A HOLISTIC APPROACH TO DEFINE THE RISK OF DRIVER DISTRACTION AND INATTENTION

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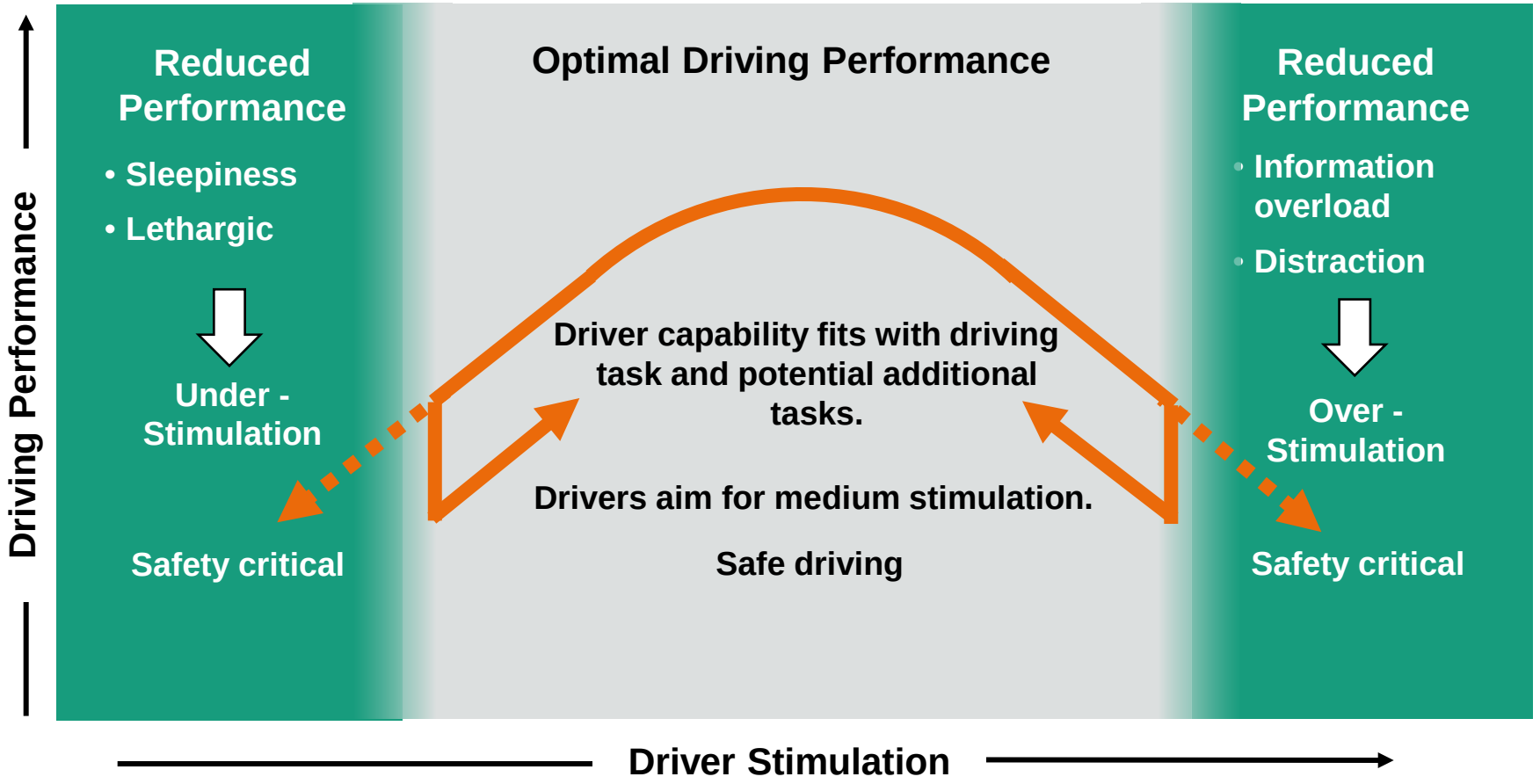
http://www.wechealthunit.org/workplace-health/health-topics/images/distractedcaa.jpg

Driving is not just driving

20% of driving time are spend with additional tasks.

A global view on Driving Performance

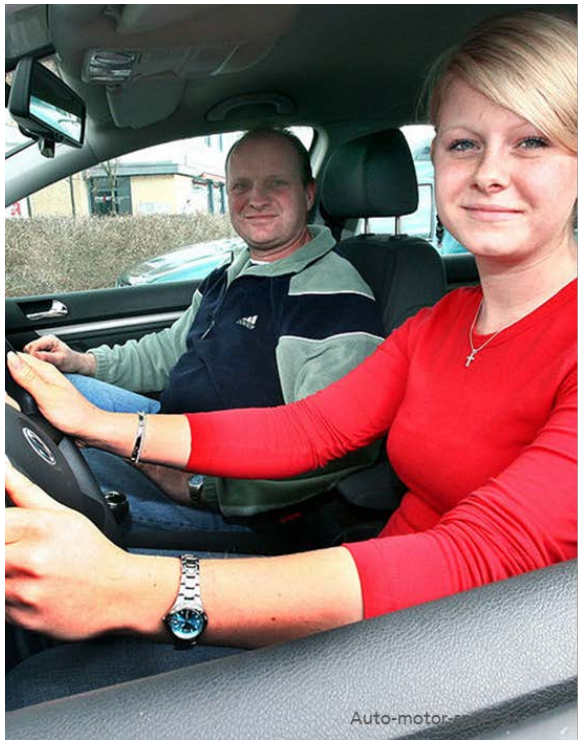


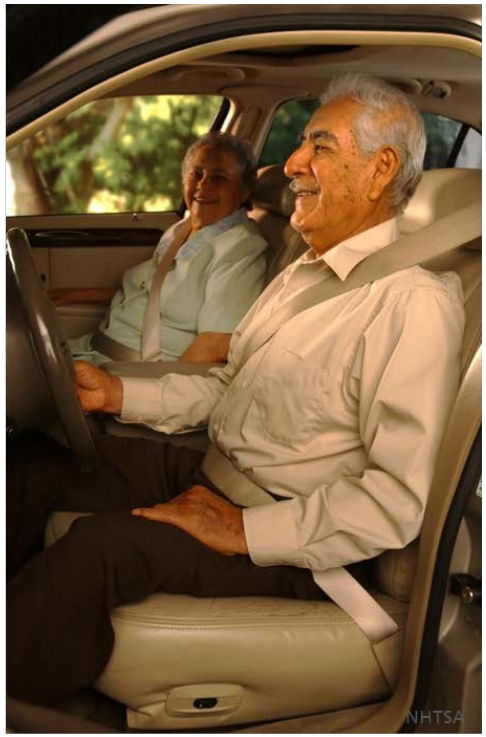
Over- and under-stimulation reduce driving performance.
The curve's shape is an individual driver factor.

Yerkes-Dodson Law (1908) adapted to the driving task.

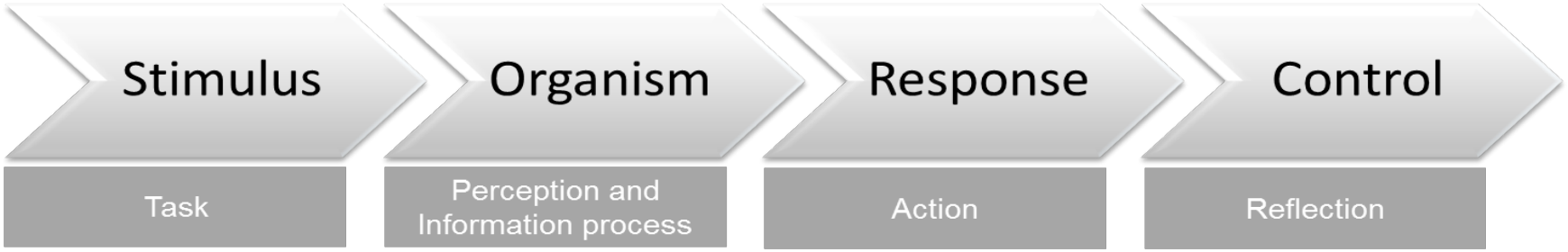
DRIVER FACTOR

Passenger car licence holders age from 16 to 65+ with different possibilities and resources





Classification of driver capability



- During the driving task different stimuli affect the driver: visual, auditive, olfactory, tactile and vestibular. They are percept and processed within the organism to generate actions.
- The quality and time of perception and information processing, action and control depend on a high number of individual driver factors, e.g. cognition, physical abilities.
- Based on this model and the stress-strain-correlation an accident analysis and literature study was made to classify the drivers.

S-O-R-C model (adapted from Hacker, 1978).

Driver profiles

Factor \ Age	18-24		25-34		35-44		45-54		55-64		65+	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Perception	++	++	++	++	+	+	○	○	-	-	--	--
Cognition	++	++	++	++	+	+	○	○	-	-	--	--
Experience	--	--	○	○	+	+	++	++	++	++	++	++
Reaction time	++	+	+	○	○	-	-	--	--	--	--	--
Physical mobility	+	++	○	+	-	○	--	-	--	--	--	--
Motion speed	++	+	+	○	○	-	-	--	--	--	--	--
Numbers of accidents	--	--	○	○	++	++	++	++	○	○	--	--
Mortality risk	--	-	-	○	+	++	++	++	○	○	--	--
Risk behaviour	--	-	-	○	○	○	○	○	+	+	++	++
Alcohol or drug misuse	--	+	--	+	-	+	-	+	-	-	+	++
Performance	+	○	++	+	+	○	○	-	-	--	--	--
Σ	0	3	4	7	5	6	1	1	-7	-8	-11	-11
Driver Group	3		1				2		3			

++ very good (2) **+ good (1)** **○ neutral (0)** **- bad (-1)** **-- very bad (-2)**

DRIVING TASK

Different driving tasks define different driver stimulation

The driving task as a factor for driving performance

- According to Rasmussen (1983) the driving task can be classified by the required cognitive effort:
  - **Driving task without experience**: knowledge based performance is required. These actions require the highest cognitive effort.
  - **Known driving task**: action patterns are well known, memorized actions are used within this rule based behaviour.
  - **Automated driving task**: based on highly automated sensor motoric stimulus-response-mechanism.
- A multitude of previous research was analysed to define the complexity of scenarios. Factors found e.g. are:
  - Road section, Road pathway, Roadside boundaries, Road condition, Visibility and weather, Traffic density as well as Driving speed.

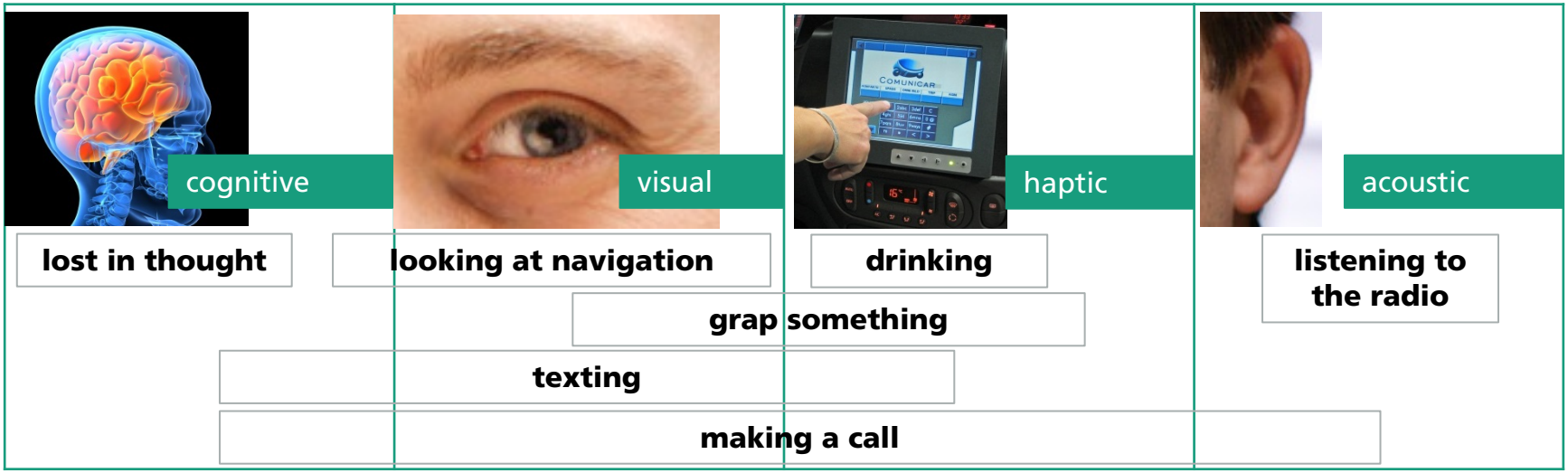
The driving task influences the driver stimulation and is therefore reflected in the variance of driving performance.

DISTRACTION

"The diversion of attention away from activities critical for safe driving toward a competing activity" Lee (2009)

Distraction as a factor for driving performance

- Additional tasks interfere with resources needed for the driving task.
- The stronger the interference the higher the impact on the driving task.



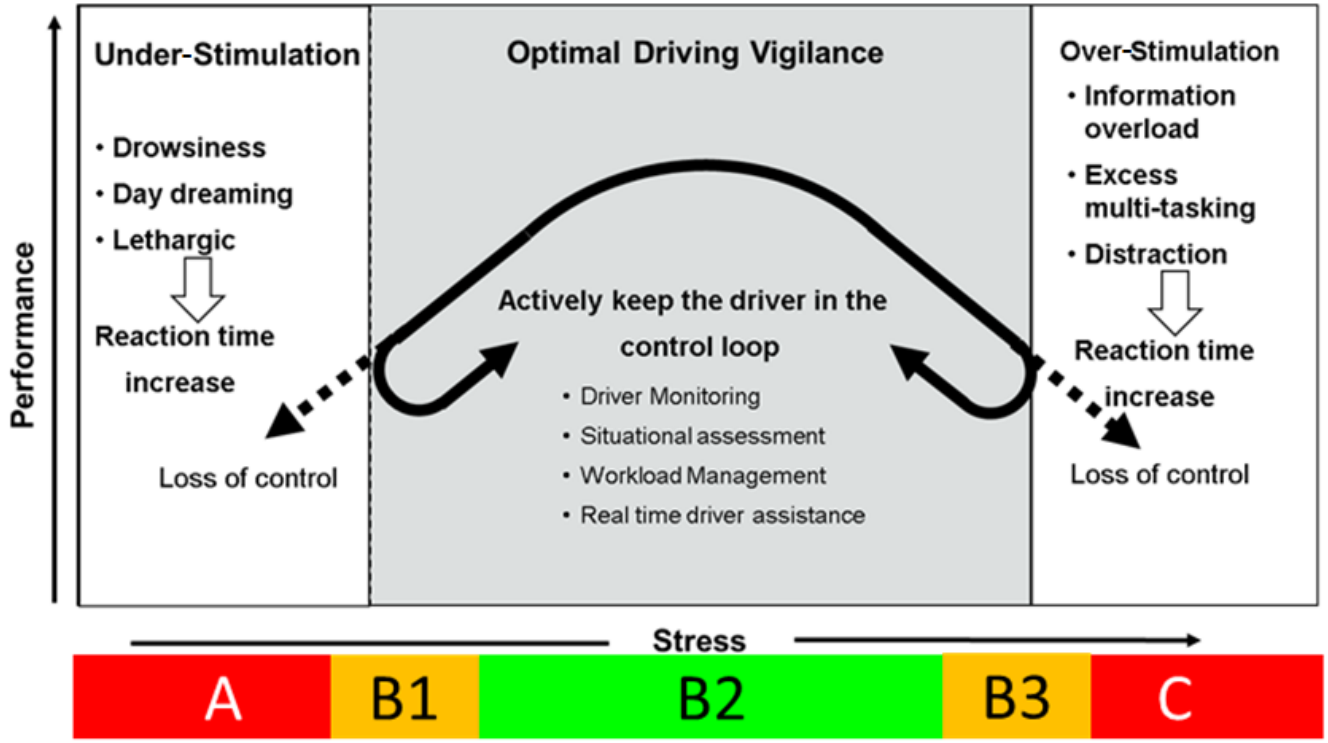
The interference of resources required for the additional task with the driving task are reflected in the variance of driving performance.

The principle of BABS

Distraction	none	low	middle	high
Visual	No interference - view to the road		Middle interference - interrupted view on the road	High interference - highly interrupted view on the road
Manual	No interference - both hands on wheel	Low interference - low manual interruption	Middle interference - middle manual interruption	High interference - high manual interruption
Auditive	No interference - just listen to music		Middle interference - not able to perceive all auditive information	
Cognitive	No interference - full cognitive resources for driving task	Low interference - low cognitive interruption	Middle interference - middle cognitive interruption	High interference - high cognitive interruption

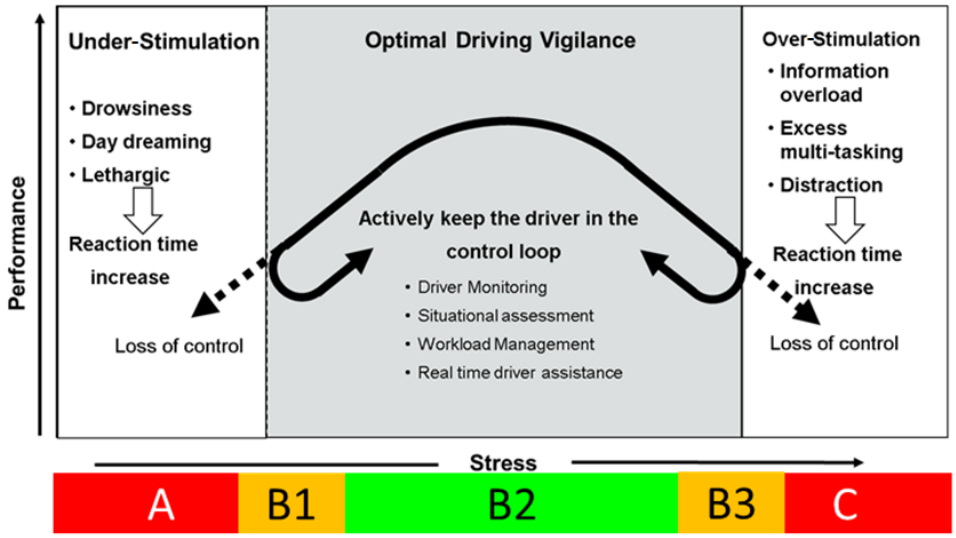
THE DRIVER-DRIVING TASK-DISTRACTION INTERRELATION

Combination of driver factor, driving task classification and BABS based distraction rating



Risk level of driver-driving task-distraction interrelation

- The different capability of the driver groups (stress level) as well as the height of demand out of the driving task and distraction (strain) influences the attribution to these five risk levels.
  - Under-stimulation by driving task (A, B1)
  - Under-stimulation by driving and distraction (A, B1)
  - Optimal stimulation by driving task (B1-B3)
  - Optimal stimulation by driving and distraction (B1-3)
  - Over-stimulation by driving task (B3, C)
  - Over-stimulation by driving and distraction (B3, C)



Driver group	Driving task		
	Easy	Middle	Difficult
No distraction			
1	A	B1	B1
2	B1	B1	B2
3	B2	B2	B3
Low distraction			
1	B1	B1	B2
2	B1	B2	B3
3	B2	B3	C
Middle distraction			
1	B1	B2	B3
2	B2	B3	C
3	B3	C	C
High distraction			
1	B2	B3	C
2	B3	C	C
3	C	C	C

SIMULATOR STUDY

Analysis of the new approach

Experimental Design

Driver group	Driving task		
	Easy	Middle	Difficult
No distraction			
1	A	B1	B1
2	B1	B1	B2
3	B2	B2	B3
Low distraction			
1	B1	B1	B2
2	B1	B2	B3
3	B2	B3	C
Middle distraction			
1	B1	B2	B3
2	B2	B3	C
3	B3	C	C
High distraction			
1	B2	B3	C
2	B3	C	C
3	C	C	C

- Due to the complexity of the whole DDD approach only a part of it was covered within this experiment:
  - Factor driver was chosen as a constant with drivers out of group 1 (n=23)
  - Easy driving task on a highway (HW)
  - Middle driving task on a countryside road (CS)
  - Each driving task had to be performed once without distraction and once with high distraction.

Summary of Results

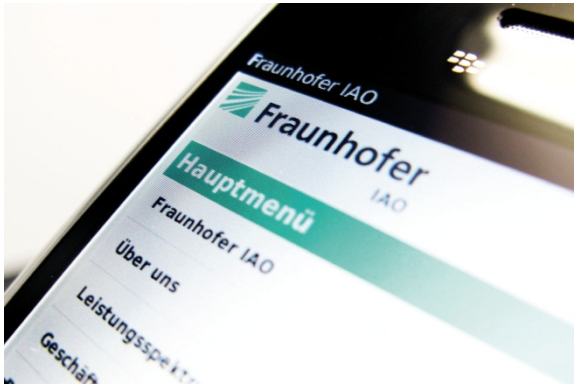
Driver group	Driving task	
	Easy	Middle
No distraction		
1	A	B1
High distraction		
1	B2	B3

- The additional task lead to a high distraction.
- No significant correlation between driving performance and performance in additional task were found (highway p=0.93 and countryside p=0.79).
- The chosen participants are a group of drivers with homogeneous capacity.
- The results of the dependent variables show clear differences in the difficulty of driving tasks.
- Similar results for speed and steering wheel angle for both countryside road scenarios (as it was expected).
- The expected differences between highway with and without distraction were not found.

Conclusion

- A global approach to assess the safety of driving performance was presented.
- This approach investigates all influencing factors, which are:
  - Driver capability, driving task and distraction.
- A method to assess the risk level of this driver-driving task-distraction interrelation was presented.
- Results of a first simulator experiment did not verify all aspects of the approach, but some of them. A more detailed study with more participants is necessary.
- The approach seems to be the right direction, but further research is needed.

CONTACT



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