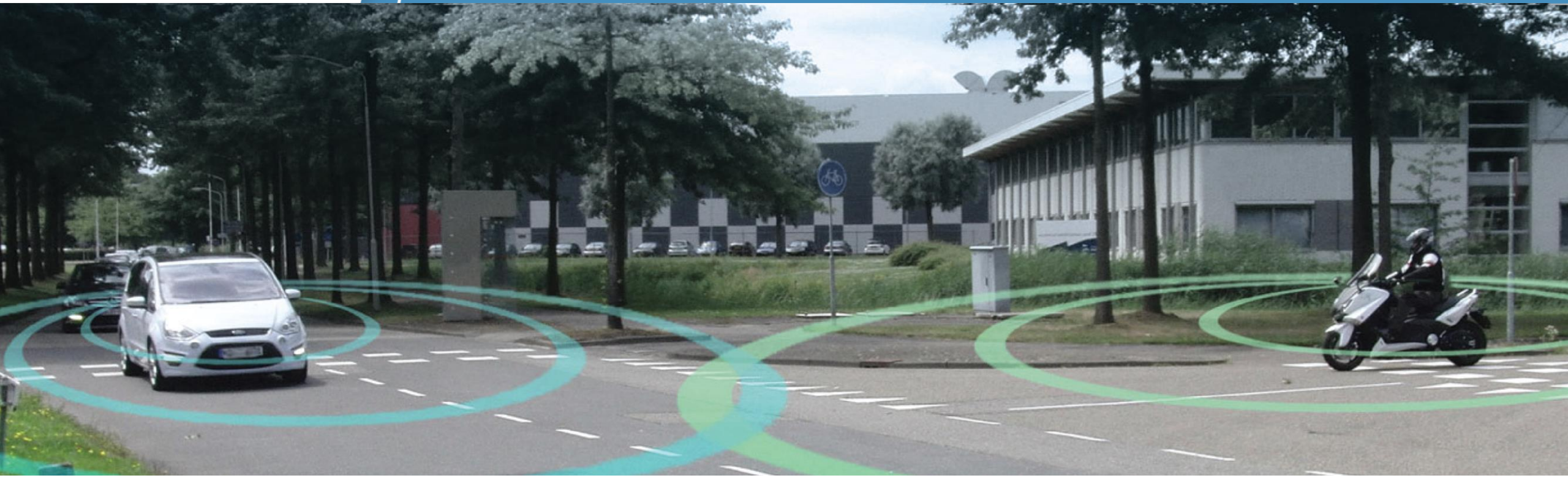
# Rider Reaction Times – Overview



Dr. Sebastian Will, WIVW
Dr. Raphael Pleß, WIVW

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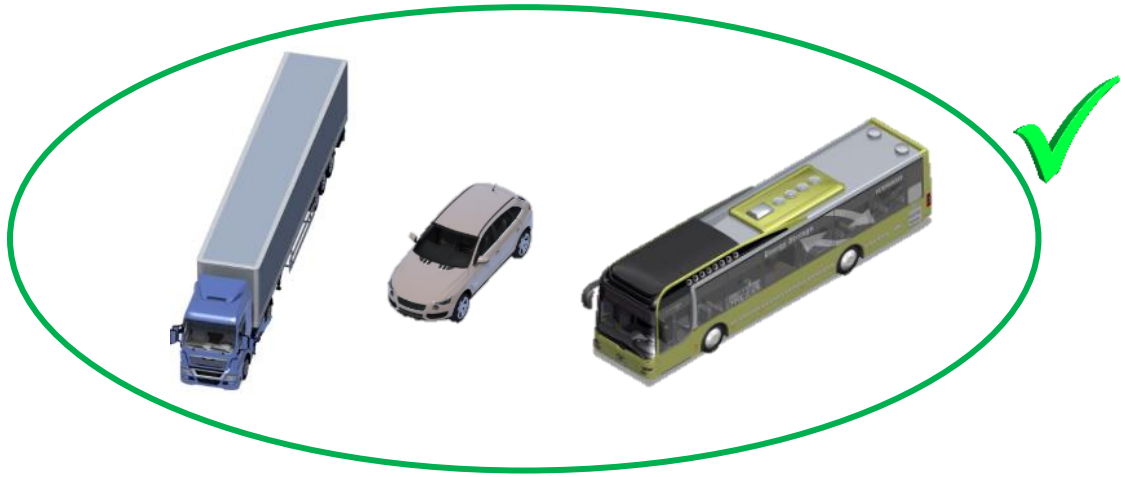
What takes…

# 0.005 SECONDS…?

# BACKGROUND & MOTIVATION

# Background & Motivation

- Any safety applications that run in the PTW need an **interface** to communicate information to the rider (e.g., warning), because the rider needs to initiate the necessary avoidance maneuver, e.g., braking.
- If the communication from PTW to rider fails, the safety benefit of an application as well as the acceptance drops.
- Consequently, CMC decided to investigate PTW-specific notification concepts with the following **research question**: What are motorcyclists' reactions towards different types of advisory notifications/ warnings?



# Background

## The “typical” reaction

PTW rider reaction times measured on different motorcycles in public traffic will vary significantly due to a series of factors. Furthermore, the focus was on reactions towards advisory notifications instead of imminent crash warnings.

# METHODS

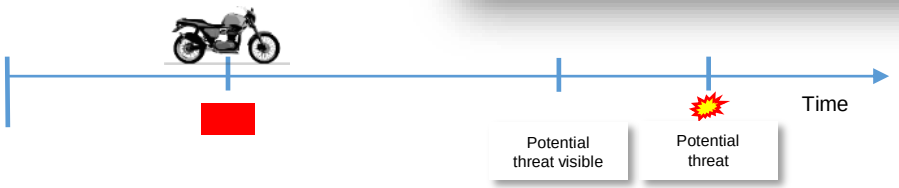
# Methods

## DESMORI Motorcycle simulator

### Specifications

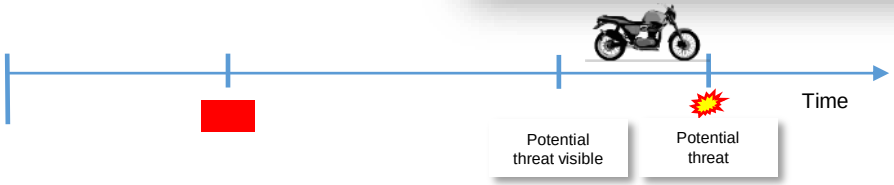
- Mock-up: BMW F800S with fully functional controls
- 220° field-of-view
- 7“ TFT-screens as mirrors
- 10“ touchscreen as dashboard
- 6-dof motion system
- 80 Nm force feedback steering torque
- Sound via helmet-mounted body shakers
- G-Vest rope-towing mechanism

# Methods




Screenshot from rural scenario warning period.

# Methods




Screenshot from rural scenario situation.

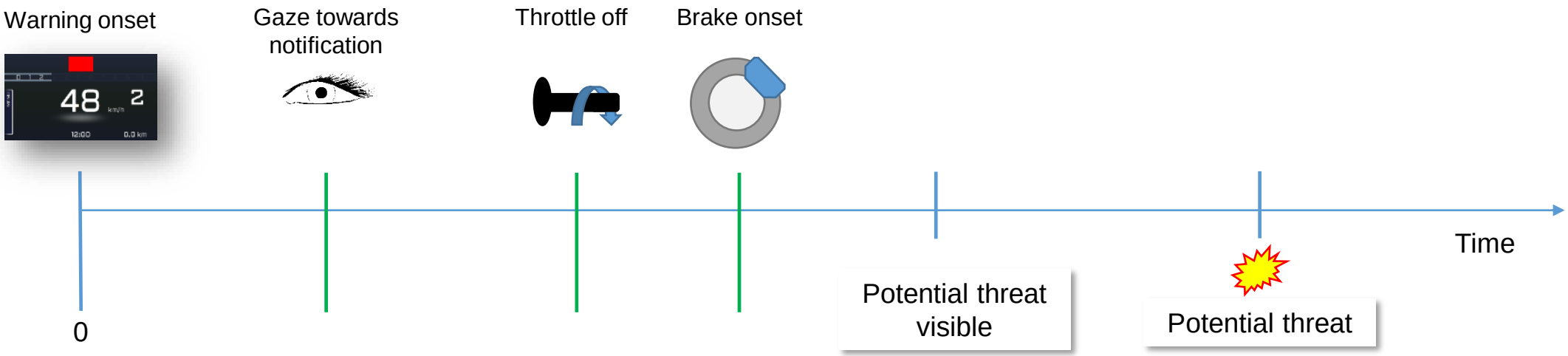
# Methods

Screenshot from urban scenario.

# Methods

## Types of reactions

*Please note:* Not every type of reaction is measurable for every rider in every scenario (e.g., if someone was not braking). The analysed period ends when the rider has passed the critical situation if not stated otherwise.

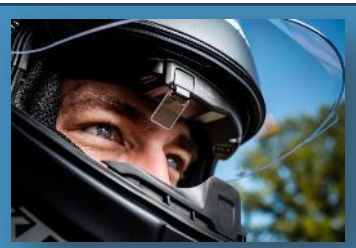



Schematic representation of different possibilities to calculate reaction times.

# Methods

## Rider notification concepts

**Visual**

**Auditory**

Trigger: TTA = 3.0 sec before the obstacle becomes visible

**Haptic**

CMC Supporters for this study:

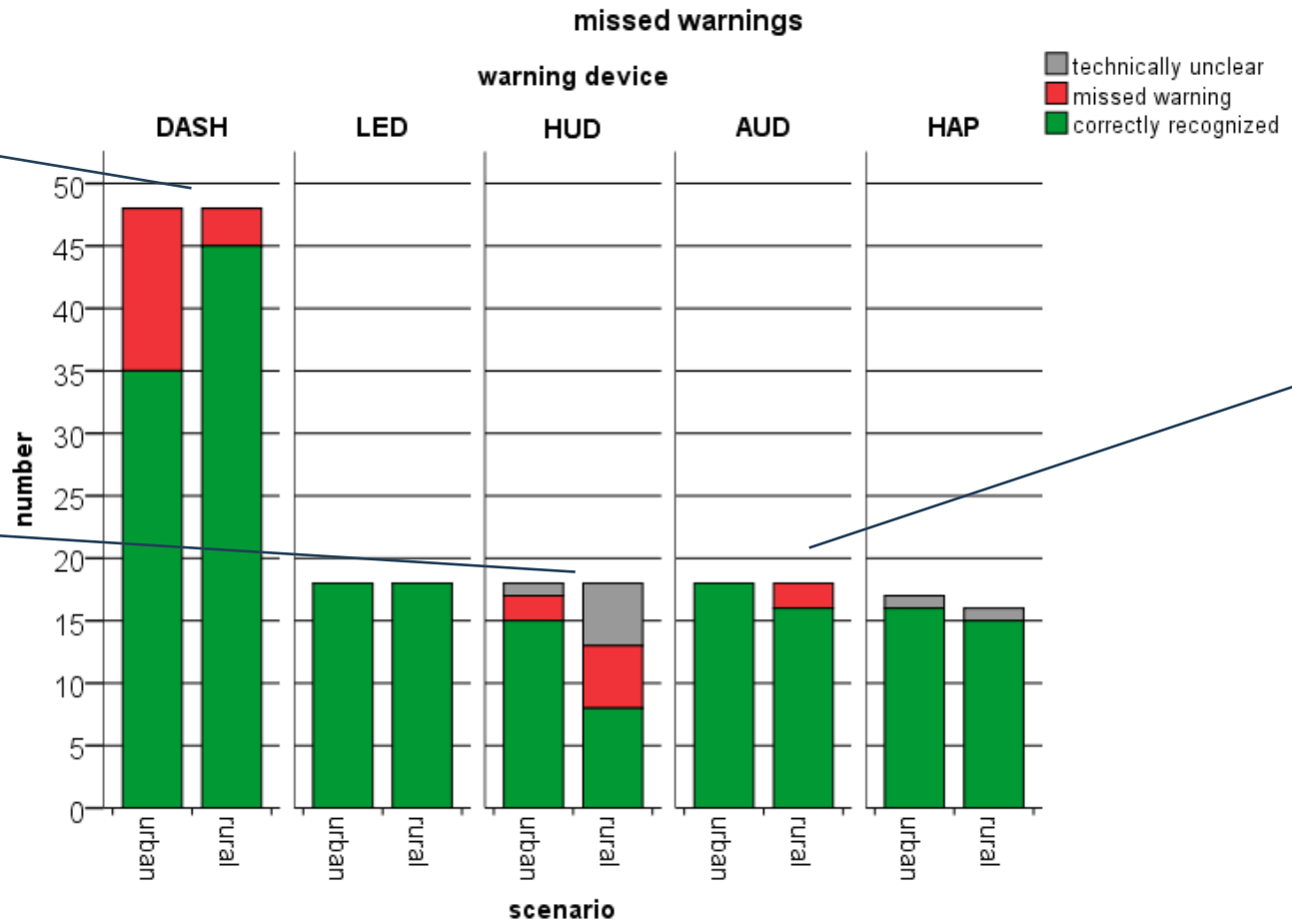
MOTOBIT TILSBERK

# RESULTS

# Results

*Not salient enough to capture the riders' attention.*

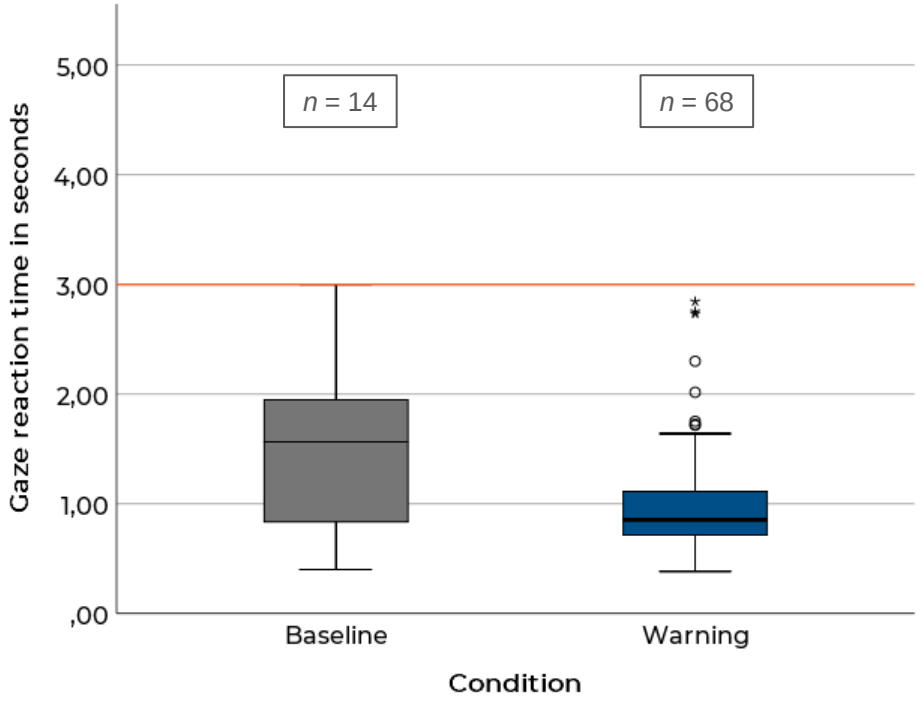
*Visually controlling the environment (behaviour of other traffic participants at crossings, trajectory planning on rural roads), led to a decreased focus on the HUD screen content.*




*Would have preferred a louder auditory warning.*

# Results

## Gaze reaction dashboard warning

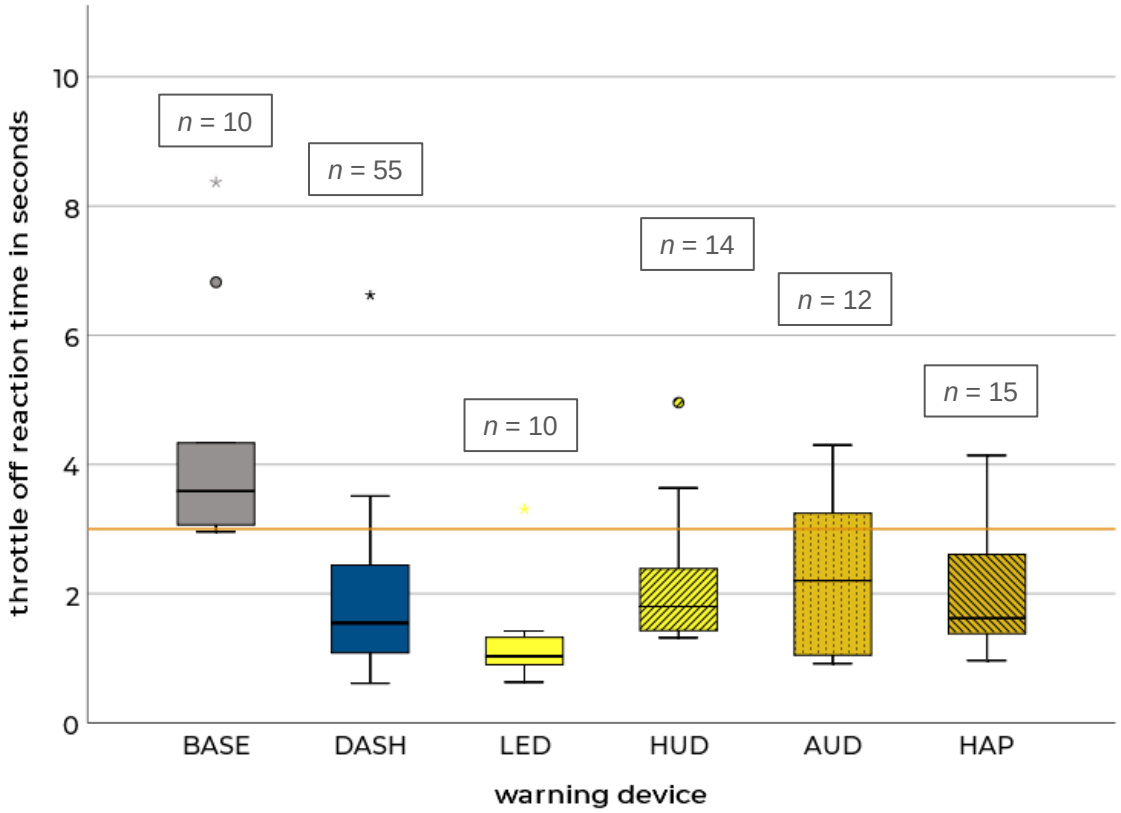



- Regular control gazes towards the dashboard appear in the baseline condition without warning as well. Yet, with a warning riders look faster towards the dashboard.
- Furthermore, the major difference is the frequency of gazes towards the dashboard, which is significantly increased in the warning condition.

- the orange line indicates the point in time when the obstacle becomes visible and the warning disappears

# Results

## Throttle off reaction

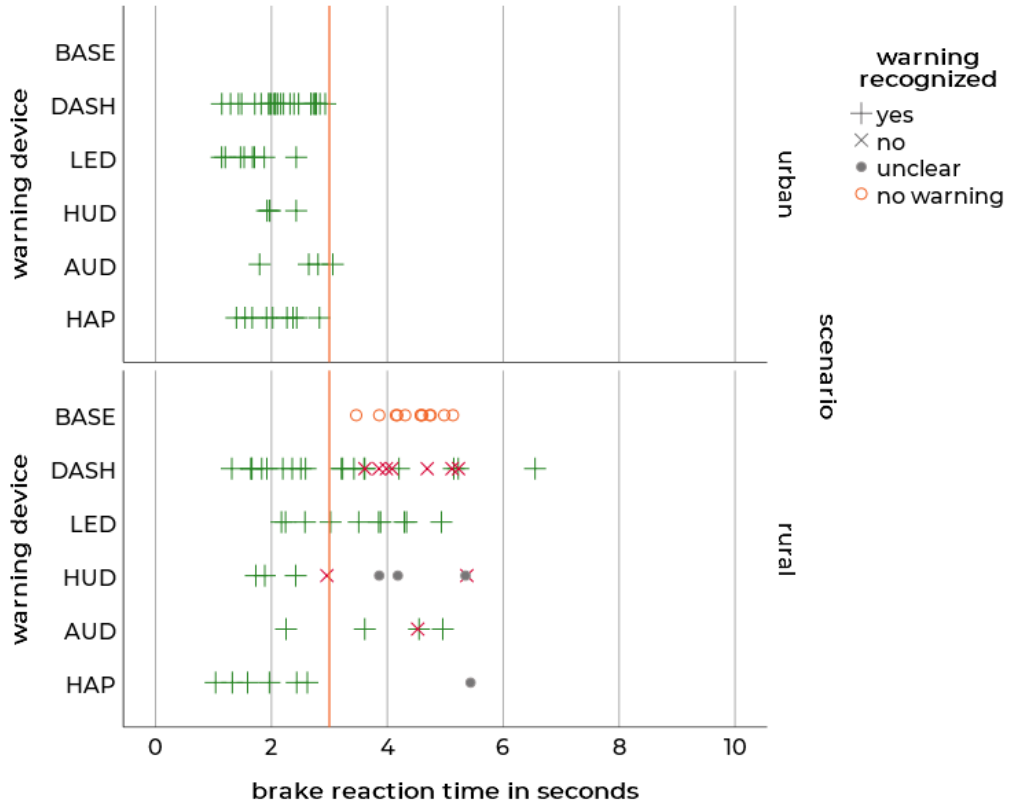



- On average, all warnings provoke earlier throttle off reactions than those observed in the baseline (before potential threat is seen).
- Tendentially, the LED reactions are faster on average and more homogenous.

- the orange line indicates the point in time when the obstacle becomes visible and the warning disappears

# Results

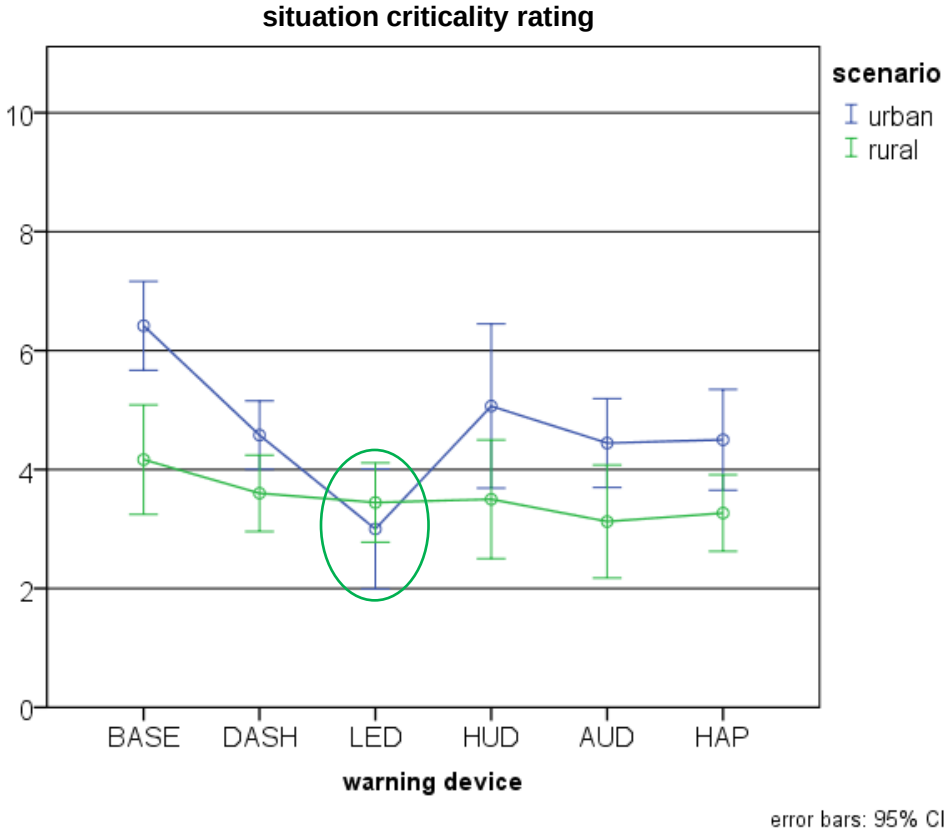
## Brake reaction




- The brake reactions in the urban setting are observed before the potential threat can be seen.
- In the rural scenario, riders wait longer with the braking on average.

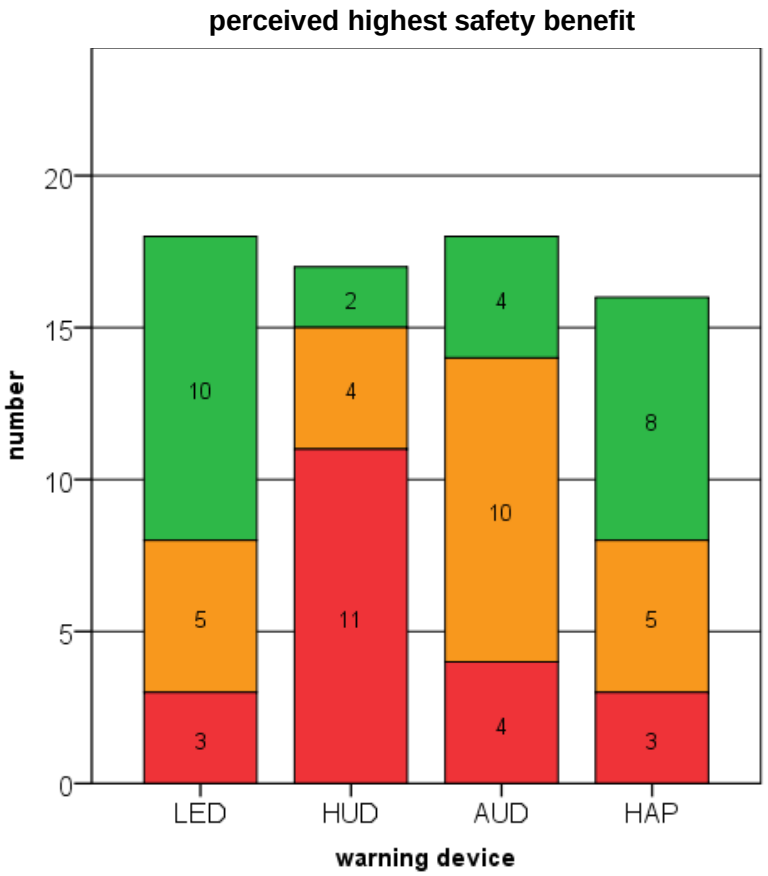
the orange line indicates the point in time when the obstacle becomes visible and the warning disappears

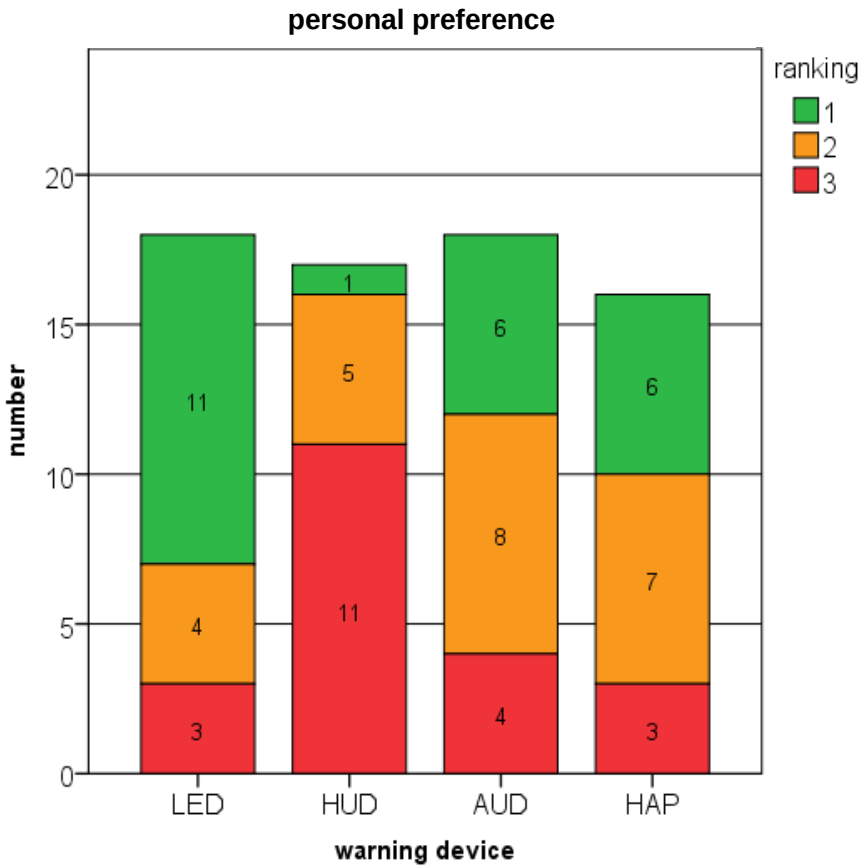
# Results




- On average, the scenarios created unpleasant to dangerous situations as intended (baseline). The riders could recognize the given warnings as a useful assistance justifying the warnings (so-called true-positives).
- The urban crossing scenario is perceived as more critical than the rural broken-down vehicle scenario, when no warning is given.
- The different warning devices decrease the perceived situation criticality to a harmless or maximum unpleasant level on average.
- The LED creates the least critical situations.
- The effect is more dominant in the more critical urban scenarios.

# Results




- Individual preferences: all warning devices receive rankings from best to worst.
- The PTW-fixed LED is seen as most safe and most accepted at a time.

# CONCLUSION

# Conclusion

## General

- **Participant studies on the motorcycle riding simulator** created empirical evidence for the comparison of future notification concepts in a safe and controlled environment.
- The number of missed warnings and reaction time distributions compared to passenger car research suggest the need for **PTW-specific rider reaction analysis**.
- The distributions of rider reaction times can serve as important input to the tuning of **rider reaction time models**, which are e.g., required to create effectiveness estimations by means of traffic simulation.

# Conclusion

## Rider notification concepts

- The **dashboard notification** as stand-alone warning creates too much missed warnings.
- **All other warning devices** are generally useful to reduce the situation criticality by means of an increased situation awareness (attention towards the road and potentially critical upcoming situations). Throttle off and braking are less often necessary or can be initiated later and smoother.
- Yet, the **mirror-mounted LEDs** received the highest acceptance for reasons of comfort (e.g., “cannot be forgotten”, “fear of battery running low”) and perceived safety (e.g., “no stable connection to external device necessary”), while the reaction times of those riders that decided to decelerate (throttle off & braking) were fast.

Connected Motorcycle Consortium

# Thanks to all CMC members contributing to these studies

BMW MOTORRAD

HONDA

DUCATI

HARLEY-DAVIDSON

TRIUMPH

SUZUKI

nfiniity

VUFO GmbH

CERTH CENTRE FOR RESEARCH & TECHNOLOGY HELLAS

wivw

Technische Hochschule Ingolstadt

ika | RWTH AACHEN UNIVERSITY

ifz Institut für Zweiradsicherheit e.V.

FIM FÉDÉRATION INTERNATIONALE DE MOTOCYCLISME

acem The Motorcycle Industry In Europe

www.cmc-info.net

contact@cmc-info.net

KTM

YAMAHA

bertrandt