ABSTRACT

This study investigated drivers’ collision avoidance behaviors using a simulated car-following task under different initial headways and different lead vehicle decelerations. A total of 30 drivers were given the opportunity to avoid a collision by brakepipeering when a lead vehicle slowed at initial headway distances of 1.5sec, 2.5sec, and at decelerations of 0.3g, 0.5g, and 0.75g. Results showed that:

- drivers’ Perception Response Time was less under low than under higher headway conditions; drivers released the accelerator faster under short than under longer initial headway conditions; drivers started braking more quickly and with more pressure under the higher risk conditions, especially under large lead vehicle decelerations.

METHOD - GENERAL

Participants: Thirty participants were initially recruited from the population of licensed drivers in Shanghai. Six of the Participants were female and 24 were male. The age was from 23 to 59 years. All the participants possess a valid driver’s license and have driven at least 10,000 kilometers mileage.

RESULTS

Braking/Steering Behaviors and Collisions:

- Among the total 15 trials simulated scenarios, 87.85% involved using a Brake-only maneuver, and 12.15% were observed using a Brake-with-Steering maneuver.
- Among those scenarios with Brake-only maneuver, 25.7% (39 out of 152) were involved in collisions, whereas for those with Brake-with-Steering maneuvers (either braking first or steering first) only 4.8% (1 of 21) were involved in collisions.

Dependency variables:

- Initial headway (with/n干货): Short headway: 1.5sec; Long headway: 2.5sec.
- LV deceleration (with/n干货): Frontal deceleration: 0.3g; Middle deceleration: 0.5g; Rear deceleration: 0.75g.
- Gender (with/n干货): Male, Female.
- Age (without/n干货): Middle age drivers: 26-49; Older: ≥50.
- Driving experience (without/n干货): Middle experience: 350,000-500,000; Experienced: >500,000.

Dependent variables:

- Perception response time: drivers responded faster when the LV deceleration increased or the initial headway decreased.
- ANOVA revealed significant main effects of initial headway (F(2,15)=99.83, p<0.0001) and LV deceleration (F(2,15)=11.75, p<0.0005).

Independent variables:

- Initial headway (without): Short headway: 1.5sec; Long headway: 2.5sec.
- LV deceleration (without): Frontal deceleration: 0.3g; Middle deceleration: 0.5g; Rear deceleration: 0.75g.
- Gender (without): Male, Female.
- Age (without): Middle age drivers: 26-49; Older: ≥50.
- Driving experience (without): Middle experience: 350,000-500,000; Experienced: >500,000.

Dependent variables:

- Perception response time: drivers responded faster when the LV deceleration increased or the initial headway decreased.
- ANOVA revealed significant main effects of initial headway (F(2,15)=99.83, p<0.0001) and LV deceleration (F(2,15)=11.75, p<0.0005).

Reaction Sequence:

- Significant effect of initial headways (F(2,15)=20.16, p<0.0001) and initial headway × LV deceleration (F(4,30)=5.27, p<0.028) on T_pump.
- Significant effect of initial headways on T_pump (F(2,15)=7.01, p<0.004).
- LV decelerations has significant effect on T_pump (F(2,15)=7.04, p<0.005).
- Significant effect of initial headway and LV decelerations on T_pump.
- Significant effect of LV deceleration on T_pump.

CONCLUSIONS

- Brake-with-Steering maneuver may be more effective at high risk rear-end scenarios than Brake-only maneuver; while most of the drivers failed to perform steering maneuver against high risk scenarios.
- Drivers’ throttle release maneuvers were found to be significantly different on the initial headways and were faster under shorter initial headway conditions; Drivers’ post-brake behaviors including T_pump, T_brake, and T_max are strongly depend on the LV decelerations; drivers braked significantly faster as the LV deceleration increased.
- Drivers’ perception response time showed the significant different under different initial headway and LV deceleration conditions. Drivers would respond faster under a high risk scenario (shorter initial headway or higher LV deceleration).
- Drivers’ maximum brake pedal pressure/peak deceleration strongly depend on the LV decelerations; the max brake pedal pressure/peak deceleration increases as the LV deceleration increases.