Evaluation of Bike Boxes at Signalized Intersections: Initial Findings

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Outline

- Background
- Methods and Results
  - Video observation
  - Surveys
- Preliminary Conclusions
Why Bike Boxes?

Right Hook Collision

Bike Box Layout
Typical Plan (Colored)

- 24" Stop Bar
- "WAIT HERE" Marking
- Existing Crosswalk
- Mount sign on new 2B pole
- Hang Sign from existing span wire
- NO TURN ON RED EXCEPT BICYCLES
Bike Boxes in Portland

9 - Green Bike Boxes

3 - Uncolored Bike Boxes
936 hours of video collected
  • ~48 hours per location
Before video
  Jan to March 2008
After video
  April to June 2009
Both Pre-Post video
  • 10 bike box (7 green, 3 uncolored)
  • 2 control
Video Data Analysis

- All video digitized and stored on central server (after video was digital)
- For each location
  - 2 peak hours
  - 1 off-peak hour
- Three research assistants viewed and coded video
- 7 hours of video randomly selected to test for reliability among the reviewers
Preliminary Results

- **Counts**
  - Total Cars
  - Observed Bicycles
  - Total Cars Turning Right
  - Total Cars Stopping

- **Behaviors**
  - Motor vehicle and cyclist encroachment in crosswalk
  - Motor vehicle encroachment in bike box and bike lane
  - Cyclist location stopping in bike box
  - Preliminary conflict analysis
Pre-Post Counts

- **Left figure (3 hour counts)**
  - Grey – Pre
  - Black - Post

- **Right figure – count change (post-pre)**
  - Grey – Uncolored bike box
  - Green – Colored green bike box
  - Blue – Control
Total Cars Turning Right

- NW Bway & Hoyt
- NW Everett & 16th
- SE 11th & Hawth
- SE 8th & Hawth
- SW 3rd & Mad
- SW Bway & Tylr
- SW Bway & 6th Ave
- SW Terw & T Fry, NB
- SW Terw & T Fry, SB
- SW Burn & 14th Ave
- NE 16th & Wieder
- NE 7th & Weidler

Count Change
Total Cars Stopping*
Pre-Post Behaviors

- **Left figure**
  - Count change (Post-Pre)
  - 3 hour counts

- **Right figure**
  - \((\text{Post count/normalizing}) - (\text{Pre count/normalizing})\)
  - Y-axis label gives normalizing value

- **Color legend**
  - Grey – Uncolored bike box
  - Green – Colored green bike box
  - Blue – Control
Cyclist Stopping in Crosswalk

![Bar chart showing count change and change per cyclist arriving on red for various intersections.]

- Count Change:
  - NW Bway & Hoyt SE 11th & Hawth
  - NW Everett & 16th
  - SE 7th & Hawth
  - SW 3rd & Mad
  - SW Bway & Tylr
  - SW Bway & 6th Ave
  - SW Terw & T Fry, SB
  - SW Burns & 14th Ave
  - W NE 16th & Wiedler
  - NE 7th & Weidler

- Change per Cyclist Arriving on Red:
  - NW Bway & Hoyt SE 11th & Hawth
  - NW Everett & 16th
  - SE 7th & Hawth
  - SW 3rd & Mad
  - SW Bway & Tylr
  - SW Bway & 6th Ave
  - SW Terw & T Fry, SB
  - SW Burns & 14th Ave
  - W NE 16th & Wiedler
  - NE 7th & Weidler

Change per Cyclist Arriving on Red:

- NW Bway & Hoyt SE 11th & Hawth
- NW Everett & 16th
- SE 7th & Hawth
- SW 3rd & Mad
- SW Bway & Tylr
- SW Bway & 6th Ave
- SW Terw & T Fry, SB
- SW Burns & 14th Ave
- W NE 16th & Wiedler
- NE 7th & Weidler

Change per Cyclist Arriving on Red:

- NW Bway & Hoyt SE 11th & Hawth
- NW Everett & 16th
- SE 7th & Hawth
- SW 3rd & Mad
- SW Bway & Tylr
- SW Bway & 6th Ave
- SW Terw & T Fry, SB
- SW Burns & 14th Ave
- W NE 16th & Wiedler
- NE 7th & Weidler
Motor Veh. Encroachment in Crosswalk

- Up to 25% of vehicle across line
- Up to 50% of vehicle across line
- More than 50% of vehicle across line

Minor  Moderate  Major
Minor Encroachment in Crosswalk

Count Change

-30
-20
-10
0

Change per Stopping Vehicle

-0.15
-0.10
-0.05
0.00

NW Bway & Hoyt
NW Everett & 16th
NE 11th & Hawth
SE 7th & Hawth
SW 3rd & Mad
SW Bway & Tyr
SW Bway & 6th Ave
SW Terw & T Fry, NB
SW Terw & T Fry, SB
W Burns & 14th Ave
NE 16th & Wiedler
NE 7th & Wiedler

-0.00
-0.10
-0.15
-0.20
-0.25
-0.30

Change in vehicle count per stopping vehicle.
Moderate Encroachment in Crosswalk

Count Change

<table>
<thead>
<tr>
<th>Location</th>
<th>Change</th>
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<tr>
<td>NW Everett &amp; 16th</td>
<td>-5</td>
</tr>
<tr>
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<td>NW 3rd &amp; Mad</td>
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<tr>
<td>SW Bway &amp; Tylr</td>
<td>-1</td>
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<tr>
<td>SW Bway &amp; 6th Ave</td>
<td>0</td>
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<tr>
<td>SW Terw &amp; T Fry, NB</td>
<td>0</td>
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<tr>
<td>SW Terw &amp; T Fry, SB</td>
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<td>W Burns &amp; 14th Ave</td>
<td>0</td>
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<tr>
<td>NE 16th &amp; Wiedler</td>
<td>0</td>
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<tr>
<td>NE 7th &amp; Wiedler</td>
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Change per Stopping Vehicle

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<th>Location</th>
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<tr>
<td>NW Bway &amp; Hoyt</td>
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<td>NW Everett &amp; 16th</td>
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<td>SE 11th &amp; Hawth</td>
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<td>NW 3rd &amp; Mad</td>
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<td>SW Bway &amp; 6th Ave</td>
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<td>SW Terw &amp; T Fry, NB</td>
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<td>SW Terw &amp; T Fry, SB</td>
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<td>W Burns &amp; 14th Ave</td>
<td>0</td>
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<td>NE 16th &amp; Wiedler</td>
<td>0</td>
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<tr>
<td>NE 7th &amp; Wiedler</td>
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</table>
Major Encroachment in Crosswalk

Count Change

Change per Stopping Vehicle

NW Bway & Hoyt
NW Everett & 16th
SE 11th & Hawth
SE 7th & Hawth
SW Bway & 6th Ave
SW Bway & T Fry, NB
SW Bway & T Fry, SB
SW Burns & 14th Ave
NE 16th & Wiedler
NE 7th & Wiedler

NW Bway & Hoyt
NW Everett & 16th
SE 11th & Hawth
SE 7th & Hawth
SW Bway & 6th Ave
SW Bway & T Fry, NB
SW Bway & T Fry, SB
SW Burns & 14th Ave
NE 16th & Wiedler
NE 7th & Wiedler

Change per Stopping Vehicle

NW Bway & Hoyt
NW Everett & 16th
SE 11th & Hawth
SE 7th & Hawth
SW Bway & 6th Ave
SW Bway & T Fry, NB
SW Bway & T Fry, SB
SW Burns & 14th Ave
NE 16th & Wiedler
NE 7th & Wiedler

Count Change

Change per Stopping Vehicle
Prior to Intersection  While making turn  While stopped at light

In post review we considered a “virtual” bike lane
Encroachment Prior to Intersection

Count Change

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<th>Location</th>
<th>Count Change</th>
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<tbody>
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<td>0</td>
</tr>
<tr>
<td>NW Everett &amp; 16th</td>
<td>-10</td>
</tr>
<tr>
<td>SE 11th &amp; Hawth</td>
<td>-15</td>
</tr>
<tr>
<td>SE 7th &amp; Hawth</td>
<td>-20</td>
</tr>
<tr>
<td>SW 3rd &amp; Madison</td>
<td>-25</td>
</tr>
<tr>
<td>SW Bway &amp; 6th Ave</td>
<td>-30</td>
</tr>
<tr>
<td>SW Terw &amp; T Fry, NB</td>
<td>-35</td>
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<tr>
<td>SW Terw &amp; T Fry, SB</td>
<td>-40</td>
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<tr>
<td>W Burns &amp; 14th Ave</td>
<td>-45</td>
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<td>NE 7th &amp; Weidler</td>
<td>-55</td>
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Change per Stopping Vehicle

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<th>Location</th>
<th>Change per Stopping Vehicle</th>
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<tr>
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<tr>
<td>NW Everett &amp; 16th</td>
<td>-0.120</td>
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<td>-0.240</td>
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<td>SE 7th &amp; Hawth</td>
<td>-0.360</td>
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<td>SW 3rd &amp; Madison</td>
<td>-0.480</td>
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<td>-0.960</td>
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<tr>
<td>NE 16th &amp; Wiedler</td>
<td>-1.080</td>
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<tr>
<td>NE 7th &amp; Weidler</td>
<td>-1.200</td>
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</tbody>
</table>

Note: The chart shows the change in count and change per stopping vehicle for various intersections, indicating the encroachment status prior to an intersection.
Encroachment while making a turn
Encroachment in Bike Lane while stopped

Count Change

-15 -10 -5 0 5

SW Bway & Hoyt NE 16th & Wiedler
NW Bway & Hoyt NE 16th & Wiedler
SW Terw & T Fry, NB SE 7th & Mad
SW Bway & 6th Ave SE 11th & Hawth
SW Bway & 6th Ave SE 11th & Hawth
SW Bway & 6th Ave NE 16th & Wiedler
SW Bway & Tylr NW 16th & Wiedler
SW Bway & Tylr NW 16th & Wiedler
SW Bway & Tylr NW 16th & Wiedler
SW Bway & Tylr NW 16th & Wiedler
SW Bway & Tylr NW 16th & Wiedler
SW Bway & Tylr NW 16th & Wiedler

Change per Stopping Vehicle

-0.06 -0.04 -0.02 0.00 0.02

NW Bway & Hoyt NE 16th & Wiedler
NW Bway & Hoyt NE 16th & Wiedler
NW Bway & Hoyt NE 16th & Wiedler
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NW Bway & Hoyt NE 16th & Wiedler

Location of Stopped Cyclist in Box*

![Location Diagram]

- A
- B
- C
- D

Note: 
- The diagram illustrates the location of stopped cyclists within a specific box.
- The vertical axis represents the number of cyclists, ranging from 0 to 400.
- The horizontal axis represents different sections labeled A, B, C, and D.
- The green and gray sections indicate areas where cyclists were stopped.
Conflict Analysis

- All potential conflicts were identified in video review
- Panel review of all conflicts
- 20 pre, 14 post
- Rated severity of conflict
  - Major (2); Substantial (5); Minor (27)
- Identified actions by cyclist and motorist
  - Precautionary braking, Precautionary change of direction, Emergency braking, Emergency change of direction, Full stop
Video of conflicts
Conflicts

No conflicts - SW Broadway and 6th, SW Terwilliger & Taylors Ferry (NB and SB)

More conflicts after

Fewer conflicts after

1- NW Broadway & Hoyt
2- NW Everett & 16th
3 -SE 11th and Hawthorne
4- SE 7th & Hawthorne
5- SW 3rd & Madison
8- SW Broadway & Taylor
12- W Burnside & 14th

Pre

Post
Safety in Numbers? Exposure

- Conflicts vs. Observed Bicycles
- Conflicts vs. Observed Cars Turning Right
Methods: Surveys

- Intercept survey of bicyclists
  - 5 bike box intersections
  - 47% response rate
    (468 of 997)

- On-line survey of motorists
  - 24% response rate
    (717 of 3,020)
If you approached an intersection with a red light where should you stop your car?

- 94% stop at the light
- 2% wait anywhere
- 1% either wait anywhere or stop
- 3% don’t know

9% wait anywhere
<1% either wait anywhere or stop
1% don’t know

89% stop at the light
As a driver, do you think one of the pavement marking designs is better than the other?

6% 89%
Do you think the bike box has made driving safer or more dangerous at the intersections?

<table>
<thead>
<tr>
<th></th>
<th>All motorists</th>
<th>Motorists who have never biked through bike box</th>
</tr>
</thead>
<tbody>
<tr>
<td>A lot safer</td>
<td>16%</td>
<td>14%</td>
</tr>
<tr>
<td>A little safer</td>
<td>36%</td>
<td>31%</td>
</tr>
<tr>
<td>No difference</td>
<td>18%</td>
<td>19%</td>
</tr>
<tr>
<td>A little more</td>
<td>9%</td>
<td>10%</td>
</tr>
<tr>
<td>A lot more dangerous</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Don’t know</td>
<td>18%</td>
<td>22%</td>
</tr>
<tr>
<td>n</td>
<td>717</td>
<td>490</td>
</tr>
</tbody>
</table>
Of the motorists who have not biked in a bike box...

- 40% think drivers drive more safely because of the bike boxes
- 43% think the bike boxes make driving less convenient at the intersections
- 37% feel more comfortable driving through the intersections (16% less comfortable)
- 55% think the bike boxes make drivers more aware of bicyclists generally
- 37% think the City should install more boxes
- 13% think the City should remove some or all
Do you think the bike box has made the intersection safer for you as a cyclist?
37% think most motorists understand the purpose of the box
  • 35% do not think they do
81% think motorists are more aware of cyclists because of the boxes
83% think the bike boxes make for a better environment for bicycling
72% think the City should install more
Most motorists understand and obey the boxes.
Pedestrians may benefit from reduced encroachment.
Fewer cars entering the bike lane prior to the intersection, but more are cutting the corner closer.
Very few conflicts before or after.
Preliminary Conclusions

- Improved perceptions of safety on the part of both motorists and bicyclists
- More data analysis to come
  - Project report in the winter
Acknowledgements

- City of Portland
  - Rob Burchfield
  - Tom Jensen
  - Matthew Machado
  - Roger Geller

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  - Nathan McNeil
  - Bob Kellett
  - Will Farley

- OTREC