Analysis of the SHRP 2 Naturalistic Driving Study Data [S08(B)]: Evaluation of Offset Left-Turn Lanes

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Research Objectives

Answer the following questions:

– Do offset left-turn lanes affect turn behavior and gap acceptance?
– What effect does the presence of a vehicle in the opposing left-turn lane have?

Can we answer these questions effectively and efficiently using the NDS data?
What is an Offset Left-Turn Lane?

- Positive Offset
- No Offset
- Negative Offset
Left-Turn Lanes and Sight Distance
Identify Intersections and Left-Turn Maneuvers of Interest

- Started with trip maps provided by CTRE
- Used Google Earth to identify intersections with left-turn lanes
  - Focused on routes with a high number of trips
  - Identified intersections with offset left-turn lanes first (assumed to be less common)
  - Zoomed in to street view to verify permissive only or permissive/protective signal timing (for signalized intersections)
  - Then searched same and nearby routes for intersections with negative and zero offset left-turn lanes
  - For all potential study intersections, identified specific turning movements of interest
- Study focused in Raleigh/Durham area
  - Obtained signal plans from NCDOT for several intersections
First Data Request to VTTI

Submitted first data request to VTTI

– Included 84 turns at 36 intersections
  • Negative offset: 18 turns at 9 intersections
  • Zero offset: 45 turns at 15 intersections
  • Positive offset: 22 turns at 12 intersections

– Need to assess number of left turns made by study vehicles at each location

– Need to assess how many unique study vehicles made turns at each location
## Example of Data Request Submission

### POSITIVE OFFSET LEFT-TURN INTERSECTIONS

<table>
<thead>
<tr>
<th>Major Road</th>
<th>Minor Road</th>
<th>City/Location</th>
<th>Left turn direction</th>
<th>Signal Type</th>
<th>Intersection Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR 5/Main St</td>
<td>Kensington Ave/I-290 on-ramp</td>
<td>Buffalo, NY</td>
<td>EB to NB</td>
<td>permissive</td>
<td>-78.76806566  42.95896242</td>
</tr>
<tr>
<td>US 64/Knightdale Blvd</td>
<td>Three Sisters Rd/Frontage Rd</td>
<td>Raleigh, NC</td>
<td>EB to NB</td>
<td>unsignalized</td>
<td>-78.43642799  35.80438149</td>
</tr>
<tr>
<td>US 64/Knightdale Blvd</td>
<td>Three Sisters Rd/Frontage Rd</td>
<td>Raleigh, NC</td>
<td>WB to SB</td>
<td>Unsignalized</td>
<td>-78.43642799  35.80438149</td>
</tr>
<tr>
<td>US 70/Glenwood Ave</td>
<td>Toyota Dr/driveway opposite</td>
<td>Raleigh, NC</td>
<td>NWB to SWB</td>
<td>unsignalized</td>
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<tr>
<td>US 1/Capital Blvd</td>
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<td>Raleigh, NC</td>
<td>NB to WB</td>
<td>protected/permissive</td>
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<td>SB to EB</td>
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<tr>
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<td>Raleigh, NC</td>
<td>NEB to NWB</td>
<td>protected/permissive</td>
<td>-78.57597637  35.84179856</td>
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<td>US 401/Louisburg Rd</td>
<td>Calvary Dr</td>
<td>Raleigh, NC</td>
<td>SWB to SEB</td>
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<td>Raleigh, NC</td>
<td>NEB to NWB</td>
<td>Protected only?</td>
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<tr>
<td>US 401/Louisburg Rd</td>
<td>Dansey Dr/Valley Stream Dr</td>
<td>Raleigh, NC</td>
<td>SWB to SEB</td>
<td>protected/permissive</td>
<td>-78.5693494   35.84479099</td>
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<tr>
<td>Fayetteville Rd</td>
<td>Woodcroft Pkwy</td>
<td>Durham, NC</td>
<td>NEB to NWB</td>
<td>protected/permissive</td>
<td>-78.92690969  35.92332863</td>
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<td>Durham, NC</td>
<td>SWB to SEB</td>
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<tr>
<td>Renaissance Pkwy</td>
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<tr>
<td>SR 54</td>
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<td>Durham, NC</td>
<td>EB to NB</td>
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<td>SR 54</td>
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<td>Durham, NC</td>
<td>WB to SB</td>
<td>protected/permissive</td>
<td>-79.00731754  35.90167091</td>
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</tbody>
</table>
Next Steps

- Work with VTTI to determine best approach for identifying left-turn movements of interest at potential study intersections
- Narrow list of intersections to approximately 6 to 10 for analysis
- Request full data set needed for analysis for turns of interest, including forward and rear facing video
Automate Data Capture

- Identify left-turn maneuvers (vehicle data)
- Capture the time of specific events (video data)
  - Left-turning vehicle reaching stop bar
  - Left-turning vehicle initiating turn
  - Left-turning vehicle passing through center of intersection
  - Opposing through vehicle passing through center of intersection
Analyze Data

• Measures of crash risk or driver risk taking:
  – Critical gaps, $t_c$ or $t_{50}$
  – Percentage of drivers accepting lags of specific durations less than $t_c$ or $t_{50}$
  – Rate of occurrence of erratic maneuvers during left turns

• Gap acceptance analysis
  – Estimate the effect of left-turn offset distance on drivers’ gap acceptance/rejection behavior

• Estimate effect of presence of opposing left-turners on gap acceptance behavior