Median/Centerline Barriers at Highway-Railroad Crossings for Improving Safety

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Background

• Unsafe behavior by motorists at highway-railroad grade crossings in NE is a concern

• Relatively low-cost solution

• Median/centerline barrier

• Effectiveness?
QuickKurb Centerline Barrier

• Used in areas with winter conditions
• 1 yr snow plow, 2 yr materials & workmanship and 5 yr road hazard warranty
• Reusable
Study Site

M-Street Crossing, Fremont, NE
Surveillance Equipment

- Day & Night Vision Camera & DVR
Data Collection

• Collected data items
  – Day & time of observation
  – Duration of gate closure (from gate down & up times)
  – Weather (snow, rain, fog, …)
  – Number of crossing trains, stoppage on tracks, gate malfunction
  – Vehicular queue at gate opening
  – U-turns, using wrong side of road, gate rush, alternate route usage, red light running to beat train, vehicles backing up, other unsafe maneuver
Fremont Data

- Total number of train crossing observations = 5,126
- Three time periods – pre-barrier, limited install, full install
Collected Data

- Pre-barrier train crossings: 2,989
- Limited install period crossings: 829
- Full install period crossings: 1,245

<table>
<thead>
<tr>
<th>Driver Action</th>
<th>Pre-barrier period</th>
<th>% of total</th>
<th>Limited install period</th>
<th>% of total</th>
<th>Full install period</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of gate rushes to beat train</td>
<td>539</td>
<td>66.71</td>
<td>112</td>
<td>13.86</td>
<td>157</td>
<td>19.43</td>
</tr>
<tr>
<td>No. of drivers taking alt route</td>
<td>1665</td>
<td>69.61</td>
<td>257</td>
<td>10.74</td>
<td>470</td>
<td>19.65</td>
</tr>
<tr>
<td>No. of U-turns</td>
<td>1235</td>
<td>85.06</td>
<td>85</td>
<td>5.85</td>
<td>132</td>
<td>9.09</td>
</tr>
<tr>
<td>No. of drivers that backed up</td>
<td>220</td>
<td>34.98</td>
<td>96</td>
<td>15.26</td>
<td>313</td>
<td>49.76</td>
</tr>
<tr>
<td>No. of between/after train</td>
<td>47</td>
<td>83.93</td>
<td>0</td>
<td>0.00</td>
<td>9</td>
<td>16.07</td>
</tr>
<tr>
<td>No. of wrong side entries</td>
<td>0</td>
<td>0.00</td>
<td>72</td>
<td>76.60</td>
<td>22</td>
<td>23.40</td>
</tr>
</tbody>
</table>
Before-After Comparisons

- Combined limited install and full install period data
- Compared differences in pre-install and post-install data

<table>
<thead>
<tr>
<th>Driver action</th>
<th>Pre-barrier period</th>
<th>Post-barrier period</th>
<th>t'-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Std. dev.</td>
<td>Mean</td>
</tr>
<tr>
<td>Number of gate rushes to beat train</td>
<td>0.180</td>
<td>0.684</td>
<td>0.126</td>
</tr>
<tr>
<td>Number of drivers taking alternate route</td>
<td>0.557</td>
<td>1.303</td>
<td>0.340</td>
</tr>
<tr>
<td>Number of U-turns</td>
<td>0.413</td>
<td>0.891</td>
<td>0.102</td>
</tr>
<tr>
<td>Number of drivers that backed up</td>
<td>0.074</td>
<td>0.290</td>
<td>0.191</td>
</tr>
<tr>
<td>Number of wrong side entries</td>
<td>0.000</td>
<td>0.000</td>
<td>0.044</td>
</tr>
</tbody>
</table>
Before-After Comparisons

• Evidence uncovered but some factors are unaccounted

• Unaccounted factors
  – Duration of gate closure
  – Number of trains crossing simultaneously
  – Vehicular (roadway) traffic
  – Weather
  – Weekday/weekend
Accounting for Known Factors

- Count data – Non-negative integer values
  - Number of gate rushes, number of U-turns, etc.

- Poisson and negative binomial regression models
Model for Total Unsafe Maneuvers

- Dependent variable: Count of total undesirable driver maneuvers (U-turns + gate rushes + ...)

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Est. coeff.</th>
<th>Std. error</th>
<th>t'-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of gate closure (in minutes)</td>
<td>0.034</td>
<td>0.0016</td>
<td>21.073</td>
</tr>
<tr>
<td>Gate up and down with no train (yes=1, no=0)</td>
<td>1.307</td>
<td>0.1324</td>
<td>9.869</td>
</tr>
<tr>
<td>Number of crossing trains at the same time</td>
<td>0.191</td>
<td>0.0423</td>
<td>4.513</td>
</tr>
<tr>
<td>Train stopped on crossing (yes=1, no=0)</td>
<td>0.642</td>
<td>0.0449</td>
<td>14.303</td>
</tr>
<tr>
<td>Gate malfunction (yes=1, no=0)</td>
<td>1.715</td>
<td>0.2898</td>
<td>5.917</td>
</tr>
<tr>
<td>Period dummy (pre-install=1, post-install=0)</td>
<td>0.182</td>
<td>0.0459</td>
<td>3.972</td>
</tr>
<tr>
<td>Constant</td>
<td>-2.221</td>
<td>0.0792</td>
<td>-28.054</td>
</tr>
<tr>
<td>Alpha</td>
<td>0.431</td>
<td>0.0316</td>
<td>12.626</td>
</tr>
</tbody>
</table>
Summary

• Main Finding: Barrier reduced unsafe driver actions
• Factors found significant
  – Duration of gate closure
  – Gate malfunction
  – Number of crossing trains
  – Train stoppage on the crossing
Maintenance Issues

• Damage to curbing
  – Traffic running over curbing
Maintenance Issues

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Maintenance Issues

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