Evaluation of the Effectiveness of Stop Lines in Increasing the Safety of Stop-Controlled Intersections

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Agenda

1. Background
2. Objectives
3. Cross-Sectional Safety Study
4. Observational Safety Study
5. Conclusions
Background

- Funded by MnDOT/LRRB
- No definite guidance on when to use stop line
- Focus on Non-All-Way Stop-Controlled Intersections (NAWSCIs)

Objectives

Cross-Sectional Safety Study
- Develop models to relate expected crash frequency to relevant site characteristics (including presence of stop line)

Observational Safety Study
- Compare stopping behavior and location before and after a stop line was added
Cross-Sectional Safety Study

General approach
1. Create dataset of NAWSC approach-years and respective number of crashes
2. Compare crashes per approach-year with vs without a stop line
3. Control for confounding variables
   - AADTs of major and minor roads
   - Presence of a crosswalk
   - Intersection geometry
   - Available sight distance
   - Speed limit on major road

Data needs
- All NAWSCIs in a geographic area (city)
- For each minor approach at the NAWSCIs:
  - Crash data by year
  - Stop line and crosswalk presence by year
  - AADTs for major and minor roads by year
  - Major road speed limit (assume no change)
  - Left and right sight distances (assume no change)
Cross-Sectional Safety Study

Data sources

• Five cities’ shapefiles
  – Richfield
  – Edina
  – Roseville
  – St. Louis Park
  – Golden Valley

Cross-Sectional Safety Study

Data sources

• MnDOT crash databases
• Five cities’ shapefiles
• MnDOT Streetnames layer
• MnDOT AADT layer
• MnGeo, Google Earth, & Google Street View historical imagery
• Openstreetmaps
Cross-Sectional Safety Study

Data processing
• Manually pin center of each NAWSCI
• Adjust stop sign pins from cities’ shapefiles to match MnDOT Streetname layer
• Clean crash records

Data processing (cont.)
• Identify all approaches
  – Automate for simple cases
  – Flag complex cases for manual review
• Extract AADTs and street names for all approaches
  – Interpolate missing years when reasonable
Cross-Sectional Safety Study

Data processing (cont.)

- Extract speed limits for all major approaches
  - Automate first pass
  - Use OSM, Google Maps, & assumptions for missing speeds
- Calculate required sight distances from each minor approach

Cross-Sectional Safety Study

Data processing (cont.)

- Evaluate adequacy of available sight distance
Cross-Sectional Safety Study

Data processing (cont.)
- Record presence of stop line and/or crosswalk each year

Data analysis
- Throw out incomplete records

<table>
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<tr>
<th>City</th>
<th>Num. Approaches</th>
<th>Num. Approach-Years</th>
<th>Num. Usable Approach-Years</th>
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Cross-Sectional Safety Study

Data analysis
- First, use binary logistic regression model with presence of a stop line as the only variable to assess correlation of stop line presence and crash rate
- Progressively add additional factors (major road AADT, adequacy of available sight distance, and major road speed limit) to model to help identify confounding variables

Results
- Analysis done with 4/5 cities showed no discernable impact from stop line
- Adding in St. Louis Park altered the results
- MTO is further investigating validity of new result
Observational Safety Study

General approach
1. Select sites for filming
2. Film selected sites for two weeks
3. Paint stop line
4. Wait two weeks for drivers to grow accustomed to new line
5. Film for two more weeks
6. Watch videos to compare stopping location and behavior before vs after

Site selection
- Create list of potential sites
  - Personal knowledge
  - Cities’ stop sign shapefiles
- Record attributes of sites
  - Intersection geometry
  - AADT
  - Presence of stop line and/or crosswalk
  - Speed limit
Observational Safety Study

Preliminary field work
- Check stop line status
- Measure available sight distance
- Locate pole for mounting camera

Observational Safety Study

Site selection
- Select sites based on:
  - Variety of intersection geometries
  - Variety of speed limits
  - Variety of available sight distances
  - Variety of AADTs
  - Availability of camera mounting location
  - Cities’ willingness to allow filming
Observational Safety Study

Video collection and painting
- 16 intersections at 21 approaches
- 8,205 hours of video

Observational Safety Study

Site measurement and video calibration
Observational Safety Study

Site measurement and video calibration

Observational Safety Study

Video data reduction – 1st pass

- 15-minute counts of vehicles entering via each approach
- Used to select days for further event logging

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<th>Minor B</th>
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Observational Safety Study

Video data reduction – 2nd pass

• Event data collected for each minor road vehicle
  – Stopping behavior (stop, roll, or ignore)
  – Stopping location (ft from centerline of major road)
  – Vehicle movement
  – Presence of pedestrians, vehicles on major road, and/or other vehicles on the minor road

Data analysis

• Total crossing behavior per site before/after
• Stopping locations for stopping vehicles before/after
• Histograms of roll/ignore events
• Pedestrian/no pedestrian analyses compared
Next Steps

- Further work examining the safety study results required for validation
- Investigation into site-specific factors affecting effectiveness of stop lines
Questions?

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