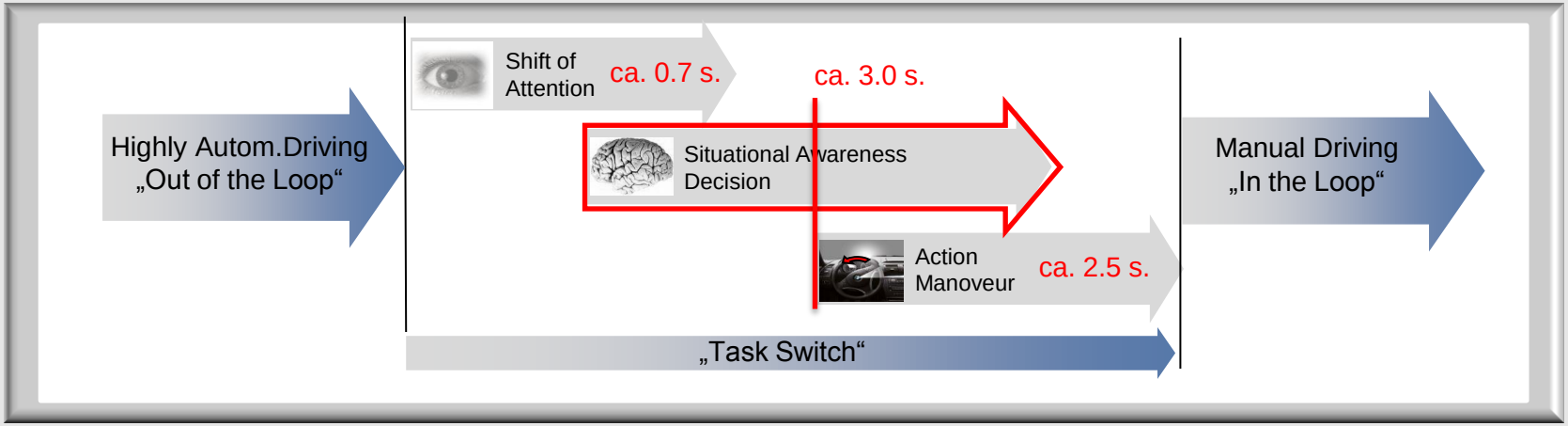
7 Sec. Time-Budget

5 Sec. Time-Budget

HMI - HIGHLY AUTOMATED DRIVING.

Conclusion:



Take-over concepts should….

- … cause a fast attention shift towards the scenery
- ….support the driver in his decision making & Situational Awareness
- ….support the driver in his action

THANK YOU FOR YOUR ATTENTION!