Using GIS to Measure the Impact of Bus Stop Location on Pedestrian Safety

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Study Purpose

• Identify bus stop locations with unsafe pedestrian behavior
• Identify common characteristics of these bus stops
• Develop safety improvement strategies
A picture is worth 1,000 words
Background

• Florida has national reputation for being pedestrian unfriendly

• 2016 Dangerous by Design Report
  – Of the 20 most dangerous metropolitan areas for pedestrians
    • 9 are in Florida.
    • The first 7 are all in Florida
**Background**

- Study sponsored by FDOT District 4
- Focused on Palm Beach and Broward Counties
- 9,085 ped crashes statewide in 2015
  - Broward ranked 2\textsuperscript{nd}
  - Palm Beach ranked 4\textsuperscript{th}
Study Approach

1. Use GIS to map ped crashes near bus stops

2. Rank the bus stops according to 3 variables
   a) No. of crashes near the bus stop
   b) Annual average daily traffic
   c) On/off at the stop
Study Approach

3. Review police reports of all crashes near bus stops
4. Conduct Road Safety Audits of worst bus stop locations in Broward and Palm Beach
Data Sets and Sources

• 2011 to 2014 pedestrian crash data
  – Florida Department of Highway Safety and Motor Vehicles

• Bus stop on/off data
  – Broward County Transit and Palm Tran

• Annual Average Daily Traffic
  – Florida Department of Transportation
Step 1: Map pedestrian crashes in GIS

Palm Beach County

Broward County
**Step 1: Map pedestrian crashes in GIS**

- Tested 100 and 300 foot buffers around bus stops
  - 300 foot buffer resulted in too much duplication (i.e. crash associated with more than 1 bus stop)
  - Went with 100 foot buffer
- 357 pedestrian crashes w/in 100 feet of BCT bus stops
- 196 pedestrian crashes w/in 100 feet of Palm Tran bus stops
Step 2: Append ped crash data with bus stop and AADT data

<table>
<thead>
<tr>
<th>Crash Report</th>
<th>Crash Date</th>
<th>Day of Week</th>
<th>Crash Time</th>
<th>Fatalities</th>
<th>Alcohol</th>
<th>Drugs</th>
<th>Weather Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>83922234</td>
<td>2/22/2013</td>
<td>Friday</td>
<td>02:14 PM</td>
<td>0</td>
<td>N</td>
<td>N</td>
<td>Clear</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Light Conditions</th>
<th>Age Category</th>
<th>Speed Category</th>
<th>Bus Stop ID</th>
<th>Bus Stop Configuration</th>
<th>Offs</th>
<th>Ons</th>
<th>AADT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daylight</td>
<td>3</td>
<td>4</td>
<td>3180</td>
<td>N</td>
<td>8</td>
<td>16</td>
<td>36,500</td>
</tr>
</tbody>
</table>
Step 3: Rank bus stops

• Three weighted variables
  – total pedestrian crashes within 100 feet of the bus stop (60%)
  – AADT of the street where the bus stop is located (20%)
  – average weekday bus passenger on/offs for the bus stop (20%)

• Each bus stop given a score of 0 to 100
  – 0 was the worst
  – 100 was the best
## Step 3: Rank bus stops

<table>
<thead>
<tr>
<th>RANK</th>
<th>BUS STOP ID</th>
<th>TOTAL PED CRASHES (2011-2014)</th>
<th>PED CRASH SCORE</th>
<th>MEAN AADT</th>
<th>AADT SCORE</th>
<th>BCT ON/OFFS</th>
<th>ON/OFF SCORE</th>
<th>COMBINED SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1808</td>
<td>4</td>
<td>0.0</td>
<td>51,500</td>
<td>6.6</td>
<td>208</td>
<td>19.4</td>
<td>26.0</td>
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<td>57,000</td>
<td>5.1</td>
<td>434</td>
<td>18.8</td>
<td>43.9</td>
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<tr>
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<td>3</td>
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<td>5.5</td>
<td>128</td>
<td>19.6</td>
<td>45.1</td>
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<tr>
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<td>19.6</td>
<td>47.0</td>
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<td>775</td>
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<td>20.0</td>
<td>45,000</td>
<td>8.4</td>
<td>25</td>
<td>19.9</td>
<td>48.4</td>
</tr>
</tbody>
</table>
Data Results

• 18 of the 357 ped crashes w/in 100 feet of a BCT bus stop involved a bus patron (5%)

• 8 of the 221 ped crashes w/in 100 feet of a Palm Tran bus stop involved a bus patron (3.6%)

• Near side stops were not disproportionately unsafe
  – 40% of BCT’s bus stops are near-side
  – 38.9% of the crashes involving a BCT bus patron (7 of the 18) occurred at a near-side stop
Data Results

• The single most recurring theme in the police reports was pedestrians crossing mid-block outside the crosswalks

• This behavior was repeatedly observed by the Road Safety Audit team
Recommendations

• RSA Team made site specific recommendations
  – Improve street lighting
  – Relocate a mid-block crossing
  – Add additional Yield to Pedestrian signs
  – Add illuminated No Turn on Red sign
  – Upgrade crosswalk markings
  – Add leading pedestrian interval to pedestrian signal
  – Add audible pedestrian signal
  – Increase pedestrian signal timing
Recommendations

• RSA Team made 2 general recommendations
  – Expand use of pedestrian barriers in the median
  – Add sidewalk stencils near bus stops directing passengers to the crosswalk
Pedestrian Barrier
Pedestrian Barrier
Sidewalk Stencil

During the RSA in Palm Beach, the team saw this at a bus stop
Sidewalk Stencil

That gave us the idea for this
• Most important thing to come out of the study was not the specific recommendations but rather the process

• FDOT District 4 now has a systematic process for reviewing bus stop location safety

• GIS plays an important role in the process

• RSAs promote collaborative problem solving
Contact Information

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