

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

- How much can drivers benefit from such a system over time (**learning**)?
- Can drivers **transfer** learned knowledge to new situations?
- 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	$x < 2 \text{ s}$	STOP	1 kHz "Beep"

4 urban scenarios of varying criticality

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

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)

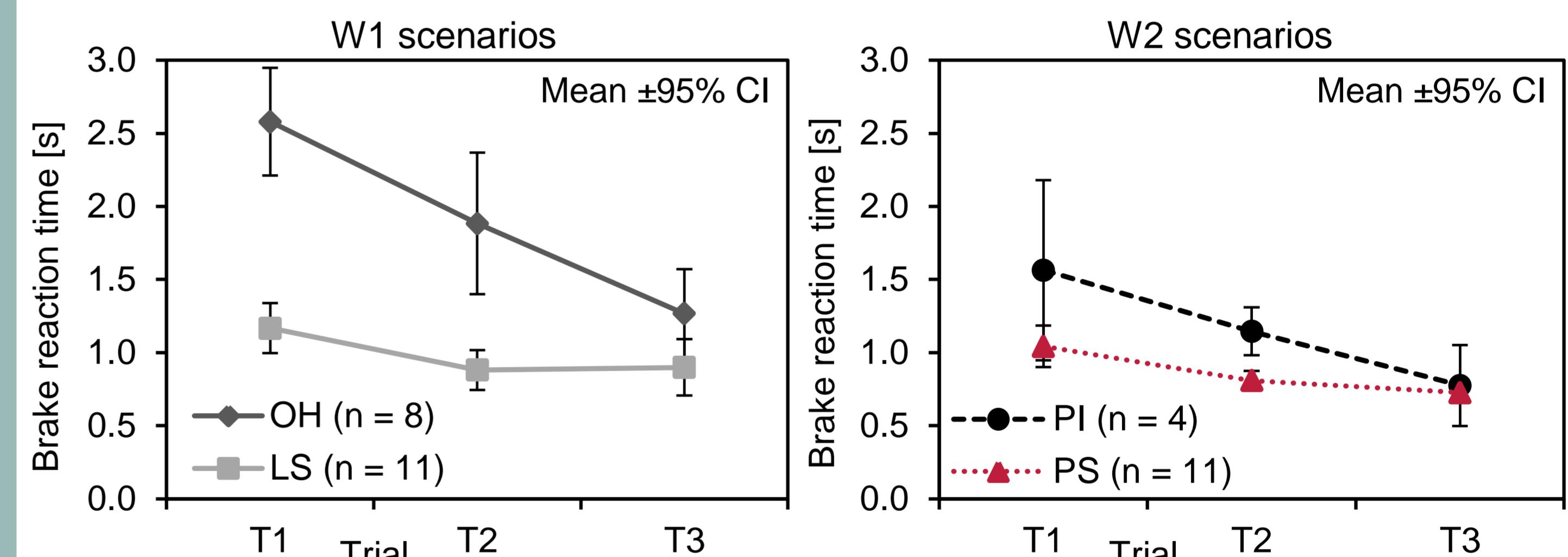
Results

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)

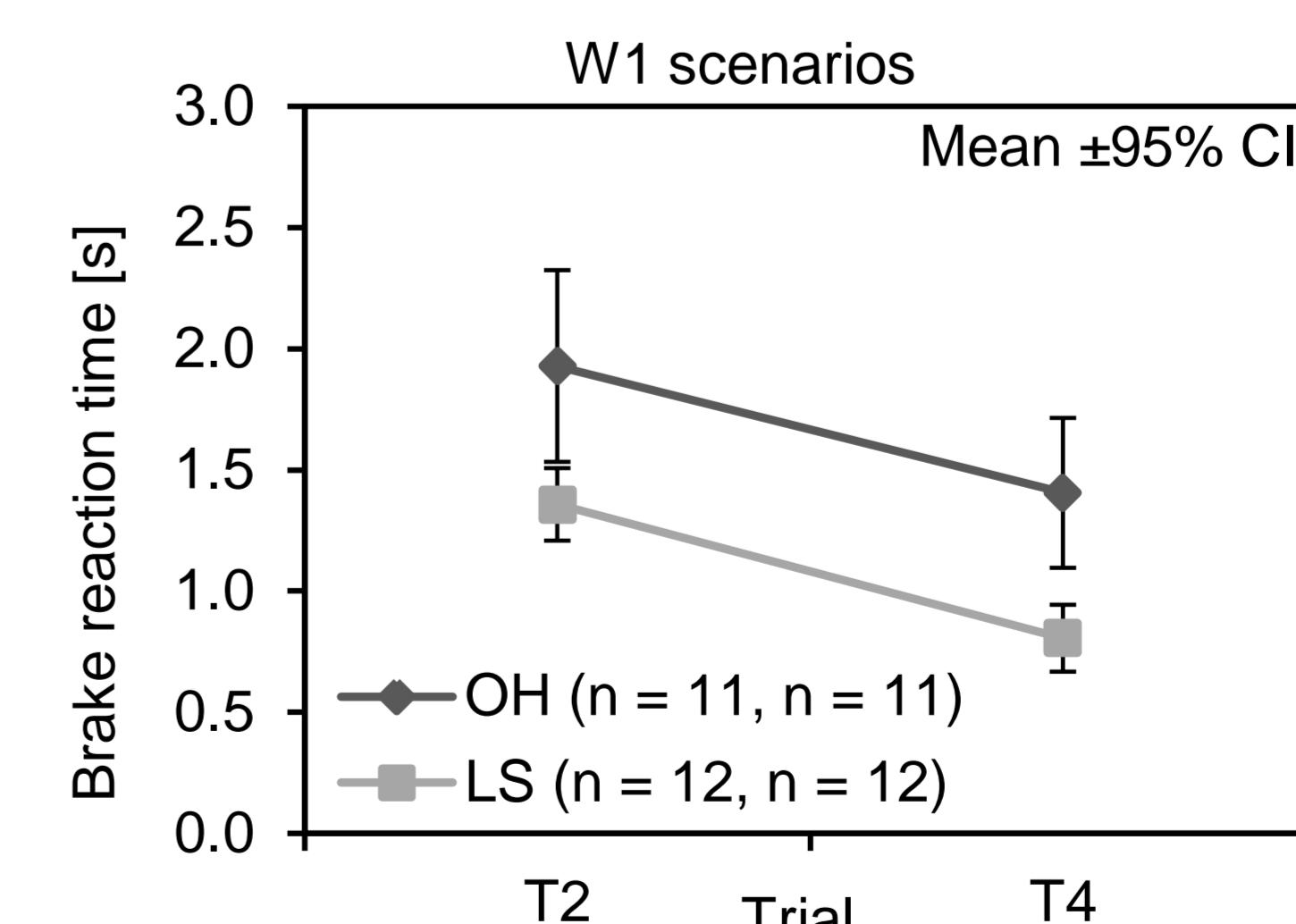
Learning effect (T1-T3)

- 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