Development of Crash Modification Factors for Cycling Facilities

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Background

• Active Transportation (AT) facilities are becoming more popular in infrastructure planning

• As more municipalities incorporate AT facilities, there is a potential for increased collision rates between network users
Study Goals

• Establish relationship between collisions and cycling facility type

• Develop Crash Modification Factors (CMFs) for cycling facilities

• Provide tools for municipalities to assess safety impacts of different cycling facilities
Study Goals - Future

• Develop Crash Modification Functions (CMFunctions) for cycling facilities as more data becomes available

• Develop CMF and CMFunctions for active transportation networks
Crash Modification Factor (CMF)

• CMFs represent relative change in crash frequency due to a change in one specific condition

• Expressed as a ratio:

\[
CMF_{\text{facility}} = \frac{[\text{average crash frequency site condition } B]}{[\text{average crash frequency site condition } A]} 
\]
Crash Modification Function

• A formula used to compute the CMF for a specific site based on its characteristics

• Allows the CMF to change over the range of a variable or combination of variables

• Preferable to develop CMFunctions over single CMFs
Data Collection

• This study used Insurance Corporation of British Columbia (ICBC) databases for crashes involving cyclists, 2008-2012
Data Collection

• It also used Google Street View to verify cycling infrastructure in place at time of crash
Cycling Infrastructure

On-Road Bike Lanes
Cycling Infrastructure

Sharrows
Cycling Infrastructure

Segregated Bike Lane
Cycling Infrastructure

Multi-Use Trail
Cycling Infrastructure

No Facility
Assumptions

• Street first identified in the ICBC database is the street on which the crash occurred

• Facilities identified in Google Street View were in place when the crash occurred
CMF Development

• Before-and-After Studies
  – Derive CMFs based on comparison of safety data before and after site treatment
  – Require sufficient sample sizes
  – May be prone to sample bias
CMF Development

• Cross-sectional Studies
  – Consider single time period over multiple sites
  – Assumes ratio of crash frequency is an estimation of CMF for implementing that feature
  – Useful where sufficient before-and-after data is not available
  – Difficult to account for unknown, or known but unmeasured, factors
## Results

### Total Overall Collisions, by Facility Type

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Total Collisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-Road Bike Lanes</td>
<td>117</td>
</tr>
<tr>
<td>Sharrows</td>
<td>154</td>
</tr>
<tr>
<td>Segregated Bike Lanes</td>
<td>88</td>
</tr>
<tr>
<td>Multi-Use Trails</td>
<td>12</td>
</tr>
<tr>
<td>None</td>
<td>736</td>
</tr>
</tbody>
</table>
## Results

Collisions per Year, by Facility Type

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Collisions per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-Road Bike Lanes</td>
<td>23.40</td>
</tr>
<tr>
<td>Sharrows</td>
<td>30.80</td>
</tr>
<tr>
<td>Segregated Bike Lanes</td>
<td>17.60</td>
</tr>
<tr>
<td>Multi-Use Trails</td>
<td>2.40</td>
</tr>
<tr>
<td>None</td>
<td>147.20</td>
</tr>
</tbody>
</table>
Results

Crash Modification Factor Calculation

Example:

\[
\text{CMF}_{\text{On-Road Bike Lanes}} = \frac{\text{Collisions Per Year}_{\text{On-Road Bike Lanes}}}{\text{Collisions Per Year}_{\text{No Facilities}}} = \frac{23.40}{147.20} = 0.159
\]
Results

Crash Modification Factors, by Facility Type

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>CMF</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-Road Bike Lanes</td>
<td>0.159</td>
</tr>
<tr>
<td>Sharrows</td>
<td>0.209</td>
</tr>
<tr>
<td>Segregated Bike Lanes</td>
<td>0.120</td>
</tr>
<tr>
<td>Multi-Use Trails</td>
<td>0.016</td>
</tr>
<tr>
<td>None</td>
<td>1.000</td>
</tr>
</tbody>
</table>
Study Conclusions

• Significant reduction in yearly collision rate when comparing no facility to some type of facility

• Locations with on-road bike lanes experienced nearly 85% reduction in collision rates

• Locations designated with Sharrows experienced nearly 80% reduction in collision rates
Study Conclusions

• Segregated bike lanes experienced substantial reductions in collision rates (88% reduction)
  – Likely due to the nature of this type of facility
  – Reasonable to assume most collisions with segregated bike lanes occur at intersections where physical separation does not exist
Study Conclusions

• Multi-Use Trails typically do not follow parallel to roadways, reducing exposure which results in a large reduction in collision rates, nearly 99%
Next Steps

- Refine CMFs through study of exposure limits of cyclist-to-motor vehicle traffic
- Conduct before-and-after study as more data becomes available and compare results
- Isolate external factors to calculate a more accurate CMF
- Develop CMFunctions based on above results