Beyond Confident Cyclists
LEVEL OF TRAFFIC STRESS IN NETWORK PLANNING

Jeff Knowles, AICP         August 2017
Bikeway Design Evolution

Bicyclists originally considered “rolling pedestrians” – very early designs separate bikes from moving vehicles

Parking protected bikeway, Davis, California, early 1970s
Vehicular Cycling Takes Over

- Bicycle planning evolves to regard bicyclists as drivers of bicycles – integration with moving auto traffic
- Laws define bicyclists as vehicles subject to same rules as motorists
- Design manuals treat bicyclists as vehicles, discourage facilities or bicyclist movements that do not have a counterpart in driver facilities or behaviors

So, for the past 40 years, this became the design standard for urban bikeways.
Lines on the map tell one story
Street conditions show the reality
Results for Ridership and Safety

- Low rates of bicycle transport
- Low rates of female bicyclists
- Higher risk of injury per km traveled by bicycle in USA than in Netherlands

Cycling and Safety
Bicycle travel per inhabitant per year (km) and number of cyclists killed per billion kilometres of bicycle travel

Who are we planning for?

- STRONG & FEARLESS (<1%)
- ENTHUSED & CONFIDENT (5%)
- INTERESTED BUT CONCERNED (60%)
- NO WAY, NO HOW (35%)
Who are we planning for?
Elements of Bicycle Boulevards

DISTINCT VISUAL IDENTITY
Unique pavement markings and wayfinding signs increase visibility of Bicycle Boulevard routes, assist with navigation, and alert drivers that the roadway is a priority route for people bicycling.

SAFE, CONVENIENT CROSSINGS
Traffic controls, warning devices, and/or separated facilities at intersections help facilitate safe and convenient crossings of major streets along the Bike Boulevard network.

BICYCLE PRIORITY
Traffic calming treatments that prioritize bicycle through-travel and discourage cut-through motor vehicle traffic, such as traffic circles, diverters, chicanes, sometimes in place of existing stop signs.
Only as strong as your weakest link...
Understanding the needs of users

STEP 1
Public Survey

STEP 2
Level of Traffic Stress Analysis
Public Survey

What if a bike lane was added? *

1. Very uncomfortable
2. Somewhat uncomfortable
3. Somewhat comfortable
4. Very comfortable

FOUR TYPES OF BICYCLISTS

- **Strong and Fearless**
- **Enthusiastic and Confident**
- **Interested but Concerned**
- **No Way No How**
Level of Comfort: How comfortable do you feel riding in different environments, from a 1 (very comfortable) to a 4 (very uncomfortable)?

1.1 Most Comfortable

Class IVA A two-lane commercial street with a separated bike lane

3.6 Least Comfortable

No Facility A four-lane street with faster, heavier traffic
### Public Survey

<table>
<thead>
<tr>
<th>Description</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Class IVA:</strong> A two-lane commercial street with a separated bike lane</td>
<td><img src="image1" alt="Class IVA image" /></td>
</tr>
<tr>
<td><strong>Class IA:</strong> A paved path separate from the street</td>
<td><img src="image2" alt="Class IA image" /></td>
</tr>
<tr>
<td><strong>Class IVA:</strong> A street with two lanes in each direction and a center divider with a separated bike lane</td>
<td><img src="image3" alt="Class IVA image" /></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Most Comfortable</th>
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<th>Somewhat Uncomfortable</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
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<td>4</td>
</tr>
</tbody>
</table>
Public Survey

Class IIB: A four-lane street with a buffered bike lane

Class IIA: A two-lane commercial

Class IIB: A street with two lanes in each direction and a center divider with a buffered bike lane

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</table>
Public Survey

**Class IIIC**: A two-lane commercial street with “sharrows”

**Class IIA**: A four-lane street with a bike lane

**Class IIA**: A street with two lanes in each direction and a center divider with a striped bike lane

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</tbody>
</table>
Public Survey

No Facility: A two-lane commercial shopping street

No Facility: A street with two lanes in each direction and a center divider

No Facility: A four-lane street with faster, heavier traffic

Most Comfortable

Somewhat Comfortable

Somewhat Uncomfortable

Most Uncomfortable

1

2

3

4
Public Survey

Level of Comfort

Participants were asked to rate how comfortable they felt riding in different environments, from 1 (very comfortable) to 4 (very uncomfortable). The results are below.

1. Very Comfortable
2. Somewhat Comfortable
3. Somewhat Uncomfortable
4. Very Uncomfortable

Residents feel the most comfortable biking on the faculty:

- A two-way commercial street with a separated bike lane
- A four-lane street with a separated bike lane
- A residential street with bike/bus lanes
- A four-lane street with a buffered bike lane
- A two-lane commercial street with no pedestrian
- A four-lane commercial street with a bike lane
- A six-lane street with bike lanes in each direction and a center divider
- A four-lane street with a center divider and a striped bike lane
- A four-lane street with many lanes in each direction and a center divider

Residents feel the least comfortable biking in this environment:

- A street with two lanes in each direction and a center divider
- A four-lane street with heavy traffic

Strong and Fearless
- 3% Strong
- 1% Fearless

Enthusiastic and Confident
- 16% Enthusiastic
- 7% Confident
- 13% Confident
- 15% Confident

Interested but Concerned
- 71% Interested
- 60% Concerned
- 45% Concerned
- 39% Concerned

No Way, No How
- 10% No Way
- 33% No How
- 38% No How
- 44% No How

Berkeley
Portland
Edmonton
Austin

*Level of comfort on bicycle facilities as reported by survey respondents who were identified as interested but concerned.
LTS Analysis Methodology

**STEP 1**
Public Survey

**STEP 2**
Level of Traffic Stress Analysis
Level of Traffic Stress (LTS) Analysis

<table>
<thead>
<tr>
<th>Level of Traffic Stress</th>
<th>Comfortable up to % of Berkeley Residents*</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTS 1</td>
<td>90%</td>
</tr>
<tr>
<td>LTS 2</td>
<td>79%</td>
</tr>
<tr>
<td>LTS 3</td>
<td>16%</td>
</tr>
<tr>
<td>LTS 4</td>
<td>3%</td>
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</tbody>
</table>

Types of Cyclists
- Interested, But Concerned
- Enthusiastic & Confident
- Strong & Fearless
CORRIDOR INPUTS
- Posted speed limit
- Bike lane presence/width
- Number of travel lanes
- Parking aisle presence/width

INTERSECTION INPUTS
- Posted speed limit
- Presence of median
- Number of travel lanes to cross
- Presence of signal

LTS Results and Ground truthing

- Low Stress, with attention required
- Level of stress that most adults will tolerate

Channing Way & San Pablo Ave

LTS 2

- Low Stress, with attention required
- Level of stress that most adults will tolerate
Lessons Learned

1. LTS inputs do not necessarily capture the full range of cyclist experience
2. Additional data and calibration may be required; i.e. traffic volumes
3. Utilize survey results
1. Average Daily Traffic volumes applied to unsignalized intersections on bikeways that cross another bikeway or a major street.

2. Link LTS score applied to signalized intersections on bikeways that cross another bikeway or a major street.
Recalibrated Level of Traffic Stress Analysis

LINKS
- LTS 1 - ALL BICYCLISTS
- LTS 2 - INTERESTED BUT CONCERNED
- LTS 3 - ENTHUSIASTIC AND CONFIDENT
- LTS 4 - STRONG AND FEARLESS

INTERSECTIONS
- LTS 1 - ALL BICYCLISTS
- LTS 2 - INTERESTED BUT CONCERNED
- LTS 3 - ENTHUSIASTIC AND CONFIDENT
- LTS 4 - STRONG AND FEARLESS
# Bicycle Boulevard Crossing Treatments

<table>
<thead>
<tr>
<th>CROSSING TREATMENT</th>
<th>TRAFFIC VOLUMES</th>
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<tbody>
<tr>
<td></td>
<td>VERY LOW</td>
</tr>
<tr>
<td></td>
<td>Up to 3 lanes</td>
</tr>
<tr>
<td>Marked Crossing</td>
<td>LTS 1</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Median Refuge Island¹</td>
<td>LTS 1</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>RRFB²</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>RRFB with median¹,²</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Pedestrian Hybrid Beacon (HAWK)²</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic Signal²</td>
<td>X</td>
</tr>
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</table>

- X No additional benefit
- 1. Minimum 6-ft wide median
- 2. Subject to successful warrant analysis

*LTS refers to Level of Traffic Stress*
Bicycle Boulevard Crossing Treatments
Conclusion

• Low-stress facilities are needed to convert significant proportions of the population to cycling for transport

• Research shows that separated bikeways improve safety and increase ridership

• Statistically valid community surveys and LTS analysis links network planning to target user groups, emerging mode choice quantification

• Challenge is not one of design, but of having the political will to make the trade-offs necessary to implement
How are you engaging the “interested, but concerned” cyclist in your planning process?

Jeff Knowles, AICP
jeffknowles@altaplanning.com
@knoja