Infrastructure Preference and Value Among Transportation Cyclists in the U.S.

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Abstract

A decade of surging bicycle use has attracted little research seeking to measure bicycle utility, infrastructure preferences, and the tension between transportation budgets versus the demands of cyclists, pedestrians, and motorists. A review of the literature shows only one study applying non-market valuation tools to study this issue and demographic surveys tracking gender, age, and income have provided little guidance. Using paired comparison and contingent valuation methods, this paper adds to existing research regarding cyclists' infrastructure preference and attempts to identify a model for valuing specific infrastructure options. Results suggest strong and easily identifiable preference ordering but do not return an explanatory model for infrastructure valuation.

1. Introduction

In the past decade bicycle mode share in the United States increased 25%, now accounting for 1% of all yearly transportation trips (Bikes Belong, 2011). Cities across the country are seeing the positive impact bicycle transportation has on public and environmental health, community "livability," and local economies (United States Department of Transportation, 2011; Bikes Belong, 2011).

Efficient bicycle network allocation requires a delicate balance between limited transportation budgets and infrastructure demands from cyclists, pedestrians, and motorists. Current cycling trends increase the value of understanding how cyclists fit into this cost/benefit analysis. Non-market valuation tools, common in public and enviornmental goods valuation, provide a way to model cyclists' infrastructure prefence rankings and estimate the value underlying these preferences.

To my knowledge, only one study exists attempting this (Tilahun and Krizek, 2007). Tilahun and Krizek (2007) administer an attribute based stated preference survey to 161 employees at the University of Minnesota to determine the additional time respondents will pay for four different bicycle infrastructure improvements. They then estimate the dollar value for each infrastructure choice with a mean value of time. Their results indicate individuals are willing to pay the most for designated bike lanes, followed by the absence of parking, and then by off-road facilities. I hope to add to this research by surveying a larger sample and investigating an alternative way to gather value information.

I administer an online stated preference survey to transportation cyclists[1] across the country. The survey includes a preference ranking section to verify Tilahun and Krizek's (2007) findings and a valuation section asking respondents to compare their most preferred infrastructure choice with their current options. The infrastructure choices I will use for this survey, detailed in Appendix A, are: side streets, arterials, pained bicycle lanes, multi-use paths, scenic paths, and cycle tracks.

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[1] Transportation cyclists are individuals who ride their bicycle as a mode of transportation. Cyclists who ride only for exercise are not considered in this survey.

In the next section I review the literature on cyclists' infrastructure preferences and non-market valuation techniques. In the third section I discuss my survey design and administration. In the fourth section I discuss my data. I then discuss my model and results in the fifth and sixth sections and I conclude in the final section.

2. Literature Review and Methods

Current bicycle commuting research focuses on the socio-economic, environmental, and infrastructure determinants of bicycling commuting. Some additional research addresses how attitudes, social influence, and habits affect bicycle mode choice. The characteristics we may consider obvious predictors of cycling behavior—gender, income, age, race, education levels, etc—are not actually useful. The only conclusive predictor for infrastructure preference seems to be cycling experience (Sinson and Bhat, 2004; Wiltox and Tindemans, 2004).

I will cover the literature on transportation cyclists' demographic characteristics and environmental preferences and then move to a discussion of the current research on infrastructure preferences. I will then discuss the non-market valuation theory and methods relevant to my research.

Demographic Characteristics

Gender has a role in cycling, but the data contain contradictions. Research indicates that men are more likely to commute by bicycle than women (Banister and Gallant, 1999; Pucher et al., 1999; Krizek et al., 2004; Rietveld and Daniel, 2004; Rodriguez and Joo, 2004; Moudon et al. 2005; Plaut, 2005; Stinson and Bhat, 2005; Dill and Voros, 2007). Wiltox and Tindemans (2004) also found this to be the case for the general population; however they add that in the population of active cyclists more women than men commute via bicycle.

Age also has an unclear effect on bicycle commuting probability. Some studies show bicycle commuting decreases with age (Pucher et al., 1999; Moudon et al., 2005; Dill and Voros, 2007). Other studies show age has a non-linear effect on propensity to cycle to work (Wardman et al., 2007; Heinen et al., 2011). This heterogeneity may reflect differences in research methodology. Wardmen et al. and Heinen et al. restricts their data to individuals within working age, 18-65, and find bicycle commuting percentages first increases with age, and then falls.

And similarly again with income, the correlation is unclear. In several studies income is positively correlated with cycling (Pucher et al., 1999; Stinson and Bhat, 2005; Dill and Voros 2007). Some studies show bicycle commuters are more highly educated and education is highly correlated with income (Krizek et al., 2009; Winters and Teshke; 2010). Paradoxically, individuals who work less (and theoretically make less) also tend to commute by bicycle more. Similarly, car ownership correlates closely with car-commuting and with income indicating that higher income individuals may commute primarily by car (Sener et al., 2009).

Environmental Preferences

Cyclists commute more in the summer and fall (Hunt, 2002; Stinson and Bhat, 2004; Guo et al., 2007). Seasons affect regional commute rates differently and these effects do not vary as one would expect. For instance, year-round bicycle commuting is more common in Canada than in the United States despite Canada's colder temperatures (Pucher and Buehler, 2006). Canadian cyclists do still show a preference for more mild temperatures relative to their environment (Pucher and Buehler, 2006). Temperature is also correlated with bicycle commuting levels. Hot and cold extremes negatively affect commuting numbers (Bergstrom and Magnusson, 2003). Women are more affected by this extreme than men (Nankervis, 1999). Rain is cited in several studies as the most disliked environmental aspect of bicycle commuting (Nankervis, 1999; Sener et al., 2009).

Hilliness, amenity density, traffic stops, trip distance, trip length, and trip safety also impact bicycle use (Heinen et al., 2011). Findings on hilliness' effects are mixed. Some studies find hillier routes negatively impact the amount of bicycle commuting (Aultman-Hall et al., 1997; Stinson and Bhat, 2003; Rodriguez and Joo, 2004; Hunt and Abraham, 2007). Other studies show no significance (Moudon et al., 2005). These differences are strongly affected by the sample studied. Frequent cyclists care less about hills than part-time or non-cyclists (Akar and Clifton, 2009).

Proximity to amenities, city centers, and business centers affect bicycle commuting non-linearly (Parkin et al., 2008; Guo et al., 2007; Dill and Voros, 2007; Pucher and Buehler, 2006; Moudon et al., 2005). However, one study shows actual residential densities do not affect bicycle mode share (Rodriguez and Joo, 2004).

Cyclists see traffic stops negatively and choose their routes accordingly (Stinson and Bhat, 2003). Similarly, time and distance negatively affect bicycle commuting, more so than driving (Akar, 2009; Stinson and Bhat, 2004). Travel time more negatively affects non-cyclist's perceptions towards bicycle commuting than it affects the behavior of actual bicycle commuters (Gatersleben, 2007). Experienced cyclists prefer shorter routes to safer ones (Stinson and Bhat, 2004; Hunt and Abraham, 2007). This preference swaps for less-experienced or un-experienced cyclists indicating safety plays a larger role for these groups (Stinson and Bhat, 2004; Hunt and Abraham, 2007).

Infrastructure Determinants

Tilahun and Krizek (2007) found commuters prefer on-road striped bicycles lanes with no adjacent parking to all forms of infrastructure, including separated bicycle paths. Winters and Tecshke (2010) found commuters prefer separated paths to all other infrastructure choices. Sener et al. (2009) found commuters prefer wide general use roadways to any form of cycling specific infrastructure. This heterogeneity most likely occurs due to differences in research methods and differences in actual available facilities in the study area. Research performed in Europe indicates a preference for separate facilities. In the United States, where these facilities are less common, the preference is mainly for striped bicycle lanes. One consistent finding is that cyclists highly prefer facility continuity (Sener et al., 2009; Tilahun et al., 2007).

Car parking negatively affects route choice and commute enjoyment. Several studies show cyclists prefer facilities and routes without adjacent parking (Stinson and Bhat, 2004; Winters and Teschke, 2010). Cyclists prefer angled parking facilities to parallel facilities, possibly because they provide the cyclist more time to react to car movements and minimize being hit by opening doors (Sener, 2009). Among routes with parking, cyclists prefer low volume and low turnover parking areas to high volume and high turnover areas (Sener, 2009). These preferences reflect an inclination for safer routes.

Cyclists desire certain end-of-commute facilities. For instance, bicycle parking at their destination is important for cyclists and plays a significant role in the decision to commute by bicycle (Hunt, 2002; Stinson and Bhat, 2004; Wardman et al., 1997). Additionally, cyclists value showers and lockers at work, however these facilities are not shown to increase mode choice (Sener, 2009; Stinson and Bhat, 2004).

Method

Paired comparison and contingent valuation surveys are both proven methods for determining market valuation (Champ, 2003). Paired comparisons provide a preference ranking and a consistency measure and can be designed to provide value information (Brown 2003). Contingent valuation methods provide the framework for ascertaining willingness to pay (WTP) or willingness to accept (WTA) values for goods (Boyle, 2003).

Both methods rely on the premise that individuals can express their preference order for a bundle of goods (Flores, 2003). An individual's preferences can be represented through their direct random utility function *U(X,Q)* where $X = [x_1, x_2, \dots, x_n]$ is a vector of the *n* market goods in an individual's bundle and $Q = [q_1, q_2, \dots, q_k]$ is a vector of the *k* non-market goods in that individual's bundle (Flores, 2003). Each combination of *X* and *Q* results in a single value of *U* such that $U(X_a, Q_a) > U(X_b, Q_b)$ only when (X_a, Q_a) is preferred to (X_b, Q_b) (Flores, 2003).

Assuming individuals are utility maximizers, the probability that item *i* has a higher utility than item *j* is:

(1) $$P\left(U_{in} > U_{jn}\right) = P(E(U)_{in} + \varepsilon_{in} > E(U)_{jn} + \varepsilon_{jn})$$

This probability increases as $E(U)_{in}/E(U)_{jn}$ ratio increases and as the distributions of the error terms narrow (Brown, 2003). Equation (1) is the basis behind paired comparison surveys.

The paired comparison literature shows that response time decreases and response reliability increases during a paired comparison exercise. This suggests respondents become more familiar with the choices and their preferences as they progress through the exercise (Brown et al., 2008). I include a paired comparison section in my survey to provide choice familiarity and thus help respondents answer the more difficult valuation questions.

Contingent valuations surveys allow us to gather value information by looking at the difference in utility between two levels of *Q*. There are two ways to measure this value, WTP and WTA. WTP is the amount of income an individual is willing to give up to get their preferred level of *Q* and WTA is the amount of compensation an individual is willing to accept to stay at their less-preferred level of *Q*.

We first note that utility maximizing individuals choose their most preferred bundle of market goods subject to their income level (y), the price of their chosen goods (P), and the rationed level of the non-market good. We can then represent the optimal demand vector as $X^* = X(P, Q, y)$, where each entry is the optimal demand function for that particular good (Flores, 2003). Plugging this into the utility function gives us,

(2) $U(X^*, Q) = v(P, Q, y)$

where v is the indirect utility function (Flores, 2003).

(3) $v(P^0, Q^0, y^0) = v(P^0, Q^1, y^0 - WTP)$[2]

where Q^1 is preferred to Q^0. And for WTA:

(4) $v(P^0, Q^0, y^0 + WTA) = v(P^0, Q^1, y^0)$

Theoretically WTA and WTP are equal measures, however the literature suggests that the WTA/WTP ratio is typically quite high (Horowitz, 2002; Randall, 1980; Willig, 1979). Horowitz (2002) finds this ratio increases the less a good is like an "ordinary private good."

3. Survey Design and Administration

I administered a stated preference survey to transportation cyclists around the country. This survey consists of a series of warm-up questions that gather information about the cyclist's reasons for riding, and riding characteristic. Respondents also provide the location they ride their bicycle to most frequently and the infrastructure characteristics of the route they take to this location. For instance, if an individual rides their bicycle downtown for social gatherings they would describe the infrastructure they use to downtown in miles per type. This provides me with their baseline as well as a measure of miles ridden. I chose to ask for mileage this way because I was concerned about the difficulty of reporting average miles per week, month, or year.

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[2] For simplicity I am assuming prices and income are constant across scenarios, but this is not required

I follow the warm-up with a set of fifteen pairs representing all combinations of the six infrastructure choices. Respondents are asked to indicate which choice they prefer when riding their bicycle for transportation. I chose to keep the paired comparisons between goods as the main intention of this exercise is to familiarize respondents with the choice options and provide a respondent reliability measure. Including monetary values would increase the number of pairs and possibly cause respondent fatigue. Respondents are not given an indifference option as this reduces the amount of information I can gather from this exercise (Brown, 2003). The overall pairs and the individual choices are presented in random order to decrease the effects of interaction between choice order and preference on the cumulative preference ordering (Brown, 2003).

The contingent valuations questions follow the pairs. I chose to develop two contingent valuation (CV) question 'frameworks'—WTP and WTA. Respondents are randomly assigned a WTP or WTA framework, and are then randomly shown an open-ended valuation question, a low-bid (10¢) dichotomous choice question with an open-ended follow-up, or a high-bid ($1.00) dichotomous choice question with an open-ended follow up. The questions ask respondents to value the route they described to me in the warm-up against their most preferred infrastructure option. They are asked to provide value in dollars per mile. All six question formats can be found in Appendix B page ix.[3] This structure gives me a way to investigate which question style provides the most accurate responses.

Administration

I emailed my survey to 755 bicycle user groups obtained from the League of American Cyclist's member lists. I asked each group to share my survey link with their members through email, Facebook, blogs, and any other applicable methods. At the end of each survey I encouraged respondents to share my survey with their contacts.

These groups represent cycling clubs, teams, advocacy groups, and general interest groups across all fifty U.S. states. I ran the survey from March 11, 2013 until April 6, 2013. During this period 1,851 people opened my survey link and 1,503 people finished the survey. Respondents were required to be at least 18 years old, live in the United States, and have ridden a

[3] For a full copy of this survey see Appendix B.

bicycle for transportation at least one time in the past year; 168 of the 349 unfinished surveys were disqualifications due to not meeting these restrictions.

4. Data

Tables 1 and 2 present summary statistics for the collected data.

Table 1.

Variable	Count	Percentage	Variable	Count	Percentage
Male	960	71.32	Female	386	28.68
White	1,253	95.43	Filipino	8	0.6
American Indian	14	1.06	Vietnamese	3	0.23
Asian	12	0.91	Samoan	1	0.08
African American	11	0.08	Hawaiian	1	0.08
Chinese	10	0.76	Guamanian/Chamorro	0	0
Education: *No High School*	1	0.07	Education: *College*	500	37.23
Education: *High School*	29	2.16	Education: *Masters*	454	33.8
Education: *Some College*	141	10.5	Education: *Doctoral*	72	5.36
Education: *Two Year Degree*	76	5.66	Education: *Professional*	70	5.21
Working Part Time	593	44.15	Working More than FT	178	13.25
Working Full Time	201	14.97	Not Working	370	27.55
Own a Car	1,198	89.34	Married	827	61.85
Have Children (in home)	319	23.84			
Region: *Mid-Atlantic*	108	9.02	Region: *Rocky*	106	8.86
Region: *New-England*	128	10.69	Region: *South*	126	10.53
Region: *Pacific*	333	27.82	Region: *South-Atlantic*	153	12.78
Ride 1 Season/Yr	8	0.67	Ride 2 Seasons/Yr	25	2.10
Ride 3 Seasons/Yr	332	27.83	Ride 4 Seasons/Yr	828	69.40
Most Preferred: *CycleTrack*	353	29.59	Most Preferred: *ScenicPath*	308	25.82
Most Preferred: *BikeLane*	174	14.59	Most Preferred: *Multi-Use*	162	13.58
Most Preferred: *Side Street*	123	10.31	Most Preferred: *Arterial*	50	4.19

Table 2.

Variable	Mean	SD	Min	Max	Count
Household Income	$75,853.66	$28,738.09	$25,000	$105,000	1230
Age	47	14	18	82	1344
Miles on Reported Route	10.9	77.16	.1	2650	1193
Rides/Week—Spring	4.28	4.72	0	100	1193
Rides/Week—Summer	4.88	5.67	0	100	1193
Rides/Week—Fall	4.34	4.72	0	100	1193
Rides/Week—Winter	2.68	3.59	0	65	1193

I have introduced the issue of self-selection bias by gathering my sample from user groups and administering the survey on the Internet. Self-selection bias can have both positive and negative effects on the accuracy and scalability of my data. My survey does not reach transportation cyclists who are not on the Internet or who do not belong to a bicycle user group. My study, as a result, is not representative of the intended population and my results must be interpreted as such.

Stinson and Bhat (2003) administer a user-group survey in a similar manner. They point out that surveying user groups in this manner does result in a higher response rate because individuals are more invested in the outcome of the research. They also indicate that individuals who belong to user groups are often more expert in that area, suggesting that they may be able to provide a more educated response than an individual who is less familiar with the survey topic.

Pucher et al. (2011) use National Household Transportation Survey (NHTS) data to describe the demographic nature of commuter cyclists. They find the following:

- 77% of commuter cyclists are male, 23% female
- 90% own cars
- 79% are White, 10% African American, 8% Hispanic, and 3% Asian
- Mean income is approximately $60,000

If my sample is drawn from the same population, commuter cyclists, men and non-White individuals are underrepresented and higher income individuals and Whites are overrepresented.

Post-hoc weighting methods can correct for these inaccuracies, however they are beyond the scope of this research.

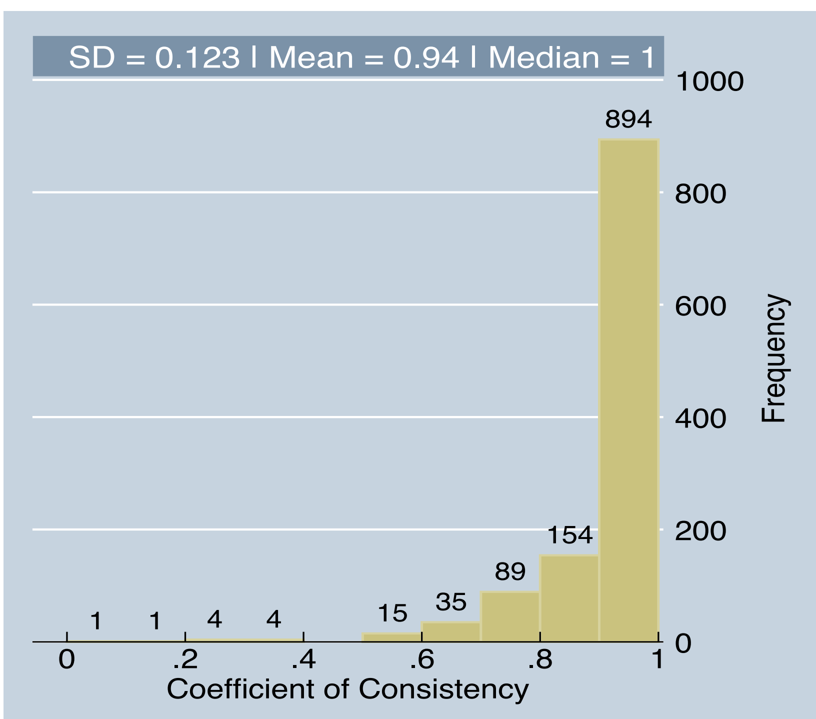
4. Results

Paired Comparisons

I first create a response matrix for each individual and sum across individuals to construct a frequency matrix for the sample. I then test the cumulative preference order through methods outlined in Brown (2003) by comparing the number of individual responses containing one or more circular triads (*i*>*j*>*k*>*i*) to the total number of possible circular triads in a six choice paired comparison. I then calculate the scale values for each choice which provides an estimate of the *E(U)s* for this sample (Brown 2003).

Figure 1 presents the individual coefficients of consistency for the paired comparison choices. This number relates the number of circular triads in an individual's response matrix to the total number of possible triads in the choice set (determined by the number of choices). The coefficient ranges from 0, indicating the maximum number of circular triads, to 1, indicating no circular triads. Within my sample, 74.69% of respondents have a coefficient of consistency equal

Figure 1.



to 1 and 95% of respondents have a coefficient over 0.75. This indicates a high level of consistency across responses (Brown, 2003; Brown et al., 2008).

Table 3 presents the frequency matrix for the paired comparison choices. A total of 1,197 responses were used for these choices, after responses were dropped for missing data and protest answers in the contingent valuation questions. The Total row indicates the number of times that column was picked over all rows. The SV row indicates the Scale Values associated with each infrastructure choice. The Scale Value is the number of times a particular choice won based on the total number of times it could win. And finally, the Interval row indicates the difference between Scale Values for adjacent choices.

Table 3.

	CycleTrack	Multi-Use	Bike Lane	Scenic Path	Side Street	Arterial
Side Street	860	814	775	638	0	182
Arterial	1073	1008	1197	915	1015	0
Bike Lane	859	655	0	527	442	95
Multi-Use	765	0	542	474	383	189
Scenic Path	770	723	670	0	559	282
CycleTrack	0	432	338	427	337	124
Total	4327	3632	3522	2981	2736	872
SV	72.30	60.69	58.85	49.81	45.71	14.57
Intervals	11.61	1.84	9.04	4.1	31.14	

We can see a clear preference ranking indicating Cycle Track > Multi-Use > Lane > Scenic > Side Street > Arterial. This is consistent with Tilahun and Krizek (2007) in that Lane > Scenic > “No Infrastructure”. My survey adds a preference structure for two additional choices, Cycle Track and Multi-Use Paths, both of which are gaining popularity in the United States (NACTO, 2013). These additional choices are still consistent with the conclusion in Tilahun and Krizek. (2007) that cyclist prefer direct routes without adjacent parking, and Cycle Track and Multi-Use Paths have both of these features. In addition, this ranking indicates a preference for separation from both cars and pedestrians, which is one aspect Tilahun and Krizek (2007) did not address in their research.

We can interpret the scale values as preference interval scales (Brown, 2003). These intervals reveal small difference in the preference for multi-use paths over painted bicycle lanes and a very large preference for all infrastructure choices over arterials. Brown (2003) notes, however, that the outer intervals are less reliable and their magnitude should be interpreted with some caution.

Contingent Valuation

The valuation questions proved much more challenging for respondents. Table 4 presents various descriptive statistics for all six versions of the valuation questions. The first section presents the raw data for all six question types. The mean WTP for the open-ended question is quite large ($100), and the mean open-ended WTA is one million times larger indicating a lack of understanding for what the question was asking. This is consistent with the literature indicating that the WTA/WTP ratio is typically high (Horowitz, 2002). The bid questions follow-up responses are somewhat more constrained, most likely a symptom of bid anchoring (Boyle, 2003).

The second section presents the open-ended questions after trimming the data by ten percent and twenty percent (five percent on each side and ten percent on each side, respectively). The third section presents the WTP data constrained to the intervals (0, 20] and (0,2]. Both methods are common in contingent valuation surveys (Boyle, 2003). We can see that the median WTP shifts down by $0.05 and $0.08 for the successive trims. Both constrained WTP medians, however, are equal to the raw median.

It is clear the WTA data does not conform to the question being asked. The WTP data looks more promising, however I will work with the constrained sample. Answers of $0 indicate either indifference between options or protest answers. In either scenario the answer is not useful to my analysis so I choose to remove them.

Table 4.

Variable	Mean	Min	Max	SD	Median	Count	Count Diff from Raw
OpenWTP	1.32	0	100	7.71	0.25	187	N/A
WTP Low	0.29	0	12	1.18	0.10	211	N/A
WTP High	0.63	-2	20	1.99	0.10	215	N/A
OpenWTA	647,028.60	0	100,000,000	7,658,285.00	1.00	172	N/A
WTA Low	5,707.83	0	1,000,000	72,114.83	0.50	194	N/A
WTA High	56,403.81	0	10,000,000	703,968.30	1.00	204	
OpenWTP (t10)[4]	0.37	0	2	0.44	0.20	179	8
OpenWTP (t20)[5]	0.33	0	1	0.37	0.17	175	12
OpenWTA (t10)	23.74	0	1,000	131.11	1.00	165	7
OpenWTA (t20)	2.19	0	20	4.51	0.50	156	16
OpenWTP (0,20][6]	0.86	0.01	20	2.14	0.25	143	44
WTP Low (0,20]	0.40	0.0075	12	1.36	0.10	154	57
WTP High (0,20]	0.90	0.01	20	2.30	0.25	152	63

From equation (3) we can now specify the indirect utility function and solve for WTP. I do not include *P*, the prices for an individual's market bundle, because it is assumed constant between utility functions. Initial utility becomes:

$$(5) \qquad U^0 = \boldsymbol{X}'\boldsymbol{\beta} + y_i + \varepsilon_i$$

where $\boldsymbol{X}'$ is the list vector $\boldsymbol{X}' = [x_1, \dots, x_6]$ of miles spent on each infrastructure type for an individual's current route, or route vector. $\boldsymbol{\beta}$ is the coefficient vector I will estimate through OLS regression**.** Utility when switching to the individual's most preferred route is:

$$(6) \qquad U^* = \beta_p X_p + \boldsymbol{X}'\boldsymbol{\beta} + y_i + \varepsilon_p$$

[4] Trimmed 10%
[5] Trimmed 20%
[6] Constrained to greater than 0 and less than or equal to 20

With the WTP question equation (6) becomes:

(7) $$U^* = \beta_p X_p + \boldsymbol{X'\beta} + y_i - WTP + \varepsilon_p$$

Setting (5) and (6) equal we have:

(8) $$\boldsymbol{X'\beta} + y_i + \varepsilon_i = \beta_p X_p + y_i - WTP + \varepsilon_p$$

Solving for WTP gives:

(9) $$WTP = \beta_p X_p + y_i + \varepsilon_p - (\boldsymbol{X'\beta} + y_i + \varepsilon_i)$$

$$= \beta_p(1 - x_p) - \boldsymbol{X}_{-p}\boldsymbol{\beta}_{-p} + (\varepsilon_p - \varepsilon_i)$$

Where $\boldsymbol{X}_{-p}\boldsymbol{\beta}_{-p}$ represent the coefficient vector and route vector without the most preferred infrastructure.

Figure 2 presents the baseline regression of WTP on route characteristics. Each infrastructure option is coded as follows:

(10) $$(I_D - Share\ of\ Route_i) * (Miles\ Spent\ on\ Route_i)$$

I_D is a dummy variable equal to 1 if infrastructure *i* is the individual's most preferred choice, and 0 otherwise. I use the WTP data from the open-ended questions, and run my first regression on the unconstrained data. The results indicate no clear relationship between an individual's current route characteristics and their WTP for their most preferred infrastructure choice.

Figure 2.

	(1)
	Open-Ended
VARIABLES	WTP
Side Street	-0.120
	(0.332)
Arterial	-0.282
	(0.283)
Bike Lane	0.0433
	(0.452)
Multi-Use Path	-0.187
	(0.494)
Scenic Path	0.159
	(0.673)
Cycle Track	0.124
	(0.460)
Observations	187
R-squared	0.004

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

I then perform two additional regressions with this model, first constraining the data on the interval $(0{,}20]$ and then on the interval $(0{,}2]$. The first interval is constructed to drop all indifferent responses and any responses over the largest value I felt reasonable for this question. The second interval also drops indifferent responses but sets the top interval at $2, the 90th percentile for this dataset. Figure 3 presents the results from these regressions. The more restrictive interval shows a negative and significant relationship between the miles an individual spends on an Arterial and WTP per mile for their most preferred route.

Figure 3.

VARIABLES	(1) Open-Ended WTP (0,20]	(2) Open-Ended WTP (0,2]
Side Street	-0.277	0.133
	(0.427)	(0.144)
Arterial	-0.404	-0.460***
	(0.279)	(0.162)
Bike Lane	-0.891	-0.239
	(0.652)	(0.194)
Multi-Use Path	-0.767	-0.166
	(0.599)	(0.200)
Scenic Path	-0.674	0.154
	(0.828)	(0.220)
Cycle Track	-0.249	0.214
	(0.679)	(0.217)
Observations	143	137
R-squared	0.094	0.330

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

I expand the model to control for individual characteristics I suspect impact an individual's WTP. I run a series of regression adding variables for the number of seasons and individual rides per year, total miles on the most frequent route (trimmed 10% from the right tail), age, gender, household income, region, education, and race. Seasons ridden per year and Total Miles are intended to act as proxies for cycling experience. The full series of regressions can be found in Appendix C. Table 4 presents the results from the final regression with all included controls.

From the final model specification we see that the most significant relationship exists between the number of seasons and individual rides per year, the total miles of their most frequent trip, and their WTP for their most preferred route. A Wald test performed after the final regression indicated no statistical difference between the coefficients for seasons.

Figure 4.

		(1)	
VARIABLES		Open-Ended WTP (0,2]	
Side Street	-0.234	Mid Atlantic	2.522
	(0.167)		(2.087)
Arterial	0.599**	New England	1.299
	(0.234)		(1.529)
Bike Lane	0.271	Pacific	-0.127
	(0.210)		(0.938)
Multi-Use Path	0.316	Rocky Mountain	0.527
	(0.226)		(1.029)
Scenic Path	0.267*	South Atlantic	0.883
	(0.135)		(1.031)
Cycle Track	0.201	Some College	-11.24
	(0.145)		(9.642)
Ride Two Seasons/Yr	10.06***	Two Year Degree	-11.64
	(3.260)		(9.661)
Ride Three Seasons/Yr	10.56***	College	-10.71
	(3.012)		(9.653)
Ride Four Seasons/Yr	10.54***	Masters	-11.72
	(3.014)		(9.628)
Total Miles on Reported Route	0.519***	Doctoral	-10.59
	(0.145)		(9.964)
Age	-0.254	Professional	0.883
	(0.224)		(1.031)
Age^2	0.00300	White	-1.482
	(0.00242)		(3.086)
Female	1.157	Black	-6.946**
	(0.809)		(3.202)
Household Income	7.24e-07	Hispanic	-1.857
	(1.63e-05)		(3.170)
		Asian	2.750
			(1.707)
Observations			129
R-squared			0.521

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5 looks at the relationship between the bid and open-ended questions on the unconstrained WTA and WTP data. The first row presents the raw bid data with the number of respondents answering “no” to the bid question followed by the total number of individuals who received this question type and then by the proportion of “no” answers. I then preform this same analysis on the open-ended values. If an individual’s value is over the hypothetical bid they answered “no” to the hypothetical WTA bid and “yes” to the hypothetical WTP bid. For instance, if an individual reports $1.20 as their lowest WTA then we would expect them to answer “no” to both bid levels.

The proportions are consistent between question formats despite the large variation in raw WTA and WTP values. Approximately 25% of individuals answering the bid WTA question and 32% of individuals answering the open-ended WTA question value their most preferred infrastructure between 10¢ and $1.00. For the WTP question, approximately 35% of bid respondents and 40% of open-ended respondents value their most preferred infrastructure between 10¢ and $1.00.

Table 5.

Bid Proportions (Number of Respondents Answering “No”)												
Question Type	WTA Low	N	$\hat{p}$(10¢)	WTA High	N	$\hat{p}$($1)	WTP Low	N	$\hat{p}$(10¢)	WTP High	N	$\hat{p}$($1)
Bid	134	194	0.691	97	210	0.462	98	212	0.462	174	218	0.798
Open-Ended	113	172	0.657	57	172	0.331	62	187	0.332	140	187	0.749

6. Discussion

Paired Comparisons

The paired comparison exercise proved the most valuable. Responses to these questions are highly consistent which adheres to the literature on aired comparisons and general choice models (Brown, 2003; Boyle, 2003). Cyclists are very comfortable making these choices, as they face them every time they ride.

The preference rankings are consistent with the findings in Tilahun and Krizek (2007). This indicates that the preferences they observed in their smaller sample are consistent with the preferences of a more diverse population of cyclists.

The preference order suggests a desire to be separated from vehicles and pedestrians, as well as an overall dislike for riding directly in traffic. The two most preferred infrastructure options, cycle tracks and multi-use paths, also top the cost list. It is promising to note that bicycle lanes, one of the least expensive options, are preferred in over 59% of their pairs.

Policy or transportation planning will find it helpful that individuals did not seem to struggle with ranking a choice they have never used before (i.e. cycle tracks). It should not be difficult for cyclists to express their preferences towards new policy or design plans that include unfamiliar options.

The two most preferred infrastructure options, cycle tracks and multi-use paths, also top the list on cost. It is promising to note that bicycle lanes, one of the least expensive options, were preferred in over 59% of their pairs. This indicates the potential for favorable cost/benefit ratios from retrofitting existing roadways with painted bicycle lanes. This result should be met with some caution, however, due to the high experience level of cyclists in my study. Previous research indicates that beginner and prospective cyclists would likely not rate bicycle lanes as highly.

Contingent Valuation

The results from the contingent valuation portion of this survey are much less conclusive. The wide variance and high WTA/WTP ratio are consistent with the literature and indicate a lack of understanding towards the WTA questions (Boyle, 2003). The bid questions did reduce the variances somewhat, but practical use of this application would require extensive pretesting to establish appropriate bid levels.

There may be potential to improve the value responses through better “training” in the beginning of my survey. I doubt any of my participants ever consider the dollar value of their bicycle rides. Giving them several practice non-market valuation questions may help their response accuracy with the more difficult versions. The paired comparison exercise may have more of the desired training effect if ordinary private goods and monetary values are included in the pairs. Another option is to present value questions in a price card format where individuals can indicate the interval containing their value rather than having to formulate it with little or no reference point.

The lack of explanatory power in my contingent valuation model indicates extensive heterogeneity between ceteris paribus responses. This is not surprising give then difficulty respondents faced when providing a value. Improved survey construction or payment vehicle may solve this issue, or the determinants of WTP for cycling infrastructure may not exist within my model.

Although the Seasons variable was highly significant, the Weld test indicated no significant difference between the coefficients for two, three, or four seasons. This could indicate the answers were provided with a response bias or that the single-season cyclists have significantly different WTP from the remaining sample.

The data on bid proportions does present some hope for future research. The proportion of bid and open-ended data are fairly consistent across value intervals. This indicates that individuals would have likely answered with a similar reference point if their question format had been different. This points again to the idea that my model was not defined in a way that captured the individual determinants for infrastructure value.

7. Conclusion

My results suggest strong and easily identifiable preference ordering but do not return an explanatory model for infrastructure valuation. The surveyed cyclists have a strong preference for all infrastructure options over riding directly in traffic. Their preference ordering also suggests a desire for separation from both cars and pedestrians. Research suggests that infrastructure improvements result in increased bicycle mode share but preferences have not been included in such studies (Dill and Carr, 2003; Gatersleben, 2010; Guo et al., 2007; Moudon et al., 2005).

I was unable to determine an accurate model for modeling WTP or WTA for individual's most preferred infrastructure options. My results indicate a need for survey design alterations, specifically with regard to the payment vehicle. Future research may benefit from using a payment card to gather values or by including a more specific training structure to prepare cyclists for answering value questions.

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APPENDIX A. Infrastructure Choices

NO INFRASTRUCTURE—SIDE STREET		
	**Separation from Cars**	NO
	Separation from Pedestrians	YES—Physical Barrier Between Pedestrians and Cyclists
	Posted Speed Limit for Cars	20 Miles Per Hour
	Route Directness	Routes are side streets. With this option you could possibly follow the same route you would take if you drove your car to your destination.
	Other	None

NO INFRASTRUCTURE—ARTERIAL		
	**Separation from Cars**	NO
	Separation from Pedestrians	YES—Physical Barrier Between Pedestrians and Cyclists
	Posted Speed Limit for Cars	35 Miles Per Hour
	Route Directness	Routes are on main roads. With this option you can follow the same route you would take if you drove your car to your destination.
	Other	None

PAINTED BICYCLE LANE		
	**Separation from Cars**	YES—Painted Barrier Between Cars and Cyclists
	Separation from Pedestrians	YES—Physical Barrier Between Pedestrians and Cyclists
	Posted Speed Limit for Cars	35 Miles Per Hour
	Route Directness	Routes are on main roads. With this option you can follow the same route you would take if you drove your car to your destination.
	Other	Cars may cross this painted lane when entering/exiting driveways and at intersections.

MULTI-USE PATH

Separation from Cars	YES—Physical Barrier Between Cars and Cyclists
Separation from Pedestrians	YES—Painted Barrier Between Pedestrians and Cyclists
Posted Speed Limit for Cars	Not Applicable (No Cars)
Route Directness	Routes will follow main roads. With this option you can follow the same route you would take if you drove your car to your destination.
Other	Cars will cross this path at driveways and intersections. Laws require that cars yield to pedestrians and cyclists at intersections.

SCENIC BICYLE PATH

Separation from Cars	YES—Physical Barrier Between Cars and Cyclists
Separation from Pedestrians	NO
Posted Speed Limit for Cars	Not Applicable (No Cars)
Route Directness	Routes are separate from main streets. This will require that you take a different route than if you drove your car to your destination.
Other	This path is also used for pedestrian and other recreational use.

CYCLE TRACK

Separation from Cars	YES—Physical Barrier Between Cars and Cyclists
Separation from Pedestrians	YES—Physical Barrier Between Pedestrians and Cyclists
Posted Speed Limit for Cars	All Speeds Possible
Route Directness	Routes will follow main roads. With this option you can follow the same route you would take if you drove your car to your destination.
Other	Dedicated traffic signals for cyclists: pedestrians and cars are stopped at a red light while cyclists are given dedicated time to move through an intersection. Cars will only be allowed to cross the Cycle Track at these protected intersections.

Appendix B: Survey

Please note, the formatting and presentation of questions is not easily described on paper. Conditional formatting is displayed in blue highlighting, and "pull-forward" text is displayed in bracketed italics.

Bicycle Infrastructure Valuation Survey - Multiple Good Survey

Q189 Welcome! This survey will gather information about how you value different transportation networks. This survey will only take about 12 minutes to complete. At the end of the survey you will be given the option to enter a raffle for an Amazon gift card. You will not be able to go backwards in this survey, so please make sure you read and respond to questions accurately the first time. When you are ready to start press "Next". Thank you in advance for taking this survey!

Q1.1 SURVEY PURPOSE: Researchers at the University of Colorado want to learn about what types of infrastructure you prefer when you ride your bicycle to work. Infrastructure is the basic physical structures needed to ride your bicycle. For instance, a bicycle lane painted on a road is one type of bicycle infrastructure. Throughout the survey we will be asking for your input, how often you ride a bicycle, and some basic information similar to what you would find on the United States Census. PARTICIPATION CONSENT: The information that you provide will not be linked to your identity. We will not reveal any of your personal information, nor will we reveal any of your responses. Your participation is voluntary and very much appreciated. QUESTIONS ABOUT THE RESEARCH: If you have any questions regarding this study, you may contact Cassie Finer at cassie.finer@colorado.edu. QUESTIONS ABOUT YOUR RIGHTS AS A RESEARCH PARTICIPANT: If you have any questions you do not feel comfortable asking the researcher, you may contact Dr. Nicholas Flores at nicholas.flores@colorado.edu. Or contact the director of the University of Colorado's Institutional Review Board (IRB) at 303-735-3702. The IRB is independent from the research team. By clicking Yes I am agreeing that I have read and understood the above consent form and desire of my own free will to participate in this study.

- ❍ Yes (1)
- ❍ No (2)

Q2.1 We are now going to ask you four questions to see if you qualify for this survey.

Q2.2 1. Are you 18 years of age or older?

- ❍ Yes (1)
- ❍ No (2)

Q2.3 2. Do you own a bicycle?

- ❍ Yes (1)
- ❍ No (2)

Q2.4 3. Do you live in the United States?

- ❍ Yes (1)
- ❍ No (2)

Q86 Throughout this survey we will ask you questions about riding your bicycle for transportation. Riding your bicycle to work instead of driving is an example of riding a bicycle for transportation. Riding your bicycle only for exercise does not qualify as riding for transportation. 4. In the past year have you ridden your bicycle for transportation at least one time?

- ❍ Yes (1)
- ❍ No (2)

Answer If 1. Are you 18 years of age or older? No Is Selected Or 2. Do you own a bicycle? No Is Selected Or 3. Do you live in the United States? No Is Selected Or Throughout this survey we will ask you questions about ri... No Is Selected

Q2.5 I'm sorry, but one of your answers disqualifies you from this survey. Thank you for your time.

If I'm sorry, but one of your ... Is Displayed, Then Skip To End of Survey

Q2.6 1. What kinds of transportation have you used during the past year? (Select all that apply)

- ❑ Car (1)
- ❑ Bike (2)
- ❑ Bus (3)
- ❑ Walk (4)
- ❑ Train (5)
- ❑ Other, please specify (7) ____________________

❑ Answer If Throughout this survey we will ask you questions about ... QID94 (Count) Is Greater Than 1

Q2.7 2. During a typical week, which form do you use the most? Enter 1 for most used, 2 for second most used, and so on. *{Rank transportation choices}*

Q5.1 Now we would like to ask you nine questions about you and your riding. We are interested in learning more about the decisions you make when you choose to ride your bicycle for transportation. REMEMBER: When we talk about riding your bicycle for transportation we mean that you are choosing your bicycle over other methods of transportation. For example, riding your bicycle to work instead of driving or taking the bus.

Q5.2 1. How did you hear about this survey?

- ❍ Direct email from bike shop/cycling group (1)
- ❍ Twitter/Facebook (2)
- ❍ Friend (3)
- ❍ Other, please specify (4) ____________________

Q5.3 2. How would you describe your most expensive bicycle? (This bicycle does not need to be the one you use for transportation).

- ❍ Very Basic (e.g. less than $300 new) (1)
- ❍ A step above basic (2)
- ❍ A good bike (3)
- ❍ Top End (4)
- ❍ The best money can buy (e.g. more than $4000 new) (5)

Q5.5 3. Please indicate how much you agree or disagree with the following statements. Consider these statements as they relate to YOUR decision to ride your bicycle for transportation. You choose to ride your bicycle for transportation because it is:

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Cost effective (1)	❍	❍	❍	❍	❍
Fun (2)	❍	❍	❍	❍	❍
Easier than other options (3)	❍	❍	❍	❍	❍
Parking is too expensive or too hard to find (4)	❍	❍	❍	❍	❍
Exercise (5)	❍	❍	❍	❍	❍
Friends also ride (6)	❍	❍	❍	❍	❍
Beneficial to my health (7)	❍	❍	❍	❍	❍
Good for the environment (8)	❍	❍	❍	❍	❍
I have no other option (9)	❍	❍	❍	❍	❍

Q180 4. You can use the space below to tell us about any other factors that influence you to ride your bicycle for transportation. (This is optional).

Q5.6 5. When you can't ride your bicycle for transportation, how much do the following factors influence this choice?

	Not At All (1)	Little (2)	Some (3)	A Lot (4)
Riding takes too long (1)	❍	❍	❍	❍
The weather isn't suitable (2)	❍	❍	❍	❍
The route is not safe (3)	❍	❍	❍	❍
Destination is too far away (4)	❍	❍	❍	❍
Responsibilities require a car (5)	❍	❍	❍	❍
Other transportation choices are more convenient (6)	❍	❍	❍	❍

Q181 6. You can use the space below to tell us about any other factors that influence you when you can't ride your bicycle for transportation. (This is optional).

Q5.7 7. How often do you ride your bicycle to:

	Never (1)	Rarely (2)	Often (3)	All of the Time (4)	Not Applicable (5)
Work (1)	❍	❍	❍	❍	❍
School (2)	❍	❍	❍	❍	❍
Run Errands (3)	❍	❍	❍	❍	❍
Social Activities (4)	❍	❍	❍	❍	❍
Other (please specify) (5)	❍	❍	❍	❍	❍

Answer If How often do you ride your bicycle to: - Not Applicable Is Not Equal to 4

Q5.8 8. Where do you ride most frequently?

{Answers from previous question are pulled forward to this question}

Q5.10 9. During a normal seven day period in each season, how many times do you ride your bicycle to the location you chose in the last question? NOTE: You chose *{Most Frequent Location}*

SPRING (1)
SUMMER (2)
FALL (3)
WINTER (4)

Q7.1 We are now going to show you a series of questions where you will tell us which option you prefer. Below you will find the list of all options you will see in these questions. Take a second to look through this list so you are ready to tell us which you like. *{Infrastructure choice images are presented here}*

PAIRED COMPARISONS (Respondents see 15 of these questions, each question presents a pair of infrastructure choices drawn from the images in Appendix A)

Q87 Which do you prefer when riding your bicycle for transportation?

- ❍ (1)
- ❍ (2)

(…)

Q91 Which do you prefer when riding your bicycle for transportation?

- ❍ (1)
- ❍ (2)

Q182 Think about the location you said you ride to most frequently. Recall, you said: *{Most Frequent Route}.* For the rest of the survey we are going to call this location your Most Frequent Route. We think this will make it easier for you to remember what we are talking about! So just remember, for you Most Frequent Route means you are riding to: *{Most Frequent Route}*

ROUTE DESCRIPTION

Q6.1 1. Now consider the following six options and think about which ones you use when riding to your Most Frequent Route. Then use the text boxes below each picture to indicate how many miles of your route are spent on that route type. These are the same route options you saw on the previous set of choice questions.

We understand that these options may not exactly match your current route. Please try and match your route to the route options that are most like what you ride. For instance, if you ride 2.5 miles on "No Infrastructure -- Arterial" but the posted speed limit is 30 miles per hour (not 35 as described here) you can still put "2.5" in the box below "No Infrastructure -- Arterial." If you don't use an option please leave the text box blank.

(Note: Respondents see all six infrastructure images plus one option to describe their own infrastructure option)

- ❑ (1) ____________________
- ❑ (2) ____________________
- ❑ (3) ____________________
- ❑ (4) ____________________
- ❑ (5) ____________________
- ❑ (6) ____________________
- ❑ If your route, or a portion of your route, does not match the options above please enter the number of miles spent on this route and use the text box below to tell us about the route. (7) ____________________

Q183 2. Are these numbers above for a one-way trip or round trip?

- ❍ One-way (1)
- ❍ Round trip (2)

MOST PREFERRED INFRASTRUCTURE CHOICE

Q6.2 3. Think about your Most Frequent Route. If you could only pick one type of route for this ride, which would it be? Do not worry about what is possible, even if you know this option will never exist on your ride. We just want to know which one is your favorite! If you described a route to us in the previous question and it is your favorite please pick the last option "Described Route".

(Note: Respondents see all six infrastructure images plus an option to pick their described route).

- ❍ (1)
- ❍ (2)
- ❍ (3)
- ❍ (4)
- ❍ (5)
- ❍ (6)
- ❍ Described Route (7)

Q6.3 4. Earlier you told us how many times you ride your bicycle during each season. In this question we asked you to report the number times you ride to your Most Frequent Route. Now consider the preferred route you picked in the last question and imagine it is available on this ride. Would you choose to ride to your Most Frequent Route more often?

- ❍ Yes (1)
- ❍ No (2)

Answer If Earlier we asked you how many trips you take on your bicy... Yes Is Selected

Q6.4 5. Now that you have your favorite route, how many additional trips would you make to your Most Frequent Route in a typical week during each season? Recall, you responded: Spring: {spring value entered} Summer: { summer entered values} Fall: {fall entered values} Winter: {winter entered values} Enter additional number of trips here:

SPRING (1)
SUMMER (2)
FALL (3)
WINTER (4)

VALUATION QUESTIONS (Respondents randomly shown one of the following options)

Open Ended WTA: Q173 Earlier in this survey you described your current and your ideal route for your Most Frequent Route. Here is what you told us: For your Current Route you ride: *{Description of Current Route}* Your ideal route is: *{Most Preferred Infrastructure Choice}* . Now, suppose we have the power to make your ideal route available for your Most Frequent Route. What is the least amount we would have to pay you per mile (every time you ride to your Most Frequent Route) so that you would give up the opportunity to have your ideal route and instead stay with your current route?

Enter and amount in US Dollars: (1)

WTA Low Bid: Q424 Earlier in this survey you described your current and your ideal route for your Most Frequent Route. Here is what you told us: For your Current Route you ride: *{Description of Current Route}* Your ideal route is: *{Most Preferred Infrastructure Choice}* Now, suppose we have the power to make your your ideal route available for your Most Frequent Route. If we paid you $0.10 (ten cents) per mile (every time you ride to your Most Frequent Route) would you give up the opportunity to have your ideal route and instead stay with your current route?

- Yes (1)
- No (2)

WTA Low Follow-Up: Q425 What is the smallest amount we would have to pay you per mile (every time you ride to your Most Frequent Route) so that you would give up the opportunity to have your ideal route and instead stay with your current route?

Enter and amount in US Dollars: (1)

WTA High Bid: Q430 Earlier in this survey you described your current and your ideal route for your Most Frequent Route. Here is what you told us: For your Current Route you ride: *{Description of Current Route}* Your ideal route is: *{Most Preferred Infrastructure Choice}*. Now, suppose we have the power to make your ideal route available for your Most Frequent Route. If we paid you $1.00 per mile (every time you ride to your Most Frequent Route) would you give up the opportunity to have your ideal route and instead stay with your current route?

- Yes (1)
- No (2)

WTA High Follow-Up: Q431 What is the smallest amount we would have to pay you per mile (every time you ride to your Most Frequent Route) so that you would give up the opportunity to have your ideal route and instead stay with your current route?

Enter and amount in US Dollars: (1)

Open Ended WTP: Q174 Earlier in this survey you described your current and your ideal route for your Most Frequent Route. Here is what you told us: For your Current Route you ride: *{Description of Current Route}* Your ideal route is: *{Most Preferred Infrastructure Choice}.* Now, suppose we have the power to either make your ideal route available for your Most Frequent Route or leave your route as-is. What is the most you would be willing to pay per mile (every time you ride to your Most Frequent Route) to guarantee that we make your ideal route available for your Most Frequent Route?

Enter and amount in US Dollars: (1)

WTP Low Bid: Q175 Earlier in this survey you described your current and your ideal route for your Most Frequent Route. Here is what you told us: For your Current Route you ride: {description of current route} Your ideal route is: {most preferred infrastructure choice}. Now, suppose we have the power to either make your ideal route available for your Most Frequent Route or leave your route as-is. Would you be willing to pay $0.10 (ten cents) per mile (every time you ride to your Most Frequent Route) to guarantee that we make your ideal route available for your Most Frequent Route?

- Yes (1)
- No (2)

WTP Low Follow-Up: Q177 What is the most you would be willing to pay per mile (every time you ride to your Most Frequent Route) to guarantee that we make your ideal route available for your Most Frequent Route?

Enter and amount in US Dollars: (1)

WTP High Bid: Q432 Earlier in this survey you described your current and your ideal route for your Most Frequent Route. Here is what you told us: For your Current Route you ride: *{Description of Current Route}* Your ideal route is: *{Most Preferred Infrastructure Choice}*. Now, suppose we have the power to either make your ideal route available for your Most Frequent Route or leave your route as-is. Would you be willing to pay $1.00 per mile (every time you ride to your Most Frequent Route) to guarantee that we make your ideal route available for your Most Frequent Route?

- Yes (1)
- No (2)

WTP High Follow-Up: Q433 What is the most you would be willing to pay per mile (every time you ride to your Most Frequent Route) to guarantee that we make your ideal route available for your Most Frequent Route?

Enter and amount in US Dollars: (1)

Q9.1 Ok! You've finished all of the hard questions! We are now going to ask you a few demographic questions similar to what you would see in the US Census.

Q9.2 1. What is your zip code?

Q9.3 2. How would you describe the area you live in?

- City (1)
- Suburb (2)
- Rural (3)
- Other (please specify) (4) ____________________

Q9.4 3. What is your sex?

- Male (1)
- Female (2)

Q9.5 4. What is your age in years?

- 18 (18)
- …
- 100+ (100)
- I prefer not to say (101)

Q9.6 5. Are you of Hispanic, Latino, or Spanish origin? For this survey Hispanic origins are not races.

- No, not of Hispanic, Latino, or Spanish origin (1)
- Yes, Mexican, Mexican American, Chicano (2)
- Yes, Puerto Rican (3)
- Yes, Cuban (4)
- Yes, another Hispanic, Latino or Spanish origin (5)

Q9.7 6. What is your race?

- White (1)
- African American (2)
- American Indian or Alaska Native (3)
- Asian Indian/Japanese (4)
- Native Hawaiian (5)
- Chinese (6)
- Guamanian or Chamorro (7)
- Filipino (8)
- Vietnamese (9)
- Samoan (10)
- Other Asian - Print race, for example: Hmong, Laotian, Thai, Pakistani, Cambodian, and so on (11) ____________________
- Other Pacific Islander - Print race, for example: Fijian, Tongan, and so on (12) ____________________
- Other - print race (13) ____________________

Q9.8 7. What is your marital status?

- Now married (1)
- Widowed (2)
- Divorced (3)
- Separated (4)
- Never married (5)

Q9.9 8. Are you currently attending school at least part time?

- Yes (1)
- No (2)

Q9.10 9. What is the highest level of education you have completed?

- Less than High School (1)
- High School / GED (2)
- Some College (3)
- 2-year College Degree (4)
- 4-year College Degree (5)
- Masters Degree (6)
- Doctoral Degree (7)
- Professional Degree (JD, MD) (8)

Q9.11 10. If you are employed, how many hours do you work per week?

- Full Time (32-40 hours per week) (1)
- Part Time (less than 32 hours per week) (2)
- Not Employed (3)
- More Than Full Time (more than 40 hours per week) (4)

Q9.12 10. a) On an average workday at what time do you arrive at work? Answer in Hours:Minutes AM/PM

Q9.13 10. b) On an average workday at what time do you leave work? Answer in Hours:Minutes AM/PM

Q9.14 10. c) Does your employer provide incentives to encourage you to ride your bicycle to work? (Incentives could include paid-time off, prizes, etc.)

- Yes (1)
- No (2)

Q9.15 11. What is your combined annual household income?

- ❍ Less than 30,000 (1)
- ❍ 30,000 – 39,999 (2)
- ❍ 40,000 – 49,999 (3)
- ❍ 50,000 – 59,999 (4)
- ❍ 60,000 – 69,999 (5)
- ❍ 70,000 – 79,999 (6)
- ❍ 80,000 – 89,999 (7)
- ❍ 90,000 – 99,999 (8)
- ❍ 100,000 or more (9)
- ❍ I prefer not to say (10)

Q9.16 12. How many children (under the age of 18) are currently living in your house?

- ❍ 0 (1)
- ❍ 1 (2)
- ❍ 2 (3)
- ❍ 3 (4)
- ❍ 4 (5)
- ❍ 5 + (6)

Q9.17 13. Do you own a car?

- ❍ Yes (1)
- ❍ No (2)

Q188 You are done! Thank you for participating in this survey. We are raffling off eight gift certificates to Amazon.com; two $100 cards, four $50 cards, and four $25 cards. If you would like to enter this raffle please use the space below to enter an email address, phone number, or address where we can send the gift certificate if you win. This is completely optional. None of your information will be used for any purpose other than this raffle.

APPENDIX C. Full Regressions

Figure 4.

VARIABLES	(1) Open Ended WTP (0,2]	(2) Open Ended WTP (0,2]	(3) Open Ended WTP (0,2]	(4) Open Ended WTP (0,2]	(5) Open Ended WTP (0,2]
Side Street	0.136	-0.284*	-0.243	-0.229	-0.234
	(0.146)	(0.162)	(0.161)	(0.162)	(0.167)
Arterial	-0.452***	0.617**	0.662**	0.710**	0.599**
	(0.169)	(0.307)	(0.319)	(0.319)	(0.234)
Bike Lane	-0.268	0.356	0.363	0.324	0.271
	(0.197)	(0.269)	(0.278)	(0.247)	(0.210)
Multi-Use Path	-0.159	0.308	0.331	0.325	0.316
	(0.204)	(0.204)	(0.222)	(0.205)	(0.226)
Scenic Path	0.169	0.252	0.313*	0.298*	0.267*
	(0.225)	(0.152)	(0.168)	(0.159)	(0.135)
Cycle Track	0.217	0.281*	0.263*	0.218	0.201
	(0.223)	(0.161)	(0.147)	(0.144)	(0.145)
Ride Two Seasons/Yr	4.483*	8.447**	11.45***	12.14***	10.06***
	(2.702)	(3.659)	(3.999)	(4.063)	(3.260)
Ride Three Seasons/Yr	5.854*	9.231***	11.63***	12.39***	10.56***
	(2.998)	(3.297)	(3.551)	(3.505)	(3.012)
Ride Four Seasons/Yr	5.779**	9.573***	12.04***	13.03***	10.54***
	(2.882)	(3.451)	(3.791)	(3.855)	(3.014)
Total Miles on Reported Route		0.519***	0.582***	0.597***	0.519***
		(0.197)	(0.205)	(0.193)	(0.145)
Age			-0.339*	-0.350*	-0.254
			(0.173)	(0.179)	(0.224)
Age^2			0.00371*	0.00387*	0.00300
			(0.00194)	(0.00196)	(0.00242)
Female			0.925	0.989	1.157
			(0.708)	(0.810)	(0.809)
Household Income			5.79e-06	1.76e-06	7.24e-07
			(1.19e-05)	(1.42e-05)	(1.63e-05)
Mid Atlantic				3.528	2.522
				(3.079)	(2.087)
New England				0.912	1.299
				(1.582)	(1.529)
Pacific				-0.581	-0.127
				(0.829)	(0.938)
Rocky Mountain				0.644	0.527
				(0.911)	(1.029)
South Atlantic				0.757	0.883
				(1.034)	(1.031)
Some College					-11.24
					(9.642)
Two Year Degree					-11.64
					(9.661)

College					-10.71
					(9.653)
Masters					-11.72
					(9.628)
Doctoral					-10.59
					(9.964)
Professional					0.883
					(1.031)
White					-1.482
					(3.086)
Black					-6.946**
					(3.202)
Hispanic					-1.857
					(3.170)
Asian					2.750
					(1.707)
Observations	137	130	129	129	129
R-squared	0.334	0.347	0.395	0.432	0.521

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1