EFFECTS OF LEFT TURN TREATMENTS ON INTERSECTION SAFETY

Azadeh Azad
Emelinda Parentela

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OVERVIEW

- INTRODUCTION
- METHODOLOGY
- CONCLUSION
Road fatalities represent a major engineering and public health concern.

In the U.S., intersections are the locations with the highest number of motor vehicle crashes, with over 2.8 million intersection-related crashes occurring each year. (FHWA)

These crashes resulted in the loss of about 8,500 lives and over 1 million injuries per year.
INTRODUCTION

➢ This paper presents analysis of the type of left-turn control & its impact on safety at signalized intersections.

➢ The number of accidents is correlated with:

1. The Type of left-turn control
2. Speed
3. Number of lanes
4. Other variables
INTRODUCTION
The left-turn operation is a critical component for the safe and efficient operation of a signalized intersection.

Selection of the type of left-turn protection is normally based on:

- Volumes of the left-turning vehicles
- Cross product of left-turning movements & opposing flow
- Intersection Geometry
- Speed
- Accident History
LEFT – TURN OPTIONS

- Manual on Uniform Traffic Control Devices (MUTCD); Left-turning movements at signalized intersections may operate under:

1) **Protected –only** Left turn Control
2) **Permissive –only** Left turn Control
3) **Protected/Permissive** Left turn Control
“Protected –Only” Left-Turn Phasing

(a) Protected left-turn phasing using a three-section signal head with red, yellow, and green arrows.

(b) Protected left-turn phasing using a three-section signal head with red ball, yellow arrow, and green arrow and an accompanying sign.
“Permissive –Only” Left-Turn Phasing

(a) Permissive left-turn phasing using three-section signal heads over the through lanes only.

(b) Permissive left-turn phasing using three-section signal heads over the through lanes and a three-section signal head and accompanying sign over the left turn lane.
“Protected - Permissive” Left-Turn Phasing
“Protected - Permissive” Left-Turn Phasing

(a) Protected-permissive left-turn phasing using a five-section head located directly above the lane line that separates the exclusive through and exclusive left-turn lane, along with an accompanying sign.

(b) Protected-permissive left-turn phasing using a five-section signal head located directly above the exclusive left-turn lane.
METHODOLOGY

Data Collection

Intersection Geometry
Traffic Volume
Accident Data
Signal Phasing
# Intersection Information

<table>
<thead>
<tr>
<th>NO.</th>
<th>Intersection</th>
<th>Street Dir.</th>
<th>Speed Limit (mph)</th>
<th>No. of Lane (EB)</th>
<th>No. of Lane (WB)</th>
<th>Width of Lane (ft)</th>
<th>Intersection</th>
<th>Street Dir.</th>
<th>Speed Limit (mph)</th>
<th>No. of Lane (NB)</th>
<th>No. of Lane (SB)</th>
<th>Width of Lane (ft)</th>
<th>Type of Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Imperial HWY</td>
<td>E/W</td>
<td>35</td>
<td>3</td>
<td>3</td>
<td>12</td>
<td>Inglewood Ave.</td>
<td>N/S</td>
<td>35</td>
<td>2</td>
<td>2</td>
<td>12</td>
<td>Permissive</td>
</tr>
<tr>
<td>2</td>
<td>Imperial HWY</td>
<td>E/W</td>
<td>35</td>
<td>3</td>
<td>3</td>
<td>12</td>
<td>Hawthorne Blvd.</td>
<td>N/S</td>
<td>35</td>
<td>3</td>
<td>3</td>
<td>12</td>
<td>Protective</td>
</tr>
<tr>
<td>3</td>
<td>120th St.</td>
<td>E/W</td>
<td>40</td>
<td>3</td>
<td>2</td>
<td>12</td>
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<td>N/S</td>
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<td>3</td>
<td>3</td>
<td>12</td>
<td>Protective</td>
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<tr>
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<td>E/W</td>
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<td>3</td>
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<td>Hawthorne Blvd.</td>
<td>N/S</td>
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<td>Prairie Ave.</td>
<td>N/S</td>
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<td>3</td>
<td>3</td>
<td>12</td>
<td>Prot / Perm</td>
</tr>
<tr>
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<td>40</td>
<td>3</td>
<td>3</td>
<td>12</td>
<td>Crenshaw Blvd.</td>
<td>N/S</td>
<td>40</td>
<td>3</td>
<td>3</td>
<td>12</td>
<td>Prot / Perm</td>
</tr>
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<td>3</td>
<td>3</td>
<td>12</td>
<td>Hindry Ave.</td>
<td>N/S</td>
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<td>2</td>
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<td>3</td>
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<td>Prot / Perm</td>
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</tbody>
</table>
Total & Left Turn Accident Rates vs. Intersection

Accident Rate (Year 2010)

<table>
<thead>
<tr>
<th>Intersection No.</th>
<th>Total Accident Rate</th>
<th>Left Turn Accident Rate</th>
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</thead>
<tbody>
<tr>
<td>1</td>
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<td>0.23</td>
<td>0.09</td>
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<td>0.26</td>
<td>0.10</td>
</tr>
<tr>
<td>6</td>
<td>0.40</td>
<td>0.20</td>
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<tr>
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<td>0.30</td>
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<tr>
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<td>0.35</td>
<td>0.15</td>
</tr>
<tr>
<td>10</td>
<td>0.42</td>
<td>0.20</td>
</tr>
</tbody>
</table>
Total Accident Rate vs. Type of Signal Control

**Total Accident Rate**

- Prot/Prot
- Perm/Perm
- Prot/Prot-Perm
- Prot-Perm/Prot-Perm
Left Turn Accident Rate vs. Type of Signal Control
Accident Rate vs. Type of Signal Control

Average Accident Rate

Accuracy Rate, acc/million veh

Left Turn Control Type
1=Protective/Protective; 2=Protective/Protective-Permissive; 3=Protective-Permissive/Protective-Permissive; 4=Permissive/Permissive

Average Total Accidents
Average Left Turn Accidents
CONCLUSION

- Evaluates the effects of different types of left-turn signal control on intersection safety.

- 10 four-leg signalized intersections with different type of traffic signals were studied.

- Intersection with:
  Permissive/Permissive left turn ➔ highest left-turn accidents.
  Protective/Protective left turn ➔ lowest left turn accidents.

- The use of a combination of protective-permissive left turn controls show mixed-results.
THANK YOU