



## Biking practices and preferences in a lower income, primarily minority neighborhood: Learning what residents want

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### ABSTRACT

This paper examines if, in a lower-income minority neighborhood, bicycling practices and bicycle-environment preferences of Blacks and Hispanics were different from Whites. During the summer of 2014, surveys were mailed to 1537 households near a proposed cycle track on Malcolm X Boulevard in Roxbury, MA. On the Boulevard, intercept surveys were distributed to cyclists and observations noted about passing cyclist's characteristics. Data were analyzed from 252 returned-mailed surveys, 120 intercept surveys, and 709 bicyclists. White (100%), Hispanic (79%), and Black (76%) bicyclists shown pictures of 6 bicycle facility types in intercept surveys perceived the cycle track as safest. More White mailed-survey respondents thought bikes would not be stolen which may explain why more Hispanics (52%) and Blacks (47%) preferred to park their bikes inside their home compared with Whites (28%), with H/W B/W differences statistically significant ( $p < 0.05$ ). More Hispanic (81%) and Black (54%) mailed-survey respondents thought they would bicycle more if they could bicycle with family and friends compared with Whites (40%). Bicyclists observed commuting morning and evening included Blacks (55%), Whites (36%) and Hispanics (9%). More Whites (68%) wore helmets compared with Hispanics (21%) and Blacks (17%) ( $p < 0.001$ ). More Blacks (94%) and Hispanics (94%) rode a mountain bike compared with Whites (75%). Minority populations are biking on roads but prefer cycle tracks. They also prefer to park bikes inside their homes and bicycle with family and friends. Wide cycle tracks (bicycling with family/friends) and home bike parking should be targeted as capital investments in lower-income minority neighborhoods.

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### 1. Introduction

Race and income are often overlooked factors when considering locations for safe-from-traffic bicycle routes and secure bicycle parking. Race is a factor because more Hispanics (77.9%) and Blacks (76.2%) are burdened with obesity compared with Whites (67.2%) (Ogden et al., 2014). To counter obesity, walking is often recommended but a study revealed that slow walking (2–3 Metabolic Equivalent of Task - METs) (Ainsworth et al., 2000) was not associated with controlling weight (Lusk et al., 2010). Brisk walking (>3–6 METs) (Ainsworth et al., 2000) was associated with controlling weight (A. C. Lusk et al., 2010) but for people who are overweight, walking can be difficult (Larsson and Mattsson, 2001). A walker, as does a runner, has to carry their bodyweight but with bicycling the bike bears the weight, lessening knee damage (Ransdell et al., 2009). Bicycling (8–16 METs) (Ainsworth et al., 2000) is an effective way to travel far and was shown to be associated with controlling weight (Lusk et al., 2010). Wide adoption of this physical activity is easier because, according to the 2001–2009 National

Household Transportation Survey, more Black (90%) and Hispanic (30%) individuals are changing to biking for trips compared with Whites (20%) (People for Bikes and Alliance for Biking and Walking, 2015).

Income is also a factor because the safest bicycle facilities are not being built in lower income communities. Bicycle environments, including safer cycle tracks (barrier-protected bicycle-exclusive paths) (Lusk et al., 2011, 2013; Thomas and DeRobertis, 2013), are being built but neighborhoods receive funding for bicycle facilities based on bike counts, engineering decisions, and forceful advocacy (Buehler and Handy, 2008; Craddock et al., 2009). In North Carolina, nine out of ten residents in wealthier counties had active transportation in their plans compared with only one in five residents in the lower-income areas (Aytur et al., 2008). In a study of 264 municipalities and counties across the country, 14% of higher-income neighborhoods had zoning/land use laws for bike lanes compared with only 5% of lower income neighborhoods (Thrun et al., 2012). As a result, superior bike facilities are provided in areas with many White, wealthier bicyclists and not in neighborhoods of color or lower socio-economic status (League of American Bicyclists and the Sierra Club, 2013; Powell et al., 2006; Roberts, 2014).

Perhaps lower income minority populations do not want safer bicycle facilities but in a study with 16,193 respondents, more Hispanics

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(53%) and Blacks (48%) expressed a willingness to bike more compared with Whites (44%) if they were physically separated from vehicles (People for Bikes and Alliance for Biking and Walking, 2015). If provided with safe bicycle environments, ethnic-minority and low income populations would have the largest projected increase in bicyclists (Sallis et al., 2013). Without the safest bicycle environments, the many bicyclists in the lower-income minority communities are more vulnerable. In lower-income communities in Austin, Texas, where many residents biked to work and there were no safe bicycle networks, there were more bicycle crashes (Yu, 2014). In the U.S., the age-adjusted biking deaths per 100,000 population are greater in Hispanics (0.28) and Blacks (0.23) compared with Whites (0.18) (People for Bikes and Alliance for Biking and Walking, 2015).

Though lower-income ethnic-minority populations might want safer bicycle facilities, the assumption cannot be that the bicycle facilities preferred by White bicyclists would be equally preferred by ethnic-minority residents. White, Black, and Hispanic residents might have different perceptions of risk of theft and thus might prefer different bike parking. White, Black, and Hispanic residents might have different opportunities to travel to places such as the Netherlands, ride on a cycle track, or attend lectures about bicycle facilities to gain awareness. Therefore, a visual preference survey was mailed to bicycling and non-bicycling residents in a low income ethnic-minority neighborhood and distributed to bicyclists on a major bicycling street in that neighborhood. The study aimed to identify if, in a lower-income ethnic-minority neighborhood, bicycling practices and preferences about bike route designs and bike parking of Blacks and Hispanics were different from Whites, if lower-income minority populations were bicycling, and if the observed characteristics of Black and Hispanic bicyclists were different from White bicyclists (bike, clothing, helmet, child on the bike, or carrying items on the bike or in a backpack).

## 2. Methods

### 2.1. Study population

Construction of a two-way cycle track on Malcolm X Boulevard in Roxbury, Massachusetts is in the 2013 Boston Bike Network Plan (Boston Department of Transportation, 2013) due to outside-advocacy that was guided by locals' preferences. Thus, the opportunity exists for pre-construction data collection. At the time of this study, Roxbury had no cycle tracks and only some miles of painted bike lanes and sharrows (double chevrons with a bicycle symbol to indicate to drivers and bicyclists to share the road). In 2010, Roxbury had a population of 59,640 individuals in which 42.7% identified as Black, 26.2% as Hispanic, and 21.2% as White (Boston Public Health Commission, 2013). Thirty-nine percent of Blacks, 24% of Whites, and 19% of Latinos were obese. Fifty-one percent of the female-headed households in Roxbury had children under the age of 18, 44% of households were headed by females, 31% of families lived with income below the poverty level, and 24% of individuals had less than a high school diploma. To approximate crime/theft risk, the average annual homicide per 100,000 residents was 16.4 in Roxbury compared with 7.9 in all of Boston and nonfatal gunshot/stabbing was 2.2 in Roxbury compared with 0.9 for all of Boston. Human Subjects approval to conduct this research was received from the Harvard T. H. Chan School of Public Health.

### 2.2. Mailed survey distribution and content

A random sample of mailing addresses (without names) from six 2010 Census Tract/Block Groups near Malcolm X Boulevard in Roxbury, Massachusetts was received from John Snow, Inc. (JSI) in Boston. The original survey was pretested involving 12 community-representative volunteers who suggested shortening sections. A total of 1537 surveys were mailed in August of 2014. To better assure a high return, booklet envelopes were hand addressed and affixed with a return sticker with

a bicycle drawing. The envelopes were meter stamped because neighborhood representatives perceived that as more official than a postage stamp. Two cellophane-wrapped mints were taped to the cover letter as incentive and a stamped addressed return envelope was included.

Because an individual cannot have a perception about an environment they have never seen, the three page double-sided mailed survey included 42 colored pictures. The first page included a representative picture of a: 1) road without a bicycle provision; 2) road with a sharrow (shared lane marking); 3) painted bike lane beside parallel parked cars; 4) painted bike lane beside a sidewalk curb; 5) shared use path; and 6) two-way cycle track. Pictures of cycle track/vehicle separators included: 1) posts and paint; 2) low concrete islands; 3) bushes in planters; and 4) trees and bushes. Other pictures were of a wide variety of options for parking their bike where they live, at work/school, and at shops. Questions included how, if a cycle track was built on Malcolm X Boulevard, they would perceive their neighborhood. Respondents were asked about their travel mode per week. They were also asked what, of the options, would make them want to bicycle or bicycle more often, what they think of bicyclists, and how they would see themselves as a bicyclist. If they were a bicyclist, they were asked about their riding practices and where they currently park their bike. All respondents were asked for anonymous demographic information.

The respondents could add their name and address to be eligible to receive by lottery either one check for \$500 or one of five checks for \$100. Three hand addressed reminder post cards were sent in spaced time increments in August and September to addresses for which either a returned envelope or a completed survey had not been received. Eighty-nine surveys were returned, leaving a balance of 1448 household-received surveys. In total, 252 completed surveys were mailed back, resulting in a return rate of 17%.

### 2.3. Intercept survey to bicyclists on Malcolm X Boulevard

For three weeks in August 2014, on three clear days each week from 7:30 until 9:30 AM and 4:30 until 6:30 PM, the two-page single-sided intercept surveys with colored pictures were mounted on clipboards with pencils and distributed to bicyclists riding on Malcolm X Boulevard. As a time-courtesy to passing bicyclists, this survey included the same but fewer questions as on the mailed survey. The same pictures of six bicycle environments and four cycle track-traffic separation design options were included. Questions were asked about their perception of the neighborhood if the cycle track was built and their demographics.

A table, with a banner and chairs, was set up on one side of the street and a person with a chair was on the other side so the survey station looked commanding. As the bicyclists approached, the purpose of the survey was explained and they were asked if they would complete the voluntary survey. In total, 120 intercept surveys were completed. No participation rate was determined because some of the same bicyclists commuted and had earlier completed the survey.

### 2.4. Observations about bicyclists on Malcolm X Boulevard

During the same three weeks in August at the same location and at the same times in the morning and evening, observations of bicyclists who were riding on Malcolm X Boulevard were noted. In total, 709 bicyclists were visually identified for gender, age (child/younger than 14, adult, senior), wearing a helmet, type of bike (touring, Hubway-shared, traditional level-handlebar/durable-tire mountain bike), clothing (bike, skirt, regular), child on bike, carrying items on bike, carrying items in a backpack, and time of day biking (AM or PM).

### 2.5. Statistical analysis

The demographic characteristics, perceptions, and preferences for bicycling and bike facility by race/ethnicity were compared and

analyzed. Bicyclists included self-reported bicyclists from the mailed survey (~60%) and all bicyclists from the bicycle intercept survey (counted bicyclists were analyzed separately). Pairwise comparison was conducted between Whites, Blacks and Hispanics. A two-sample independent *t*-test was used to determine the differences in means if continuous variables were normally distributed and the non-parametric analog, Wilcoxon-Mann-Whitney test, if not. The Chi-square test was used to determine the difference in percentage and the Fisher's exact test when the assumptions for Chi-square test were violated. With respect to preferences for cycle tracks (Table 2), variables that differed

between White, Black, and Hispanic were further adjusted using multi-variate logistic regressions with variables including gender and age. Other variables were not included, such as BMI, because this would adjust away the factors that differ between the different ethnic groups. For survey questions that had ordinal responses, the top or bottom two categories (e.g. extremely safe/very safe; strongly agree/agree) were combined in the analysis to maximize statistical power. All the hypothesis tests were two-sided and  $p < 0.05$  was considered as statistically significant. SAS (SAS 9.3, SAS Institute, Cary, NC) was used to perform all the statistical analyses.

**Table 1**

Descriptive characteristics of participants in the Roxbury, MA mailed and intercept surveys (Summer 2014).

	Mailed survey				Intercept survey				All bicyclists - mailed and intercept			
	All (n = 252)	White (n = 93)	Black (n = 94)	Hispanic (n = 27)	All (n = 120)	White (n = 43)	Black (n = 38)	Hispanic (n = 19)	All (n = 248)	White (n = 104)	Black (n = 90)	Hispanic (n = 34)
Male % <sup>a</sup>	43	58	38	15	75	72	77	78	62	67	59	55
Age, % <sup>a,c</sup>												
18–24	9	15	2	12	38	30	35	56	20	18	14	32
25–35	28	41	17	38	25	26	21	38	28	38	16	35
36–45	11	15	10	8	12	9	12	6	11	12	9	6
46–55	20	18	23	4	12	12	18	0	19	18	24	0
56–65	17	3	30	27	11	19	12	0	17	10	27	23
66–75	11	8	16	7	3	5	3	0	7	5	9	3
76 and older	2	0	1	4	0	0	0	0	0	0	0	0
BMI (kg/m <sup>2</sup> ), mean <sup>a,b,c</sup>	26.5	24.8	27.9	29.5	25.1	24.9	26.7	24.9	25.6	24.8	27.4	26.4
Biking confidence, % <sup>c</sup>												
Strong and fearless	15	18	12	19	24	16	21	47	23	22	18	38
Enthusiastic and confident	36	42	30	19	41	53	37	42	44	52	40	35
Interested but concerned	41	35	46	50	34	30	39	11	31	26	38	24
No way no how	8	4	12	12	1	0	3	0	3	0	5	3
No. of child, median	2	1	2	1								
Child age (years), mean <sup>a</sup>	10	7	12	9								
Know how to ride a bicycle, %	97	100	97	89								
Own a bike, % <sup>a</sup>	60	72	47	52								
Own a car, %	56	61	51	59								
Days/week of traveling, median												
Car	2	1	2	3								
Walking	4	3	5	5								
Bus/train	3	2	3	2								
Bicycle <sup>a</sup>	2	3	0	1								
Other	0	0	0	1								
Language spoken at home, % <sup>a</sup>												
English	79	92	80	32								
Not English	8	1	10	12								
Mixed	14	7	11	56								
Education, % <sup>a</sup>												
No high school	4	0	5	15								
High school	18	3	28	26								
2 years college	17	9	26	22								
4 years college	28	42	17	19								
Graduate school	30	44	20	15								
Other	3	2	3	4								
Self-reported bicyclist, %	59	66	55	56								
Total time/day on a bike, % <sup>d</sup>												
5–15 min	5	5	8	9								
16–59 min	48	55	46	18								
1 h	24	27	21	36								
>1 h	22	13	26	36								
Days/week of biking, median <sup>d</sup>												
Work/school <sup>a</sup>	3	3	0	3								
Shopping/personal	2	2	2	3								
Recreation	2	1	2	3								

For continuous variables, a two-sample independent *t*-test was used for normally distributed variables whereas Wilcoxon-Mann-Whitney test was used for non-normally distributed variables.

For categorical variables, a chi-square test was used or a Fisher's exact test when at least one of the category has an expected frequency of five or less.

<sup>a</sup> *p*-Value < 0.05 in Mailed survey.

<sup>b</sup> *p*-Value < 0.05 in Intercept survey.

<sup>c</sup> *p*-Value < 0.05 in all bicyclists; All *p*-values were calculated only between White and Black.

<sup>d</sup> Calculated only among self-reported bicyclists.

### 3. Results

#### 3.1. Mailed and intercept study samples

In the mailed survey for residents in Roxbury who identified their race, 37% were White, 37% Black, and 11% Hispanic. (Table 1) Fifty-eight percent of Whites were male, 38% of Blacks male, and 15% of Hispanics male. There was a median of 2 children per household, and the mean BMI of the mailed survey respondents was 26.5 kg/m<sup>2</sup>, with the highest BMI among Hispanics at 29.5 kg/m<sup>2</sup>. Only 8% of all mailed survey respondents indicated they would not bike (no way no how). Ninety-seven percent of all respondents know how to ride, 60% own a bike, and 56% own a car, with 51% of Blacks owning a car. Of the mailed survey respondents who self-reported as bicyclists, 66% were White, 56% were Hispanic and 55% were Black.

In the bicyclist intercept survey on Malcolm X Boulevard, 36% were White, 32% Black, and 16% Hispanic with males comprising the majority at 78% Hispanic, 77% Black, and 72% White. The mean BMI of the intercept survey bicyclists was 25.1 kg/m<sup>2</sup> with Blacks having the highest BMI at 26.7 kg/m<sup>2</sup>. More Hispanics (47%) identified themselves as strong and fearless bicyclists compared with Blacks (21%) and Whites (16%).

#### 3.2. Preferences and practices of those surveyed

In the mailed survey that included responses from bicyclist and non-bicyclist residents, Whites (90%), Hispanics (74%) and Blacks (64%) thought they would feel extremely/very safe biking on the pictured cycle track. (Table 2) If the cycle track was built on Malcolm X Boulevard, Whites (94%), Blacks (78%), and Hispanics (67%) thought biking safety would increase. In the bicyclist intercept survey, White (100%), Hispanic (79%) and Black (76%) bicyclists felt safest on the cycle track. Of all the combined preferences of bicyclists from the mailed and intercept surveys, 89% of White bicyclists preferred trees and bushes as cycle track separators compared with 74% of Hispanic bicyclists and 54% of Black bicyclists.

For current bike parking, 62% of Hispanic, 43% of White, and 40% of Black bicyclists who completed the mailed survey parked their bicycles inside their house. (Table 3) When asked preferences, 52% of Hispanic

and 47% of Black bicyclist/non-bicyclist mailed-survey respondents wanted to park their bicycle inside their homes compared with only 28% of White bicyclist/non-bicyclist respondents. This may be because White bicyclist/non-bicyclist mailed-survey respondents (83%) agreed/strongly agreed that their bicycle would not be stolen compared with Hispanics (74%) and Blacks (67%). Only about 20% of White, Black, and Hispanic bicyclists preferred to park in the basement and far fewer preferred a shed, garage, or front porch. Bike cages at work/school and outdoor racks at shops were preferred over current parking practices. (Fig. 1) More Hispanic (30%) and Black (24%) bicyclists/non-bicyclists agreed that most bicyclists are women, children, or seniors compared with Whites (5%). More Hispanic (81%) and Black (54%) bicyclists/non-bicyclists thought they would bicycle more if they could bicycle with their family and friends compared with Whites (40%).

#### 3.3. Observations about bicyclists on Malcolm X Boulevard

Bike observations on Malcolm X Boulevard included Blacks (55%), Whites (36%), and Hispanics (9%) with counts for males as Black (94%), Hispanic (94%), and White (80%) (Table 4). More Whites (68%) wore helmets compared with Blacks (17%) and Hispanics (21%), more Hispanics (98%) and Blacks (97%) wore their regular/daily clothing compared with Whites (90%), and more Whites (7%) wore spandex compared with Blacks (2%) and Hispanics (0%). More Blacks (94%) and Hispanics (94%) rode a regular bike (level-handlebar/mountain bike) compared with Whites (75%) while more Whites (19%) rode a racing bike (skinny-tire drop-down handlebar) compared with Blacks (5%) and Hispanics (6%). Few Whites (1%) and no Blacks or Hispanics rode with a child on the bike. More Whites (17%) carried items on their bike compared with Hispanics (3%) and Blacks (2%). Skirt-wearing is an indication of gender inclusion and comfortable bicycling environment and 4% of White, 0.30% of Black, and no Hispanic bicyclists wore a skirt while they bicycled.

### 4. Discussion

Cycle tracks were the most preferred of the six bicycle facilities but more White residents/bicyclists preferred the cycle track compared with Blacks and Hispanics. This might be because White residents/

**Table 2**  
Perceptions and preferences about facilities in Roxbury, MA (Summer 2014).

	Mailed survey			Intercept survey			All bicyclists		
	White	Black	Hispanic	White	Black	Hispanic	White	Black	Hispanic
Biking facility, %									
Extremely/very safe									
Road with a sharrow	9 <sup>a</sup>	19 <sup>a</sup>	37 <sup>b</sup>	16	29	21	13 <sup>a</sup>	20 <sup>a,b</sup>	29 <sup>b</sup>
Bike lane by curb	32 <sup>a</sup>	31 <sup>a</sup>	56 <sup>b</sup>	53	50	47	42	40	59
Cycle track	90 <sup>a</sup>	64 <sup>b</sup>	74 <sup>b</sup>	100 <sup>a</sup>	76 <sup>b</sup>	79 <sup>b</sup>	95 <sup>a</sup>	66 <sup>b</sup>	79 <sup>b</sup>
Bike lane by car	7 <sup>a</sup>	10 <sup>a</sup>	26 <sup>b</sup>	9	11	32	10 <sup>a</sup>	10 <sup>a</sup>	29 <sup>b</sup>
Road	3	5	11	0	5	5	3	6	9
Shared-used path	80 <sup>a</sup>	43 <sup>b</sup>	56 <sup>a,b</sup>	77	68	84	79 <sup>a</sup>	53 <sup>b</sup>	74 <sup>a,b</sup>
Separation for cycle track, %									
Prefer a lot/some									
Bushes in planters	69	59	51	70	61	74	69 <sup>a</sup>	54 <sup>b</sup>	65 <sup>a,b</sup>
Low concrete island	76	63	70	51 <sup>a</sup>	61 <sup>a,b</sup>	79 <sup>b</sup>	68	57	76
Posts and paints	65	63	70	53	68	58	63	66	71
Trees and bushes	90 <sup>a</sup>	56 <sup>b</sup>	63 <sup>b</sup>	91 <sup>a</sup>	55 <sup>b</sup>	74 <sup>a,b</sup>	89 <sup>a</sup>	54 <sup>b</sup>	74 <sup>a</sup>
If a cycle track was built, %									
Increase a lot/some									
Living desirability	86 <sup>a</sup>	49 <sup>b</sup>	48 <sup>b</sup>	91 <sup>a</sup>	66 <sup>b</sup>	84 <sup>a,b</sup>	89 <sup>a</sup>	59 <sup>b</sup>	65 <sup>a</sup>
Driving safety	55	56	52	65	68	79	57	64	62
Walking safety	50	43	44	72	74	74	59	57	76
Biking safety	94 <sup>a</sup>	78 <sup>a,b</sup>	67 <sup>b</sup>	100 <sup>a</sup>	95 <sup>a,b</sup>	84 <sup>b</sup>	95 <sup>a</sup>	86 <sup>a,b</sup>	71 <sup>b</sup>
Biking likelihood	70	54	63	81	79	74	80	70	71

<sup>a,b</sup> Pairwise comparison was conducted between Whites, Blacks and Hispanics; numbers (in the same line) without same upper letters mean statistically significant difference at *p* value <0.05 based on logistic regression analysis adjusted for age (18–24; 25–45, 46–65, 56 and older) and gender (male or female).

**Table 3**  
Further inquiry from the mailed survey about preferences and perceptions in Roxbury, MA (Summer 2014).

	White	Black	p <sup>†</sup>	Hispanic		White	Black	p <sup>†</sup>	Hispanic
Preferred bike parking location, <sup>‡</sup> %					Current bike parking location, <sup>§‡</sup> %				
Home			0.05		Home			0.48	
Outside the house	13	10		8	Outside the house	5	9		0
Front porch	8	2		4	Front porch	5	2		0
Garage	10	7		8	Garage	7	0		7
Shed	11	3		4	Shed	5	4		5
Basement	24	25		8	Basement	20	20		23
Inside the house	28 <sup>a</sup>	47 <sup>b</sup>		52 <sup>b</sup>	Inside the house	43	40		62
Work/school			0.58		Work/school			0.77	
Outside on a post	4	3		4	Outside on a post	11	12		23
Outdoor rack	29	34		52	Outdoor rack	37	29		31
Bike cage	30	34		28	Bike cage	7	10		8
Garage	26	15		0	Garage	17	10		0
Inside at cubicle	5	8		4	Inside at cubicle	11	12		8
Shops			0.91		Shops			0.002	
Outside on a post	11	10		8	Outside on a post	49	26		31
Outdoor rack	39	34		48	Outdoor rack	39	30		46
Outdoor covered area	42	44		40	Outdoor covered area	2	15		0
In the store	1	1		0	In the store	2	2		0
Take the bike along	3	7		0	Take the bike along	0	6		8
Perception about bicyclists, <sup>§</sup> %					Perception about him/herself being a bicyclist, <sup>§</sup> %				
They don't pollute	85	78		78	I would be more fit and trim	83	83		81
They are friendly	48	41		56	I would enjoy - bicycling	82	80		89
Mostly women, children, or seniors	5 <sup>a</sup>	24 <sup>b</sup>		30 <sup>b</sup>	Set a good example for my children	80	78		89
The area is safer from crime	29	30		26	Save on transportation	86	90		93
They improve economy	39	38		44					
A car driver might hit them	88 <sup>a</sup>	67 <sup>b</sup>		81 <sup>a,b</sup>	Factors encouraging biking, <sup>§</sup> %				
They do not obey laws	55	55		59	The neighborhood is safe	33 <sup>a</sup>	47 <sup>a</sup>		74 <sup>b</sup>
They slow down car drivers	34	43		52	Paths/cycle tracks exist	76	72		70
They don't belong on the road with cars	21 <sup>a</sup>	34 <sup>a,b</sup>		52 <sup>b</sup>	Wear work/school clothes	46	38		59
They are healthier	75 <sup>a</sup>	55 <sup>b</sup>		67 <sup>a,b</sup>	Easy to park bicycle	67	57		59
They cause car crashes	12 <sup>a</sup>	30 <sup>b</sup>		30 <sup>b</sup>	Bicycles won't be stolen	83	67		74
They hit pedestrians	11	22		22	Showers and lockers at work	56	40		59
					Maps and signs of routes	32	37		41
					Bathrooms/water on the route	32	33		44
					Bike with family and friends	40 <sup>a</sup>	54 <sup>b</sup>		81 <sup>c</sup>
					Look good biking	16	27		33
					Could carry things on a bike	53	50		48
					Have access to a bike shop	40	43		41
					No helmet hair	29	44		37

<sup>†</sup> p Value was calculated based on the difference between White and Black.

<sup>‡</sup> The number in a column under the same category might not add to 100 because the percentage for "other" responses was not shown.

<sup>§</sup> All the percentage results reflected agree/strongly agree.

<sup>a,b,c</sup> Pairwise comparison was conducted between Whites, Blacks and Hispanics; numbers (in the same line) without same upper letters mean statistically significant difference at p value <0.05 based on logistic regression analysis adjusted for age (18–24; 25–45, 46–65, 56 and older) and gender (male or female).

<sup>§</sup> Results were based on a subgroup of participants from the Roxbury survey who self-reported as bicyclists. The sample size was 61 for White, 52 for Black and 15 for Hispanic.

bicyclists had knowledge about the function and safety of cycle tracks. Therefore, in lower income ethnic-minority neighborhoods, the different types of bicycle facilities should be described in the local press and community presentations. A pilot cycle track should also be built in these neighborhoods so residents can knowingly advocate for superior bicycle facilities (Weber, 2014). While the entire responsibility for improving bicycle environments should not fall upon lower-income ethnic-minority communities (Kumanyika et al., 2012), residents should be given a voice (Whitt-Glover et al., 2009).

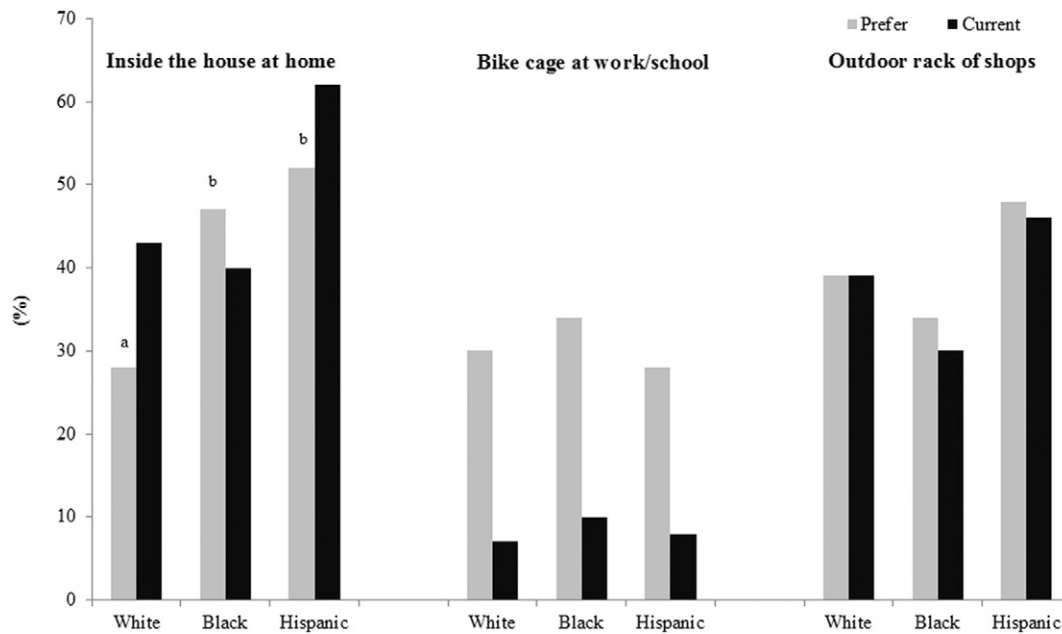
The bike observations revealed that more Whites (68%) wore helmets compared with Blacks (17%), a finding corroborated in a study on helmets, race, and pediatric cyclists (Gulack et al., 2015). Even with the research that helmets lower the risk of head injuries (Thompson et al., 1996) and after passage of a youth helmet law, more White than Black high school students in Florida, Dallas, and San Diego wore helmets (Kraemer, 2016). Though helmet laws are intended to be beneficial, these laws have discouraged bicycling (Robinson, 2007) and lower income minority residents would gain the most from this physical activity. If helmet laws are passed, lower-income ethnic-minority residents would also suffer disproportionately due to the cost of tickets. In Tampa, more Black bicyclists were cited (5.3%) than Whites (3.2%) (Ridgeway et al., 2016) and in Minneapolis, where 61% of the

population is White and 18% Black, more Black bicyclists (48%) were cited for an infraction than Whites (35%) (Hoffman and Kmiecik, 2016). Helmet wearing can be encouraged but helmet laws would not equally serve lower-income ethnic-minority populations.

The bike observations also revealed that Blacks are bicycling in higher numbers than Whites and have their own bike-appearance with mountain bikes, regular clothes, and no items carried on their bikes. Few bicyclists were female, carried a child on the bike, or wore a skirt, all signs about bicycle environment comfort. The observations demonstrated that more insights could be learned from having a person in the field than if only tube sensors count tires.

For bicycle parking, while many White, Black, and Hispanic bicyclists currently park their bicycle in their house, more Black and Hispanic bicyclists and non-bicyclists preferred to park their bikes inside their house. This might be because, compared with Blacks and Hispanics, more Whites had the perception that bikes would not be stolen. As theft of pedals or a saddle can bring economic hardship to a lower income family, affordable housing should be designed so that bike parking is provided inside each dwelling unit. With the in-unit bike parking, bike-seated children and grocery-laden bikes could be wheeled in near the kitchen.

More Blacks and Hispanics thought bicyclists were mostly women, children, and seniors and more Blacks and Hispanics thought they



**Fig. 1.** Preferred and current bike parking location among different study population in Roxbury, MA (Summer 2014). <sup>a,b</sup>Pairwise comparison was conducted between Whites, Blacks and Hispanics; column without same upper letter means statistically significant difference at  $p$  value  $<0.05$  level based on logistic regression analysis adjusted for age (18–24; 25–45, 46–65, 56 and older) and gender (male or female).

would bike more if they could bike with family and friends. To comfortably bicycle with someone, the bicyclist would prefer to ride beside and not in front or behind their companion. Therefore, cycle tracks in lower income ethnic-minority neighborhoods should be wide to enable side-by-side riding with family and friends. (C.R.O.W., 2006; Rietveld and Daniel, 2004).

More Blacks and Hispanics also preferred low concrete islands or posts/paint compared with Whites who preferred trees and bushes. As landscaping could provide a greater sense of separation from road traffic and Blacks and Hispanics wanted to bicycle with family and friends, perhaps trees-as-separation could still be considered in lower income neighborhoods. With the need to cool cities (Flocks et al., 2011), limbed up trees could provide shade and a perception of safety from crime (Donovan and Prestemon, 2012).

Other studies have utilized visual preference surveys with pictures of cycle tracks but the race of the survey participants was not included. (Winters and Teschke, 2010) Residents and bicyclists in

Roxbury preferred cycle tracks and studies confirm that cycle tracks are perceived as safer (Lusk et al., 2014; Monsere et al., 2014; Winters and Teschke, 2010) and are safer than the road or other bike facilities (Federal Highway Administration, 2015; Lusk et al., 2011, 2013; Thomas and DeRobertis, 2013). Over half of the mailed-survey respondents were female and the cycle track was most preferred, as confirmed in other studies that included gender (Garrard et al., 2008; Harris et al., 2006; Lusk et al., 2014).

#### 4.1. Strengths and limitations

The mailed survey response rate was only 17% but the findings about bike environment preferences are confirmed in other studies. Only one picture was included for each bicycle environment and that might not have captured all designs. The intercept survey did not have a response rate because commuters had earlier completed the survey. The bike observations were conducted in August and bicyclists would vary seasonally. The mailed surveys were sent during August when people might have been on vacation or housing was vacant. Observations about passing bicyclists (age, race, etc.) were deduced by the researchers. Though this survey was only conducted in one lower-income minority neighborhood, the findings can be generalized to other lower-income minority neighborhoods in Northeastern and Western regions in the U.S. The terrain is relatively flat, the traffic reflective of a city, and the percentage of commuting bicyclists in Boston (1.7%) similar to other large cities in the northeast (1.0%) or the west (1.4%). (McKenzie, 2014)

## 5. Conclusion

Cycle tracks should be targeted as capital investments in lower income minority neighborhoods to achieve greater construction benefits related to health than only creating cycle tracks in wealthier neighborhoods. Minority populations are biking and have even adopted their own bike appearance. Cycle tracks in lower income neighborhoods should be built wide enough for side-by-side riding because Blacks and Hispanics want to ride with family and friends. Affordable housing should include bike parking rooms inside the housing units because Black and Hispanics preferred to park their bicycles inside their house or apartment.

**Table 4**  
Characteristics of bicyclists counted on the road in Roxbury, MA (Summer 2014).

	White	Black	Hispanic	$p^{\dagger}$
No. of bicyclists	253	393	63	
Male, %	80	94	94	$<0.001$
Age group, %				$<0.001$
Child	0	12	5	
Adult	93	86	95	
Senior	7	2	0	
Wearing a helmet, %	68	17	21	$<0.001$
Type of bike, %				$<0.001$
Touring	19	5	6	
Hubway	5	1	0	
Regular	75	94	94	
Type of clothing, %				$<0.001$
Bike	7	2	0	
Skirt	4	0.30	2	
Regular/daily	90	97	98	
Child on the bike, %	1	0	0	0.30
Carrying items on the bike, %	17	2	3	$<0.001$
Carrying items in the backpack, %	64	66	57	0.37
Biking in the evening, %	50	61	44	0.004

<sup>†</sup>  $p$  Value was calculated among three race/ethnicity groups.

## Conflict of interest

The authors declare there is no conflict of interest.

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