Quantitative analysis of rear-end crashes and near crashes in a commercial fleet in Shanghai

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Background

Previous qualitative analyses¹ about rear-end crashes and near crashes (CNC) in China showed that:

• Main crash causation factor is adoption of small margins
• Drivers have typically eyes on the road and react quickly to unexpected critical situations
• Scanning mismatches are main cause of delayed reactions

Problem: no quantitative analyses about drivers’ eye glances and kinematics


Vehicle fleet

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47 commercial vehicles instrumented for 1 year in Shanghai:
• 14 light trucks
• 30 vans
• 3 long-haul heavy duty vehicles
37 drivers

Equipment

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Lytx/DriveCam Video Event Recorder (VER)

• Events triggered by hard accelerations/decelerations
• 12 seconds data collection (8 seconds before trigger)
• Data included speed (1 Hz), forward and driver’s video views (4 Hz) and 3 axis accelerations (20 Hz) signals
51 rear-end crashes and near crashes (CNC):
• SV and LV in the same lane for whole event
• SV speed above 15 km/h at trigger point
• SV driver did not wear sunglasses

Variables analyzed
1. Manual coding of driver glance behaviour

Variables analyzed
3. Optical and kinematic parameters
   - Optical angle $\theta$ and optical expansion rate $\dot{\theta}$
   - Looming ($\gamma$), approximated to Time To Collision (TTC)
   - Time headway (THW)
1. Low percentage of non-driving related eye glances (≈10% of time before VER triggering)

2. Mean duration of off-path glances among Chinese drivers (1.16 [s]) is lower than among Western drivers (1.51 [s])

3. Mean $\frac{3}{s}$ value at off-path glance start for Chinese drivers (0.02 [s]) is lower than for Western drivers (0.07 [s])

4. Mean THW value at off-path glance start for Chinese drivers (1.29 [s]) is lower than for Western drivers (2.54 [s])
Conclusions

- Duration of off-road glances is lower and mostly not due to distraction for Chinese drivers compared to Western drivers.
- Chinese drivers start to look away when the situation is less kinematically critical (lower value of $1/TTC$) but when THW is shorter compared to Western drivers.

Implications for active safety system in China:
1. FCW might not be effective (low distraction).
2. How to set triggers for AEBS intervention?
3. How to develop comfortable and safe automated driving?

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