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Evaluating the Level-of-Service of Protected Bike Lanes

Nick Foster
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11/21/14

Outline

- Introduction
- Previous Research
- Project Methods
- Results
- Implications/Limitations

Objectives

- LOS Model for Protected Bike Lanes
  - Segments Only
  - Readily Available Inputs
- Comparison to Other Facilities

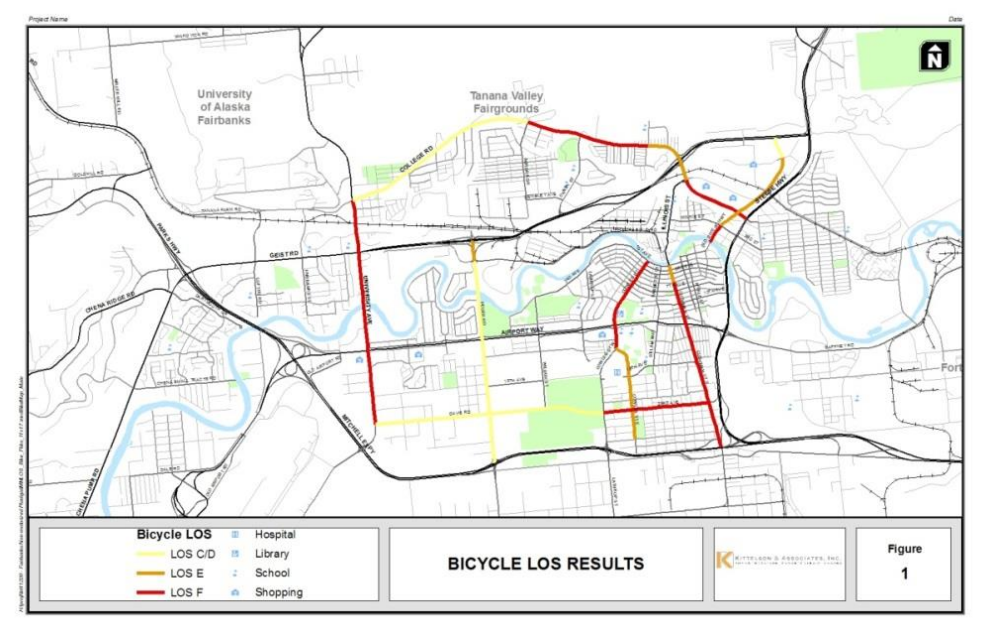
Protected Bike Lanes

Measuring User Perception

- Quality of Service (QOS)
  - Level of Service (LOS)
- Comfort/Stress/Safety
- Typically ‘A-F’ scale

Motivation

- Increased Interest in Non-Capacity Performance
- No North American-based Model



Previous Research

Select Previous Efforts

Method	Form	# of Participants	# of Study Sites	Considers Protected Bike Lanes?
HCM 2010 BLOS	OLS Regression	145	30*	No
Danish BLOS	Logistic Regression	407	56*	Yes
FDOT BLOS	OLS Regression	60-150	21-30*	No
FHWA BCI	OLS Regression	202	78*	No
Level of Traffic Stress	Index	Not Based on Empirical Data		Yes
San Francisco BEQI	Index	Not Based on Empirical Data		Partially

*All Sites Not Shown at Each Viewing

Typical Factors Considered

- Motor Vehicle Speeds/Volumes
- Facility Type
- Space

Methods

Video Collection

Image Source: Tara Goddard, Portland State University

Site Selection

- Protected Bike Lanes & Reference Videos
- 20-30 Seconds Length
- 23 clips
- Criteria
  - Buffer & Facility Type
  - 1-way vs. 2-way
  - Traffic Volumes

Selected Clip Examples


#1, 11, 17a – NE Multnomah St


#2, 20a – Dearborn St


#5 – SW Broadway St


#20b – Milwaukee Ave


#8 – Fell St


#19 – Cully Blvd

Selected Clip Examples


#3a, 7, 10 – SW Barbur Blvd


#4 – NE Knott St


#9 – Springwater Trail


#13 – SW Barbur Blvd


#3b – SE Ankeny St


#17b – NE Multnomah St

Survey Administration

- Online & In-Person

Neighborhood Street Study

#3

Video Clip Questionnaire

Please circle the letter grade that best represents how comfortable you would feel riding a bicycle in each situation shown. Please match the clip # on this survey sheet to the number shown on the video. Thank you!

A = Extremely Comfortable, F = Extremely Uncomfortable

Clip #	Rating					
1	A	B	C	D	E	F
2	A	B	C	D	E	F
3	A	B	C	D	E	F

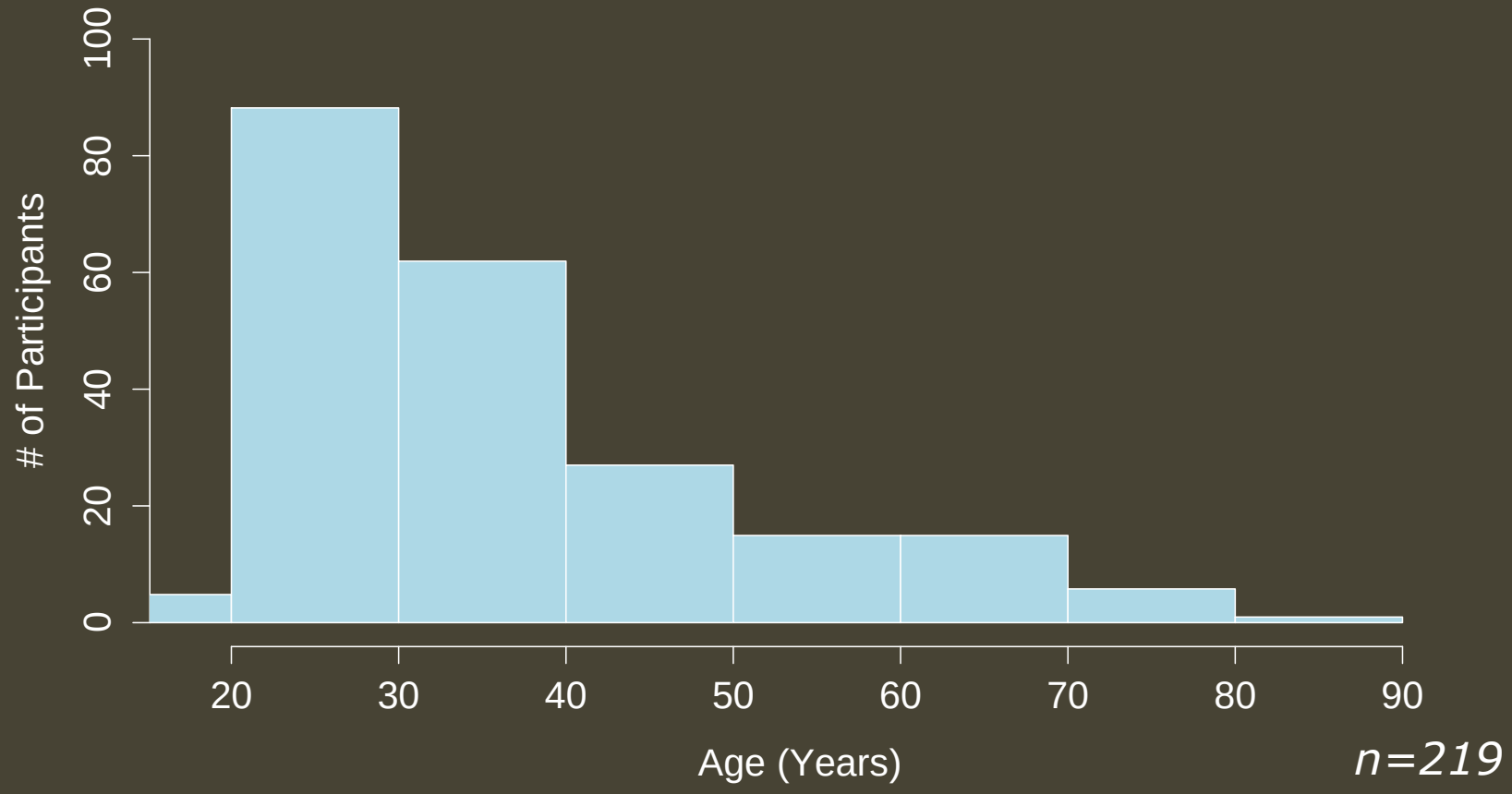
Video Clip Example

- https://www.youtube.com/watch?v=F7gXQX54-HE

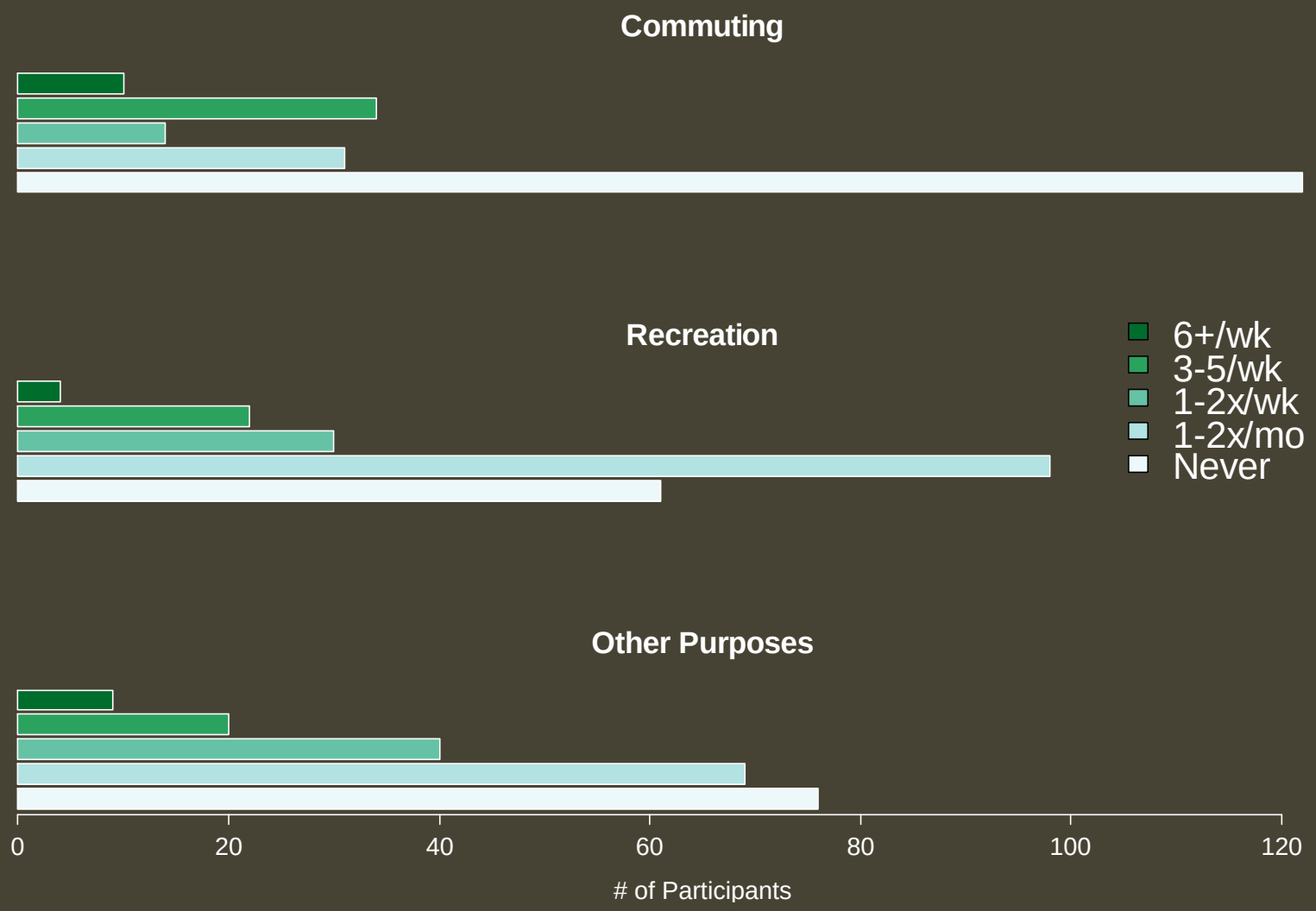
Results – In Person Survey

Demographics – Age & Gender

- 53% Female



Demographics – Riding Habits

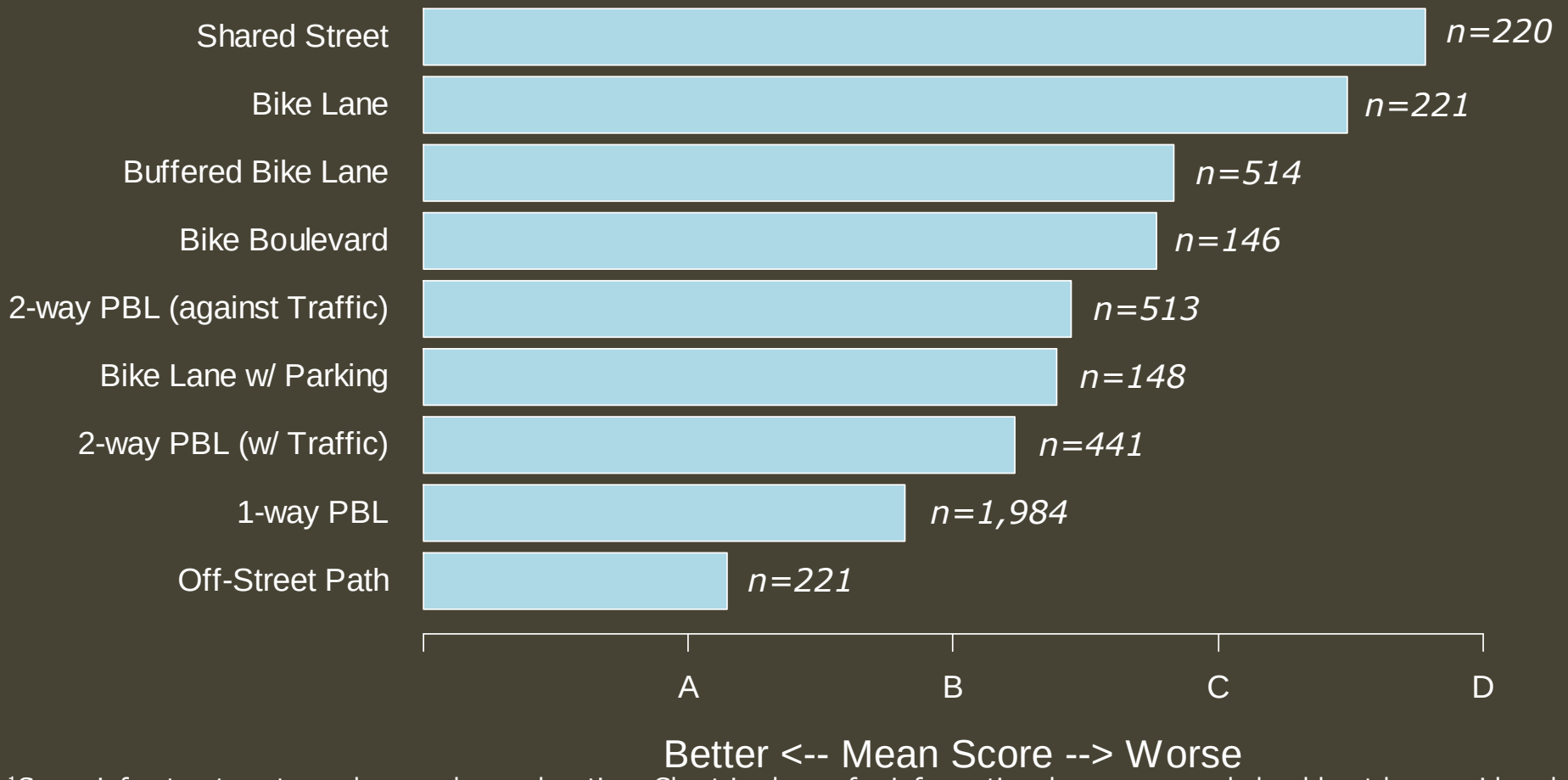


Demographic Impacts

Factor	Correlation with Ratings
Age	0.06*
Gender (0=Male)	0.03
Riding Habits	0.10**

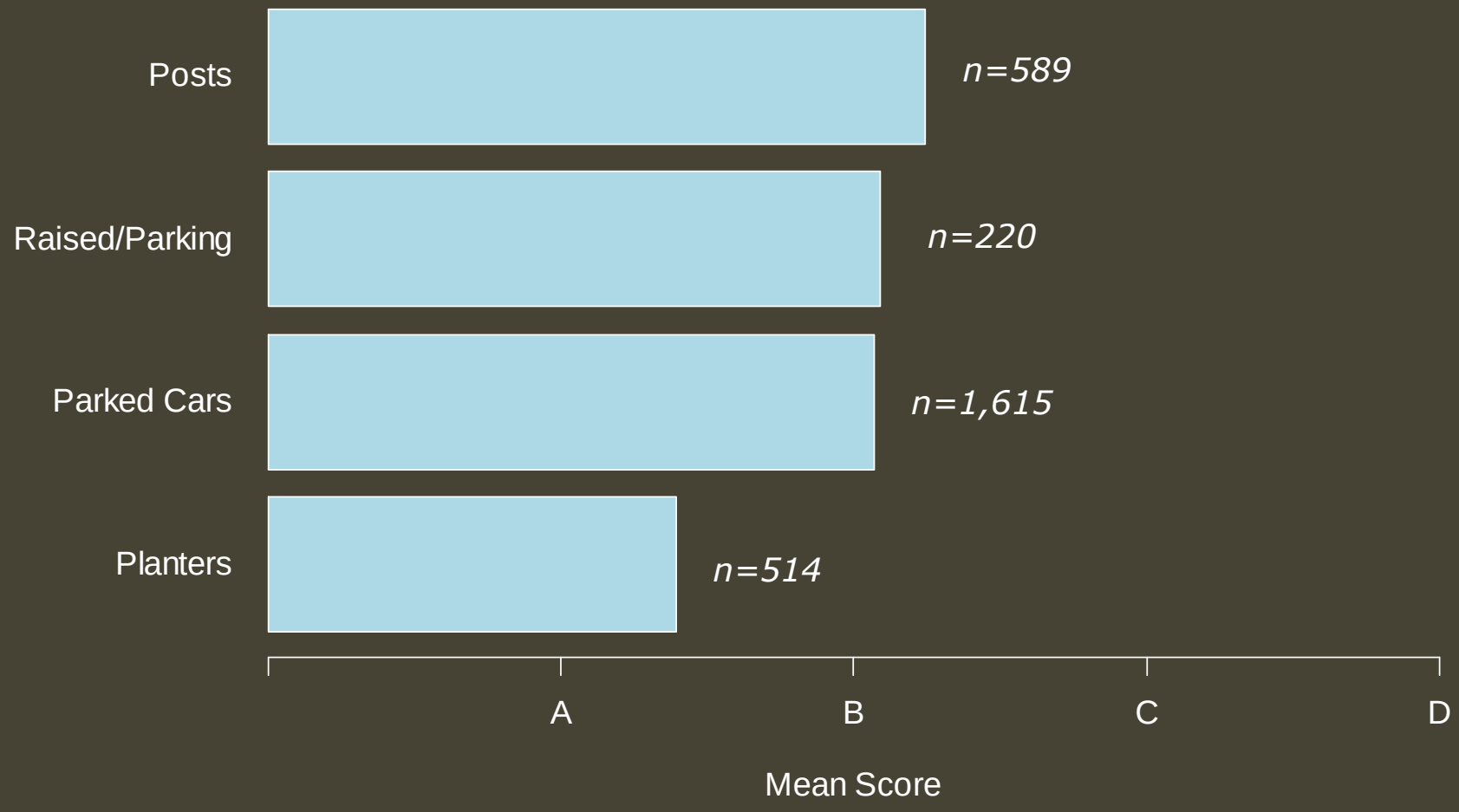
*=Significant at the 95% confidence level
**=Significant at the 99% confidence level

Score by Infrastructure Type[1]



[1]Some infrastructure types have only one location. Chart is shown for informational purposes and should not be considered an absolute preference rating hierarchy.

Score by Buffer Type



Other Factors

Factor	Correlation
MV Volume (Adjacent Lane)	0.06
MV Volume (Total in Video)	0.06
MV Volume (ADT)	0.09
MV Speed	0.03
Unsignalized Conflicts/Mile	0.03
# of Travel Lanes	0.18
Buffer Width	-0.002

Significant at 99% confidence level – all protected bike lanes

Significant at 99% confidence level – after controlling for one-way vs. two-way travel

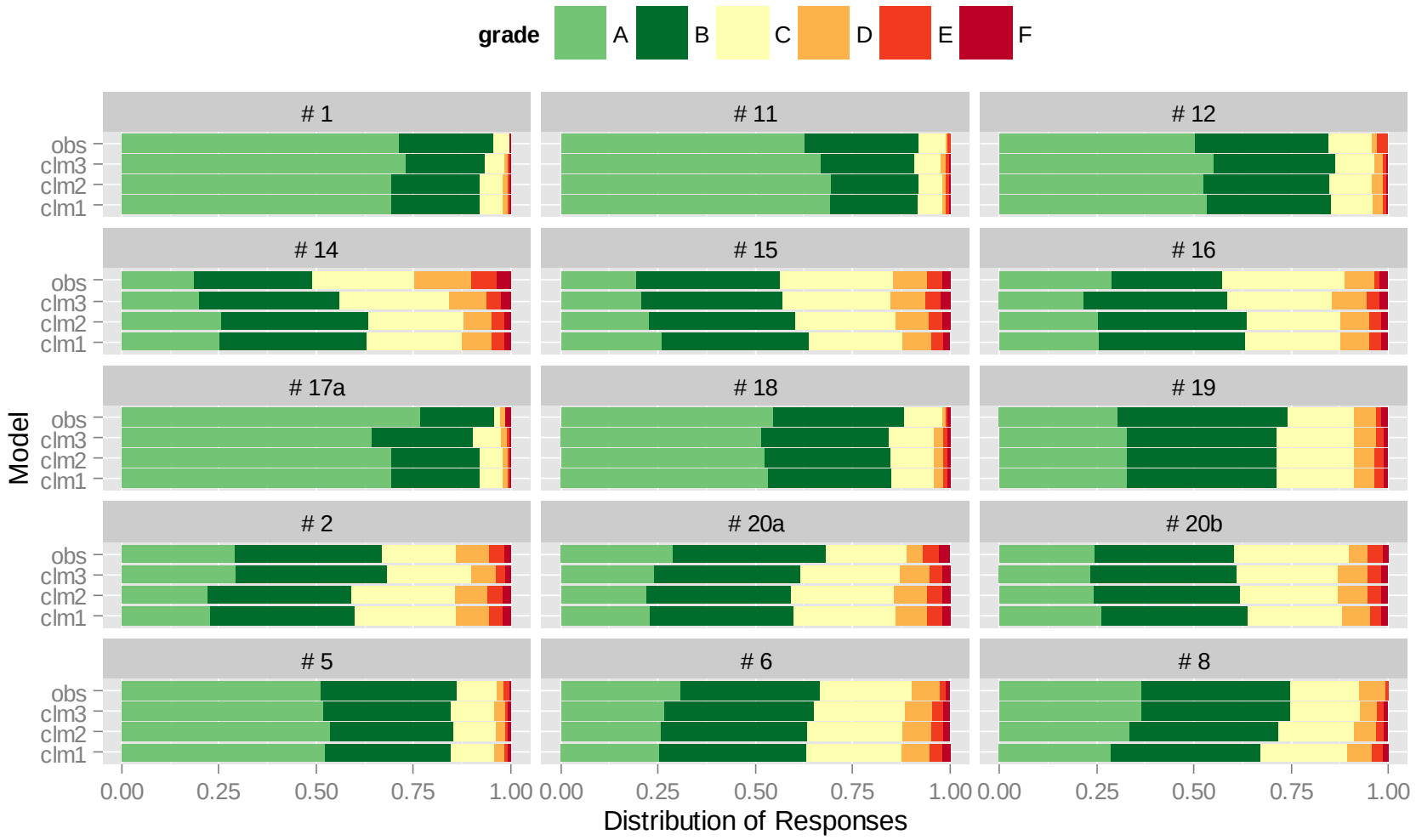
Models

- Index Table
- Regression Models (OLS & Logistic)
- Variables Considered
  - Buffer Type
  - 1-Way vs. 2-Way
  - MV Speed
  - *# of Travel Lanes*
  - *MV Volume (ADT)*

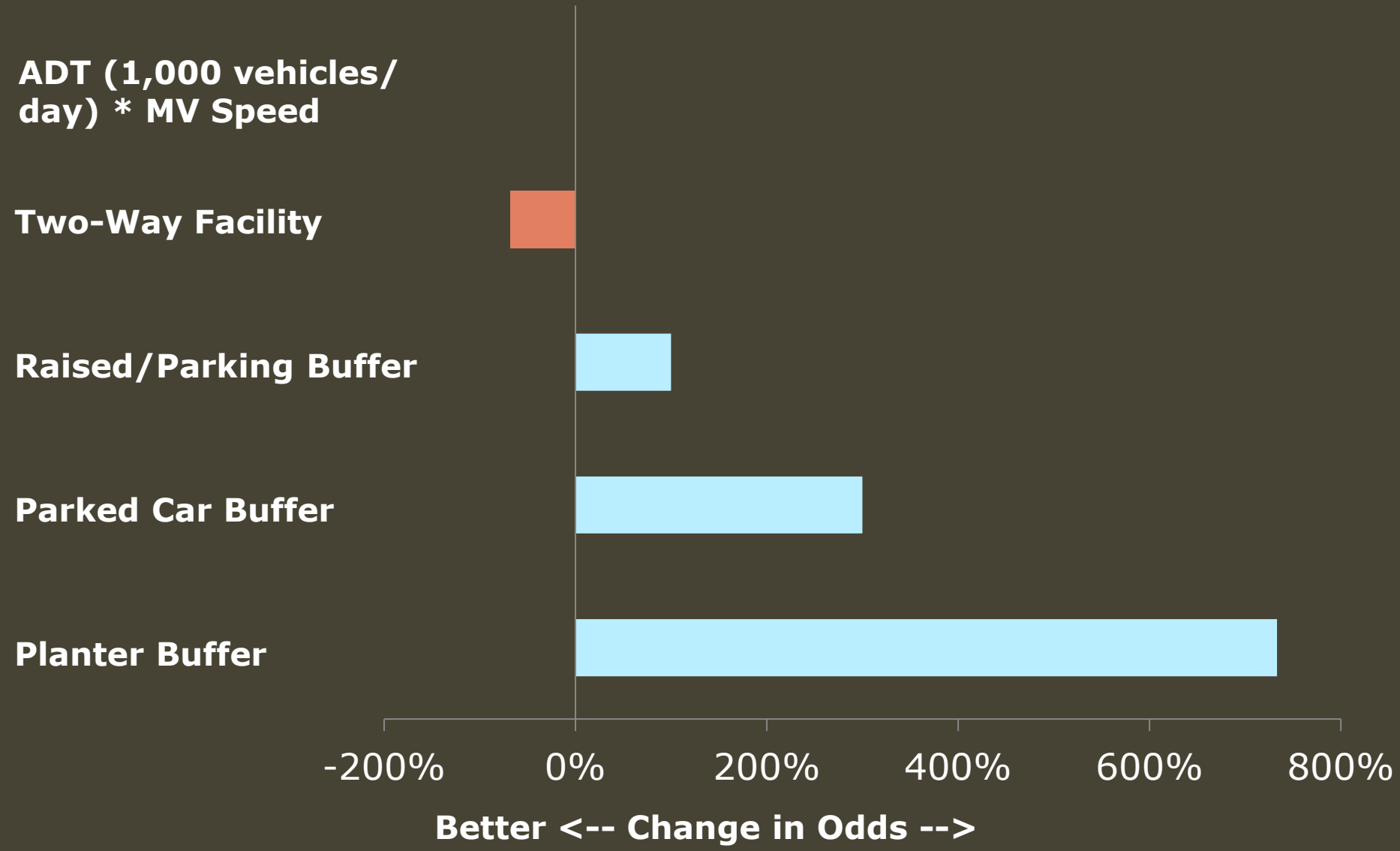
Regression Models

Model 1	Model 2	Model 3
Buffer Type		
One-way vs. Two-Way		
MV Speed		MV Volume (Adjacent Lane)
# of MV Lanes	MV Volume (ADT)	Buffer Width
Log Likelihood= -3,676	-3,671	-3,657

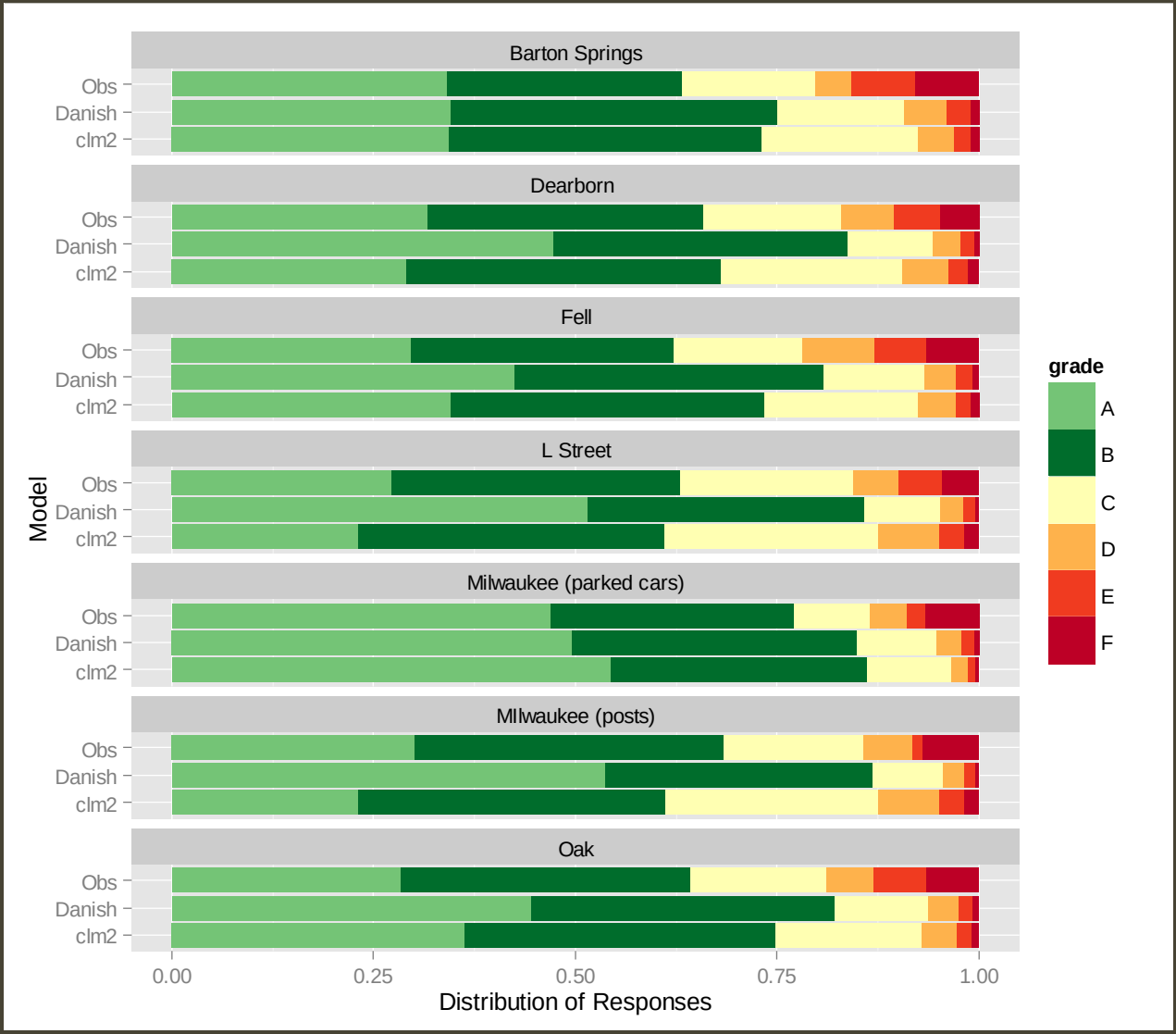
Model Distribution Comparison



Recommended Model Odds Ratios



Comparison to Intercept Surveys



Example Application

Existing Conditions

- 11,000 ADT
- HCM Link LOS 'D'

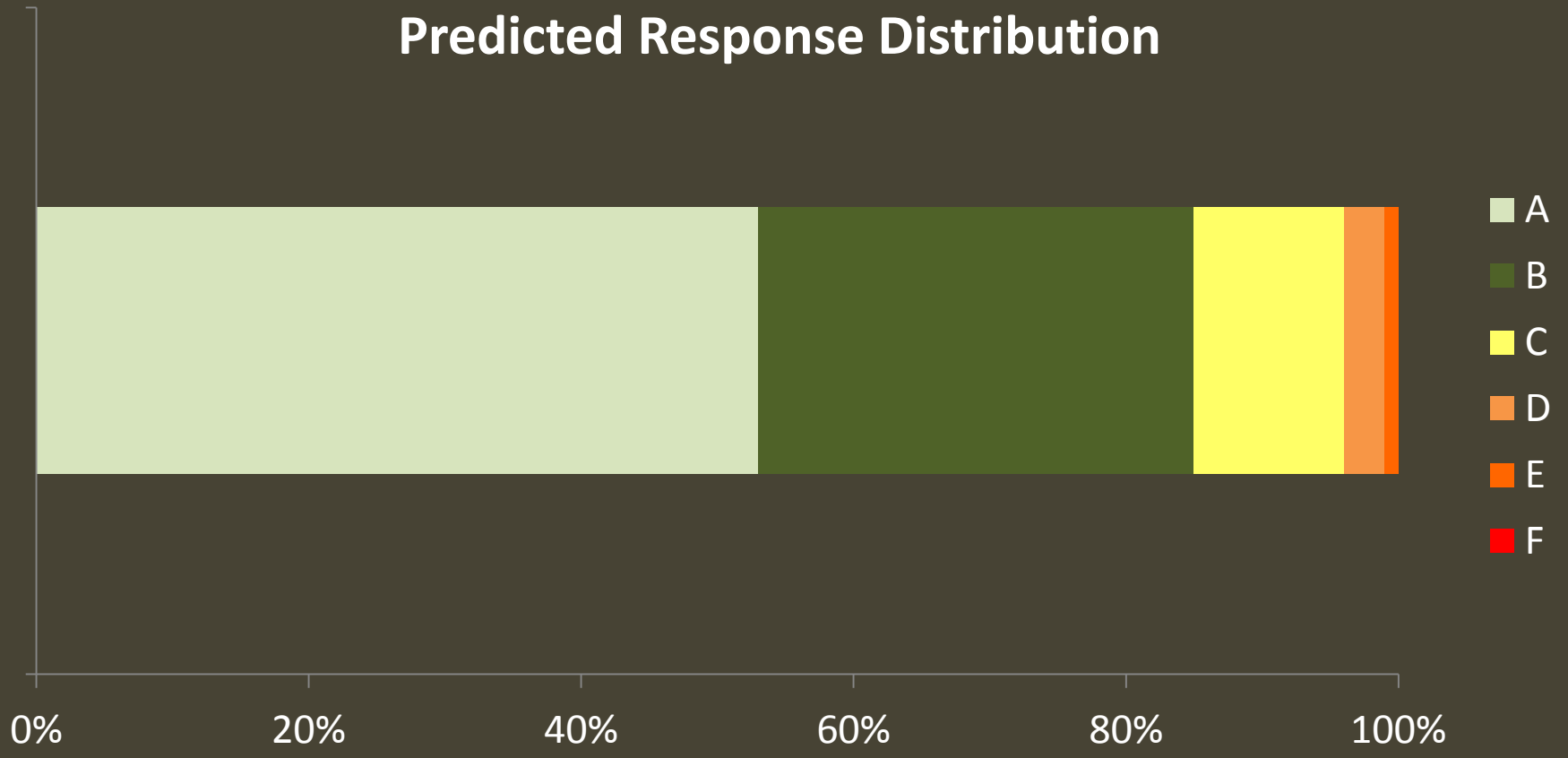
Build Conditions

Build Conditions LOS Calcs

- Probability of an 'A' rating = $1/(1+e^{(-(-1.60)-1.38-0.001*(30*11,000/1,000))}) = 0.53$

- $p(B) = 1/(1+e^{(-(0.05)-1.38-0.001*(30*11,000/1,000))}) - 0.53 = 0.32$

Build Conditions LOS



Index Table

Index Table

Variable	Comfort Score A	Comfort Score B
Buffer Type	Planters Parked Cars	Posts
Motor Vehicle Speed (MPH)	<=30	35
ADT (vehicles/day)	<15,000	>=15,000
# of MV Travel Lanes	2	3

Index Table Performance

Clip #[1]	Predicted Median Score	Observed Median Score	Difference
1 (1-way - P)	A	A	None
2 (2-way - PC)	A	B	Better
5 (1-way – PC)	A	A	None
6 (2-way – PC)	B	B	None
8 (1-way – PO)	B	B	None
11 (1-way – P)	A	A	None
12 (1-way – PO)	A	A	None
15 (1-way – PC)	B	B	None
16 (2-way – PC)	B	B	None
17a (1-way – P)	A	A	None
18 (1-way – PC)	A	A	None
19 (1-way – R)	B	B	None
20a (2-way – PC)	A	B	Better
20b (1-way – PO)	B	B	None

[1]Directionality and buffer type indicated in parentheses. P = Planters; PC = Parked Cars; PO = Posts; R = Raised/Parking (mostly unoccupied)

Results – Online Survey

Comparison to In-Person Survey

- Older
  - Mean age 43 vs. 36 years
- More Male
  - 65% vs. 47%
- Bicycle More Often
- Administration Method Effect
  - 0.28 points less comfortable

Conclusions

Recommended Model

- Regression Model #2
  - Readily Available Data
- Model Valid Ranges
  - ADT: *9,000-30,000 vehicles/day*
  - MV Speed: *25-35 MPH*
  - Buffers: *Planters, Parked Cars, Posts, Raised w/ Unoccupied Parking*

Secondary Conclusions

- Protected Bike Lanes > Other On-Street Infrastructure
- Buffer Type Significant
- One-way vs. Two-way Matters
- MV Volumes Significant
- Online Surveys Produce Different Results
  - Advertising Method Matters

Limitations

- Variety of Protected Bike Lanes
- Range of Traffic Conditions
- No Intersections
- Video Production Methods
- Sample Demographics

Implications/Future Work

- Model is Ready for Use
  - within identified ranges only
- Future Work:
  - Intersection Research
  - Overall Method for All On-Street Infrastructure

Acknowledgments

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- Questions?
  - nfoster@kittelson.com
- Thesis available at:
  - http://www.its.pdx.edu/publications.php

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