A Working Concept of “Accessibility” (Usability Measures)

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(Very) Brief Background

• The Crossing Task for a Blind Traveler
  ➢ Finding the Crosswalk
  ➢ Aligning to Cross
  ➢ Deciding when it is safe to cross
  ➢ Maintaining Alignment during crossing

• Special Challenges at RBTs
  ➢ Uninterrupted Flow (no signal)
  ➢ Unassisted Crossing (no signal)
  ➢ Potentially High Speeds
  ➢ Ambient Noise
  ➢ Non-straight geometry (vehicle trajectories)
What makes a site accessible or usable?

- Site Geometry
  - Crosswalk Configuration
  - Crossing Distance
  - Wayfinding Aids
  - Landscaping

- Traffic
  - Volumes
  - Driver Behavior
  - Gap Distribution
  - Background Noise

- Travel Skills

A Tale of Two Roundabouts

- 9th and Davidson RBT
  Charlotte, NC (DAV-CLT)
  - Downtown Area
  - Inscribed Diameter: 140'
  - AADT: 9,900
  - Noon Peak: 535 vph

- Pullen-Stinson RBT
  Raleigh, NC (PS-RAL)
  - University Campus
  - Inscribed Diameter: 88'
  - AADT: 15,000
  - Noon Peak: 1,296 vph
Accessibility Criteria developed under NCHRP 3-78a and NIH Research

I. Crossing Opportunity Criteria

- **I: Crossing Opportunity Criterion**
  - Are there sufficient crossing opportunities in the form of yields or crossable gaps?

- **II: Crossing Opportunity Utilization Criterion**
  - Are the crossing opportunities detected and/or utilized by the pedestrian?

- **III: Delay Criterion**
  - Is a crossing opportunity taken within a reasonable time?

- **IV: Safety Criterion**
  - Does the crossing interaction occur without a significant degree of risk?

### Probability of Yielding

<table>
<thead>
<tr>
<th></th>
<th>DAV-CLT</th>
<th>PS-RAL</th>
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</thead>
<tbody>
<tr>
<td>Entry</td>
<td>10.8%</td>
<td>41.5%</td>
</tr>
<tr>
<td>Exit</td>
<td>11.8%</td>
<td>32.8%</td>
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</tbody>
</table>

### Probability of Crossable Gaps

- “Crossable” – Crossing time plus 2 second buffer

<table>
<thead>
<tr>
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<th>DAV-CLT</th>
<th>PS-RAL</th>
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<tbody>
<tr>
<td>Entry</td>
<td>62.1%</td>
<td>53.5%</td>
</tr>
<tr>
<td>Exit</td>
<td>60.9%</td>
<td>50.2%</td>
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</table>
II. Crossing Utilization Criteria

- **Yield Utilization - \( P(GO|Yield) \)**
  
  | P(GO|Yield) | DAV-CLT | PS-RAL |
  |-------------|---------|--------|
  | Entry       | 64.1%   | 83.0%  |
  | Exit        | 70.4%   | 87.8%  |

- **Crossable Gap Utilization - \( P(GO|Gap) \)**
  
  | P(GO|Gap>Min) | DAV-CLT | PS-RAL |
  |---------------|---------|--------|
  | Entry         | 66.3%   | 52.0%  |
  | Exit          | 60.3%   | 63.6%  |

III. Delay Criterion

- **Observed Delay (average per lane crossing)**
  
<table>
<thead>
<tr>
<th>Delay (sec)</th>
<th>DAV-CLT</th>
<th>PS-RAL</th>
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<tbody>
<tr>
<td>Entry</td>
<td>26.6</td>
<td>10.5</td>
</tr>
<tr>
<td>Exit</td>
<td>24.0</td>
<td>11.6</td>
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</table>

- **Delay Beyond First Opportunity**
  
<table>
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<th>DAV-CLT</th>
<th>PS-RAL</th>
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<tr>
<td>Entry</td>
<td>18.8</td>
<td>5.6</td>
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<tr>
<td>Exit</td>
<td>17.2</td>
<td>6.1</td>
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III. Safety Criterion

• O&M Interventions

<table>
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<th>DAV-CLT</th>
<th>PS-RAL</th>
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<tbody>
<tr>
<td>Total</td>
<td>0.6%</td>
<td>3.0%</td>
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</table>

• Other Safety Measures Being Developed
  - Safety Margin
  - Conflicts
  - Risky Gap Crossings (expected arrival time)

What do the measures tell us?

• High-Volume Site is more “accessible” because of lower delay
  - more frequent yielding
  - higher yield utilization

• Low-Volume Site is more “accessible” because of lower risk
  - Lower % interventions
Conclusion

• Accessibility Framework to quantify crossing performance
  - Crossing Opportunities
  - Opportunity Utilization
  - Delay
  - Safety

• Accessibility Question is complex and varies as some function of
  - Geometry
  - Volumes
  - Travel skills
  - Others …

Some Links of Interest

• Review of Literature Relevant to Roundabout Signalization to Provide Pedestrian Accessibility (Inman & Davis, 2007)

• Pedestrian Access to Modern Roundabouts (Access Board Bulletin)
  - http://www.access-board.gov/research/roundabouts/bulletin.htm

  - http://www.access-board.gov/prowac/draft.htm


Other References


