Red-Light-Running Problem Assessment and Countermeasures

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Overview

• Scope and Key Points
• Red-Light Running Problem & Consequences
• Four-Step Solution Process
• Problem Assessment & Countermeasures
• Implementation Plans
Scope & Key Points

• **Scope**
  – Handbook is intended for use by engineers and technicians working with law enforcement to address safety problems related to red-light-running.

• **Key Points**
  – Solution to RLR is 3-E process that starts with engineering
  – Focus is on crashes, not violations
  – Find and treat truly problem locations
  – Goal is to drop crashes to reasonable levels
  – If engineering treatments unsuccessful, try enforcement & public awareness campaign

The Problem

• **At a Typical Intersection...**
  – A red light violation occurs every 25 minutes
  – Every sixteenth signal cycle

• **At Busy Intersections...**
  – A red light violation occurs every 5 minutes
  – Every third signal cycle
The Consequences

- **Red-Light-Related (RLR) Crashes**
  - 15% of all intersection-related
  - 72% of right-angle, 10% of left-turn opposed
  - More likely to be severe

Violations and Crashes

<table>
<thead>
<tr>
<th>Time into Red of Red-Light Violation</th>
<th>Less than 4 seconds</th>
<th>4 or more seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of RLR Violations</td>
<td>95 %</td>
<td>5 %</td>
</tr>
<tr>
<td>Percent of RLR Crashes</td>
<td>15 %</td>
<td>85 %</td>
</tr>
<tr>
<td>Typical RLR Crash Type</td>
<td>Left-turn opposed</td>
<td>Right-angle</td>
</tr>
</tbody>
</table>
A 4-Step Solution Process

1. Conduct Engineering Study to Verify Problem

2. Implement Engineering Countermeasures
   - Check yellow duration
   - Improve signal visibility, etc.

Solution Process (cont.)

3. Use Area-Wide Officer Enforcement (include public awareness campaign)

4. If Problem Still Exists....
   - May consider automated enforcement
   - Monitor rear-end crash frequency
Problem Assessment

• Are red-light-related crashes overrepresented:
  – At this intersection?
  – Over the general area?

• If so, what is the most likely cause?
• What countermeasures are available for this most likely cause?

Cause Categories

• Unnecessary Delay
  – Violations that reflect a perception that there is...
    • No need to stop because no conflicting movements or,
    • A significant delay penalty that is unjustified by the light traffic volume.
Cause Categories

• **Congestion**
  – *Violations that reflect frustration after experiencing lengthy delay.*

• **Dense Traffic**
  – *Violations by platoon drivers in coordinated signal system. They get caught when progression band is constrained at trailing edge by signal timing.*

Vehicle position at the onset of yellow.
**Cause Categories**

- **Incapable of Stop**
  - Violation when driver sees yellow indication but determines that it is impossible to stop

- **Inattentive**
  - Violation when driver does not see signal (or sees it too late to respond).

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**Transportation Operations Group**

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**Note:** Consider targeted camera enforcement only after visible, targeted officer enforcement has been tried but found not cost-effective.
Engineering Countermeasures

- Many Available
  - Handbook lists 23 countermeasures
  - Examples...
    - Reduce delay by retiming signal
    - Remove unneeded signals
    - Add capacity using additional traffic lanes
    - Add advance warning signs
    - Add advance detection
    - Improve signal coordination & increase cycle length
    - Protected-only left-turn phasing
- Different violation causes = different countermeasures

<table>
<thead>
<tr>
<th>Category</th>
<th>Countermeasure</th>
<th>Cause of Violation in Typical Crash</th>
<th>Inattentive (A)</th>
<th>Unnecessary Delay (B)</th>
<th>Congestion, Dense Traffic (C)</th>
<th>Incapable of Stop (D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Char.</td>
<td>Reduce approach speed</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Signal Operation</td>
<td>Increase signal cycle length if v/c ratio &lt; 0.60</td>
<td>✓</td>
<td></td>
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<td>✓</td>
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<tr>
<td></td>
<td>Increase yellow interval duration (not to exceed 5.5 s)</td>
<td>✓</td>
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<tr>
<td></td>
<td>Provide green extension (advance detection)</td>
<td>✓</td>
<td></td>
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<tr>
<td></td>
<td>Add protected-only left-turn phasing</td>
<td>✓</td>
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<tr>
<td>Motorist Information</td>
<td>Improve signal visibility via better signal head location</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td></td>
<td>Improve signal visibility via additional signal head</td>
<td>✓</td>
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<tr>
<td></td>
<td>Improve signal visibility by clearing sight lines to signal</td>
<td>✓</td>
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<tr>
<td></td>
<td>Improve signal conspicuity by upgrading to 12&quot; lenses</td>
<td>✓</td>
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<tr>
<td></td>
<td>Improve signal conspicuity by using yellow LED's</td>
<td>✓</td>
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<tr>
<td></td>
<td>Improve signal conspicuity by using red LED's</td>
<td>✓</td>
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<tr>
<td></td>
<td>Improve signal conspicuity by using back plates</td>
<td>✓</td>
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<tr>
<td></td>
<td>Improve signal conspicuity by using dual red indicators</td>
<td>✓</td>
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<td></td>
<td>Add advance warning signs (no flashers)</td>
<td>✓</td>
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<tr>
<td></td>
<td>Add advance warning signs with active flashers</td>
<td>✓</td>
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<tr>
<td>Traffic Operation</td>
<td>Reduce delay through re-timing if v/c ratio &gt; 0.70</td>
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<tr>
<td></td>
<td>Reduce unnecessary delay through signal re-timing</td>
<td>✓</td>
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<tr>
<td>Geometry</td>
<td>Remove unneeded signals</td>
<td>✓</td>
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<tr>
<td>Add capacity with additional lanes or turn bays</td>
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<tr>
<td>Education</td>
<td>Implement public awareness campaign</td>
<td>✓</td>
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<tr>
<td>Enforcement</td>
<td>Increase officer enforcement</td>
<td>✓</td>
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<tr>
<td></td>
<td>Implement camera enforcement</td>
<td>✓</td>
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</table>
**Cycle Length & Delay**

- \( \frac{v}{c} = \frac{vC}{Sg} \)
- \( d = 0.5 \left( \frac{v}{c} \right)^2 \frac{v}{(1-v/c)} \)

**Expected Red-Light-Running Frequency, veh/h**

- 900 veh/h
- 700 veh/h
- 500 veh/h

**Delay**

- Short Cycle
- Long Cycle
- Low Delay
- High Delay

**Yellow Interval**

- **Effect of Yellow Duration**
  - 6 hrs data at each of 48 intersections
  - 595 red-light violations

**Observed Red-Light-Running Frequency, veh/h**

- "deficient" -> "generous"

<table>
<thead>
<tr>
<th>Speed, mph</th>
<th>Yellow, s</th>
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<tbody>
<tr>
<td>30</td>
<td>3.2</td>
</tr>
<tr>
<td>35</td>
<td>3.6</td>
</tr>
<tr>
<td>40</td>
<td>3.9</td>
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<tr>
<td>45</td>
<td>4.5</td>
</tr>
<tr>
<td>50</td>
<td>4.7</td>
</tr>
<tr>
<td>55</td>
<td>5.0</td>
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Information Transfer

• Red-Light-Running Handbook
  Training
• Tools
  – Red-Light-Running Handbook
  – Texas Red-Light-Running
    Evaluation & Analysis Tool
    (TREAT) spreadsheet
  – Available on-line at tcd.tamu.edu;
    select “Products”
• Workshop Series
  – El Paso                July 6, 2006

Closure

• Acknowledgements
  – TxDOT Project 4027, Signalization
    Countermeasures to Red-Light-Running
  – TxDOT Project 4196, Safety Effects
    of Red-Light-Running, Where is
    Enforcement Really Needed?
  – PD: Wade Odell
• More info: tcd.tamu.edu
• Questions or Comments?