



# Dimensions and challenges of holistic HMI development exemplified by "Simplify your Drive"

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# Interior Division

## 4 Strong Business Units

### Continental Corporation

Automotive Group			Rubber Group		
Chassis & Safety	Powertrain	Interior	Passenger and Light Truck Tires	Commercial Vehicle Tires	ContiTech
Electronic Brake Systems	Engine Systems	Instrumentation & Driver HMI	Original equipment	Truck Tires, EMEA	Air Spring Systems
Hydraulic Brake Systems	Transmission	Infotainment & Connectivity	Repl. Business, EMEA	Truck Tires, The Americas	Benecke-Kaliko Group
Sensorics	Hybrid Electric Vehicle	Body & Security	Repl. Business, The Americas	Truck Tires, Asia Pacific	Conveyor Belt Group
Passive Safety & Advanced Driver Assistance Systems (PSAD)	Sensors & Actuators	Commercial Vehicles & Aftermarket	Repl. Business, Asia Pacific	Industrial Tires	Elastomer Coatings
Chassis Components	Fuel Supply		Two-Wheel Tires		Fluid Technology
					Power Transmission Group
					Vibration Control
					Other Operations

# Figures prove high risks of car crash due to distracted driving

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- In 2008, nearly **6,.000 people** died in crashes that **involved distracted driving** (equals to 16% of all people died in car crashes)
- Thereof nearly **2.600 people** were distracted **by using a cell phone** while driving

Source: US National Highway Traffic Safety Administration:

<http://www.nhtsa.gov/Research/Human+Factors/Distracted>, <http://www-fars.nhtsa.dot.gov/People/PeopleAllVictims.aspx>,  
<http://www-fars.nhtsa.dot.gov/Main/index.aspx>

# The challenge...

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**535.000 years**

stuck in traffic  
about 2,5 days (Germany) <sup>1)</sup>

**4.2 billion hours**

spending in traffic jams  
one work week (US) <sup>2)</sup>

**34 %** of younger driver are  
texting while driving  
(US; Age 16-17) <sup>3)</sup>

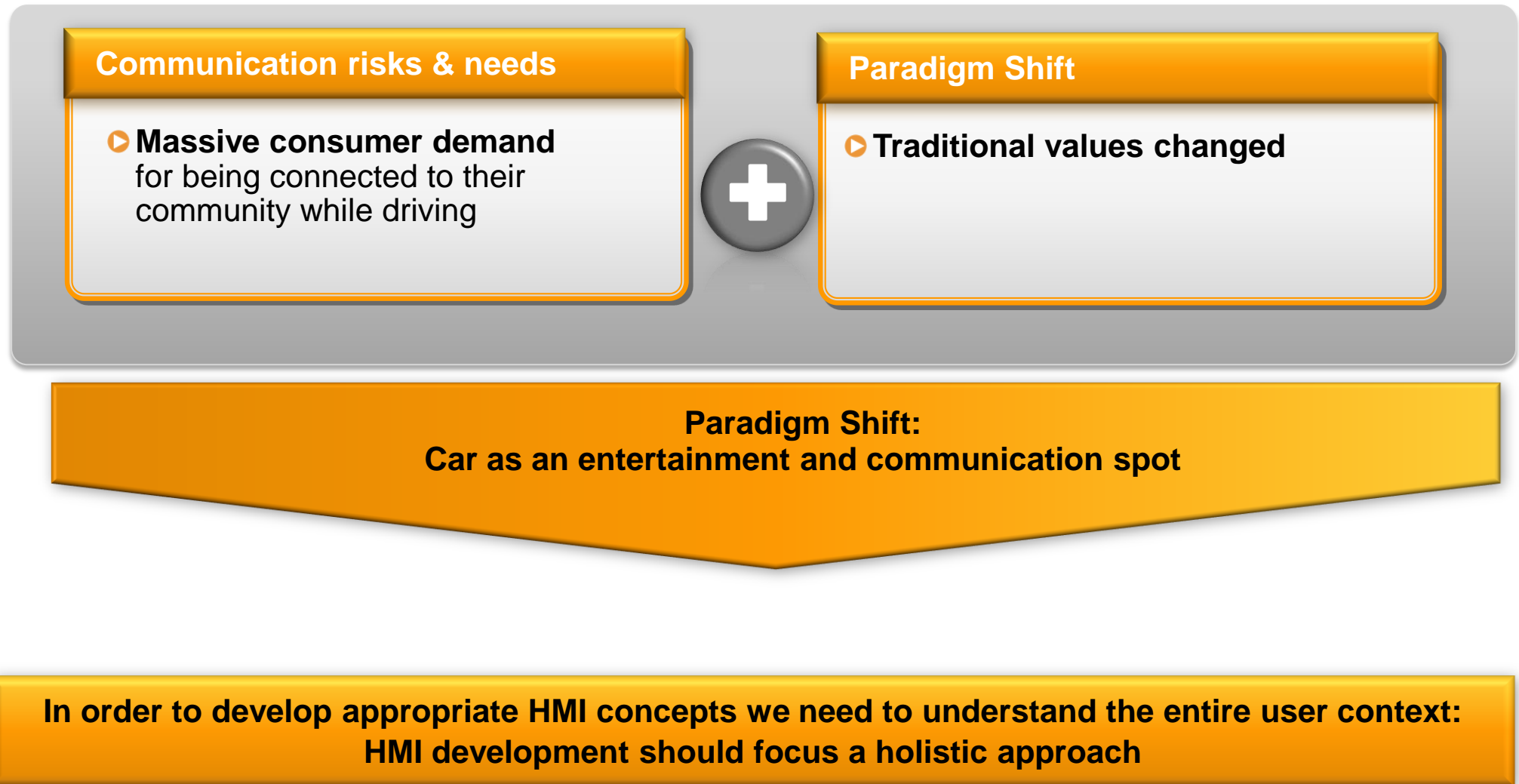
**Strong need for a seamless  
communication !**

<sup>1)</sup> Die Tageszeitung; 14.9.2010

<sup>2)</sup> Texas Transportation Institute  
[http://tti.tamu.edu/infofor/media/news.htm?news\\_id=5206](http://tti.tamu.edu/infofor/media/news.htm?news_id=5206)

<sup>3)</sup> Pew Research Center; Teens and Distracted Driving, Nov. 16, 2009, Mar Madden et al.

# Need for a holistic approach



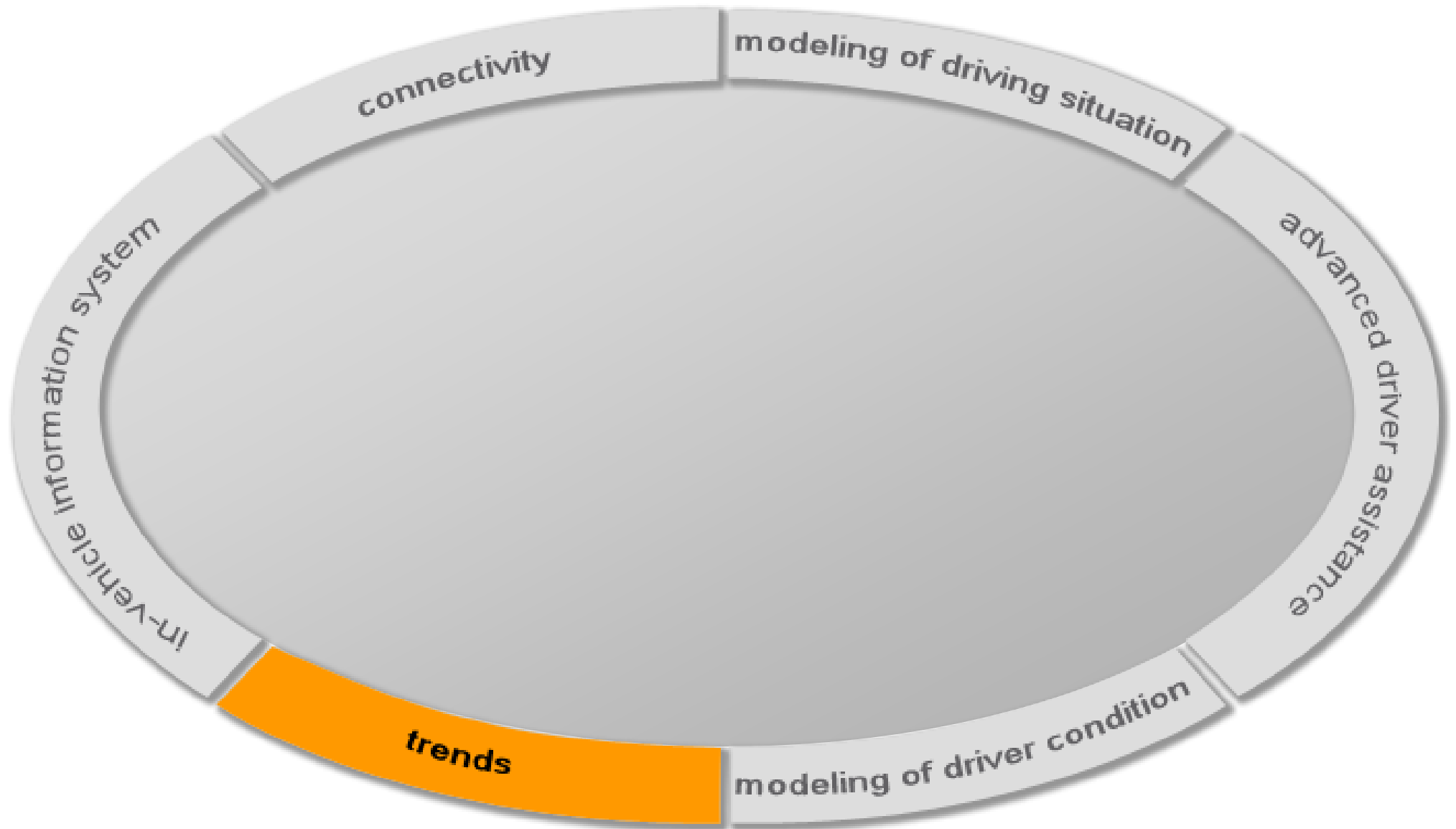
# Content

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- ▶ **Challenges and dimensions of a holistic HMI development**
- ▶ **User centered design**
- ▶ **Simplify your Drive: Concept, Creation, Validation**
- ▶ **Simplify your Drive: Service applications, examples of a holistic approach**
- ▶ **Summary**

# Holistic HMI approach (HMI on system level)

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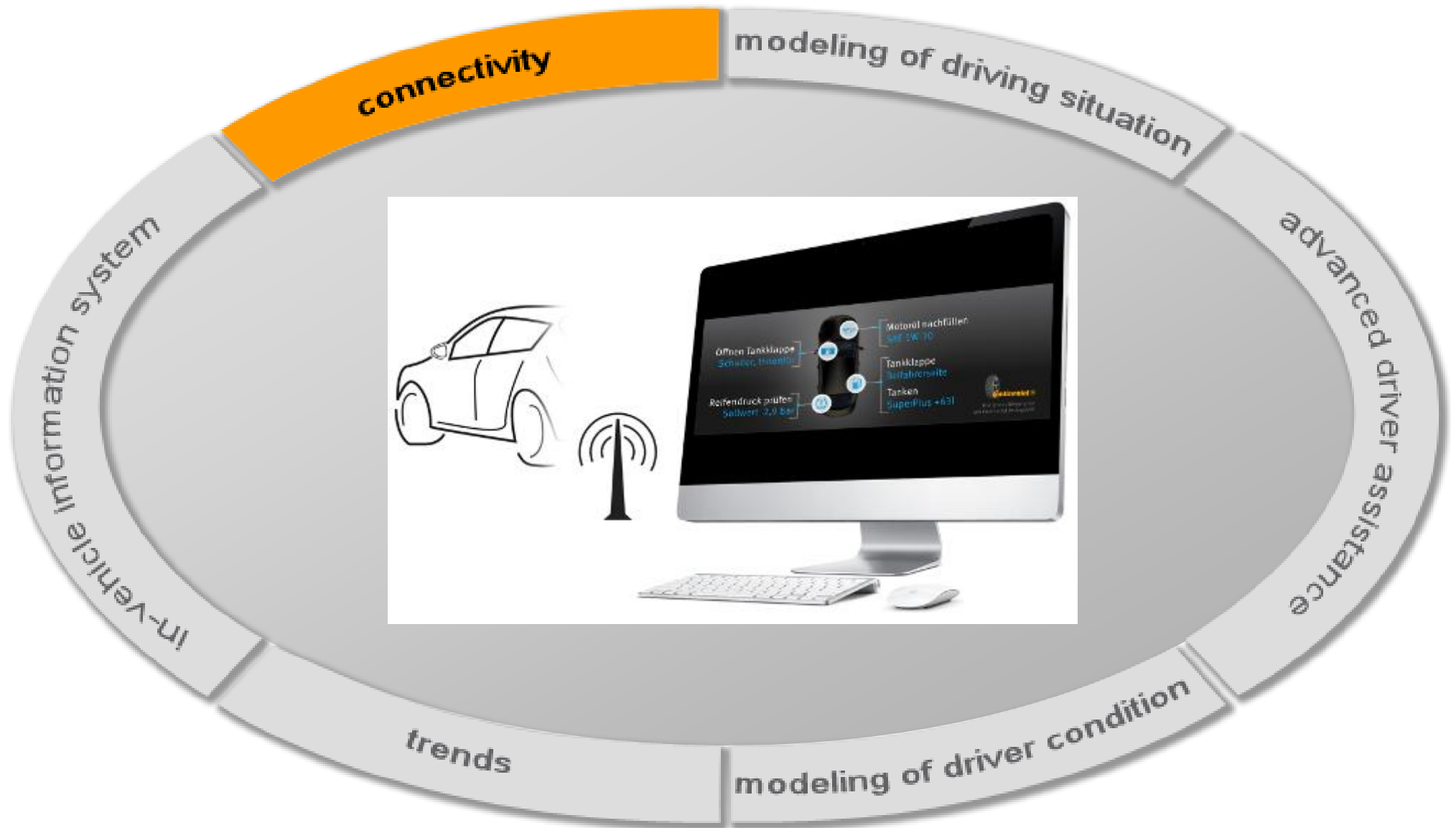


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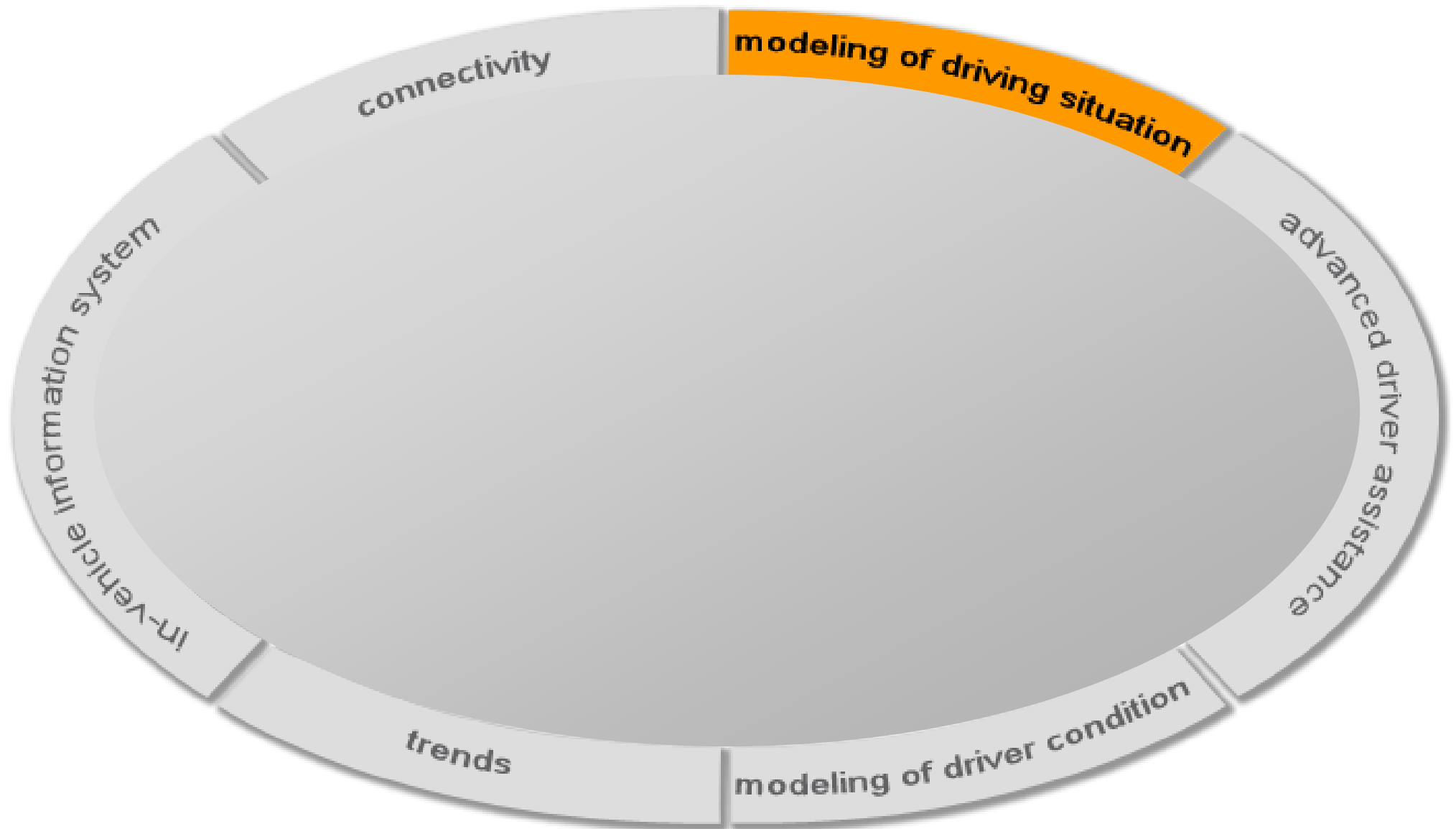


# Holistic HMI approach (HMI on system level)

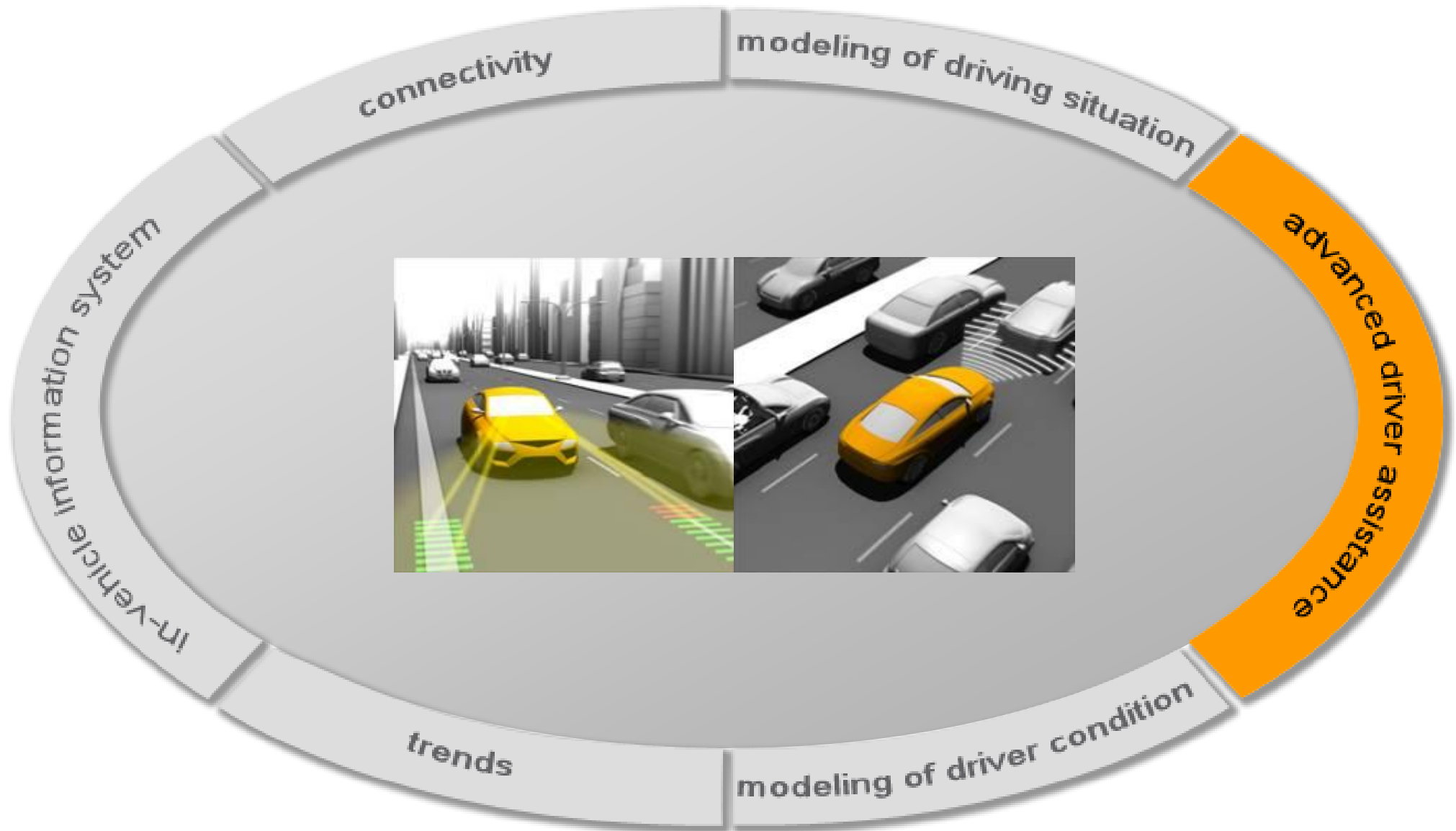


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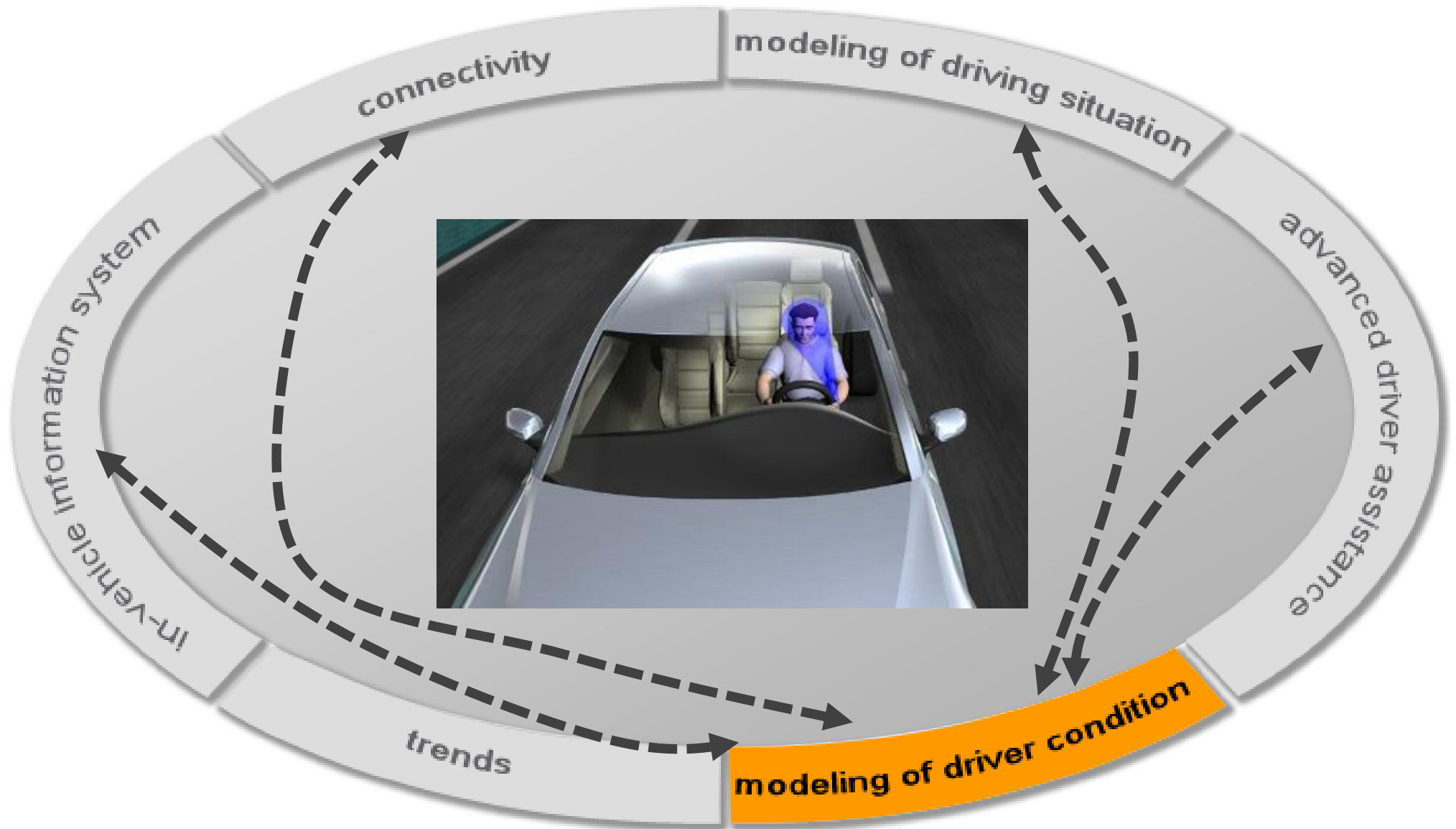
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# Holistic HMI approach (HMI on system level)

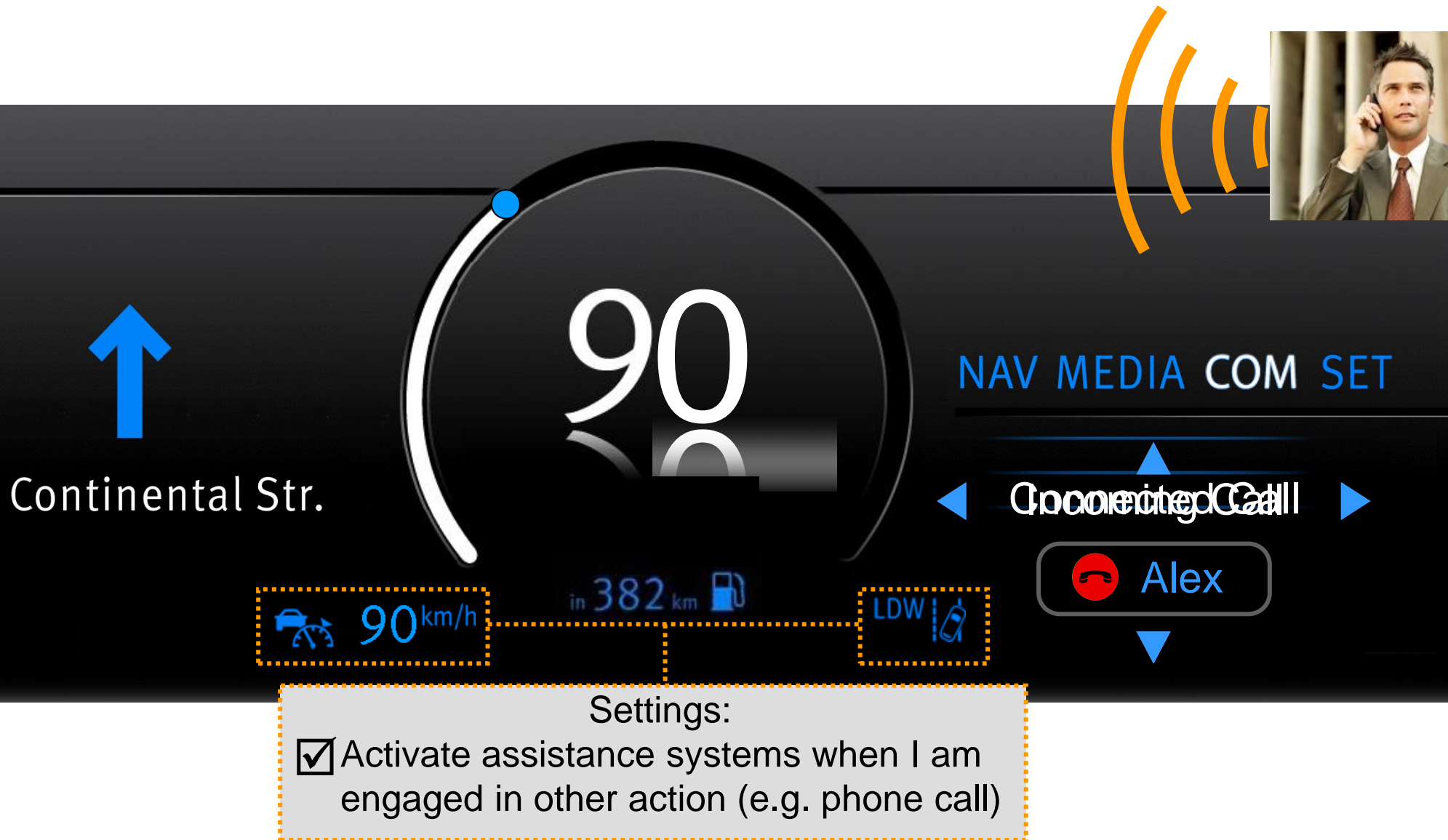


# Holistic HMI approach (HMI on system level)



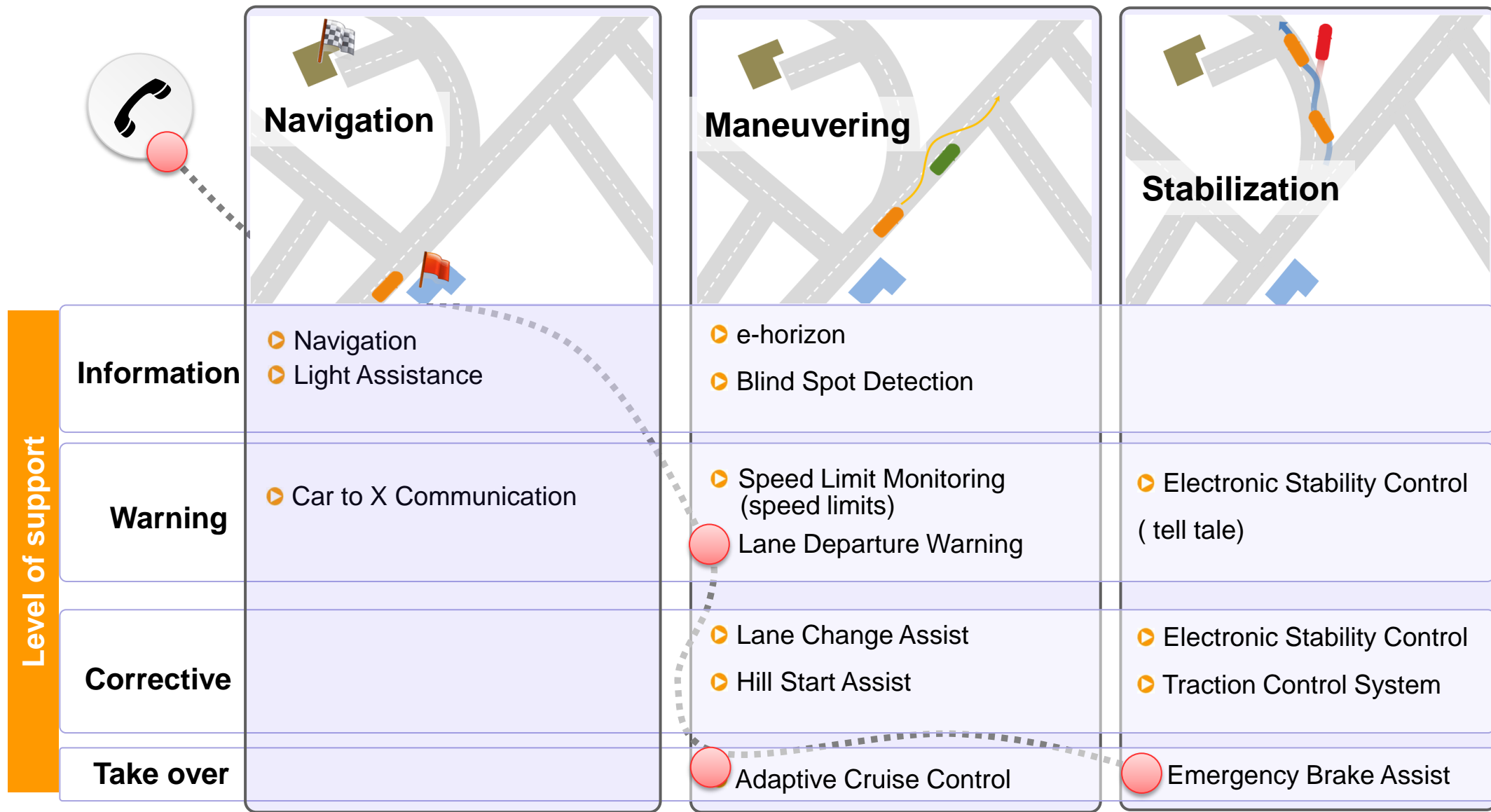
# Normal driving

## Automatic activation of Advanced Driver Assistance Systems



# Integration of information and assistance systems

## Example for a holistic HMI approach



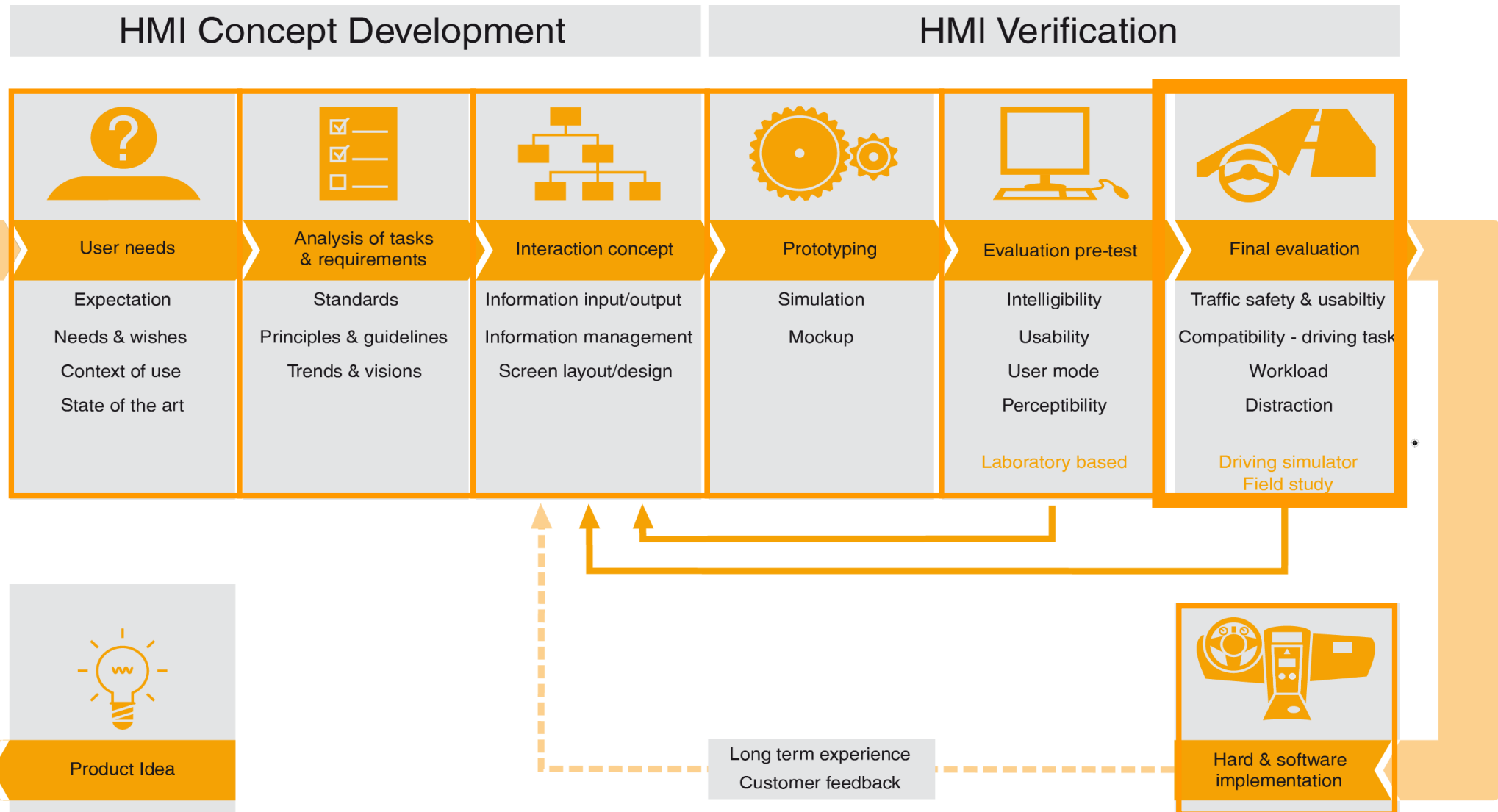
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- ▶ User centered design
- ▶ Simplify your Drive: Concept, Creation, Validation
- ▶ Simplify your Drive: Service applications, examples of a holistic approach
- ▶ Summary

# HMI development

## User centered design process





# HMI ErgoLab - Driving simulator



# Content

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# Interior's Simplify your Drive Program

## Profiles



Packaged car functions with focus on integration of vehicle domains



is a program which simplifies the driving task and the use of in-vehicle information systems

# How to reduce the HMI complexity?

*Few options to configure and operate the car –  
most tasks are handled by the car autonomously*

**Adaptivity**  
**Autonomous processes**

- 😊 Car is easy to operate
- 😊 Low workload and distraction levels
- 😞 Feeling of being patronized by the car
- 😞 Only few possibilities to personalize the car

*Many options to configure and operate the car –  
only few tasks are handled by the car*

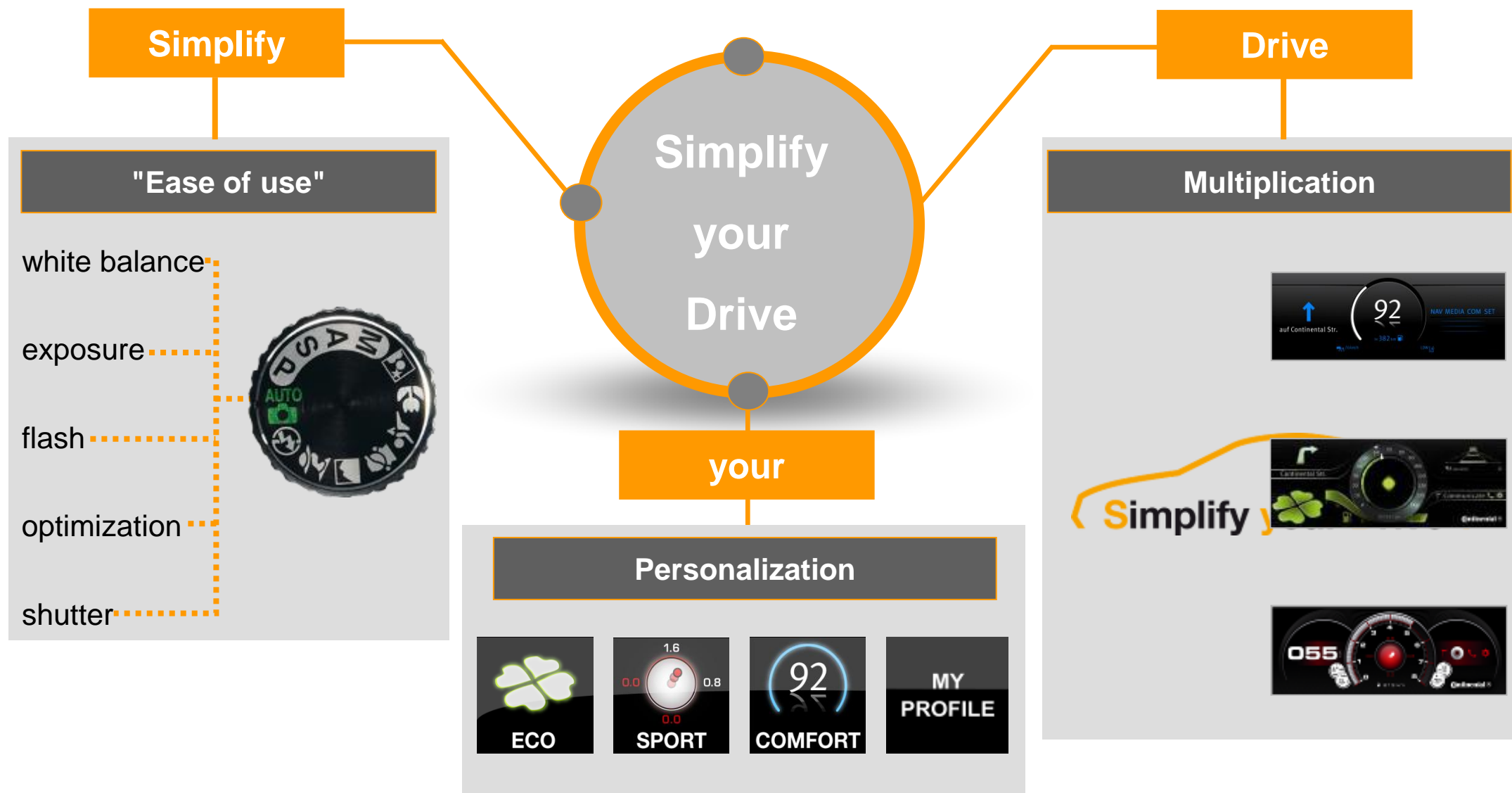
**Personalization**  
**User determined processes**

- 😊 Car can be personalized in many ways
- 😊 Details can be adjusted
- 😞 Can be very demanding and distracting
- 😞 Can be too difficult for certain user groups

***How to break  
the dilemma?***

# Mastering Complexity – Simplify your Drive

## Function bundling (profiles) and personalization



# Mastering Complexity – Simplify your Drive

## COMFORT MODE

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### Vehicle behavior

- ▶ Automatic gearbox in comfort mode (early gear shift)
- ▶ Steering and chassis adaption corresponding to comfort mode
- ▶ Active forced feedback pedal with softer response

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### UI concept

- ▶ Clearly structured
- ▶ Very basic information (keep it simple)
- ▶ Clear notification of system messages and system behavior

# Mastering Complexity – Simplify your Drive

## ECO MODE

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### Vehicle behavior

- ▶ Reduced engine power
- ▶ Automatic gearbox in eco mode (early gear shift)
- ▶ Vehicle speed limited (override will be possible)

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### UI concept

- ▶ Active forced feedback pedal behavior facilitates ecological driving
- ▶ Organic look and feel
- ▶ Magic Eye and clover leaf: Qualitative fuel consumption indicator

# Mastering Complexity – Simplify your Drive

## SPORT MODE

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### Vehicle behavior

- ▶ Engine performs full power
- ▶ Automatic gearbox in sport mode (late gear shift)
- ▶ Steering and chassis adaption corresponding to sport mode

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### UI concept

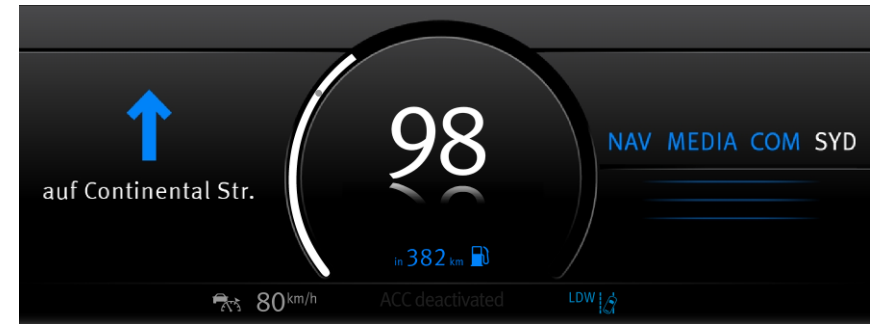
- ▶ Active forced feedback pedal with stiffer response
- ▶ G-force indicator
- ▶ Centrally positioned tachometer
- ▶ Optimal gear shift indicator



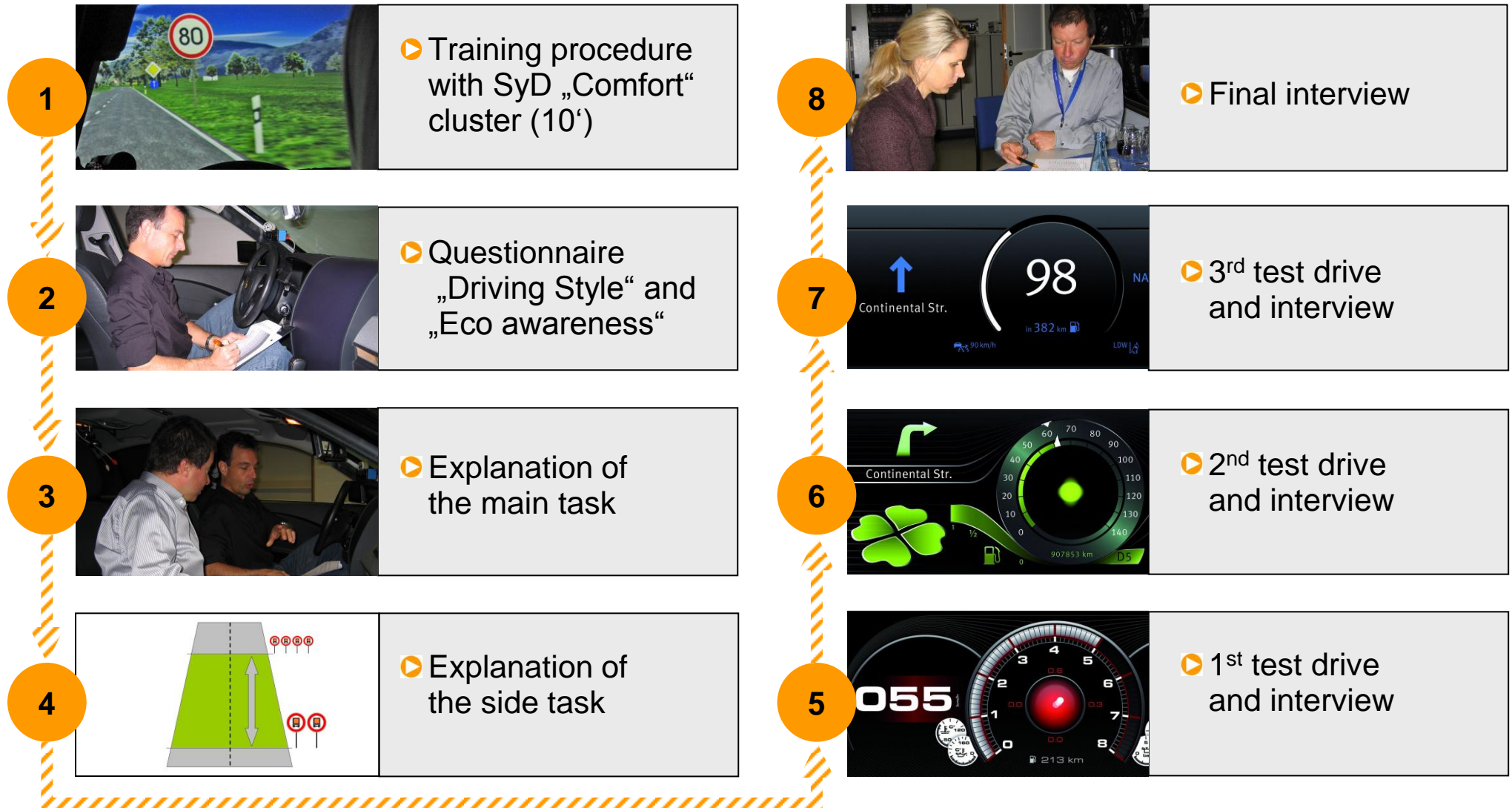
# Simplify your Drive - Validation

## Effects of the three SyD cluster instruments on driving behavior, traffic safety and subjective assessment

- ▶ Perceived workload
- ▶ Effects on the driving behavior
- ▶ Assessment of the principal idea

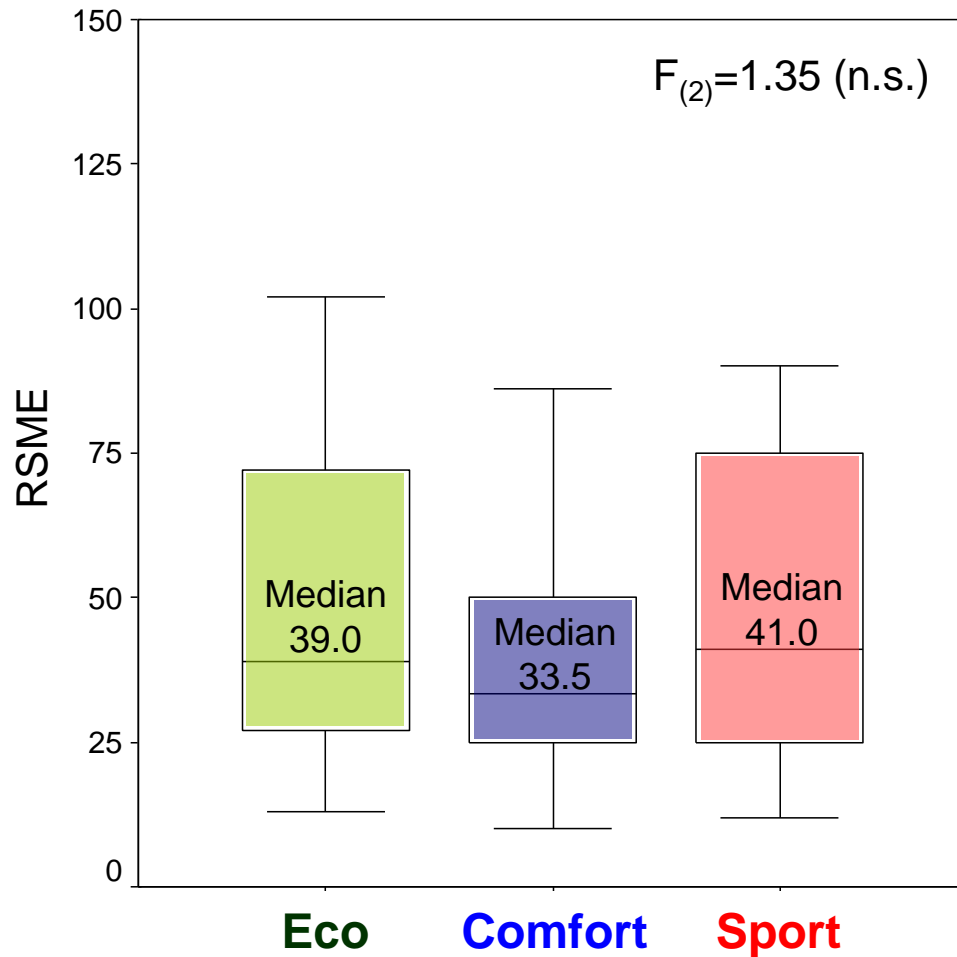


# Test procedure



# Perceived mental effort (RSME)

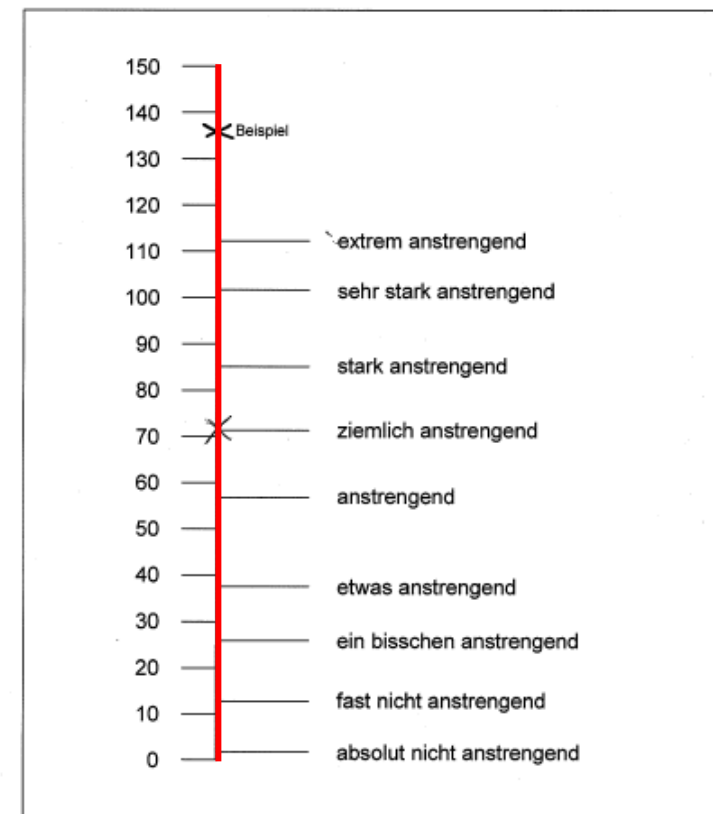
## - dependent on the three SyD cluster instruments -



► No effect between the three conditions

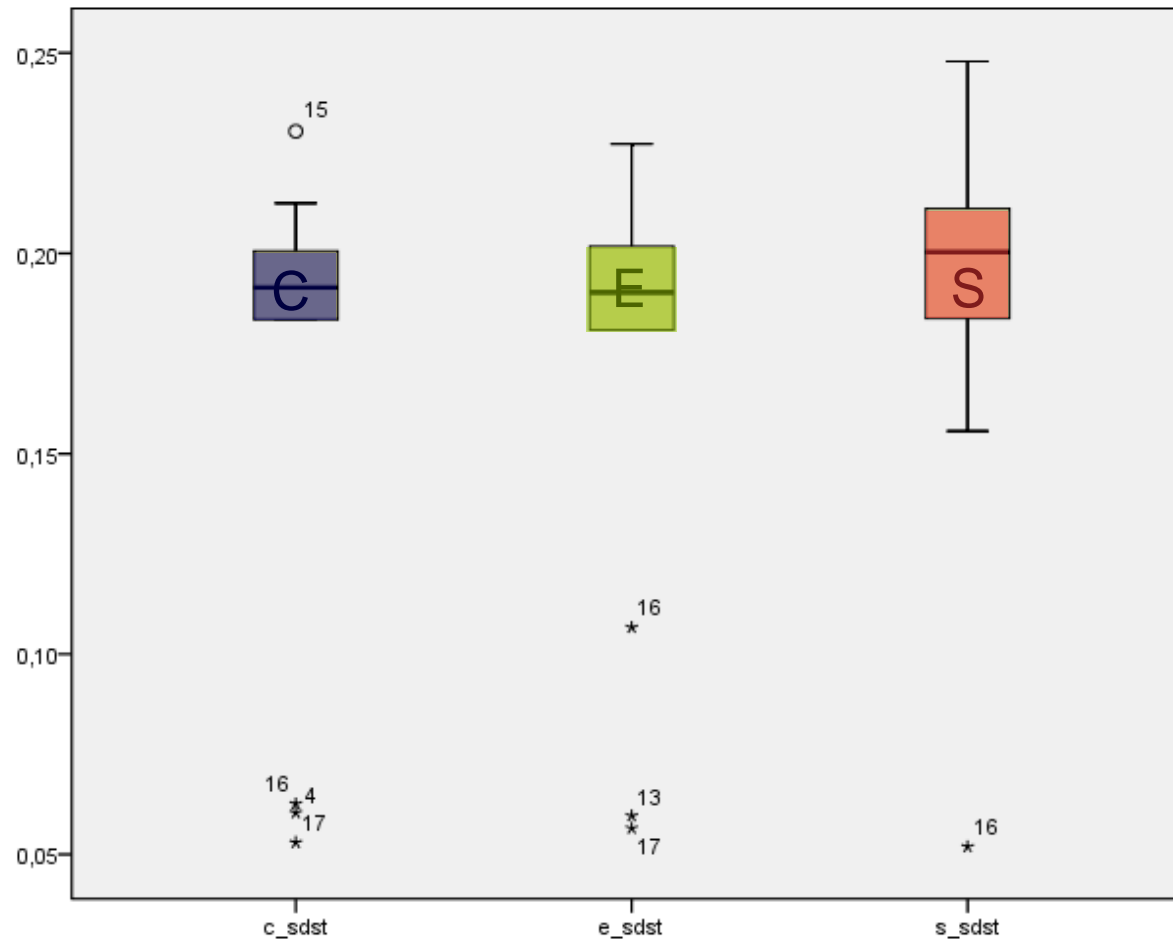
SyD - EL	04
(1) 2	

Bitte teilen Sie uns mit, für **wie anstrengend** Sie die Autofahrt mit der zuletzt getesteten Anzeige empfunden haben, indem Sie einen Wert von 0 bis 150 auf der roten Linie markieren.



# Quality of lateral control

## Standard deviation of steering angle



Mean: **0,168**  
**Comfort**

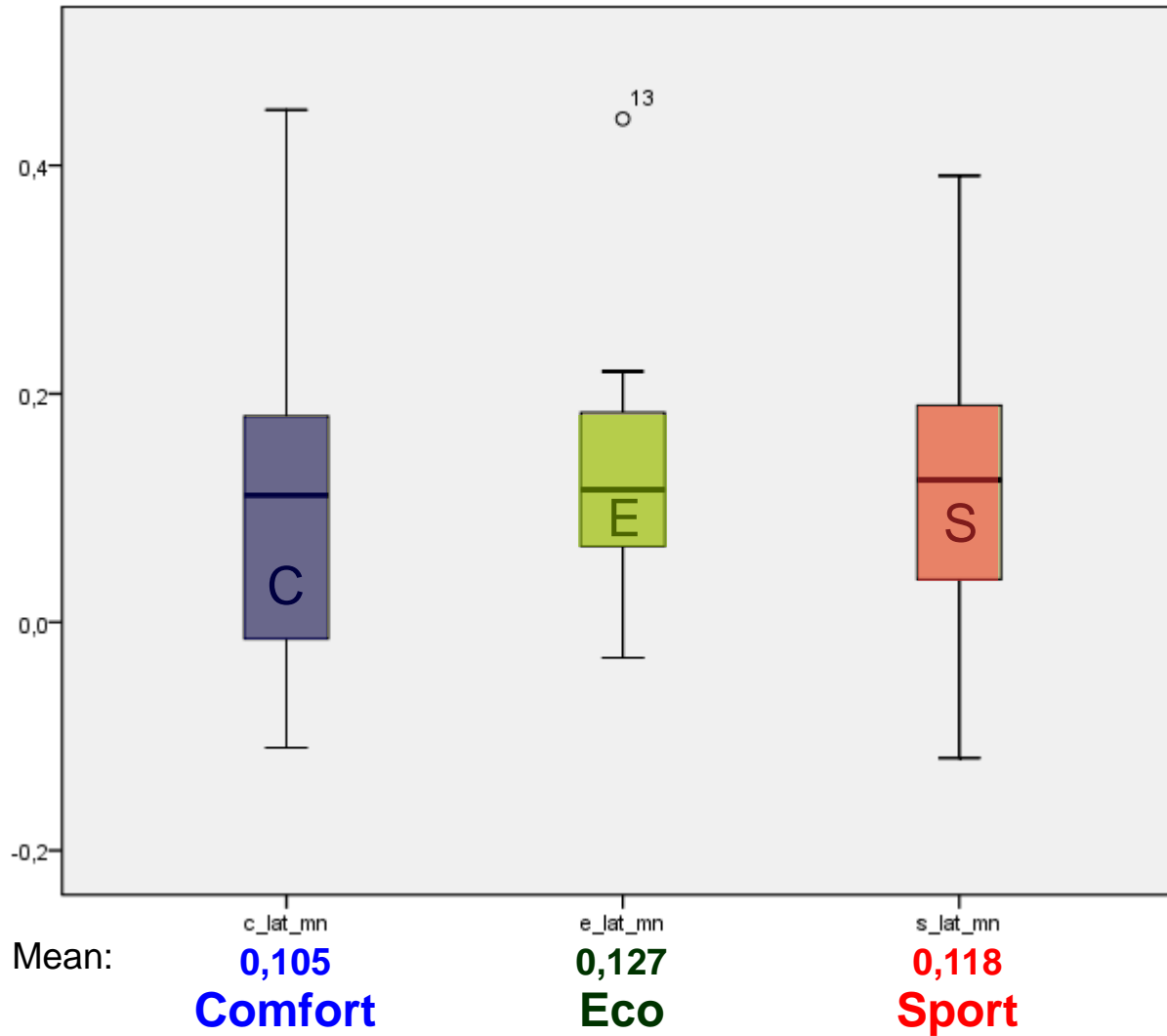
Mean: **0,170**  
**Eco**

Mean: **0,190**  
**Sport**

- ▶ No difference between the three experimental conditions

# Quality of lateral control

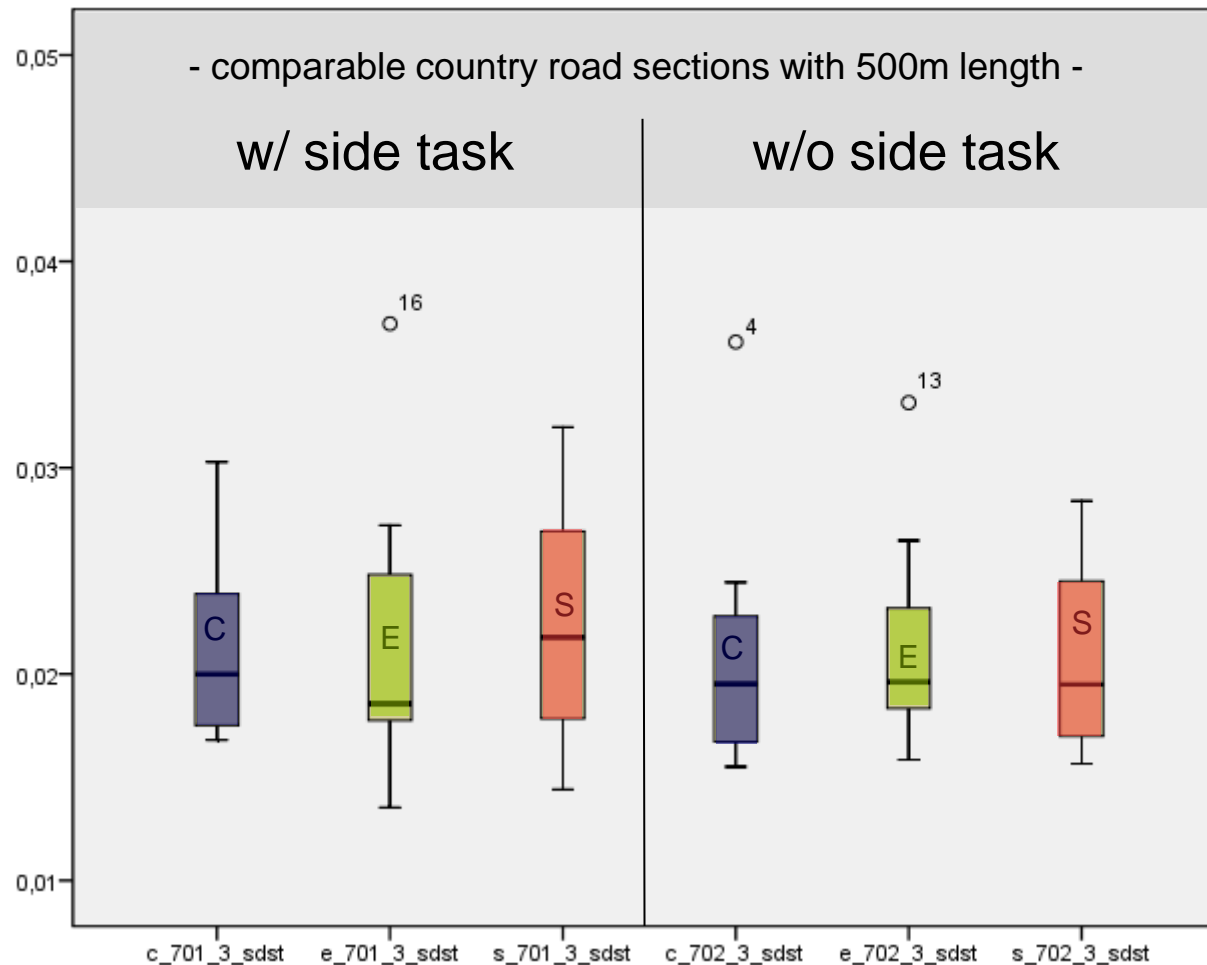
## Mean deviation from the ideal lane



▶ No difference between the three experimental conditions

# Quality of lateral control

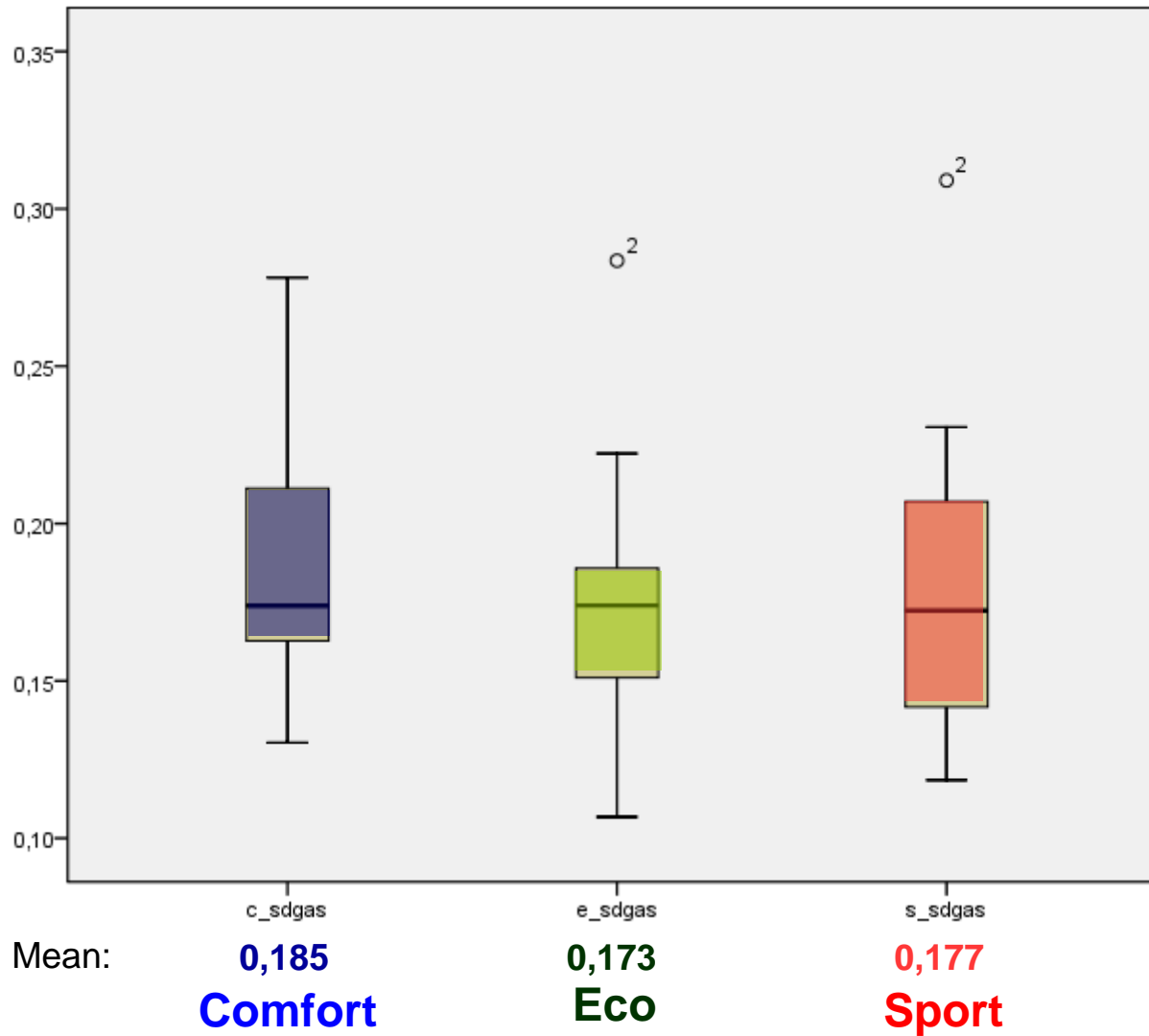
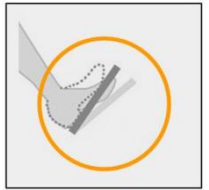
## Effect of side task „eco driving“ on SDST



- ▶ Side task instruction:
- ▶ „Please drive as efficient as possible when passing these signs.“
- ▶ The additional task does not influence the quality of lateral control in terms of SDST.
- ▶ There are no hints for a critical increase of visual distraction (caused by observing the magic eye etc.)

# Quality of longitudinal control

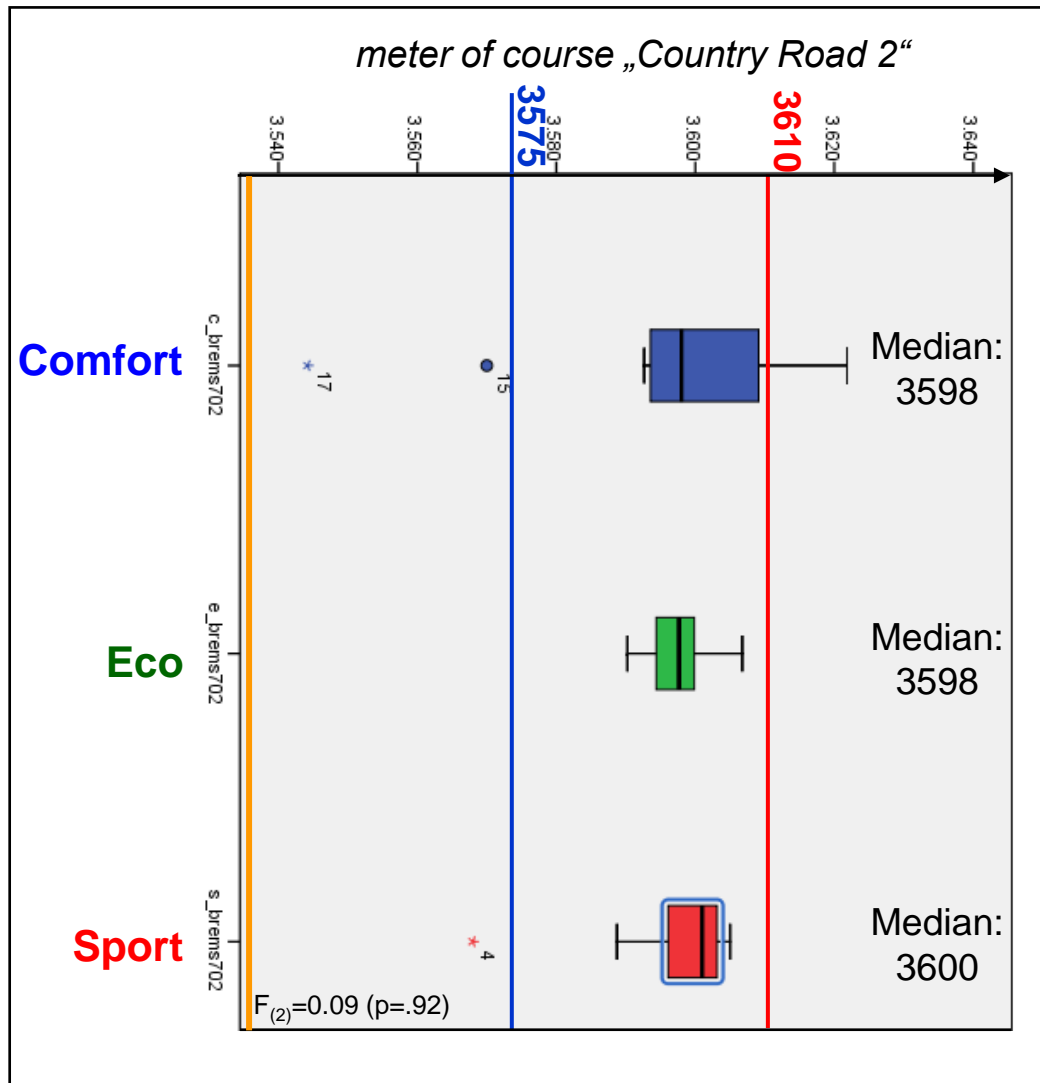
## Standard deviation of gas pedal position



▶ No difference between the three experimental conditions

# Longitudinal control

## Reaction times in an emergency situation



A vehicle moves suddenly from the shoulder to the main lane, when SimCar passes

The chart indicates the starting point of the emergency braking maneuver.

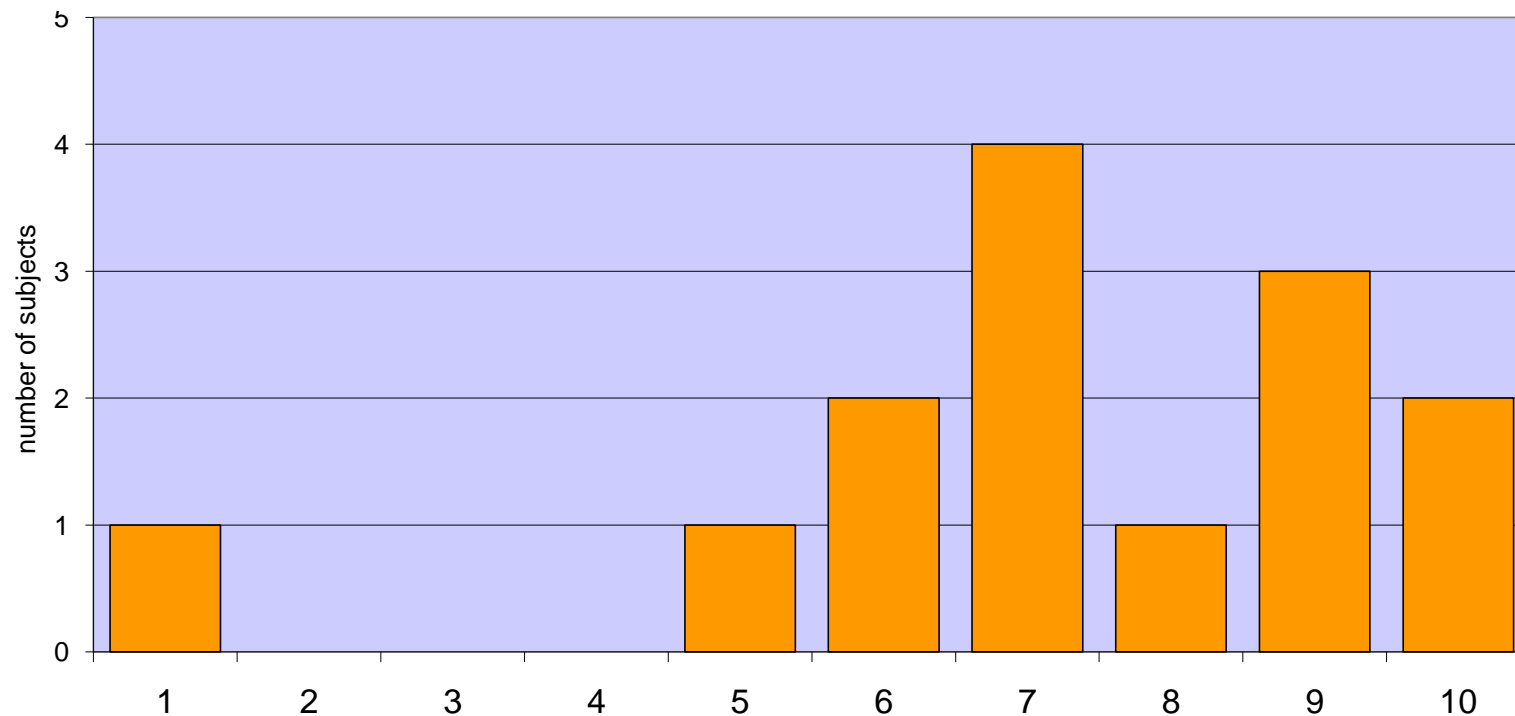
- There is no significant difference between the three experimental conditions:  $F_{(2)}=0.09$  ( $p=.92$ ).



# Assessment of the principal idea of SyD

Übrigens, Sie können – auch während der Fahrt – zwischen den drei verschiedenen Anzeigen hin- und herschalten! So können Sie beispielsweise je nach Fahrzweck, Fahrdauer etc. eine andere Anzeige-Variante auswählen. Wie beurteilen Sie diese Idee auf einer Skala von 1=überhaupt nicht nützlich bis 10 = sehr nützlich?

überhaupt nicht nützlich	○	○	○	○	○	○	○	○	○	○	sehr nützlich
	1	2	3	4	5	6	7	8	9	10	



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# Interior's Simplify your Drive Program

**AutoLinQ**



Implementation of Web services

**Profiles**



Packaged car functions with focus on integration of vehicle domains



**is a program which simplifies the driving task and the use of in-vehicle information systems**

# Internet is omnipresent




Passenger cars and internet application ?





# Simplify your Drive






# Simplify your Drive



- **Connect Me**
  - ▶ Email reading and answer
  - ▶ Personal address book
  - ▶ News reading
- **Guide Me**
  - ▶ POI search
  - ▶ Seamless navigation
  - ▶ Traffic
- **Entertain Me**
  - ▶ Musicload Button
  - ▶ Soccer World Cup reminder
  - ▶ Stop & go infotainment
- **Drive Me**
  - ▶ Logbook 2.0
  - ▶ Hidden vehicle data



# Stop & Go entertainment– the NEWS APP



↑  
Continental Str.

90 km/h

LDW

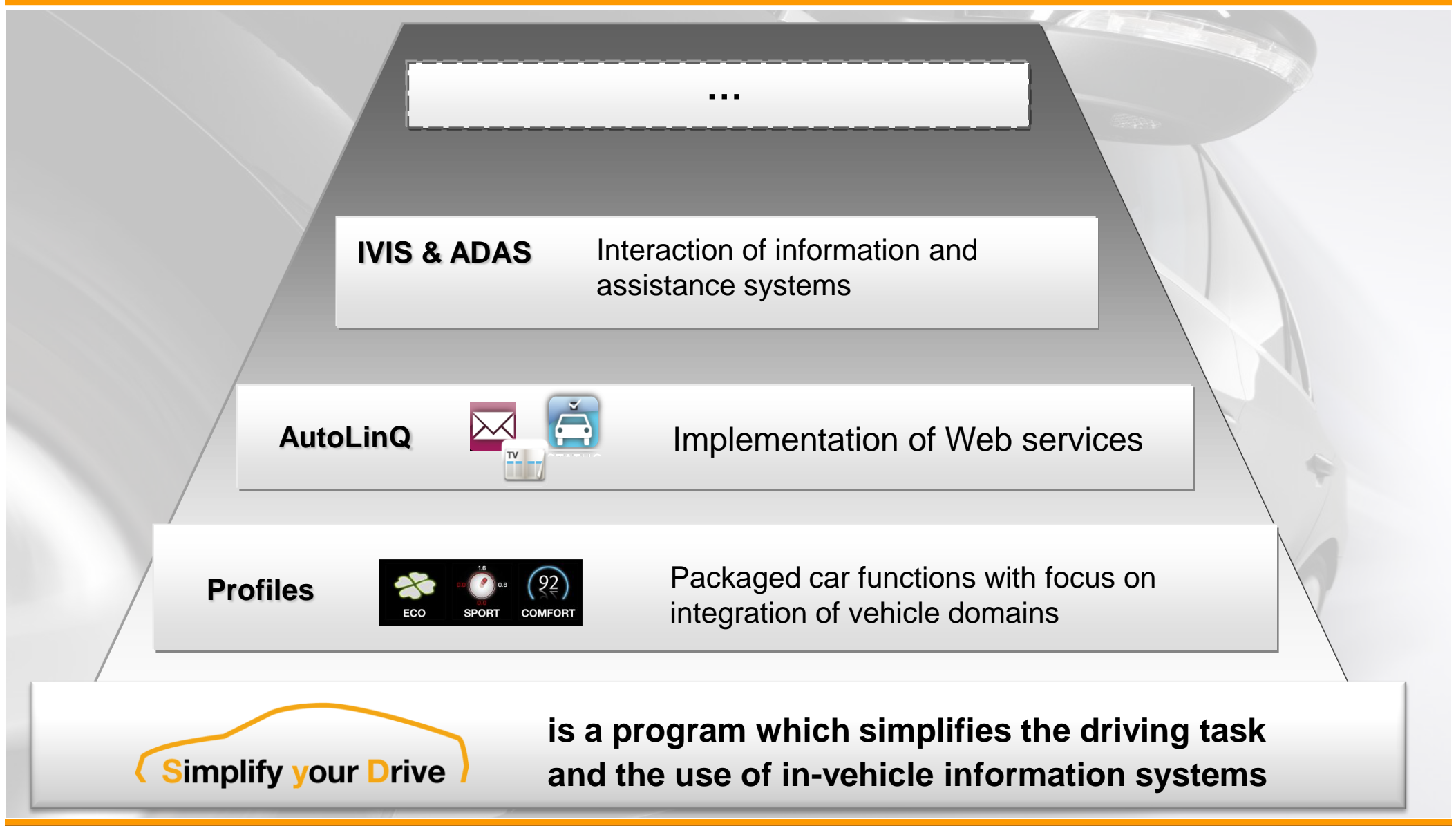
## Online Hörbücher boomen

420.000 Downloads im 1. Halbjahr

Immer mehr Deutsche laden Hörbücher aus dem Internet herunter.

Der Umsatz sei um 25 Prozent gestiegen. Der Durchschnittspreis für ein Hörbuch im Internet sei inzwischen unter zehn Euro gesunken und liege bei 9,53 Euro.

# Interior's Simplify your Drive Program

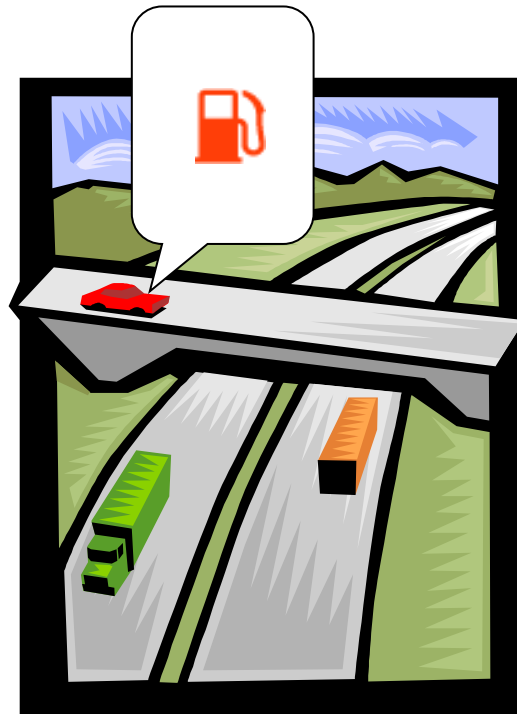




# Simplify your Drive – Support according to user expectation

## Gasoline station assist

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# Simplify your Drive – Support according to user expectation

## Gasoline station assist

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# Navigating to gas station

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# Guidance to gas station



# Approaching gas station



# Stop at gas station



# Driving preparation

## Interactive tutorials

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"Your rental car features an adaptive cruise control.

Would you like to learn more about it?  
The tutorial is available in standstill only."



"YES"



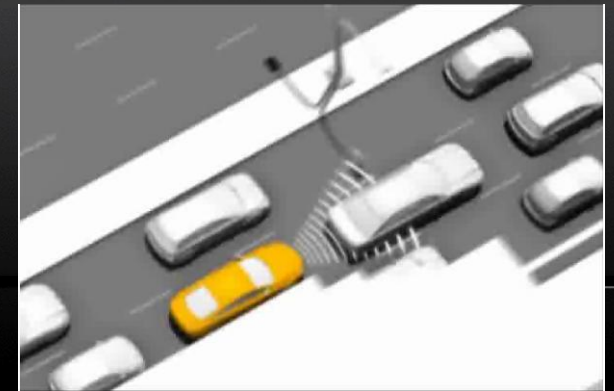
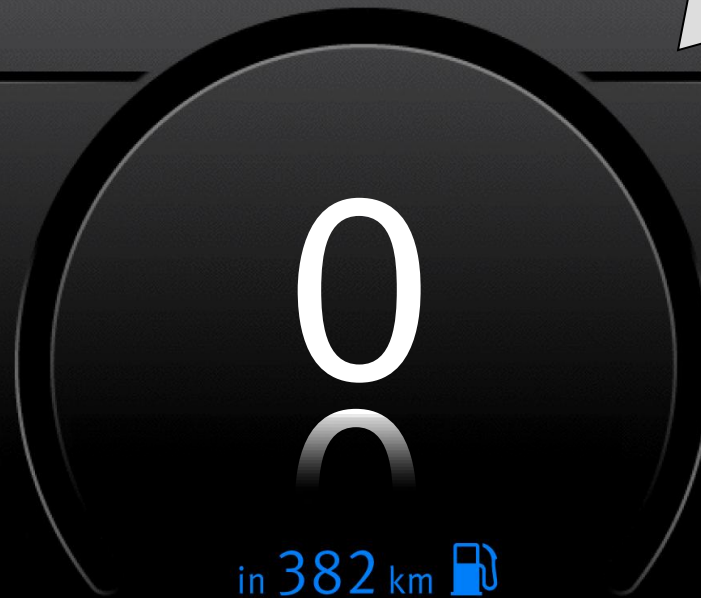
# Driving preparation

## Interactive tutorials

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"Adaptive Cruise Control (ACC) combines an automatic speed and distance control.

For instance very helpful under congested traffic conditions."



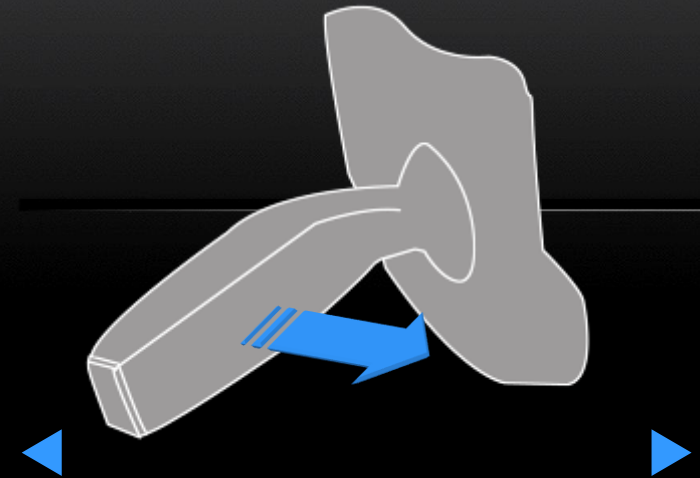


# Driving preparation

## Interactive tutorials

"Activate ACC by pulling the lower left stalk to you till it clicks into place."

How to activate ACC



# Normal driving

## Dynamic activation of Advanced Driver

"For several minutes your speed has been more or less 90 km/h.  
Would you like to activate ACC which holds your speed automatically ?"

↑  
Continental Str.

90 km/h

in 382 km

NA  Activate ACC SET



"YES"

# Normal driving

## Dynamic activation of Advanced Drive

"Your speed exceeds the limit by 42 km/h. Get ready to pay 160 Euros! In exchange, you will get 3 penalty points and be banned from driving for 1 month. Deal?"

↑  
Continental Str.



160 €   
3 penalty points   
1 month 

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# Summary

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## Challenges

- ▶ Massive demands for seamless communication

## Holistic HMI

- ▶ Modeling of driving tasks, conditions, user traits, demands
- ▶ Seamless Interaction of IVIS & ADAS

## User centered design

- ▶ Modeling of global user understanding. Addressing needs

## Simplify your Drive

- ▶ Program in order to simplify driving task
- ▶ Concept creation and evaluation
- ▶ Outlook



## **Guido Meier-Arendt**

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**Thank you for your attention !**