

‘How should I inform my driver?’ Effective advisory warnings based on cooperative perception

„Wie sage ich es meinem Fahrer?“
Effektive Fahrerinformationen basierend auf kooperativer
Perzeption

Frederik Naujoks
IZVW

Gefördert durch:



aufgrund eines Beschlusses
des Deutschen Bundestages

Potential conflict can be predicted **cooperatively**



Effect of cooperative perception:

Information about conflict
'advisory warnings'

Goal:

Attention direction,
Preparation for possible reaction

Early information without annoyance
and lowering of acceptance



Conflict can be **reliably** predicted **cooperatively**



Effect of cooperative perception:

Optimisation of warning
'imminent crash warning'

Goal:

Immediate reaction
(braking, steering)

Optimal time frame for
warning



Conflict can be **perceived** by **onboard sensors/driver**



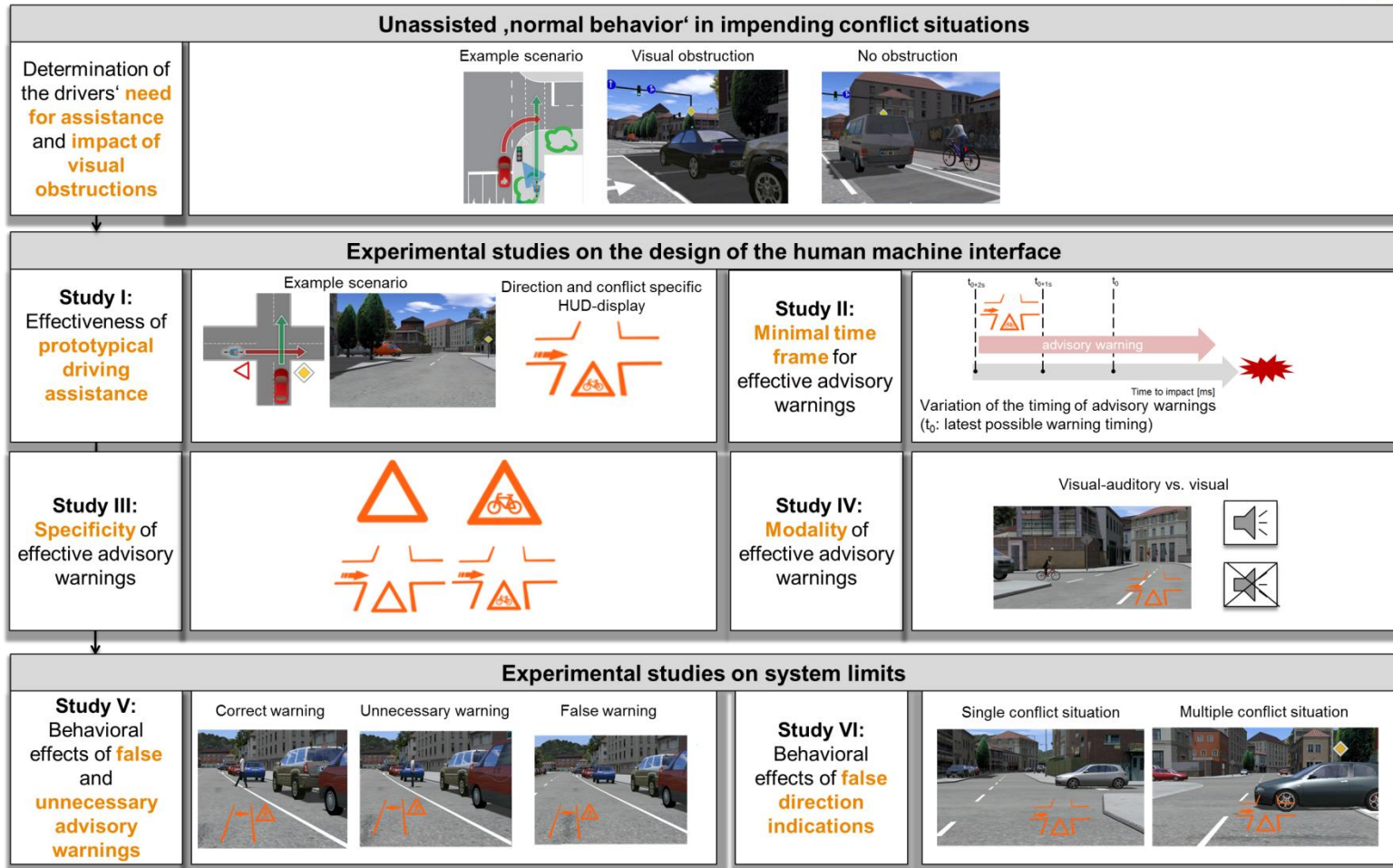
Warning signal
too late for
collision
avoidance

Time to impact

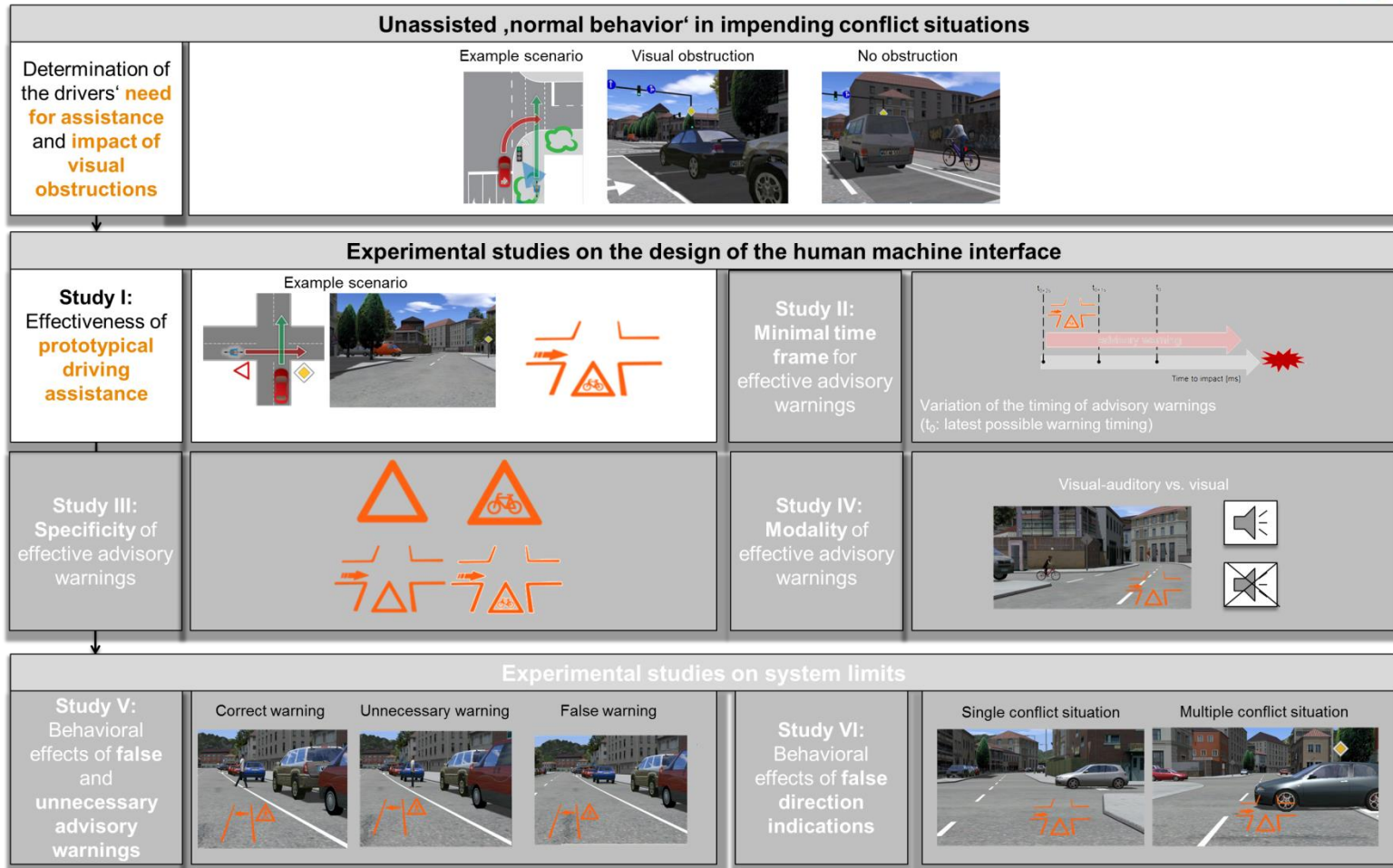
(Neukum, 2011)

Development of strategies for **early driver assistance in impending conflict situations.**

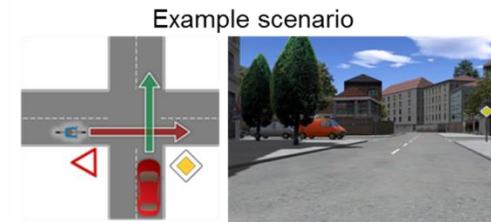
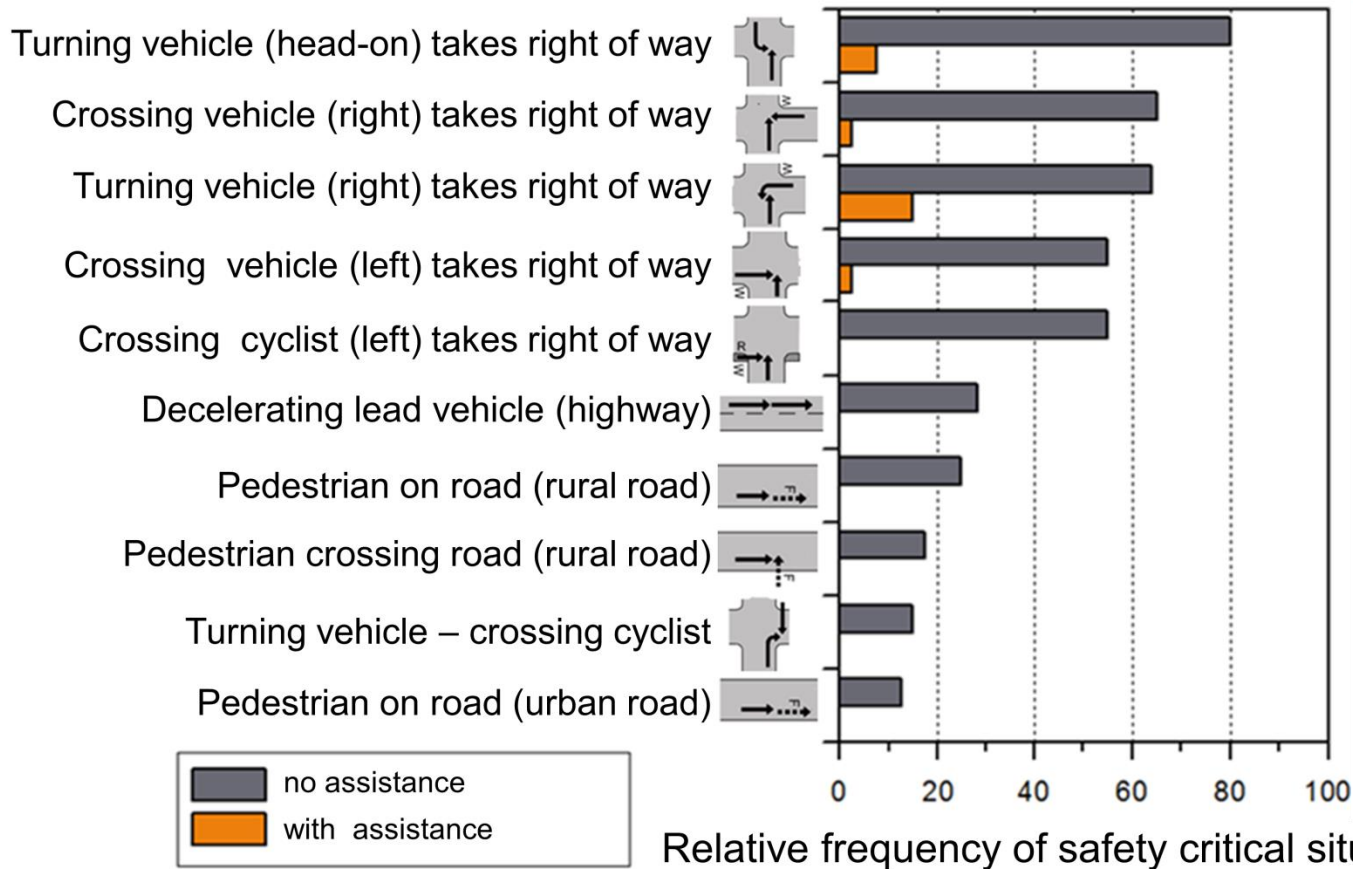
Experimental studies conducted at the IZVW



Experimental studies conducted at the IZVW



Study I: Effectiveness of prototypical driving assistance



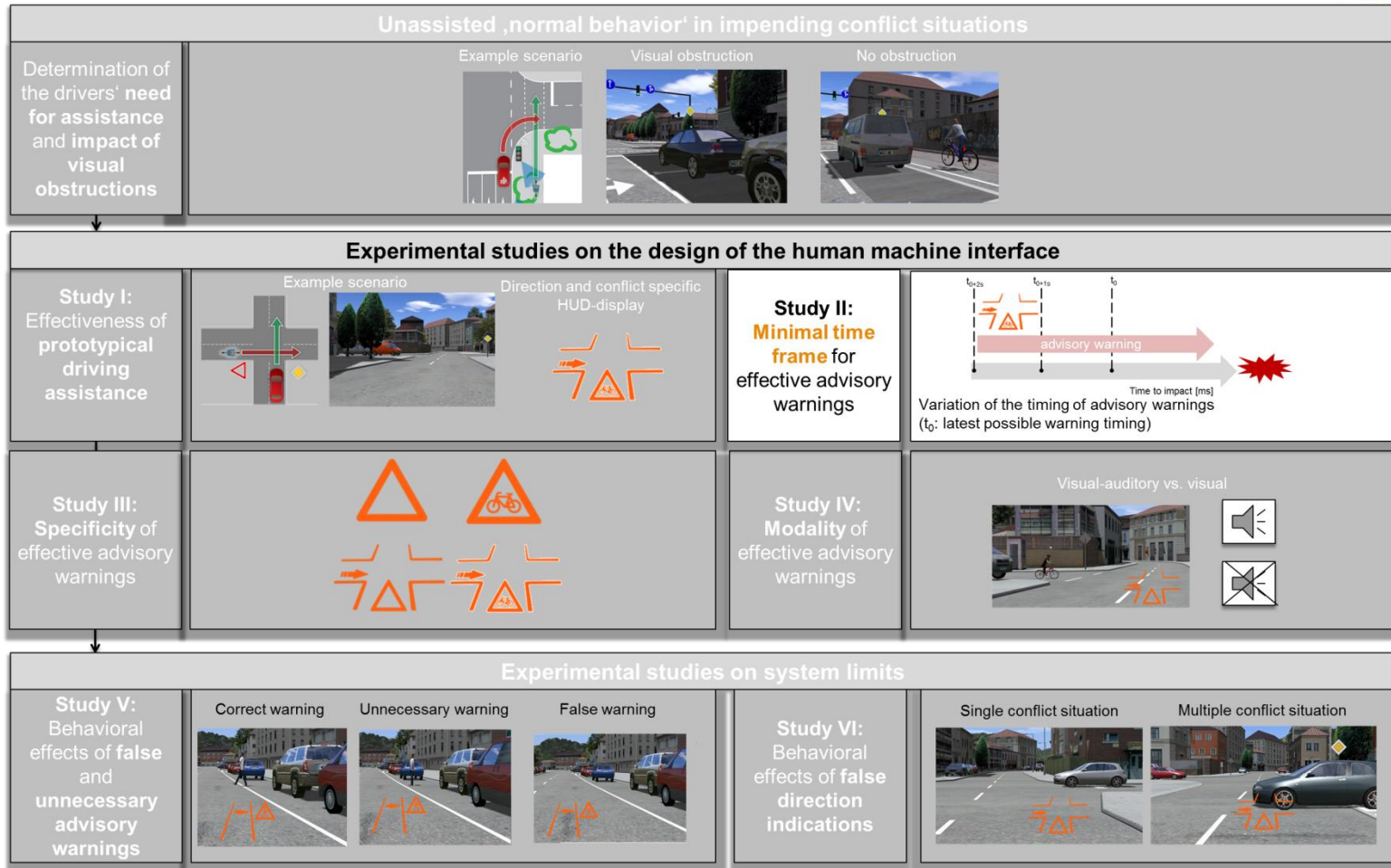
Direction and conflict specific HUD-display



N = 20 drivers, 88 driving scenarios

Strong reduction of critical situations through prototypical driving assistance

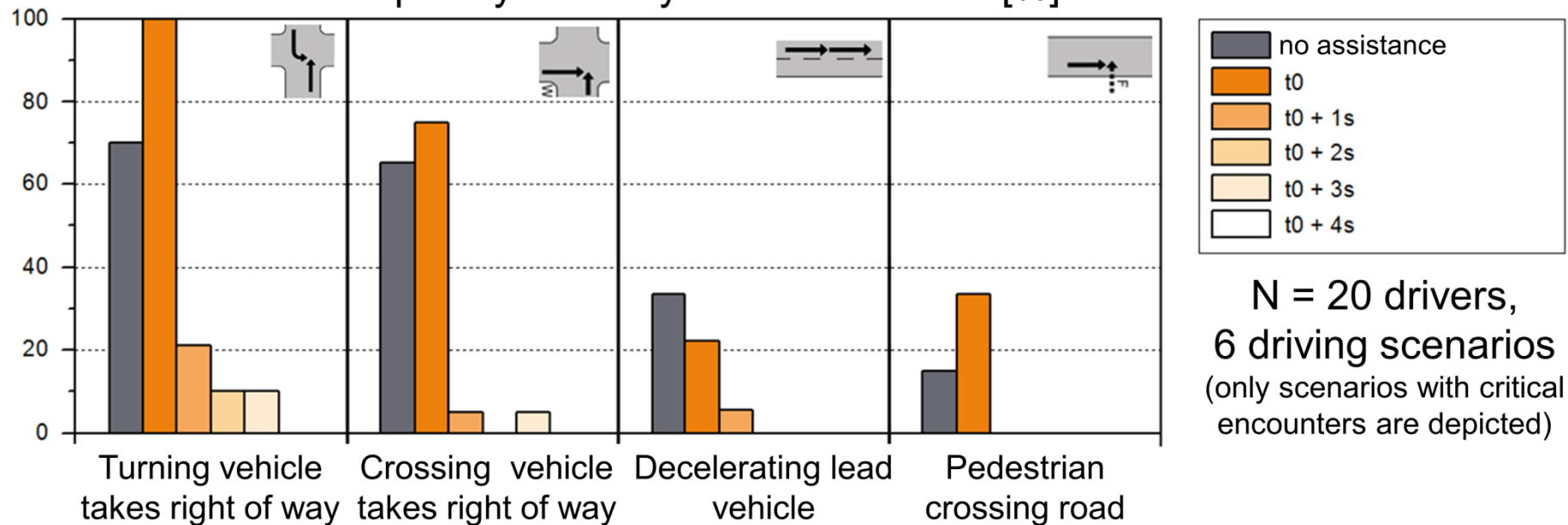
Experimental studies conducted at the IZVW



Study II: Minimal time frame for effective advisory warnings

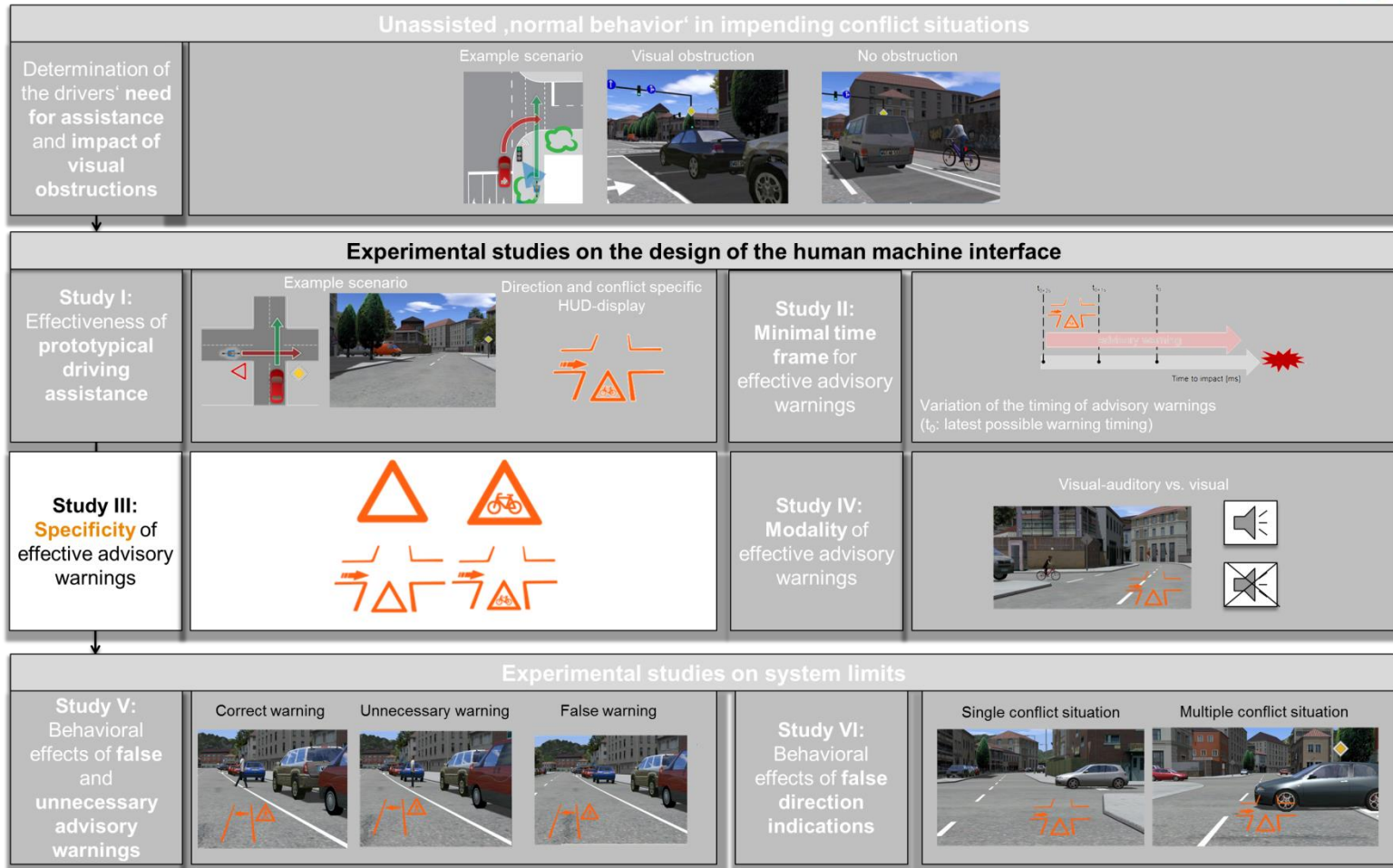


Relative frequency of safety critical situations [%]



Minimal time frame of effective advisory warnings: 1-2 seconds before latest possible warning timing (t_0)

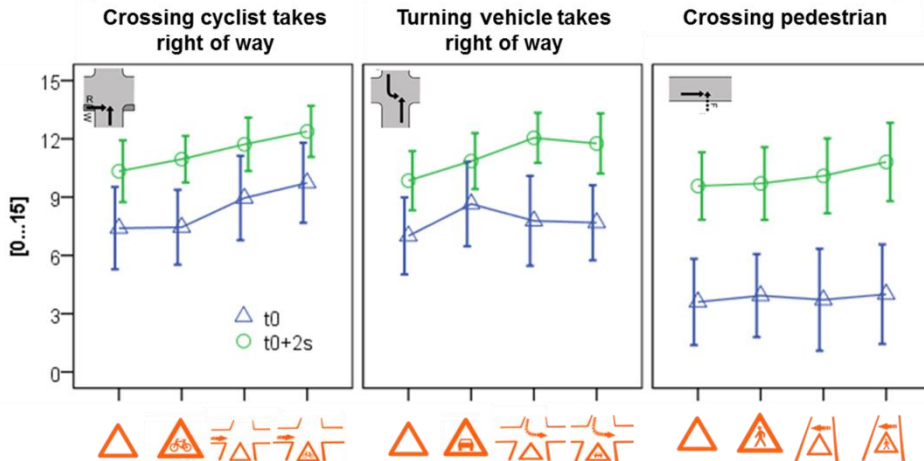
Experimental studies conducted at the IZVW



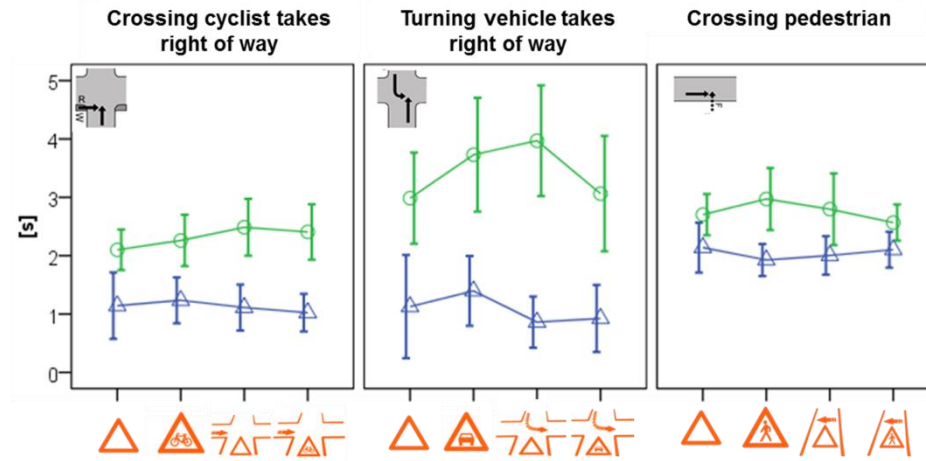
Study III: Specificity of effective advisory warnings



Usefulness ratings



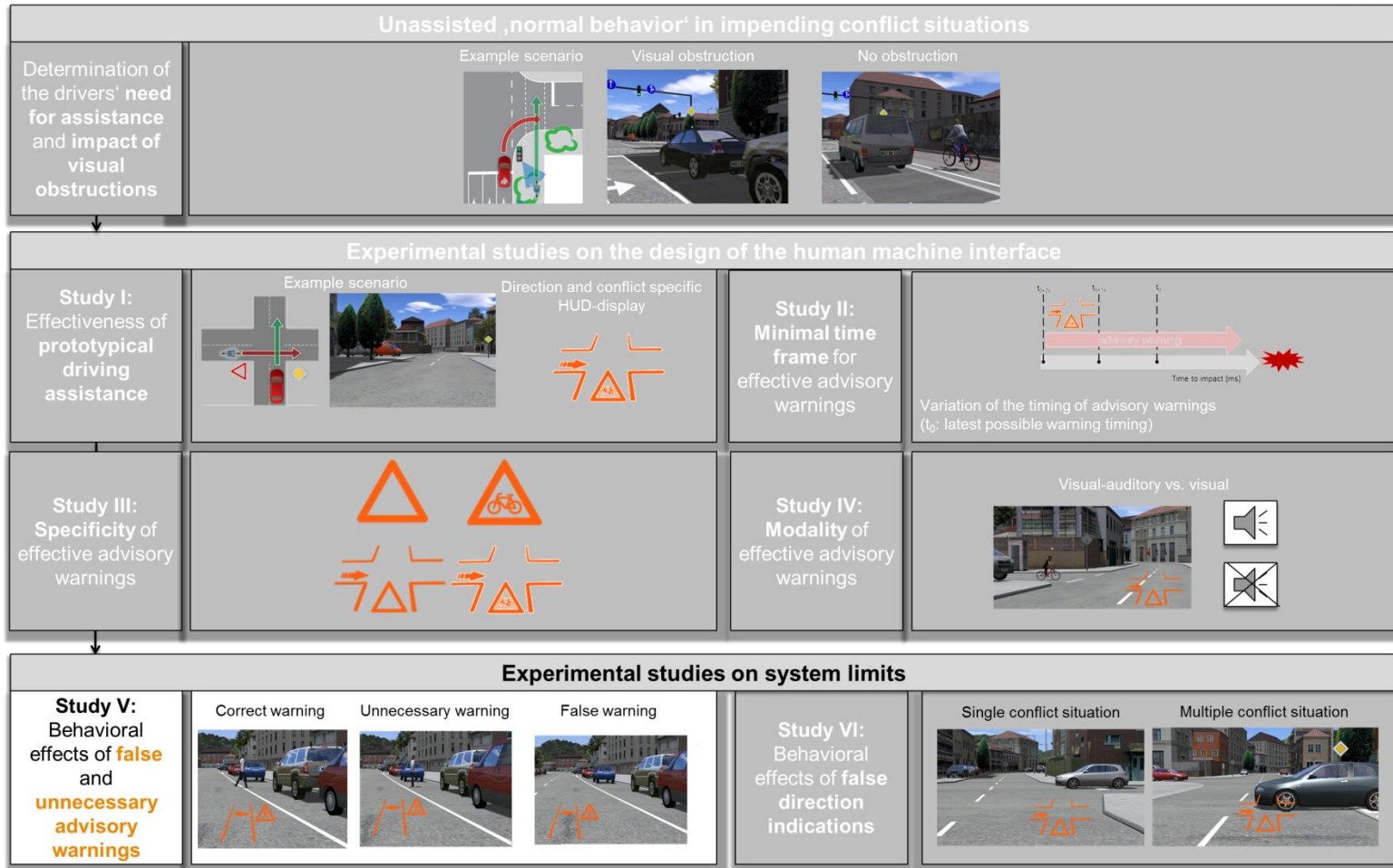
Minimum Time-to-arrival



n = 21 drivers, 6 driving scenarios (selection of the full scenrio set is shown)

Direction specific > direction unspecific in usefulness-ratings, although the effectiveness mainly depends on the warning timing.

Experimental studies conducted at the IZVW



Study V: False and unnecessary advisory warnings



Example: unnecessary advisory warning

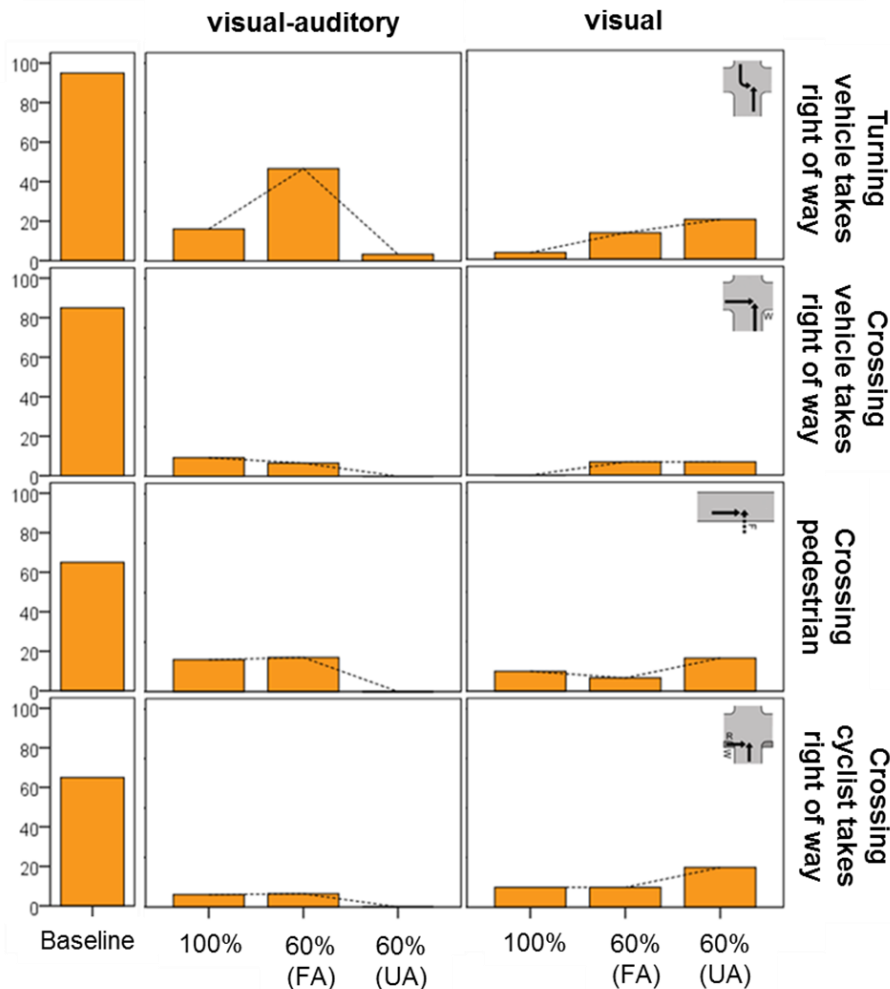


Example: false advisory warning



Study V: False and unnecessary advisory warnings

Relative frequency of safety critical situations ($TTA_{min} < 1s$)



| HMI | System reliability | | |
|-----------------|--------------------|-------------------------|-------------------------------|
| | 100% | 60% with false warnings | 60% with unnecessary warnings |
| Visual | 10 | 10 | 10 |
| Visual-auditory | 10 | 10 | 10 |
| Baseline | 20 | | |

Effectiveness of Ko-PER advisory warnings is not reduced by false and unnecessary alarms, especially in case of purely visual warnings.

Summary: How should I inform my driver?

- **Time frame:**
Minimal time frame of effective advisory warnings: **1-2 seconds before latest possible warning timing** (t_0)
- **Specificity:**
Direction specific > direction unspecific in usefulness-ratings, although the effectiveness mainly depends on the warning timing
- **Modality:**
Effectiveness of Ko-PER advisory warnings is not reduced by false and unnecessary alarms, especially in case of **purely visual warnings**





FORSCHUNGSINITIATIVE
K O - F A S

Thank you for your attention!

Gefördert durch:



aufgrund eines Beschlusses
des Deutschen Bundestages