Safety of snowplows at road-rail level crossings:

Summary of the human factors issues involved in the January 2018 London ON level crossing crash.

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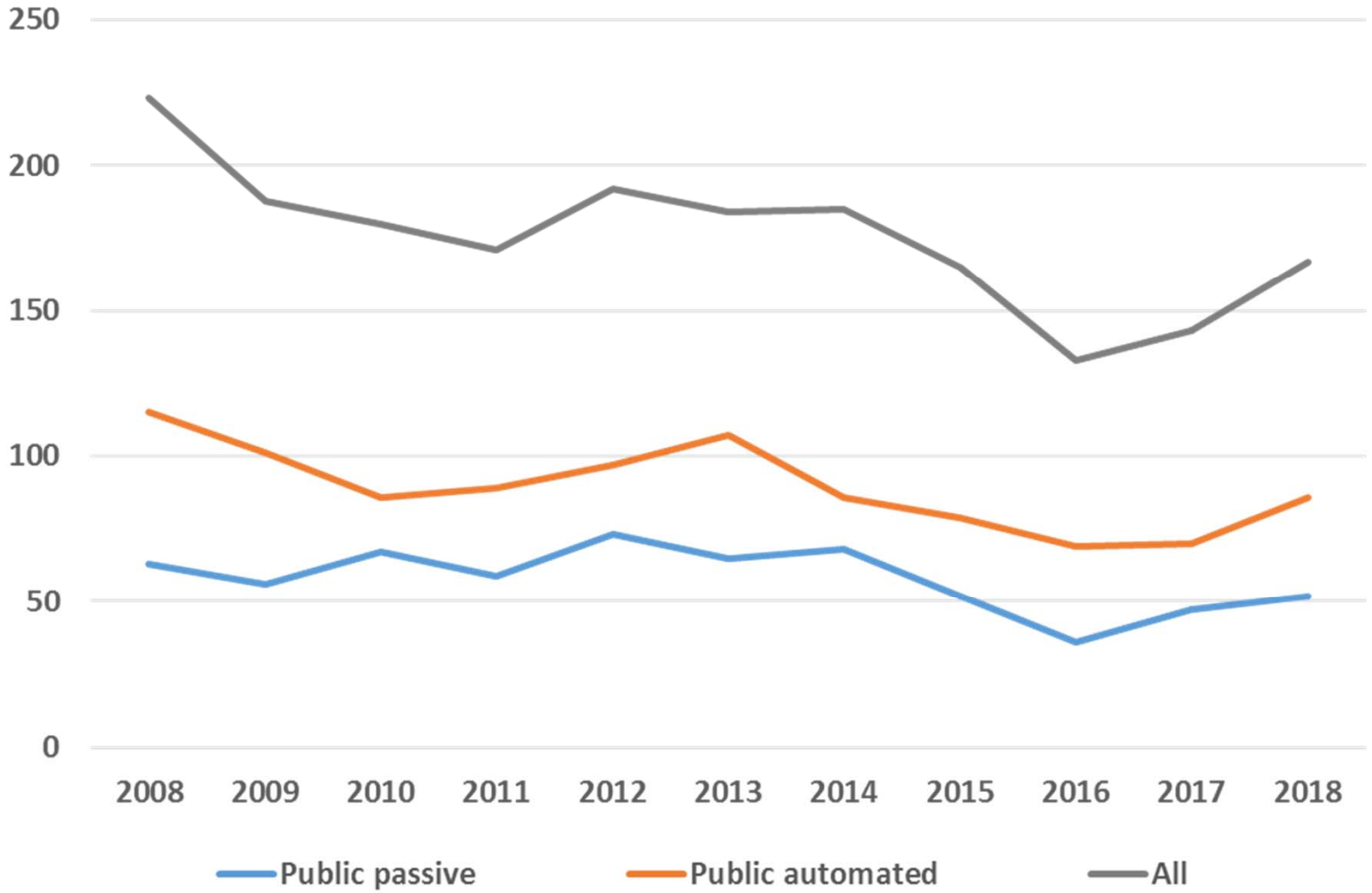
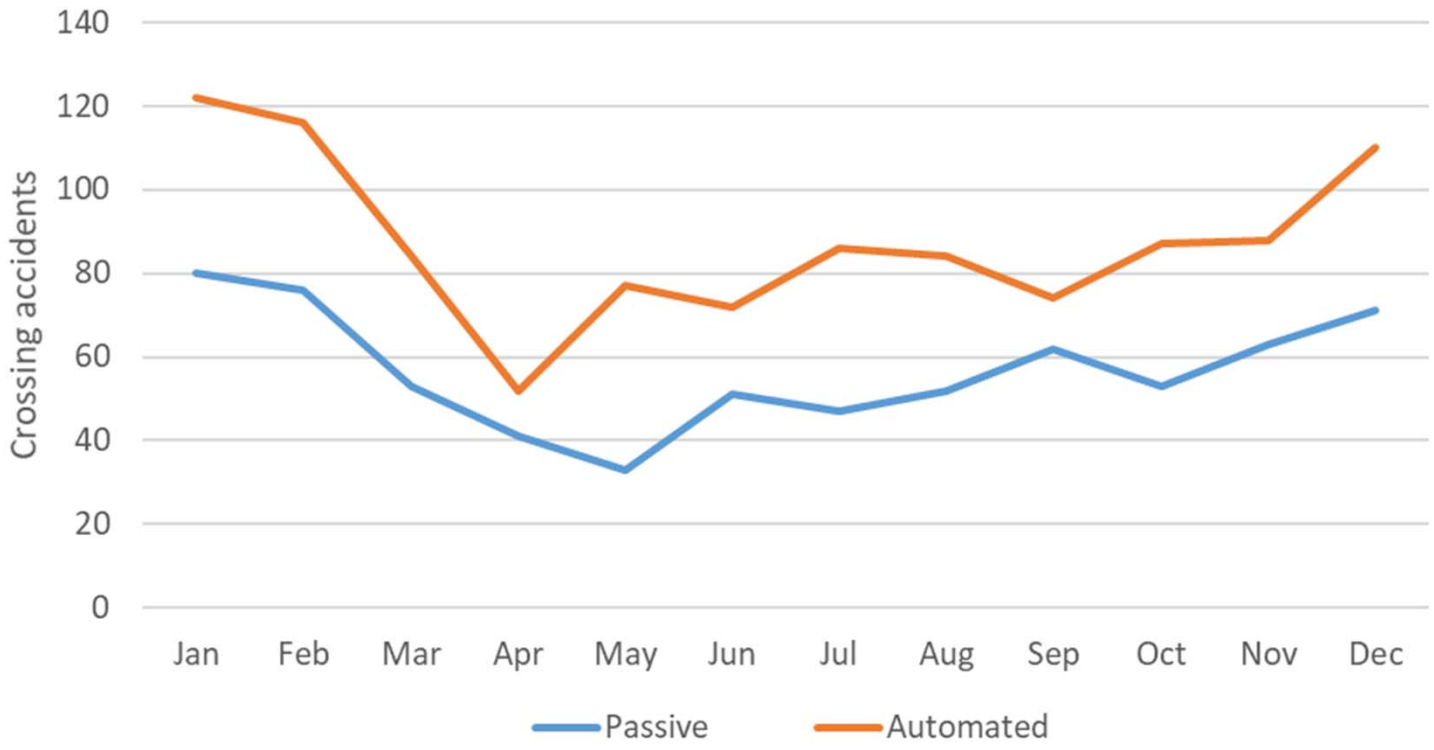
Level crossing accidents in Canada (2008 – 2018):



Crossing accidents by month:



Transportation Safety Board of Canada (TSB)

- independent agency that investigates air, marine, pipeline, and rail occurrences (~230 employees, 5 Board members)
- 6 'multi-modal' human factors investigators
- apply multi-causality model of accident causation, (not a primary or "root" cause model)

- Our philosophy:
  - ***Why*** *did actions and assessments* ***make sense at the time*** *given the conditions and circumstances present?*

Possible risk factors for increase in crossing accidents seen in winter months

1. Weather-related:
   - Visibility (falling/blowing snow, ice fog, fog
   - Impeded sightlines (snowbanks)
   - Road conditions (icy, snowy)
2. Light-related:
   - Shorter days (darkness increases accident risk?)
3. Other:
   - Driver factors?
   - Road / rail traffic levels?
     - Fleet composition? Snowplows ↑

Level crossing accident (London) – January 9, 2018

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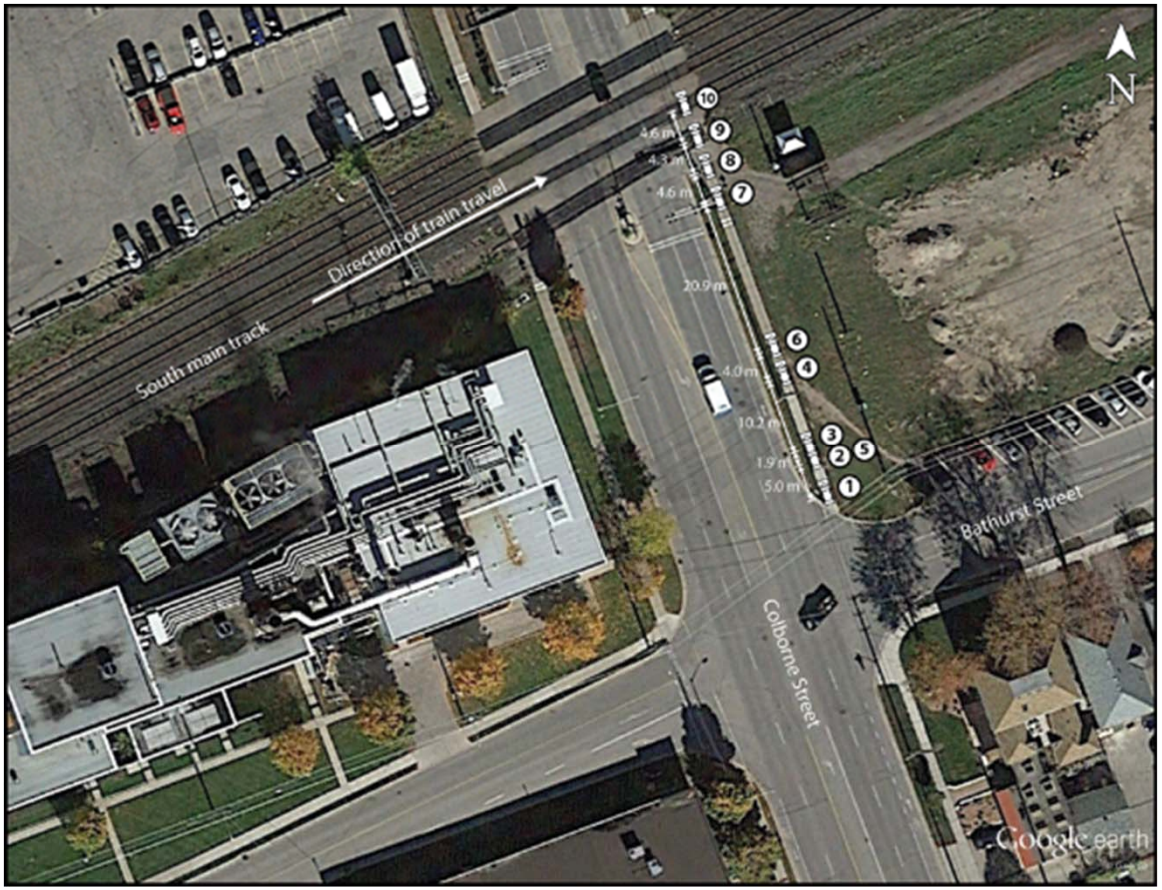


Level crossing accident (London) – January 9, 2018

Colborne Street crossing, facing north

Safety significant event: Snowplow proceeds onto tracks in front of train despite presence of multiple warning cues

Why?

Human factors issues

***** Warning conspicuity (audibility and visibility) *****

1. Locomotive horn audibility
2. Sightlines from within snowplow cab
3. Hazard detection and information processing
4. Snowplow operator attention, expectations and knowledge
5. Snowplow operator state
   → Fatigue
   → Impairment?

1. Locomotive horn audibility

- Regulatory requirements specify horn must be capable of producing minimum sound level of 96 dB(A).
- Described as “secondary alerting system” because effectiveness limited by dampening of sound by vehicle’s shell and by horn mounting configuration
- Snowplow ambient noise reduced train horn audibility
- With snowplow windows closed, train horn was at alerting level less than 1 second prior to the locomotive entering the crossing.

Horn outside

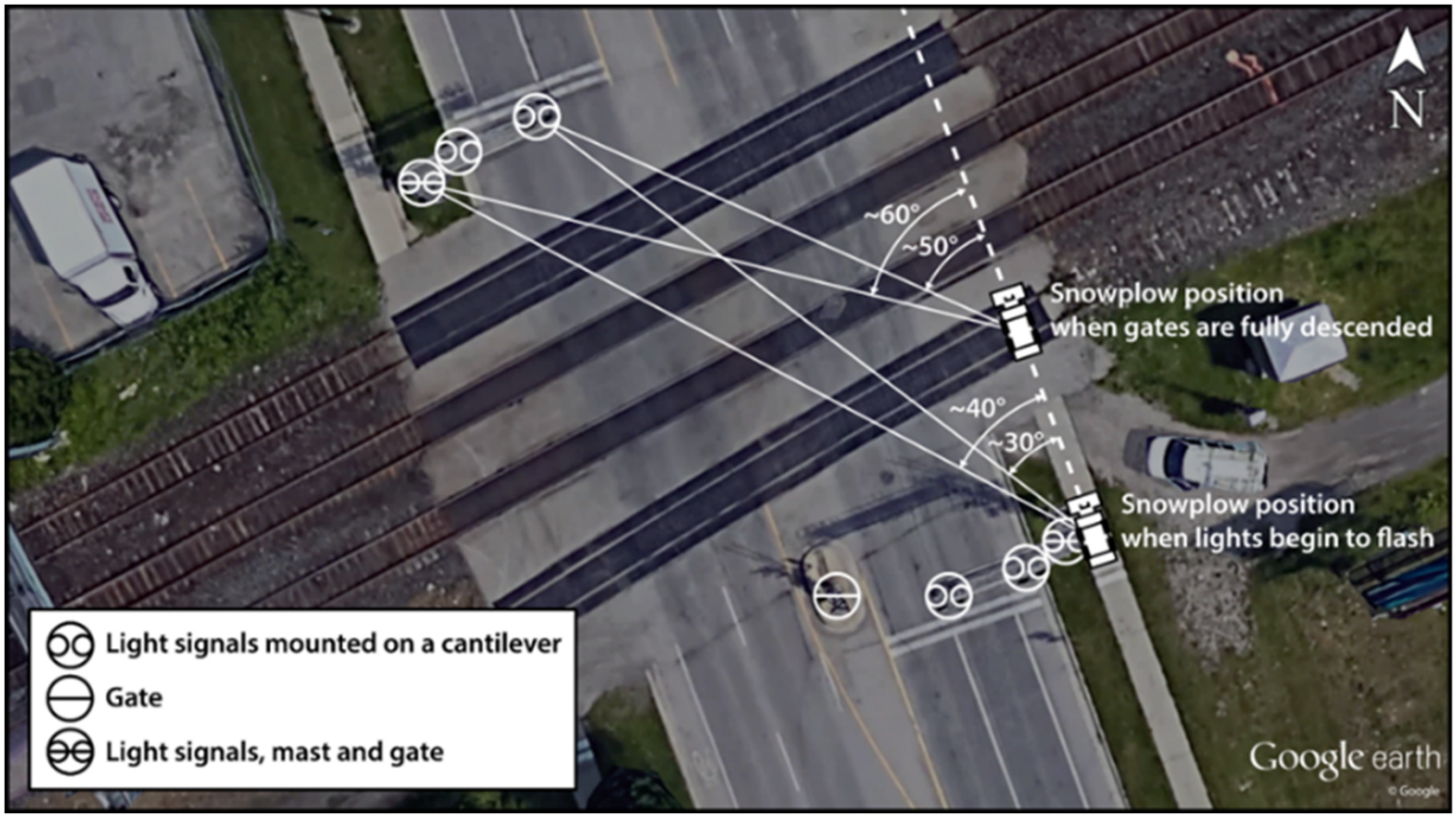
Horn inside

2. Sightlines from within snowplow cab

Operator's view to the northwest:

3. Hazard detection & information processing

Viewing angles from cab to crossing warning devices:



4. Snowplow operator attention, expectations and knowledge

- New job. Fifth shift.
- G1 driver's license.
- Limited experience with crossing as a driver.
- Experienced forklift operator.
- Factors that can lead to "tunnel vision":
  - deep concentration on a difficult task,
  - limited experience performing a task,
  - the effects of fatigue,
  - the effects of drugs or alcohol,
  - increased workload, and
  - environmental stressors such as loud noises.

5. Snowplow operator state - Fatigue

- Fatigue common in winter maintenance operations (Camden et al., 2019)
- Impairs:
  - information-processing speed,
  - active eye movements, and
  - person's ability to process information from the peripheral visual field
- Snowplow operator awake 22 hours; on the job 11 hours

5. Snowplow operator state - Impairment

- THC: principal psychoactive cannabinoid found in marijuana
- Impairs several cognitive functions involved in safe operation of vehicles, including ability to divide attention among multiple tasks (Bondallaz et al., 2017)
- maximum legal concentration of THC in the blood within 2 hours of driving is 2.0 ng/mL
- Snowplow operator's blood toxicology positive for THC (11.9 (+/− 1.5) ng/mL)
- Could not determine level of impairment (regular user, timing of use unknown)

Safety mitigations:

1. Operator training
2. Oversight of contractors by City of London
3. Oversight of employees by contractors
4. Safe work procedures at crossings during snow-clearing operations
5. ~~Warning system design? Crossing geometry?~~

For more information: http://www.bst-tsb.gc.ca/eng/enquetes-investigations/rail/2018/R18T0006/R18T0006.html

Questions?

Thank-you!

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