Driver Warning HMI

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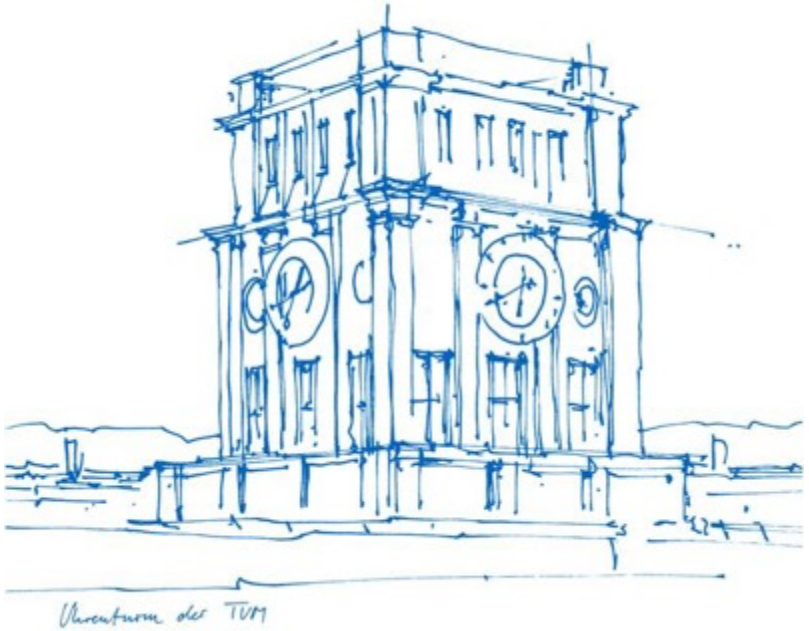
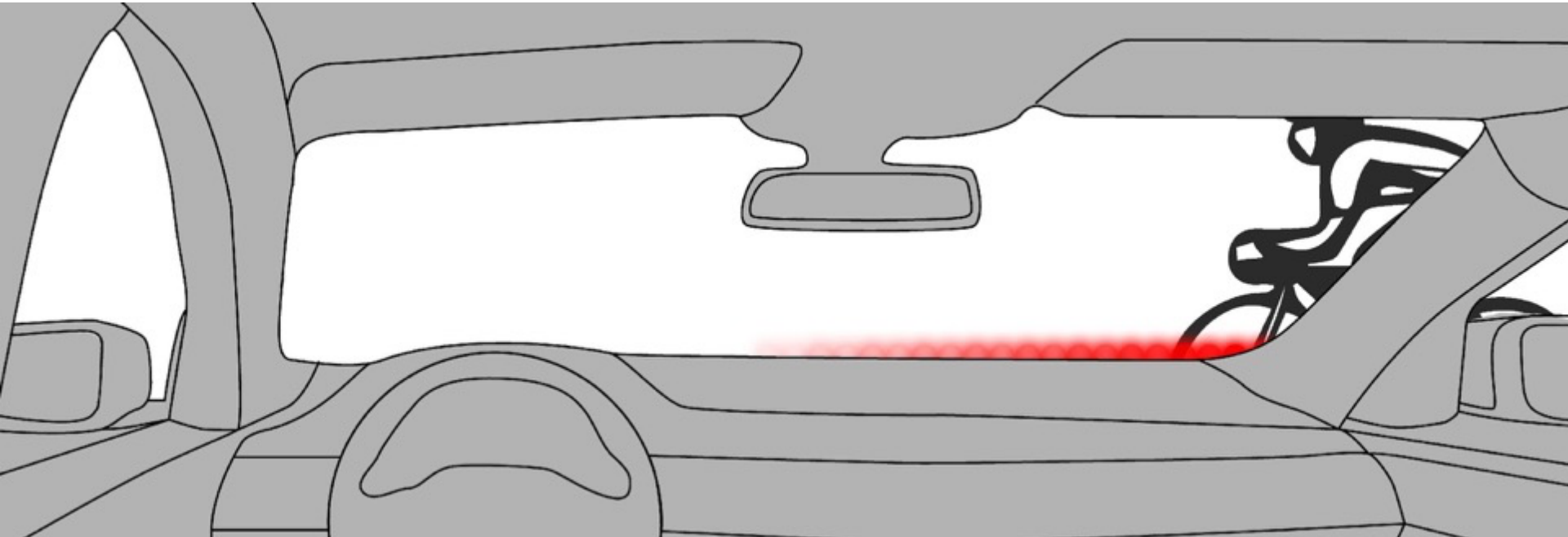


Development of an HMI for Multimodal Proactive Driver Warning to Protect Vulnerable Road Users (VRUs)



Student Team – Human Factors Engineering (M.Sc.)

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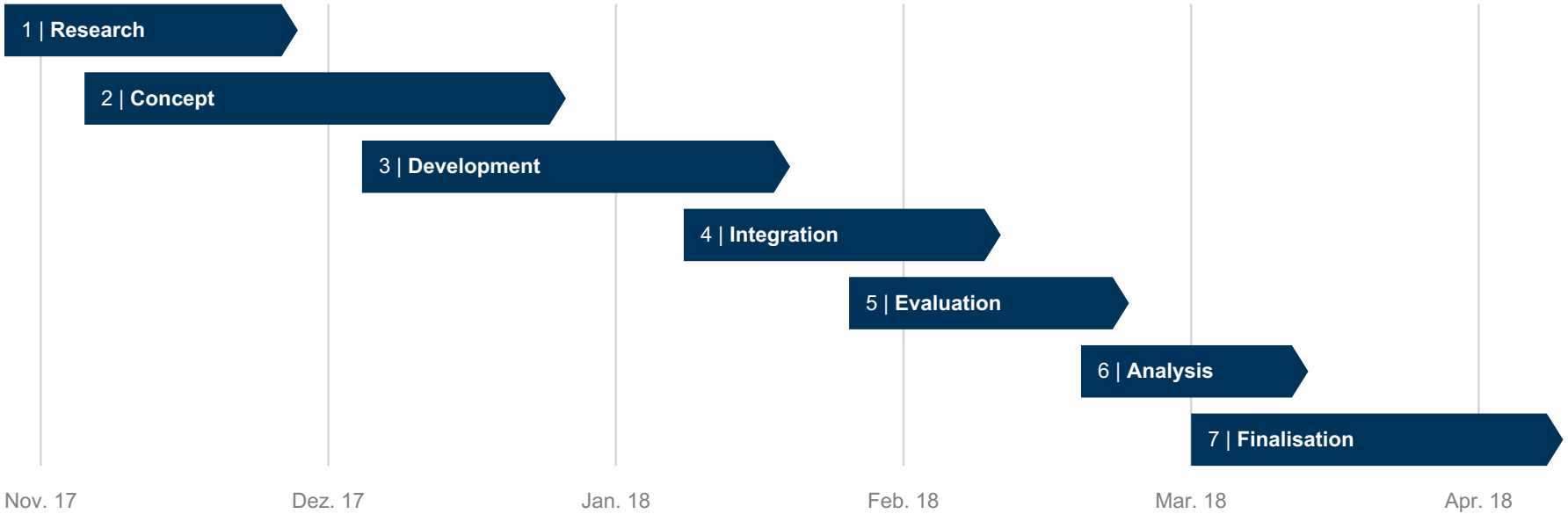
B.Sc. Business Psychology

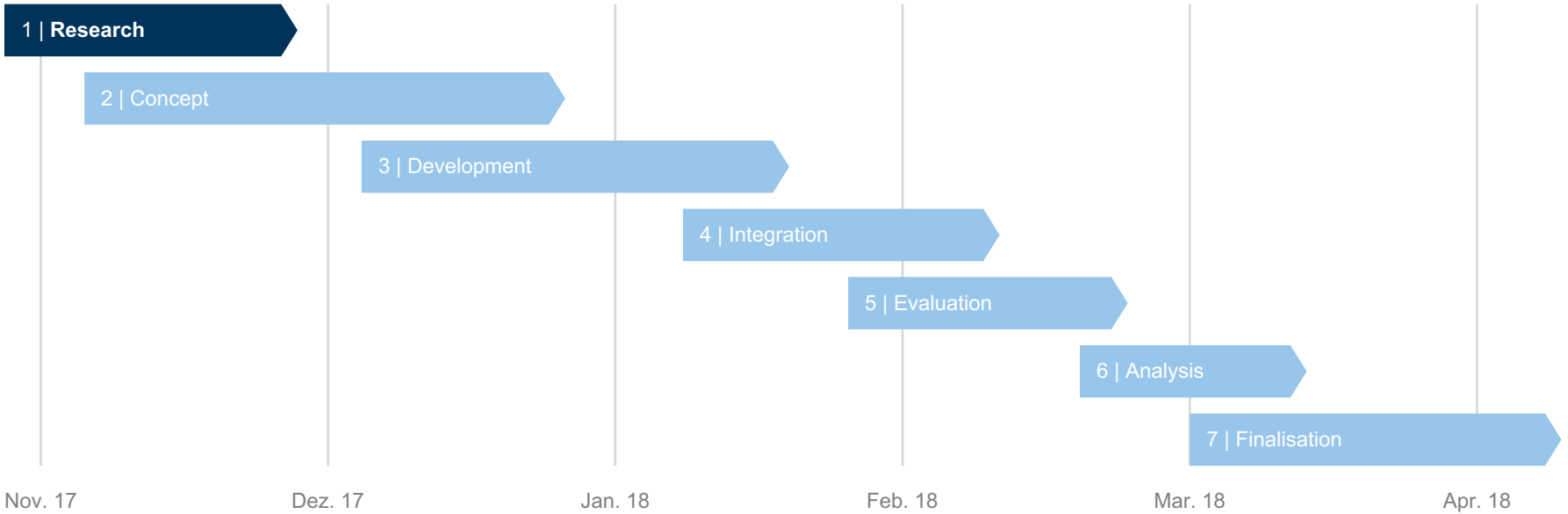
Lukas Flohr
B.A. Media Design

Dominik Janetzko
B.Sc. Psychology

Project Phases



1 | Research


1 | Research
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6 | Analysis
7 | Finalisation
Nov. 17
Dez. 17
Jan. 18
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Research

ADVANCING ACTIVE SAFETY TOWARDS THE PROTECTION OF VULNERABLE ROAD USERS: THE PROSPECT PROJECT

Context-based Pedestrian Path Prediction

Driver and Pedestrian Awareness-based Collision Risk Analysis

Perfect Timing: Urgency, Not Driving Situations, Influence the Best Timing to Activate Warnings

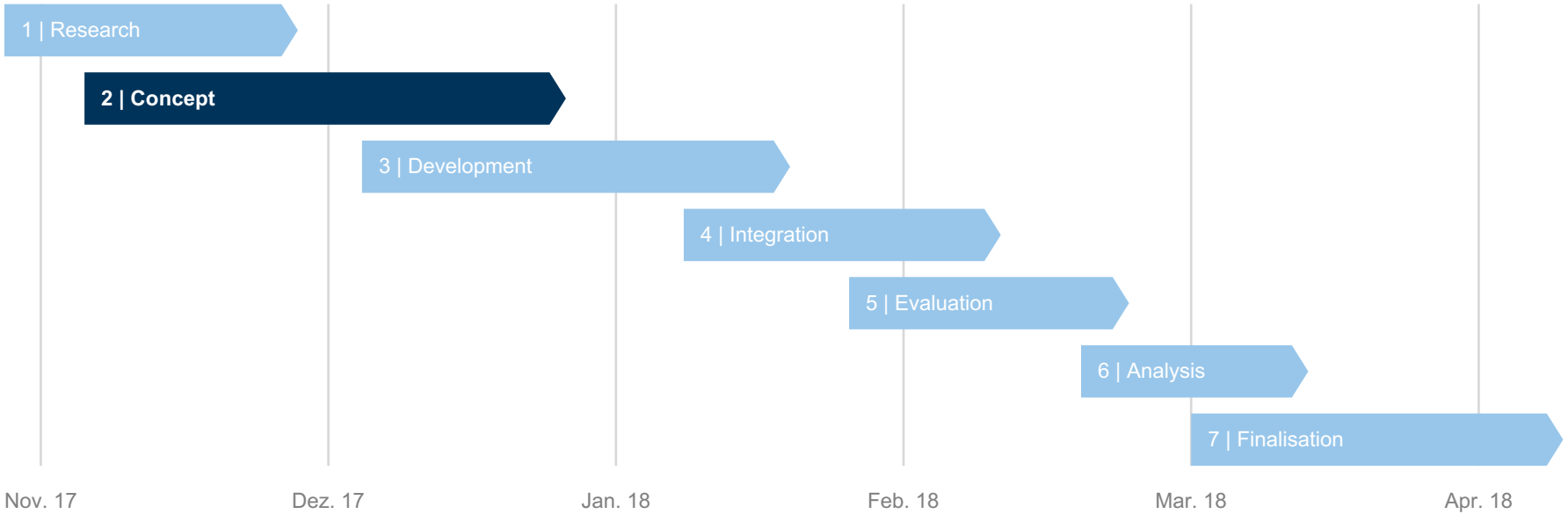
UR:BAN Human Factors in Traffic

Gestaltung zeit- und sicherheitskritischer Warnungen im Fahrzeug

Automobil-ergonomie

How to present collision warnings at intersections?—A comparison of different approaches

2 | Concept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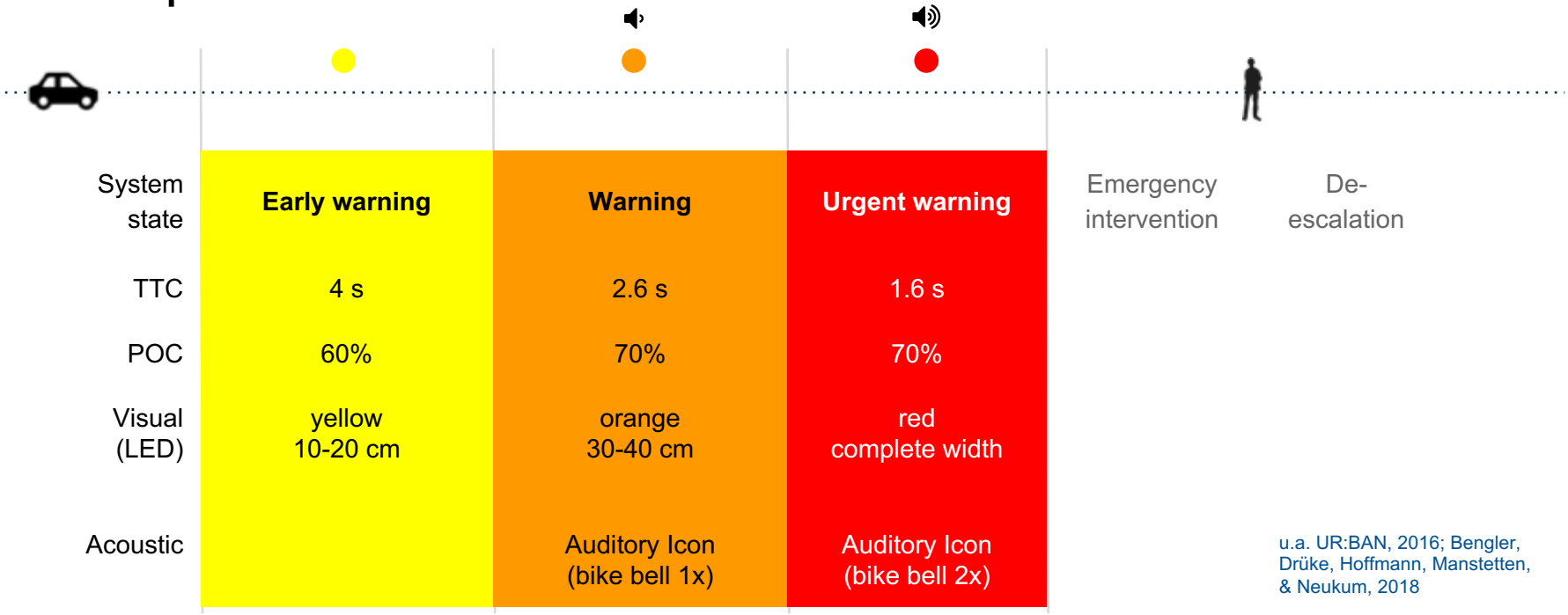
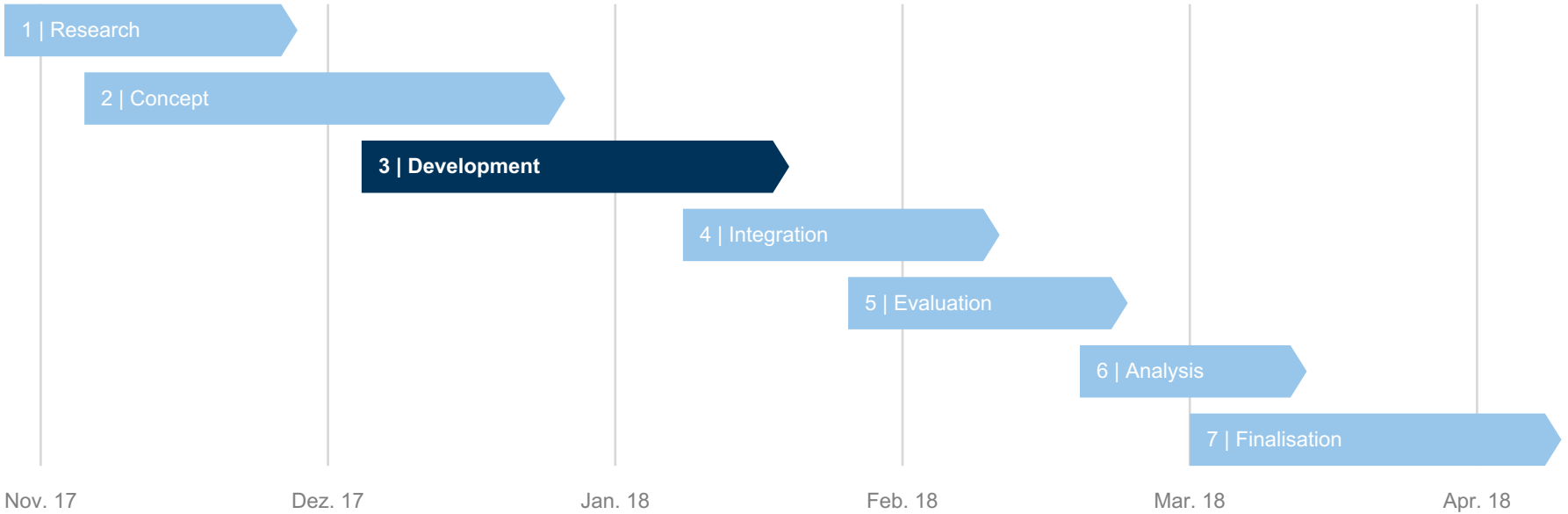
Concept

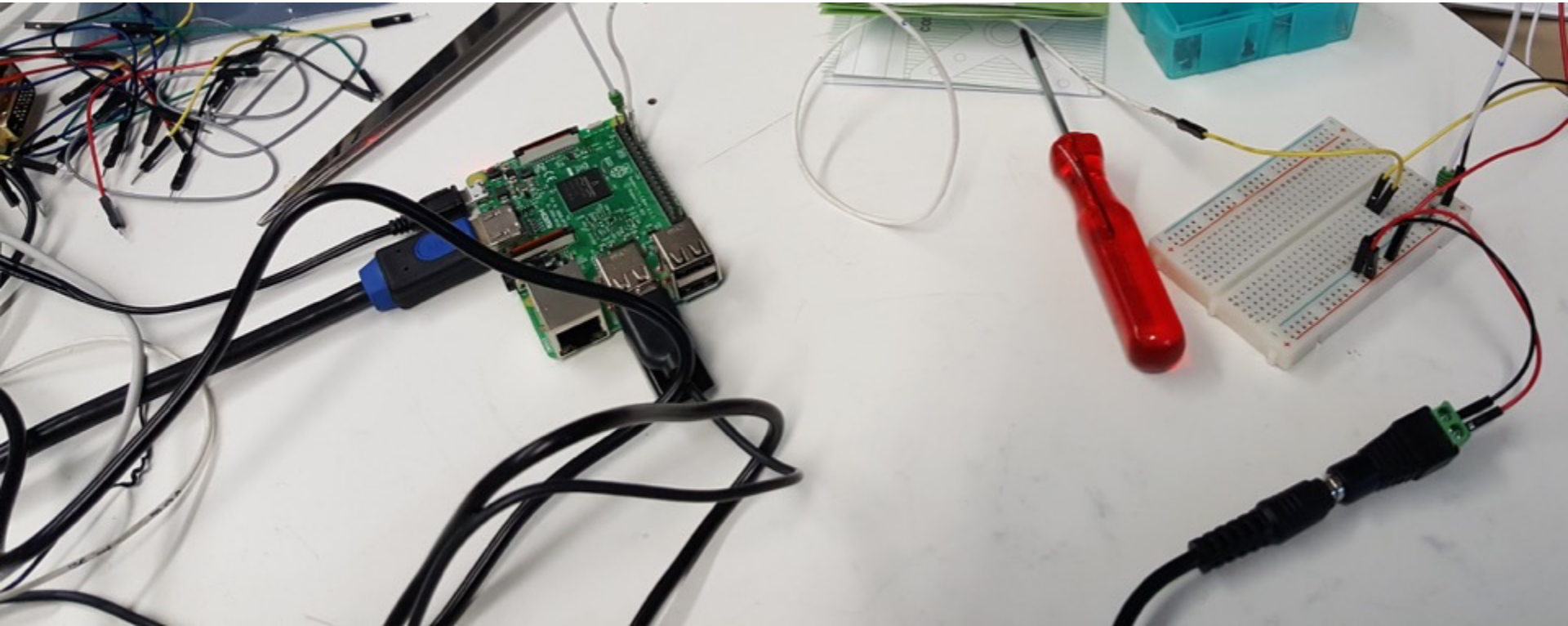


u.a. UR:BAN, 2016; Bengler, Drüke, Hoffmann, Manstetten, & Neukum, 2018

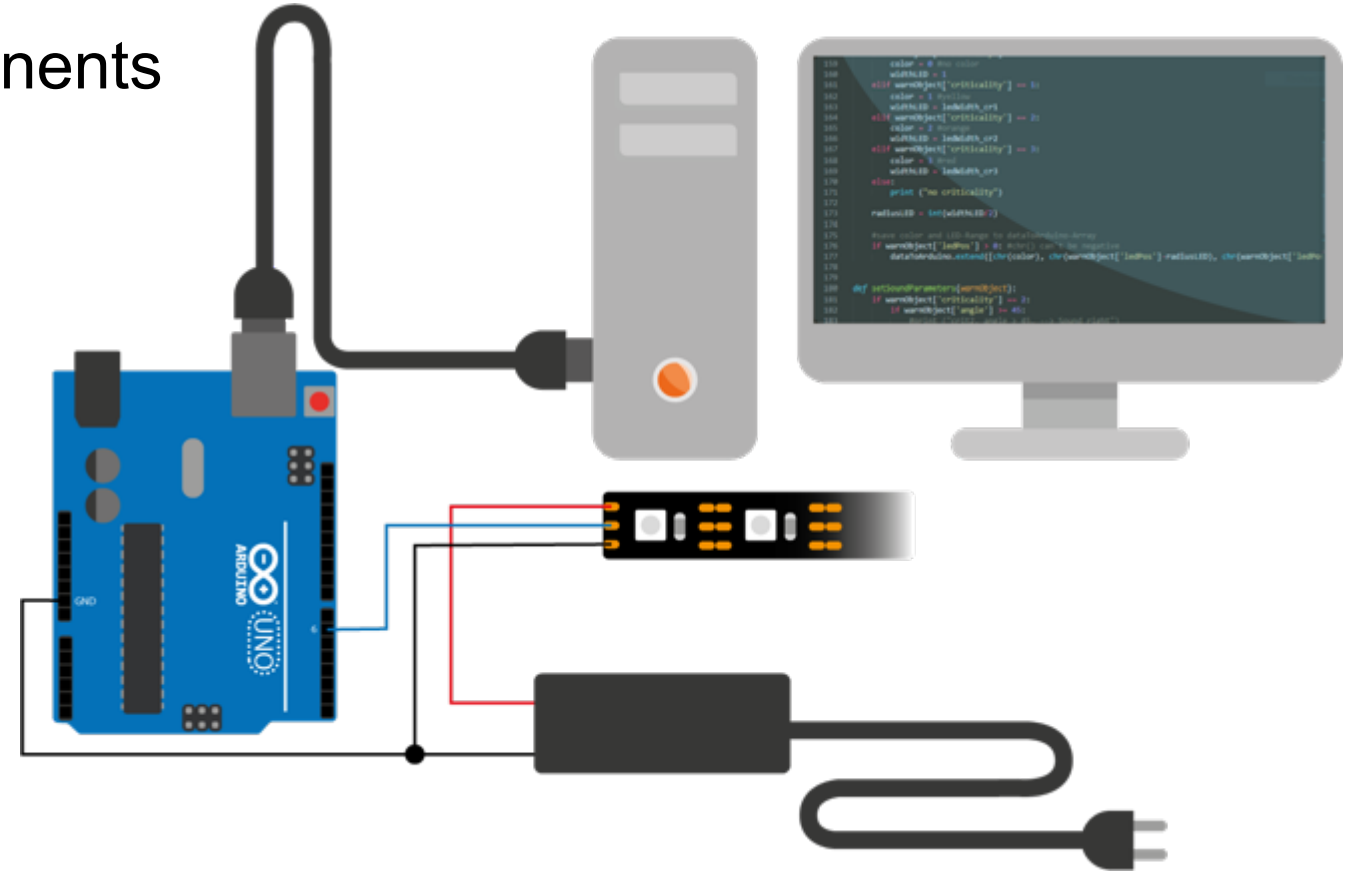
3 | Development



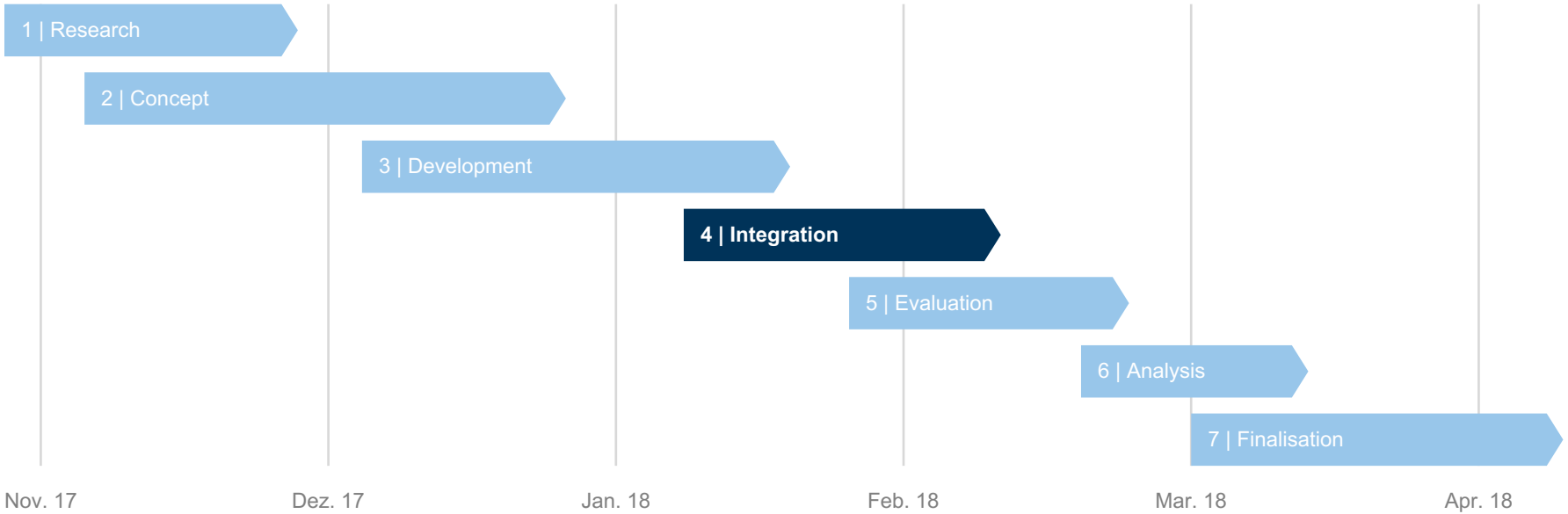
Components



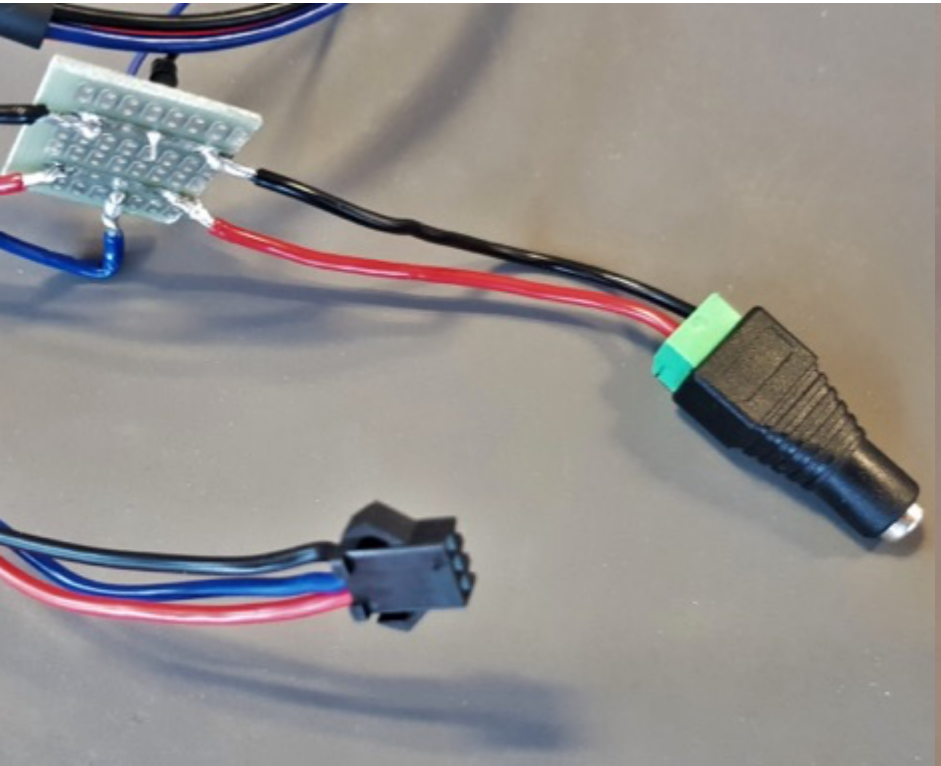
Components



4 | Integration



Hardware: PCB, Wiring and Case

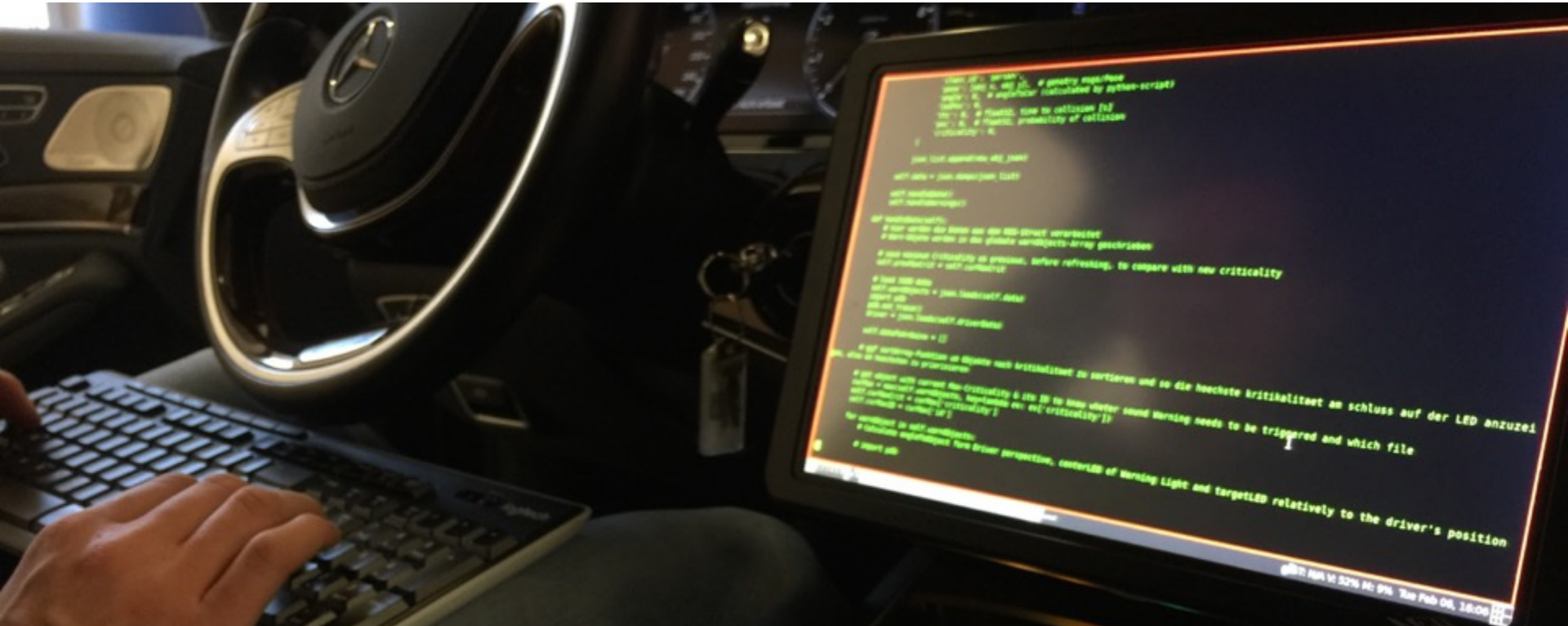


Hardware Integration: Prototype Build Concept

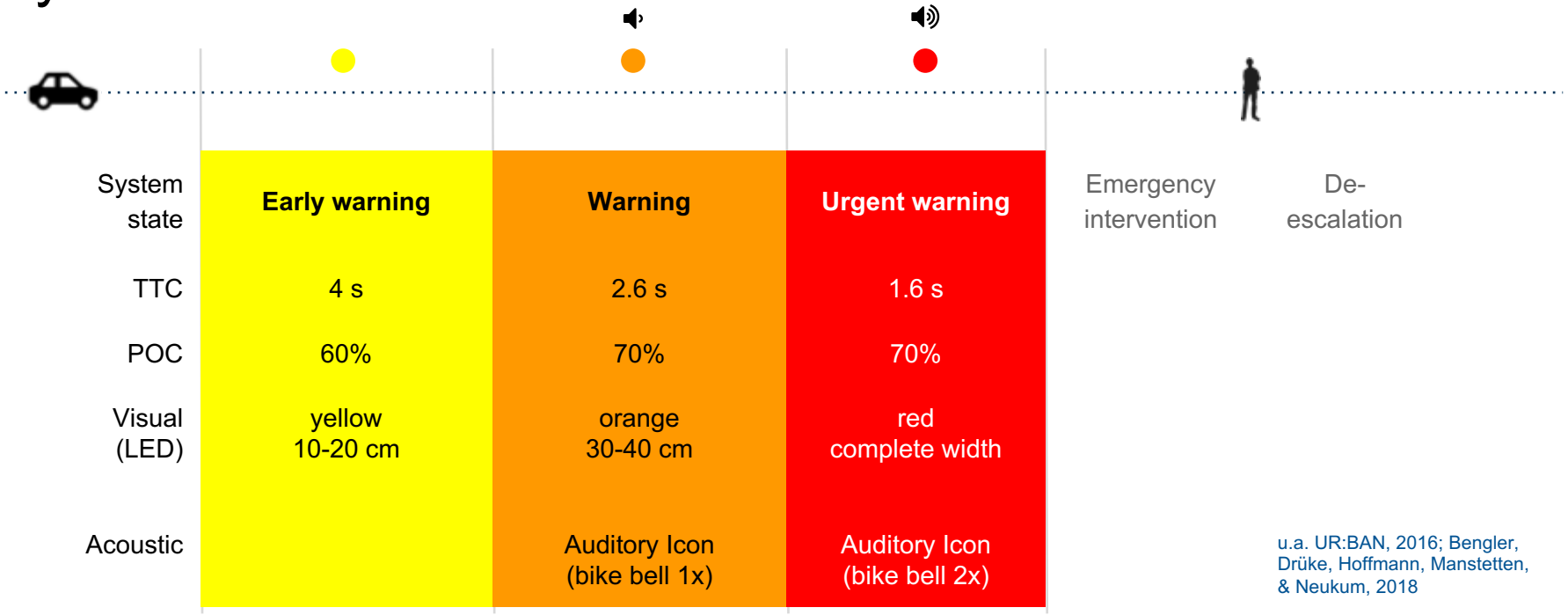
Test of various Prototype Variants

Visibility Test in Daylight

Software in Test Vehicle



System Test



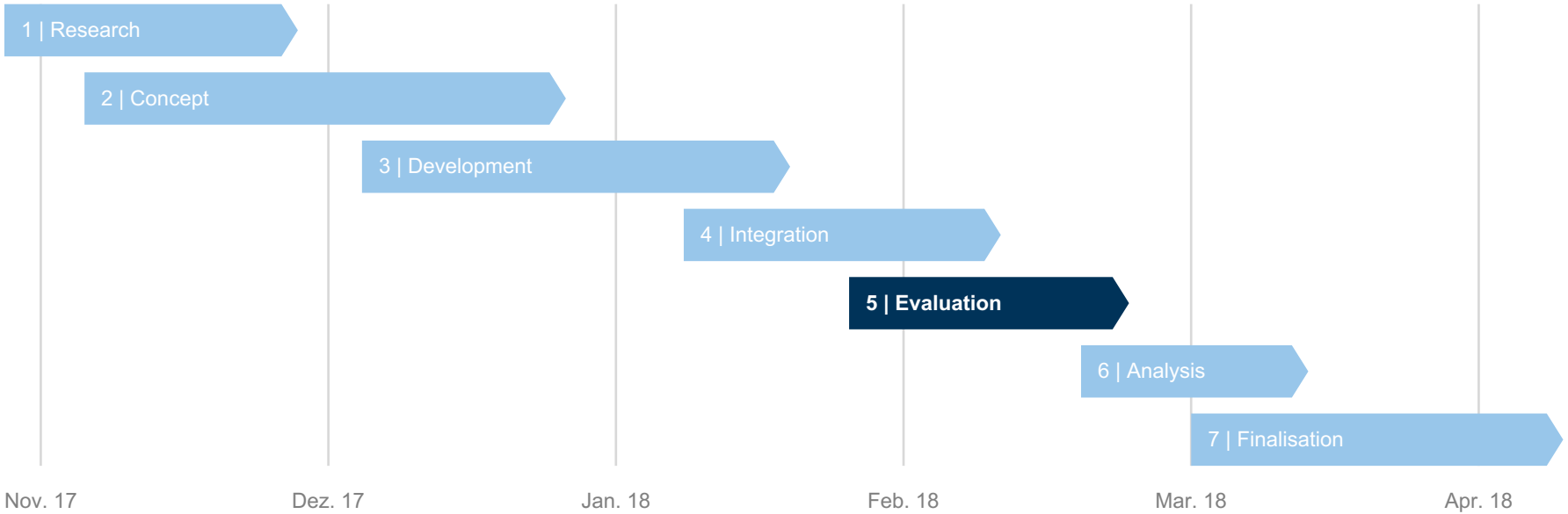
u.a. UR:BAN, 2016; Bengler, Drüke, Hoffmann, Manstetten, & Neukum, 2018


SPEED LIMIT
55


55


55

5 | Evaluation



Evaluation Details

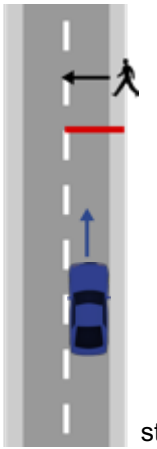
Planning & Preparation

Proof of concept and optimization study
with professional test drivers

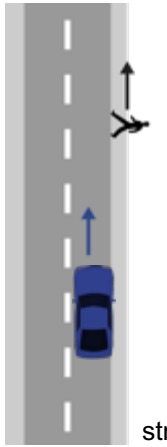
Test

What:	Mercedes Benz S-Class V-222 „Joker“
Where:	Daimler campus
Who:	Test with 12 Daimler employees
When:	12 February – 15 February: 09:00 - 17:30
	1h / test person

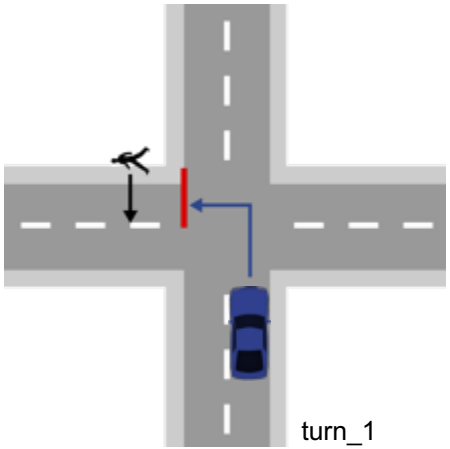
Scenarios



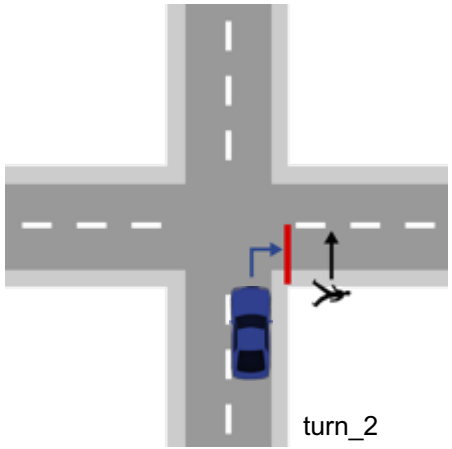
straight_1



straight_2

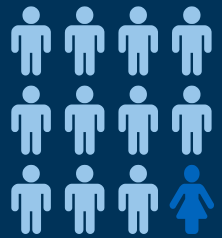


turn_1



turn_2

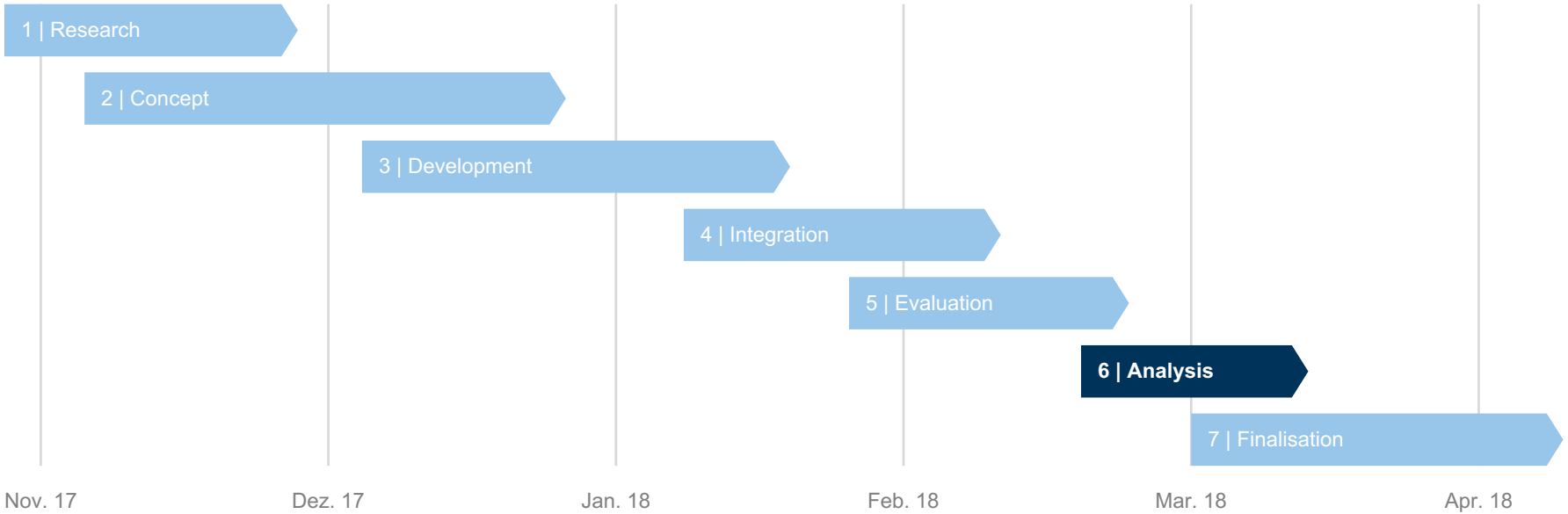
Sample: experienced & mainly male drivers



n = 12
24 – 50 years
Ø= 32.42
SD= 8.08

Driving Licence	Total Mileage	Experience with DAS	Trust in DAS
2 – 32 years Ø = 14.33 SD= 8.35	5000 – 500,000 km Ø ~ 172,000 km SD~ 136,000	2 – 6 [1;6] Ø= 4.64 SD= 1.21	3 – 6 [1;6] Ø = 4.45 SD = .93

6 | Analysis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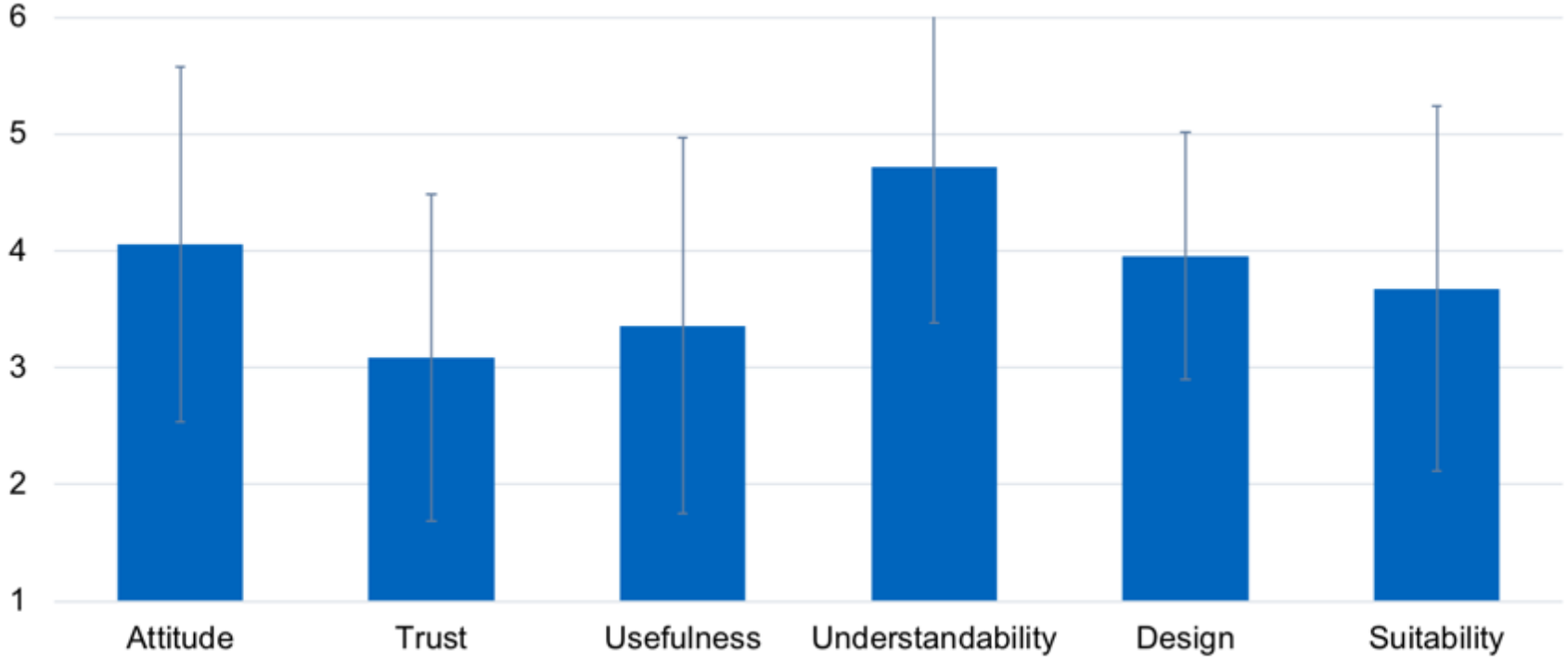
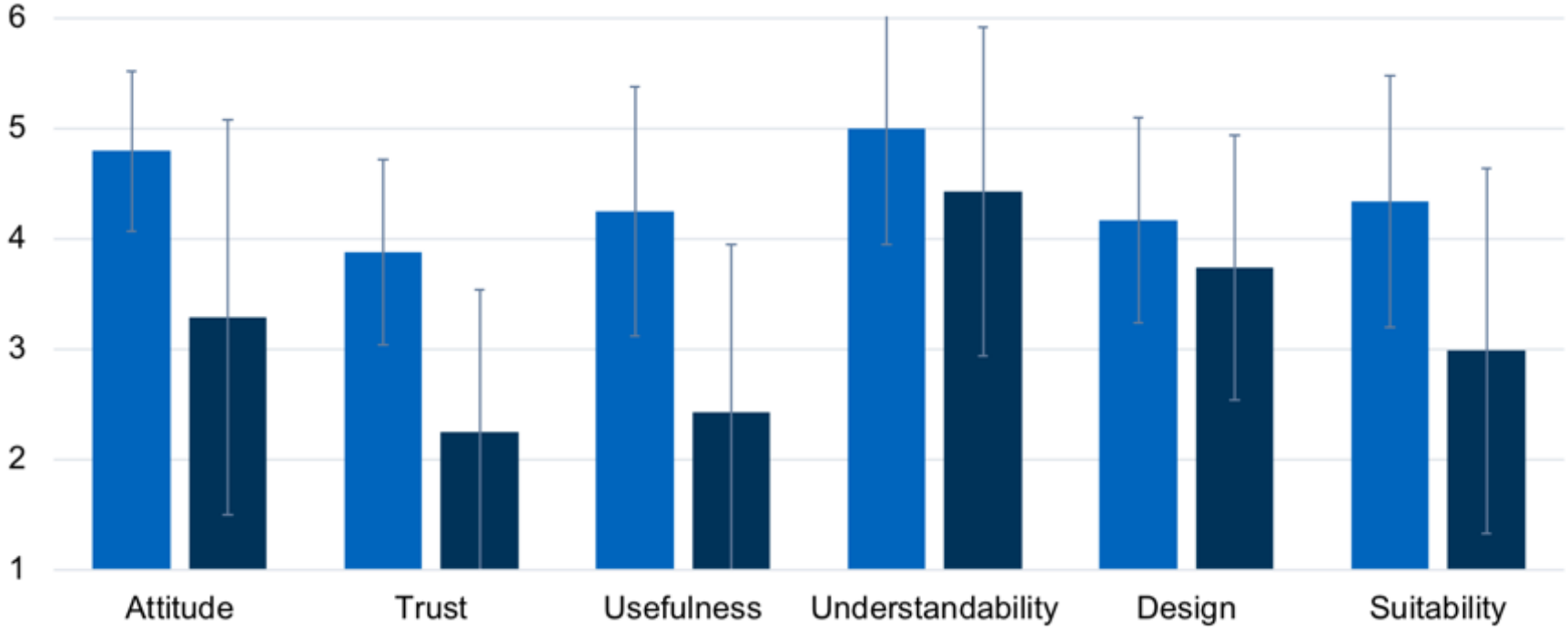
In-Between Questionnaire

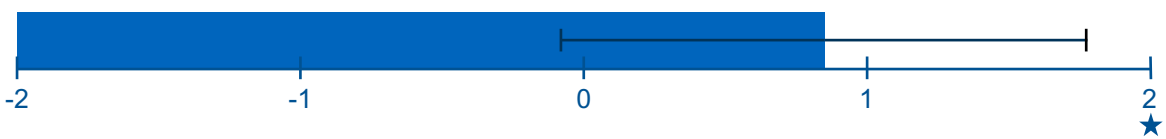


In-Between Questionnaire – Straight vs. Turn Scenarios



Final Questionnaire

Acceptance[1]
Range: [-2; 2] Target: 2
Ø = 0.85 SD = 0.93
Min = -2 Max = 2



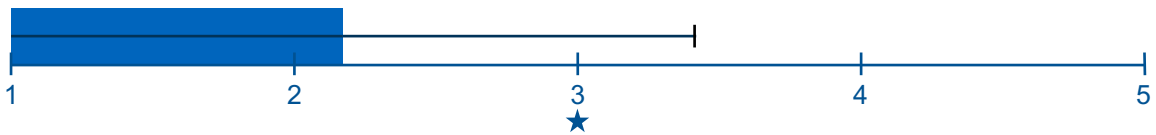
Usability[2]
Range: [1; 5] Target: 5
Ø = 4.07 SD = 1.20
Min = 1 Max = 5

Design
Range: [1; 6] Target: 6
Ø = 4.75 SD = 0.87
Min = 3 Max = 6

1: Van der Laan, 1997; 2: Brooke, 1996;

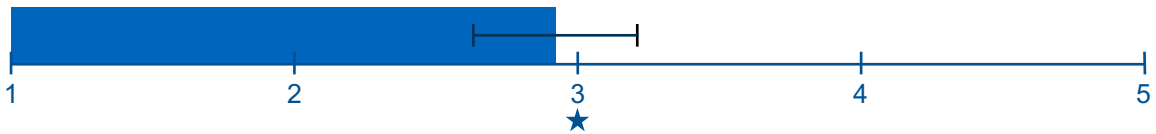
Final Questionnaire

Suitability – Criticality
Range: [1; 5] Target: 3
Ø = 2.17 SD = 1.27
Min = 1 Max = 5



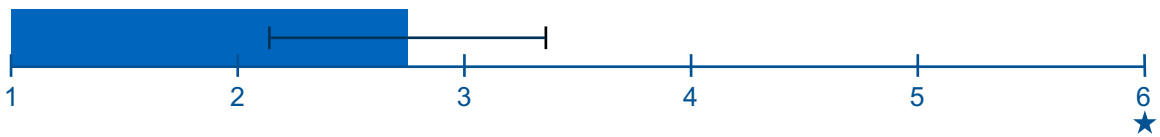
Suitability – Timing
Range: [1; 5] Target: 3
Ø = 4.08 SD = 0.79
Min = 3 Max = 5

Suitability – Info
Range: [1; 5] Target: 3
Ø = 2.92 SD = 0.29
Min = 2 Max = 3



Final Questionnaire

Trust
Range: [1; 6] Target: 6
Ø = 2.75 SD = 1.22
Min = 1 Max = 5



Safety Gain[1]
Range: [1; 5] Target: 5
Ø = 3.68 SD = 1.07
Min = 1 Max = 5

1: Arndt, 2011;

Interview

Overall meaning of warning stages clear
despite not always accurately describable in retrospective

Multimodal warning (visual & acoustic)
has been considered as beneficial and generally positive

Positive remarks concerning
display of VRU position
warning stages
resulting safety gain

→ **Willingness to use** an improved system generally quite high

Interview

Occasional jumps
of the displayed warning

Too late warnings
especially in turn scenarios

Poor system performance
especially in turn scenarios
(due to limited field of view of the front camera)

→ System performance & stability crucial

Potential for Optimization & Further Works

Technical aspects

near-to-perfect recognition performance for every scenario
adaptive vs. adjustable warn parameters (e.g. volume, brightness etc.)
extension of the LED strip into the door area

Human Factors aspects

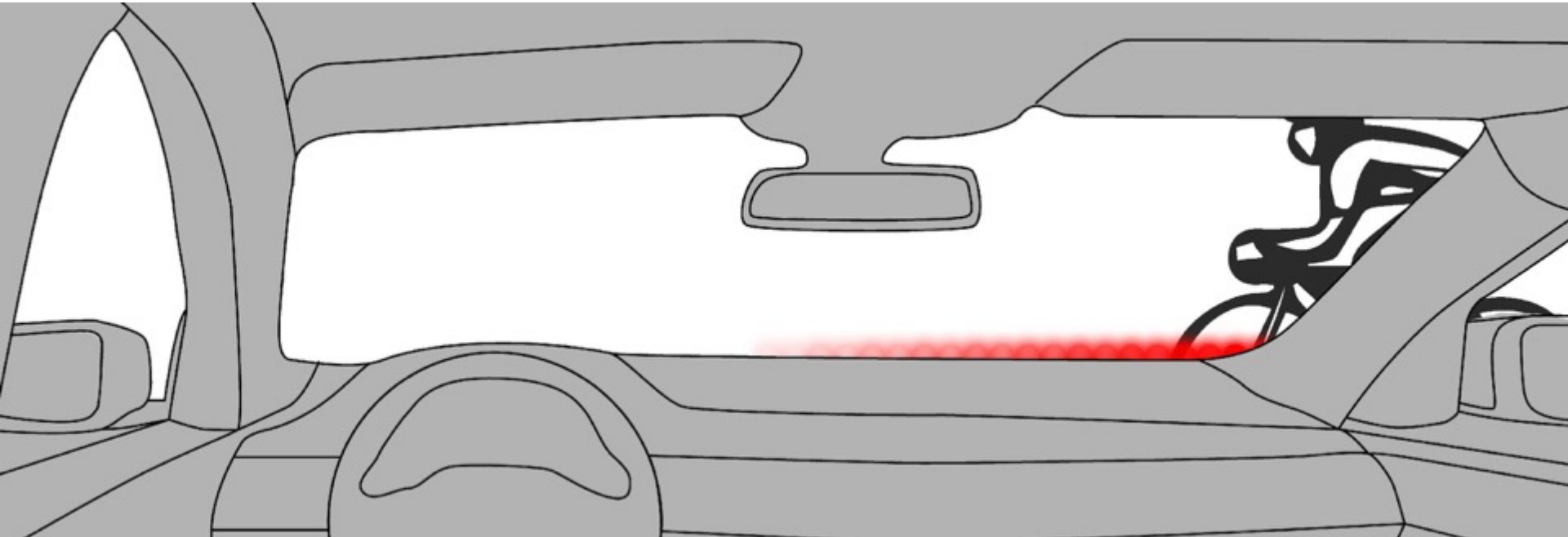
adequate brightness for all possible light conditions
optimal viewing angle for different positions (probably with usage of eye tracking)

Further aspects

Integration in existing systems and brand specific design
Addition of additional haptic component

Thank you for your attention!

Do you have questions?



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