

Practice makes perfect

Driving experience with a multi stage warning system

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Motivation

- Driver assistance can increase traffic safety
- As safety-critical situations can be diverse, integrated adaptive warnings (like a **multi stage collision warning**) need to be developed and examined in a variety of situations over time

Research questions

- 1) How much can drivers benefit from such a system over time (**learning**)?
- 2) Can drivers **transfer** learned knowledge to new situations?
- 3) How is the warning system **accepted** by drivers before and after experiencing it?

Method

Multi stage collision warning in head-up display (HUD)

- Adaptive to situation criticality & driver reaction

| Warning stage | Aim | Timing | Visual | Acoustic |
|--------------------|-----------------------|----------------------------------|--------|--------------|
| W1) Warning | Moderate decelerating | $2\text{ s} \leq x < 8\text{ s}$ | | - |
| W2) Urgent warning | Emergency braking | $x < 2\text{ s}$ | | 1 kHz "Beep" |

4 urban scenarios of varying criticality

| Hazard | Lead vehicle (L) | Obstacle (O) | Pedestrian (P) | |
|---------------|------------------|--------------|--------------------|--------------|
| Location | Straight (S) | Hill (H) | Intersection (I) | Straight (S) |
| Picture | | | | |
| Warning stage | W1) Warning | | W2) Urgent warning | |

4 trials (T) each of one less & one rather critical scenario

- Repetition: T1 without, T2+T3 with assistance (learning)
- New scenarios: T4 with assistance (transfer)

Driving simulator experiment (fixed-base)

- Brake reaction time, subjective ratings measured
- $N = 24$ drivers ($M = 27$ years, $SD = 8$ years)

Conclusion

- Multi stage collision warning system is
 - Beneficial in various critical situations
 - Well accepted
- Drivers learn to brake faster over repeated trials
 - Reduced accident severity
- Positive transfer of assistance experience to new situations is possible
- Practice with assistance is recommended to maximize its benefits

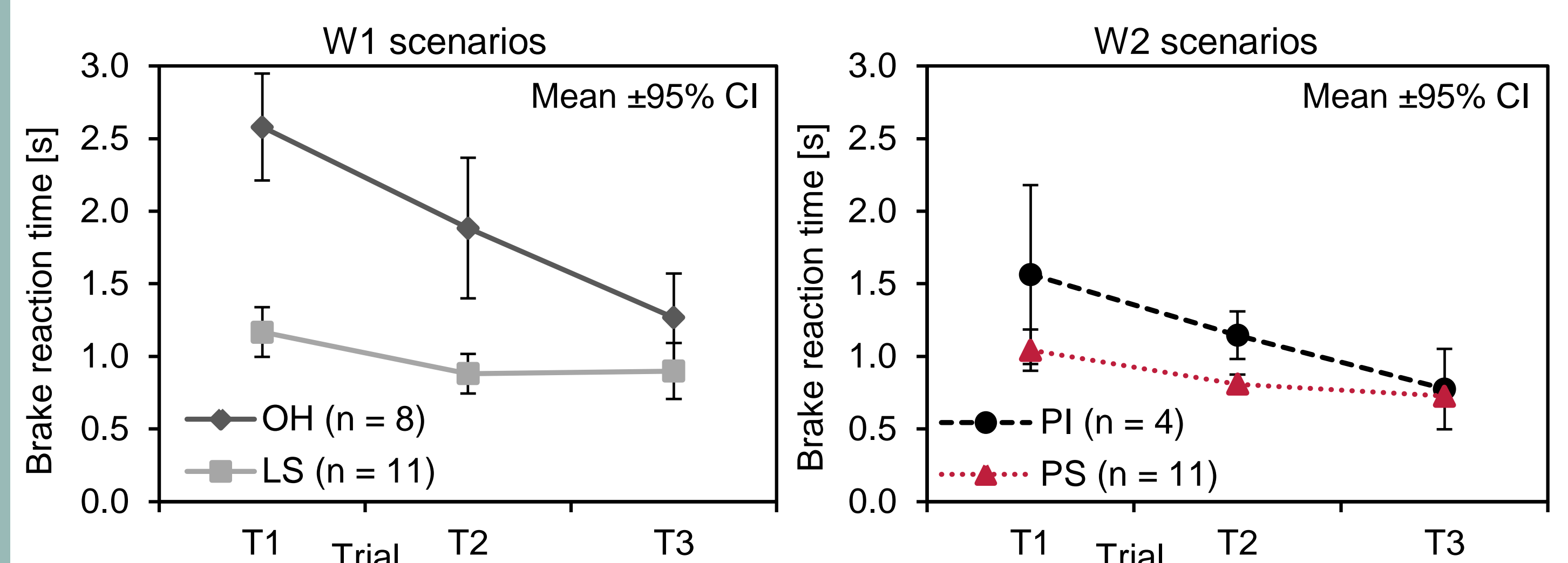
Results

Manipulation check (15-point rating scale; Heller, 1982)

- Scenarios differ significantly in situation criticality:
 - W1 scenarios: $M_{\text{all}} = 7$ ("moderate"), 95% CI (6.1, 7.9)
 - W2 scenarios: $M_{\text{all}} = 14$ ("very high"), 95% CI (13.5, 14.5)

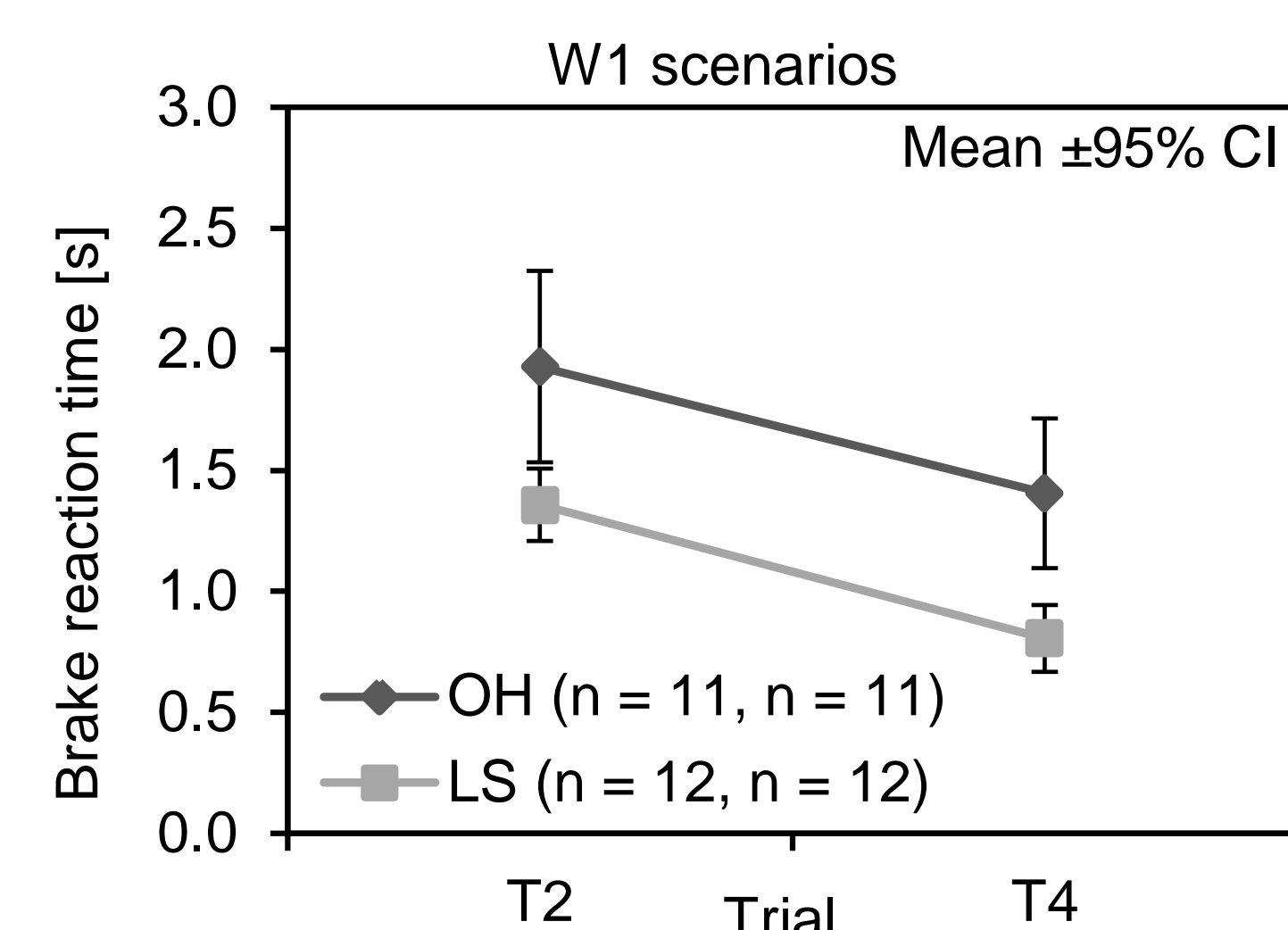
Learning effect (T1-T3)

- Significant interaction & main effects of within-subjects factor *trial* & between-subjects factor *scenario* for W1 & W2 scenarios (significant post-hoc tests in all trial comparisons)



Transfer effect (T2 & T4)

- Significant main effects of between-subjects factors *trial* & *scenario* for W1 scenarios
- Initial brake reaction time in T2 in W2 scenarios already low



System acceptance (Van der Laan, Heino, & De Waard, 1997)

- Positive system acceptance rating on a scale from -2 to +2:
 - *Usefulness*: $M_{\text{all}} = 1.1$, 95% CI (0.9, 1.3)
 - *Satisfaction*: $M_{\text{all}} = 0.7$, 95% CI (0.5, 0.9)
- No significant differences before & after system experience