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Webinar: A Comprehensive Evaluation of Protected Cycling Facilities: Lessons from Five Cities

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Early Adopters of the Protected Bicycle Lane in United States: What Have We Learned?


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Lead GRAs: Tara Goddard and Nick Foster

NITC Webinar
March 19, 2015
Webinar Overview

1. Introduction and Background
2. Methodology
3. Change in Ridership
4. Design
5. Community Support
6. Conclusions
Number of U.S. protected bike lanes:

The number of protected bike lanes has nearly QUADRUPLED in the U.S. since 2010

210 Predicted count by the end of 2014

Credit:
People for Bikes
Green Lane Project
Research Objectives

- A field-based evaluation of protected bikeways in five U.S. cities to study:
  - Safety of users (both perceived and actual)
  - Effectiveness of the design
  - Perceptions of residents and other road users
  - Attractiveness to more casual cyclists
  - Change in economic activity
Overview of Sites
Green Lane Cities Studied

- Portland, OR
- San Francisco, CA
- Austin, TX
- Chicago, IL
- Washington, DC
Austin: Rio Grande Street

Two-way protected bike lane on one-way street

Two-way bikeway

One-way vehicle lane

| 6½' Bike lane | 5½' Bike lane | 4' Buffer | 14' Drive lane | 3' Parking lane |
Austin: Bluebonnet Lane

Two-way protected bike lane on a two-way street
Austin: Barton Springs Road

One-way protected bike lane on the south side of the road

Shared-Use Path

One-way bikeway

Two-way vehicles
4 lanes
Chicago: N/S Dearborn Street

Two-way protected bike lane on one-way street
Chicago: N Milwaukee Avenue

Pair of one-way protected bike lanes on a two-way street
Portland: NE Multnomah Street

Pair of one-way protected bike lanes on a two-way street

One-way bikeway

Two-way vehicle lanes with center turn lane
San Francisco: Fell Street

One-way left-side protected lane on a one-way street
San Francisco: Oak Street

One-way right-side lane on a one-way street

One-way vehicle lanes

One-way bikeway
Washington DC: L Street

One-way protected bike lane on a one-way street

One-way bikeway

One-way vehicle lanes

8' Bike lane  3'  11' Drive lane  11' Drive lane  11' Drive lane
Methodology
Video Data

- Primarily intersections
- 3 locations per facility (not Austin) 2 cameras per location
- 2 days of video (7am to 7pm) per location
- 168 hours analyzed
- 16,393 bicyclists and 19,724 turning vehicles observed

Example Video Screenshots (2 views) from San Francisco at Oak and Broderick
Surveys

• Resident
  • Mailed to residents living near new protected bike lane(s)
  • 8 - 12 pages (~40 questions)
  • 23% response rate overall

• Bicyclist
  • Bicyclists intercepted on facility and directed to online survey
    – 33% response rate overall
## Data Used in Analysis

<table>
<thead>
<tr>
<th>Research Element</th>
<th>Video Data</th>
<th>Bicyclist Survey</th>
<th>Resident Survey</th>
<th>Count Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in Ridership</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Design/Safety Evaluation</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
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<tr>
<td>Barrier Types &amp; Comfort</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Community Support</td>
<td></td>
<td></td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>
Change in Ridership:
Safety perceptions and potential riders
Change in Observed Bicycle Volumes

<table>
<thead>
<tr>
<th>Location</th>
<th>Percent Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dearborn</td>
<td>171%</td>
</tr>
<tr>
<td>Rio Grande</td>
<td>126%</td>
</tr>
<tr>
<td>Multnomah</td>
<td>68%</td>
</tr>
<tr>
<td>Bluebonnet</td>
<td>46%</td>
</tr>
<tr>
<td>Fell</td>
<td>46%</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>21%</td>
</tr>
<tr>
<td>L Street</td>
<td>65%</td>
</tr>
<tr>
<td>Barton Springs</td>
<td>58%</td>
</tr>
</tbody>
</table>

Source: City-provided before and after counts, PSU video counts, ACS Survey
Before the new facility was built, how would you have made this trip?

Source: Cyclist intercept surveys, Green Lane evaluation
One likely reason: Improved perception of safety

I feel the safety of bicycling on ______ has . . .

- Austin Rio Grande: 27% Increased Somewhat, 66% Increased a Lot
- SF Oak / Fell: 18% Increased Somewhat, 81% Increased a Lot
- Portland Multnomah: 33% Increased Somewhat, 59% Increased a Lot
- Chicago Milwaukee: 31% Increased Somewhat, 65% Increased a Lot
- DC L Street: 29% Increased Somewhat, 66% Increased a Lot
- Chicago Dearborn: 18% Increased Somewhat, 82% Increased a Lot
- Austin Barton Springs: 33% Increased Somewhat, 56% Increased a Lot

Source: Cyclist intercept surveys, Green Lane evaluation
Resident Survey: Potential New Cyclists

I would be more likely to ride a bicycle if motor vehicles and bicycles were physically separated by a barrier.
Because of the ____ Street separated bikeway, how often I ride a bicycle overall has . . .

Source: Cyclist intercept surveys, Green Lane evaluation
Design:
Intersections, Signals, Buffers
Design Elements

• Intersections
  – Turning and mixing zones
  – Fully signalized

• Buffers
  – Type and widths
Turning Zone with Post Restricted Entry and Through Bike Lane (TBL)

MV Turn Lane
15th - 8 ft
Ct - 9 ft

Through Bike Lane
4 ft

Motor Vehicle Through Lane
10 ft

Restart Flexposts

Turn/Merge Gap is 85 ft at 15th and 50 ft at Connecticut

End of Protected Lane
175 ft

Merging Area

Bicycle

Motor vehicle
Turning Zone with Unrestricted Entry and TBL

- Bike Box
- Motor Veh. Turn Lane
  8’9” Oak / Divisadero
  8’3” Fell / Divisadero
- Motor Vehicle Through Lane
  9’6”
- Through Bike Lane
  4 ft
- Turn/Merge
  Gap is 97 ft at
  Oak / Divisadero and
  190 ft at Fell / Divisadero
- End of Protected Lane
  195 ft Oak / Divisadero
  323 ft Fell / Divisadero
Mixing Zone with Yield Entry Markings

- Mixing Zone: 11 ft
- Buffer: 3 ft
- Motor Vehicle Through Lane: 10 ft
- Turn/Merge: Gap is ~58 ft
- End of Protected Lane: 155 ft
- Parking
Mixing Zone with Sharrow Marking

- Bike Box
- Mixing Zone 12’9”
- Sharrow
- Turn/Merge Gap is ~ 90 ft
- Motor Vehicle Through Lane 9 ft
- End of Protected Lane 220 ft
Mixing Zone with Green Skip Coloring

- Mixing Zone 12'3"
- Turn/Merge Gap is ~100 ft
- Motor Vehicle Through Lane 9'6"
- End of Protected Lane 160 ft
<table>
<thead>
<tr>
<th>Intersection and Type of Design</th>
<th>Direction of Turning Traffic</th>
<th>Through Bikes Per Hour</th>
<th>Turning Vehicles Per Hour</th>
<th>Observed Correct Turning Motorist</th>
<th>Observed Correct Through Bicycle</th>
<th>% of Bicyclists Agreeing They Feel Safe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turning Zone with Post Restricted Entry and Through Bike Lane (TBL) L Street / 15th</td>
<td>Left</td>
<td>110</td>
<td>173</td>
<td>86%</td>
<td>93%</td>
<td>64%</td>
</tr>
<tr>
<td>Turning Zone with Post Restricted Entry and TBL L Street / Connecticut</td>
<td>Left</td>
<td>116</td>
<td>125</td>
<td>88%</td>
<td>89%</td>
<td>64%</td>
</tr>
<tr>
<td>Turning Zone with Unrestricted Entry and TBL Oak / Divisadero</td>
<td>Right</td>
<td>201</td>
<td>126</td>
<td>66%</td>
<td>81%</td>
<td>74%</td>
</tr>
<tr>
<td>Mixing Zone with Yield Entry Markings NE Multnomah / 9th</td>
<td>Right</td>
<td>31</td>
<td>94</td>
<td>93%</td>
<td>63%</td>
<td>73%</td>
</tr>
<tr>
<td>Mixing Zone with Sharrow Marking Oak / Broderick</td>
<td>Right</td>
<td>188</td>
<td>24</td>
<td>48%</td>
<td>30%</td>
<td>79%</td>
</tr>
<tr>
<td>Mixing Zone with Green Skip Coloring Fell / Baker</td>
<td>Left</td>
<td>226</td>
<td>48</td>
<td>49%</td>
<td>-</td>
<td>84%</td>
</tr>
</tbody>
</table>
DC Design on M Street (new)

Photo from @JenniferDillPSU
Observed Precautionary and Minor Conflicts

- Turning Vehicles When Bike Is Present * Bicycles
- Thousands

Locations with high total conflicts:
- Oak Divisadero
- Oak and Broderick
- L and Connecticut
- Fell and Baker
- L and 15th St
- Multnomah and 9th
Dearborn and Madison, Chicago, IL

Left-turn signal for cars

Bicycle signals

Photo: C. Monsere
People on Bicycles

- **Dearborn/ Randolph**: 92% waited, 8% proceeded illegally.
- **Dearborn/ Madison**: 77% waited, 23% proceeded illegally.
- **Dearborn/ Congress**: 93% waited, 7% proceeded illegally.

People in Motor Vehicles

- **Dearborn/ Randolph**: 92% legal turn, 6% illegal turn, 2% jumped.
- **Dearborn/ Madison**: 90% legal turn, 5% illegal turn, 6% jumped.
- **Dearborn/ Congress**: 84% legal turn, 10% illegal turn, 6% jumped.
Perceived Safety at Intersections

Percent Respondents Somewhat or Strongly Agreeing "Feel Safe"

- Chicago - Signalized
- Fell/Baker
- Oak/Broderick
- NE Multnomah/9th
- Oak/Divisadero
- L Street/Connecticut
- L Street/15th Street

Percent Feeling Safe
Change in Stated Comfort (from a bike lane), by bicyclist type

- Percent Increase of Normalized Score (with a standard bicycle lane as base)

- Strong and Fearless
- Enthused and Confident
- Interested But Concerned

- A painted 2-3 foot buffer
- A solid painted buffer
- A painted buffer and parked cars
- A raised concrete curb
- A 2-3 foot buffer and plastic
- Planters separating the bikeway

- Percent Increase of Normalized Score
  - A painted 2-3 foot buffer: 24%
  - A solid painted buffer: 24%
  - A painted buffer and parked cars: 31%
  - A raised concrete curb: 50%
  - A 2-3 foot buffer and plastic: 48%
  - Planters separating the bikeway: 60%

- Notes:
  - Planters separating the bikeway: 6% increase
  - A raised concrete curb: 10% increase
  - A painted buffer and parked cars: 9% increase

- Strong and Fearless:
  - A painted 2-3 foot buffer: -1%
  - A solid painted buffer: -1%
  - A painted buffer and parked cars: -5%
  - A raised concrete curb: -2%
  - A 2-3 foot buffer and plastic: 7%
  - Planters separating the bikeway: 6%

- Enthused and Confident:
  - A painted 2-3 foot buffer: 24%
  - A solid painted buffer: 24%
  - A painted buffer and parked cars: 31%
  - A raised concrete curb: 50%
  - A 2-3 foot buffer and plastic: 48%
  - Planters separating the bikeway: 60%

- Interested But Concerned:
  - A painted 2-3 foot buffer: 24%
  - A solid painted buffer: 24%
  - A painted buffer and parked cars: 31%
  - A raised concrete curb: 50%
  - A 2-3 foot buffer and plastic: 48%
  - Planters separating the bikeway: 60%
Community Support:
Motorists, Pedestrians, General
Support for Protected Lanes

Facilities that encourage bicycling for transportation are a good way to improve public health.

I would support building more protected bike lanes at other locations.

Source: Resident surveys, Green Lane evaluation
Support for Protected Lanes

- Facilities that encourage bicycling for transportation are a good way to improve public health.

- I would support building more protected bike lanes at other locations.

- Because of the protected bike lanes, the desirability of living in my neighborhood has increased.

Source: Resident surveys, Green Lane evaluation
Because of the protected bike lanes, the safety of _____ on the street has . . .

Source: Resident Surveys, Green Lane evaluation
Because of the protected bike lanes, the safety of _____ on the street has . . .

- **Portland, Multnomah**
  - Walking: 37%
  - Driving: 45%
  - Bicycling: 74%

- **San Francisco, Oak**
  - Walking: 21%
  - Driving: 38%
  - Bicycling: 80%

- **Austin, Bluebonnet**
  - Walking: 38%
  - Driving: 52%
  - Bicycling: 85%

- **Austin, Barton Springs**
  - Walking: 44%
  - Driving: 43%
  - Bicycling: 82%

- **Chicago, Milwaukee**
  - Walking: 19%
  - Driving: 28%
  - Bicycling: 74%

- **Chicago, Dearborn**
  - Walking: 15%
  - Driving: 23%
  - Bicycling: 76%

- **Washington DC - L St.**
  - Walking: 27%
  - Driving: 30%
  - Bicycling: 80%

Source: Resident Surveys, Green Lane evaluation
Conclusions

• Evidence of increased bicycle volumes
  – Within one year, mostly due to shifting routes

• Strong improved perception of safety for people riding on the facilities
  – May be improving experience for women more than men
  – Surveys of residents indicate that separation may encourage more cycling
Conclusions

- Designs choices affect safety and comfort, some worked better than others
  - Clear demarcation of the merge entry point for vehicles and the use of the “through bicycle lane” performed best
  - Use of signals effective (highest perception of safety)
  - Green markings good for communicating paths
  - Designs with buffers with highest physical separation preferred, though flexpost scored high too
Conclusions

• Generally positive perceptions for other road users
  – More negative perceptions are specific to certain streets

• Support for the protected lane concept
  – Road users appear to recognize larger benefits
Questions?

Thanks to support from:
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Reference List


BONUS SLIDES
Home Owners 2+ Adults in HH Children in HH Driver's License Transit Pass Car Share Membership Own/Lease a car Own working bicycle Female <35 years of age 35 to 54 years 55 + years White Black Hispanic or Latino/a Asian Work Outside Home Work From Home Income >$100k Four year degree + Resident Bicyclist

Source: Resident and Bicyclist surveys, Green Lane evaluation
Buffer type affects safety and comfort

Types of buffers used include:

- Flexposts and painted buffer (Fell Street, San Francisco)
- Parked vehicles and flexposts (Milwaukee Avenue, Chicago)
- Semi-permanent planter with colored pavement (Multnomah St., Portland)
Bicyclists: Mean Stated Comfort with Hypothetical Buffers

- Solid painted buffer (5)
- Painted 2-3 foot buffer (3)
- Painted buffer and parked cars (1)
- Raised concrete curb (6)
- 2-3 foot buffer and plastic flexposts (2)
- Planters separating the bikeway (4)

Locations:
- Austin Barton Springs
- Austin Rio Grande
- Chicago Dear.
- Chicago Milw.
- Portland Mult.
- SF Oak / Fell Streets
- D.C. L Street
The buffer effectively separates bikes from cars

"Strong and Fearless"
- Strongly Agree, 49%
- Somewhat Agree, 38%
- Disagree, 14%

"Enthused and Confident"
- Strongly Agree, 63%
- Somewhat Agree, 32%
- Disagree, 5%

"Interested But Concerned"
- Strongly Agree, 47%
- Somewhat Agree, 41%
- Disagree, 12%

"No Way No How"
- Strongly Agree, 30%
- Somewhat Agree, 41%
- Disagree, 29%

% Disagree
Perceptions of residents driving on street

Since the protected bike lanes were built, how safe and predictable bicyclists are acting has . . .
Perceptions of residents driving on street

Percent responding increased

- L Street: 27% to 52%
- Fell: 20%
- Oak: 22% to 54%
- Multnomah: 32% to 48%
- Milwaukee: 44% to 63%
- Dearborn: 54% to 53%
- Bluebonnet: 15% to 59%
- Barton Springs: 18% to 58%

Since the protected bike lanes were built, the amount of time it takes me to drive on this street has . . .

Since the protected bike lanes were built, how safe and predictable bicyclists are acting has . . .
Perceptions about Parking

- Oak/Fell (-50 spots): 55%
- Milwaukee (-some): 49%
- L Street (-150 spots): 46%
- Bluebonnet (-some): 44%
- Dearborn (-minimal): 41%
- Multnomah (+20 spots): 30%

% indicating negative impact on ability to find a parking spot on the street.