The Influence of Bridge Facility Attributes on Bicycle Travel Behavior

Christopher L. Melson, Jennifer C. Duthie, and Stephen D. Boyles

For presentation at the Transportation Research Board's 92nd Annual Meeting, Session #494, January 15, 2013, Washington, D.C.

THE UNIVERSITY OF TEXAS AT AUSTIN

WHAT STARTS HERE CHANGES THE WORLD

Abstract

- Develops an approach that uses GIS and an unlabeled multinomial logit model to estimate the impact bridge facility attributes have on bicycle travel behavior.
- Revealed preference data collected via a GPS-based smartphone application. Demographic (age, gender, and cycle frequency) and trip purpose data was also collected.
- Three bridge attributes were analyzed: accessibility, vehicular volume, and separation from traffic.
- Accessibility and traffic separation significantly impacted bicyclist's behavior, especially for female and infrequent trip makers.

Introduction

While previous research has investigated bicycle facility preferences, this is the first study to focus exclusively on bridges. Bridge facilities are fundamentally different from the rest of the bicycle infrastructure network; they act as a funneling system, where paths are constrained to a small handful of options. Any improvements and additions can have wide-ranging effects on travel behavior. The cost of bridge construction is also significant, making them difficult to retrofit. The objectives of the study are threefold:

(1) Contribute to bicycle route choice research using revealed preference data

(2) Use detailed GPS data to gain insights while avoiding the complications and potential errors of matching data to the full network and developing a large-scale network-based route choice model

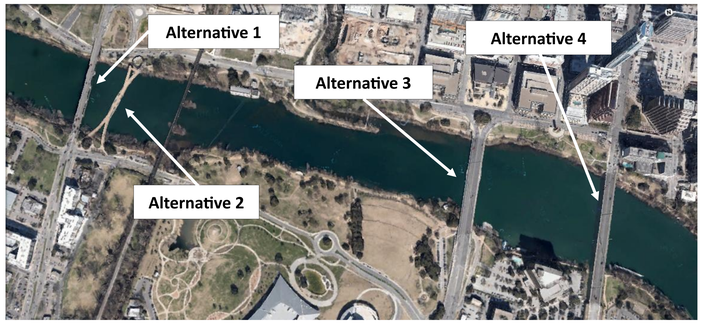
(3) Identify bridge attributes that are most necessary in making a bridge friendly to bicyclists, considering variation across gender, age, and experience.

Acknowledgements

The authors would like to thank the San Francisco County Transportation Authority staff for their data collection services, Katie Larsen for her help with ArcGIS, Dr. Chandra Bhat for his valued advice and expertise, and the Center for Transportation Research and Texas Transportation Institute for provision of the data.

Methodology

Real-time GPS data was collected in Austin, Texas May through October 2011 using the CycleTracks smartphone application. The application allowed users to input their age, gender, bicycling frequency, and trip purpose. The analysis was secluded to the four adjacent downtown bridges shown below. 508 trips by 74 users were used in the model.



Location of the four analyzed bridges — downtown Austin, Texas

Parameters of the model include the bridge attributes and all other individual/trip-specific explanatory variables interacted with these attributes. A distance variable (a measure of the shortest-path distance using each bridge) was also included.

Summary of bridge attributes

Attribute	Attribute Description	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Accessibility	Total miles of high/medium ranked bicycle infrastructure within 1/2 mile of bridge access points.	10.39	12.38	10.11	9.16
Vehicular Volume	Average directional, hourly vehicular volume within the specified time period. Four time periods were used: AM peak, mid-day off-peak, PM peak, and night.				
AM Peak - Northbound		1087	0	1198	1130
AM Peak - Southbound		433	0	340	272
Mid-day Off-Peak - North/Southbound		424	0	407	379
PM Peak - Northbound		900	0	549	578
PM Peak - Southbound		1011	0	1208	1086
Night - North/Southbound		76	0	73	68
Separation from Vehicular Traffic	Width of bicycle/pedestrian path in feet.	3.5	20	15	8

Results

The coefficient values shown below represent the change of an individual's utility based on a unit change in the corresponding variable. For variables interacted with bicycle frequency, less than monthly bicycle ridership is used as the base comparison; for gender—male is the base case; for trip purpose—commute trips.

Estimated parameters of the unlabeled multinomial logit model

Attribute and Interaction Terms	Value	t-value
Accessibility	**1.370**	**6.22**
Peak Trips	-0.727	-3.37
Weekend Trips	-0.392	-2.74
Female Cyclists	0.442	2.81
Daily Cyclists	-1.550	-6.52
Weekly Cyclists	-1.250	-5.15
Volume	**insignificant**	
Peak Trips	-0.00265	-4.91
Shopping Trips	0.00195	3.31
Traffic Separation	**0.33500**	**3.15**
Low-Light Trips	-0.17600	-4.91
Shopping Trips	0.07540	2.14
Daily Cyclists	0.11700	2.08
Weekly Cyclists	0.21900	3.64
Age	-0.00973	-4.88
Distance	**-19.10**	**-7.84**
Peak Trips	-4.050	-2.97
Exercise Trips	12.900	7.59
Shopping/Social Trips	10.400	6.98
Female Cyclists	2.030	2.09
Daily Cyclists	2.610	3.44
Age	0.156	3.49
Log-likelihood at equal shares	-646.301	
Log-likelihood at convergence	-350.656	

Conclusion

- Bicyclists are attracted to bridges that are easily accessible; this is especially true for infrequent and female cyclists.
- During peak periods, bicyclists are more attracted to low volume bridges.
- Bicyclists are inclined toward bridges with adequate traffic separation. Daily and weekly users are particularly predisposed to physical separation.
- Distance was the most significant factor, particularly for time-constrained trips (trips during the peak period and commute trips).