Assessing Safety Interactions Between Trucks and Vulnerable Road Users Using a Truck Simulator
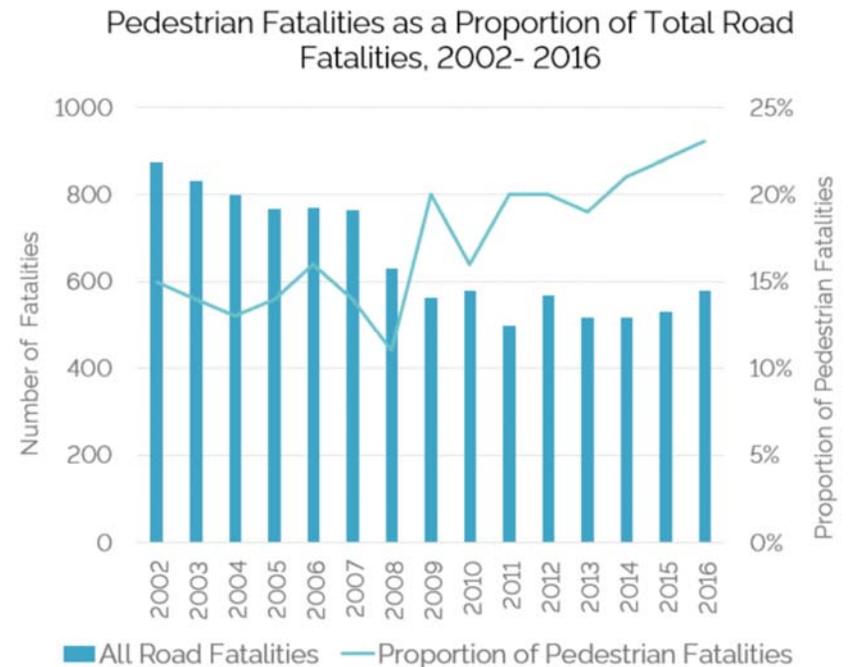
By: Alia Galal

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SMART FREIGHT CENTRE

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING
Transportation Research Institute

Background and motivation

- ~ **1.2 million** pedestrians die and **50 million** get injured annually in road collisions [1]

- 69% of fatal collisions in Toronto from 2006 to 2019 involved a vulnerable road user (VRU): 56% pedestrians, 5% cyclists [2]

- **Truck crashes** are more severe than other vehicle crashes
 - Pedestrians are **2 to 4 times** more likely to be severely injured or die in truck collisions [3]

Pedestrian Fatalities as a Proportion of Total Road Fatalities, 2002- 2016

Legend: ▮ All Road Fatalities —— Proportion of Pedestrian Fatalities

Ontario

Literature findings: Truck-VRU crashes

- **Location-related factors**: more crashes in residential and urban areas

- **Infrastructure-related factors**: intersections, smaller number of lanes, higher road speed

- **Vehicle-related factors**: blind spots, lack of blind spot mirrors, improper use and adjustment

- **Driver-related factors**: drowsiness, fatigue, distractions, aggressiveness
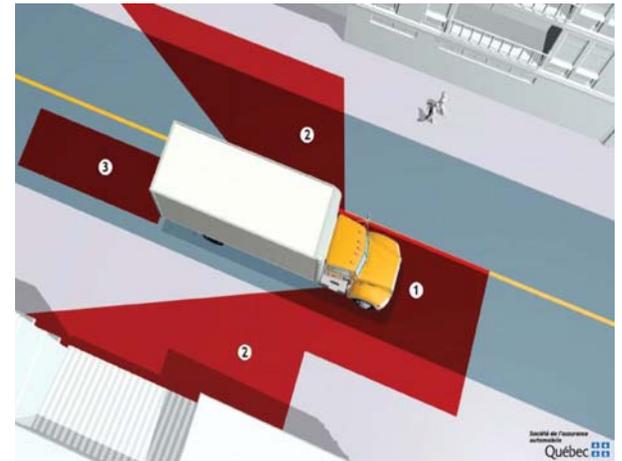
Literature review: Latent hazard anticipation
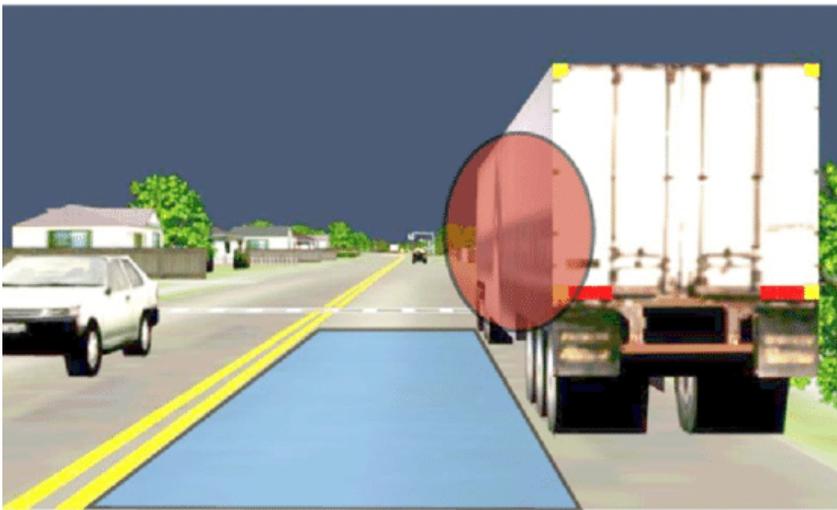
- Strongest predictor for truck crashes is **driver error**, caused by **recognition**, decision errors (e.g **risk perception**, etc.) or **distractions** [4]

- Hazard anticipation:
  - **awareness** of traffic risks and **threats to safety**,
  - visual search to **detect** elements contributing to unsafe situations,
  - **predicting** latent/hidden hazards, and
  - **responding** accordingly to avoid conflicts

- Latent hazards: potential threats, not explicitly materialized yet

Literature review: Truck driver training

- "Current Canadian truck driver training standards are **inadequate**" [5]
- No preparation to drive in certain settings [5]
- Recommendation: more behind-the-wheel training [5]
- Overall positive opinions on **simulator-based training** [6]
- Suggestions:
  - better implementation of the program ("serious training tool")
  - more realistic driving environment [6]

Research plan

🎯 **Aim: inform the development of hazard anticipation training and testing procedures for enhancing the safety of truck-VRU interactions, using:**

1. **Truck simulator**
   - quarter cab heavy truck miniSim developed by the University of Iowa National Advanced Driving Simulator (NADS)
   - High reality and validity

2. **Eye-tracking glasses**
   - Examine whether participants perform necessary checks
   - Effect of in-vehicle distraction on truck drivers' latent hazard anticipation skills

Research plan: summary of tasks

1. Online interviews

2. Create simulator scenarios

3. Test drivers' skills

4. Analyze results

5. Training & testing modules

6. Validate training module

Research plan: Expected contributions

- The first study on truck driver's VRU-related latent hazard anticipation skills

- Suggestion of a training and testing procedure for improving latent hazard anticipation skills

- Expected results: truck drivers have enhanced anticipation skills and VRU safety is significantly improved

Key Takeaways

- Truck crashes with VRUs is a serious problem
- Driver recognition and decision errors and distractions are main reasons for truck crashes
- Truck driver training standards in Canada are inadequate
→Improving hazard anticipation skills of truck drivers
→Proposing hazard anticipation training and testing procedures
→Using truck simulator and eye tracking equipment

References

[1] Desapriya, E., Subzwari, S., Sasges, D., Basic, A., Alidina, A., Turcotte, K., & Pike, I. (2010). Do light truck vehicles (LTV) impose greater risk of pedestrian injury than passenger cars? a meta-analysis and systematic review. *Traffic Injury Prevention*, *11*(1), 48–56. https://doi.org/10.1080/15389580903390623

[2] City of Toronto. (2020). *Traffic Collision Fatalities Dashboard*.

[3] Roudsari, B. S., Mock, C. N., Kaufman, R., Grossman, D., Henary, B. Y., & Crandall, J. (2004). Pedestrian crashes: Higher injury severity and mortality rate for light truck vehicles compared with passenger vehicles. *Injury Prevention*, *10*(3), 154–158. https://doi.org/10.1136/ip.2003.003814

[4] Hanowski, Richard J, Hickman, J. S., Blanco, M., & Fitch, G. M. (2011). Long-haul truck driving and traffic safety: studying drowsiness and truck driver safety using a naturalistic driving method. *Sleep, Sleepiness and Traffic Safety. NY: Nova Science Publishers Inc*.

[5] Malkin, J., Crizzle, A. M., Zello, G., Bigelow, P., & Shubair, M. (2020). Long-haul truck driver training does not meet driver needs in Canada. *Safety and Health at Work*.

[6] Morgan, J. F., Tidwell, S., Blanco, M., Medina, A., Hanowski, R. J., & Ajayi, O. C. (2017). *Driver Opinions of Simulator-Based Commercial Driver Training*.

Thank you!

Literature gaps

- Most of the literature is based on the analysis of crash data and driving records
  - o sample sizes are small,
  - o information is relatively limited,
  - o do not allow for a comprehensive study of hazard anticipation failures of drivers.
- Lack in studies examining truck driver's ability to anticipate VRUs related hazards
- The effect of latent hazard anticipation **training** on truck drivers and VRU safety
- The effect of **distraction engagement** on VRU-related latent hazard anticipation skills of truck drivers   BD6

BD6   What about other driver states? Do you not want to highlight those here?

Birsen Donmez, 11/23/2020