Tailgating Issues on Urban Highways and Counter-Tailgating Measures

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Introduction

Terminology

- Tailgating: Following a vehicle with insufficient vehicle headway
- Vehicle headway:
  Time interval between two following vehicles.

Crash Statistics:

- 6 million crashes per year in the US*
  - 2.5 million rear-end crashes.
  - 2,200 fatalities, half million injuries per year.
- Major cause: Tailgating
Driving Simulation

Description

Objectives:

- Assess drivers’ driving behavior regarding tailgating in a simulated environment.
- Assess the effect of advisory signs as counter-tailgating measures.
- Assess the effect of educational video.
Driving Simulation
Description

- Simulator
  - Input:
    - sedan’s steering wheel and pedals with force feedback.
  - Output:
    - 180° forward view, LCD front panel supported by 5 networked computers.

TranSim VS IV simulator by L-3 Communications, Inc.
Driving Simulation
Description

Counter-Tailgating Measures:

- Advisory signs:
  - Advisory Message:
    - Qualitative
    - Quantitative
  - Type of signs

- Educational video:
  - Instructed subject to use a reference point to gauge the vehicle headway, and to slow down if it was less than 2s.
Driving Simulation
Description

Design:

- Baseline Driving Scenario:
  - Highway, 8-minute in length
  - Traffic conditions:
    Changed halfway from heavy to light and vice versa by random assignment.

- Subject:
  - Randomly recruited, with a valid driver license.
  - 36 subjects (Age: 18 – 60, 10 females, 26 males)
Driving Simulation
Results

- **Subjects’ driving behavior:**
  - Average headway: 1.02 seconds < 2 seconds
  - Vehicle headway distribution:

  ![Graph 1](image1.png)
  ![Graph 2](image2.png)

  Vehicle headways collected in light traffic (left) and in heavy traffic (right)
Driving Simulation Results

**Effect of the advisory signs:**

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sign Presence</td>
<td>1</td>
<td>7.012</td>
<td>7.012</td>
<td>54.37</td>
<td>0.000*</td>
</tr>
<tr>
<td>Traffic Condition</td>
<td>1</td>
<td>4.849</td>
<td>4.849</td>
<td>37.60</td>
<td>0.000*</td>
</tr>
<tr>
<td>Error</td>
<td>573</td>
<td>73.769</td>
<td>0.129</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>575</td>
<td>85.630</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

* Significant at $\alpha = 0.05$

![Graph showing the effect of sign presence and traffic condition on average vehicle headway](image)

- **Sign Presence**: P value = 0.000
- **Traffic Condition**: P value = 0.000
Driving Simulation
Results

Effects of the advisory message and the type of sign:

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Sign</td>
<td>1</td>
<td>3.2832</td>
<td>3.2832</td>
<td>22.03</td>
<td>0.000*</td>
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<tr>
<td>Advisory Message</td>
<td>1</td>
<td>0.0886</td>
<td>0.0886</td>
<td>0.59</td>
<td>0.441</td>
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<tr>
<td>Type*Message</td>
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<td>0.4317</td>
<td>0.4317</td>
<td>2.90</td>
<td>0.090</td>
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<tr>
<td>Traffic Condition</td>
<td>1</td>
<td>2.2667</td>
<td>2.2667</td>
<td>15.21</td>
<td>0.000</td>
</tr>
<tr>
<td>Error</td>
<td>283</td>
<td>42.1784</td>
<td>0.1490</td>
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<td></td>
</tr>
<tr>
<td>Total</td>
<td>287</td>
<td>48.2485</td>
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<td></td>
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</tbody>
</table>

* Significant at α = 0.05

![Graph showing effects](image)
Driving Simulation Results

Effect of the educational video:

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>P</th>
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</thead>
<tbody>
<tr>
<td>Video Use</td>
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<td>5.532</td>
<td>5.532</td>
<td>33.95</td>
<td>0.000*</td>
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<td>Traffic Condition</td>
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<td>100.292</td>
<td>100.292</td>
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<tr>
<td>Error</td>
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<td>93.270</td>
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<tr>
<td>Total</td>
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<td>199.094</td>
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</tbody>
</table>

* Significant at α = 0.05
Driving Simulation
Conclusions

- Serious tailgating issue was identified. A need for counter-tailgating measures on urban highways was indicated.

- Tailgating could be mitigated by proposed counter-tailgating measures.

- Compared to fixed advisory message signs, advisory messages posted on overhead DMS were found to be more effective in limiting tailgating behaviors.

- The wording of the message, whether quantitative or qualitative in nature, did not affect the vehicle headway.

- Most subjects were able to maintain a two-second vehicle headway in the simulation after viewing the educational video.