ITE STUDENT PAPER COMPETITION 2010:

AN ANALYSIS ON PEDESTRIAN SAFETY AND MOBILITY

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Goal: The objective of this paper is to comprehensively reveal the factors of street environments that promote pedestrian/bicyclist activity as well as the factors that dissuade such activity by completing a day-time walking audit of two streets segments, one "enjoyable" and the other "unenjoyable".

Note: The reference literature prescribed for this study, and therefore the definitions of "enjoyable" and "unenjoyable" can be gathered from "A Technical Guide for Conducting Pedestrian Safety Assessments for California Cities" by the University of California, Berkeley Institute of Transportation Studies Technology Transfer Program.

Overview: The process for completing the analysis was split up into 5 steps:

- ***Choosing*** the Street Segments **(A)**
- ***Compiling*** the factors to observe during the audit **(B)**
- ***Conducting*** the Audit **(C)**
- ***Comprehending*** the Data **(D)**
- ***Checking*** the Results **(E)**

Timeline: (notation from "Overview" section)

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
(MARCH)		16 – A	17 - A	18 – A	19 –	20 –
21 –	22 – B	23 – B	24 – B	25 –	26 –	27 –
28 –	29 – C D	30 – C D	31	(UCTC Conference)		3
4	5 – C D	6 – C D	7 – E	8 – E		(APRIL)

Methodology and Procedures:

A. Choosing the Street Segments

To choose the "unenjoyable" street, a survey (Appendix A) was taken of pedestrians around the UC Berkeley campus and emailed to UC Berkeley students. The first 100 substantial responses were totaled – a response to 3 and 4 were deemed substantial only if there was a positive response to questions 1 and 2, respectively. The substantial responses for 3 & 4 were then tallied (Appendix B) and Shattuck Street was surveyed as being the most unsafe street with a total of 59 of the 100 tallied responses. The street segment between Center and Durant was chosen (Appendix C), and http://maps.google.com confirmed that this segment indeed satisfies the requirement of being a minimum of ¼ of a mile.

The "enjoyable" street segment was chosen by utilizing a Berkeley Bikeway Network found here: http://www.ci.berkeley.ca.us/uploadedFiles/Public_Works/Level_3_-_General/Bikeway_Network.pdf Milvia Street beginning from Hearst and ending at Cedar was chosen (Appendix D) as it was deemed both a Bicycle Boulevard and a Bike Route. It is close to the other audited street segment, and http://maps.google.com confirmed this segment also satisfies the requirement of being ¼ of a mile.

B. Compiling the Factors to Observe During the Audit

To obtain a list of street segment factors to observe, the day-time audit information mentioned in the PSA handbook, the comments in the survey responses, as well as suggestions from UC Berkeley's Principal Planner William Riggs were combined, resulting in 45 street variables to observe. For data analysis, these variables were then split into four categories:

- User – Aspects that are user generated
- Design – Aspects that are the consequences of planning
- Regulatory – Aspects that monitor or regulate users
- Stochastic – Aspects that are random or temporary

USER	DESIGN	REGULATORY	STOCHASTIC
• Traffic Speed • Pedestrian Volume • Vehicle Volume • Bicyclist Volume • Child/Senior User Volume • Curb Lane Turning Volume • Loading Frequency • Unloading Frequency • Parking Frequency • Bus Stop with Bike Lane Interaction Frequency • Nearby Land Uses • Noise Quality • Air Quality • Pedestrians & Bicyclists Disregarding Rules • Drivers Disregarding Rules	• Number of Lanes • Block Length • Sidewalk Width • Outside Lane Width • Crosswalk Width • Crosswalk Type • Median Island Width • Connectivity (Distance between Sidewalks) • Curb Ramps • Bulbouts • Truncated Domes • Transit Access • Bike Facility Type • Number of Lanes Bicyclists Need to Cross to Turn • Pavement Quality • Striping Quality • Signage Quality • Vision Obstructions • Aesthetics • Amenities	• Traffic Signal Type • Green Light Lengths • Audible Traffic Signals • Speed Limit Regulations • Traffic Control Signs	• Weather Effects • Construction • Special Events • Material Obstructions • Collisions

C. Conducting the Audit

The audit was split into two segments (refer to "Timeline") with each audit taking place from 12PM-2PM. The materials used were a camera, a ruler, a list of the variables, a clipboard, a pencil, and a printed map of both the street segments.

All the data required to analyze the "User Variables" was collected in the first audit – the volume variables were estimated by obtaining the average of 10 volumes per cycle length, and then converting the time unit to hours.

-An example of the conversion is shown here:

$$\frac{14\ pedstrians}{1\ cycle\ length} * \frac{1\ cycle\ length}{72\ seconds} * \frac{3600\ seconds}{1\ hour} = \frac{700\ pedestrians}{1\ hour}$$

The frequency variables were estimated by obtaining the time between 2 occurrences of the event and then interpolating the rate at 1 hour.

-An example of this interpolation is shown here:

$$7\ minutes\ between\ loading\ vehicles =>$$

$$\frac{1\ loading\ vehicle}{7\ minutes} * \frac{60\ minutes}{1\ hour} = \frac{8.57\ loading\ vehicles}{1\ hour}$$

The data required to analyze the rest of the street variables were then collected in the second audit through pure observation and measurements. Photos were taken to assist in the evaluation of some of the variables, which are distributed within the "Comprehend the Data" section.

D. Comprehending the Data

Initially it was assumed the survey chosen street Shattuck would have higher User Variable counts and lower quality Design Variables than the segment chosen by the Berkeley Bikeway Network map (Milvia). The results were not completely as expected – although the presumably unsafe Shattuck segment did indeed have higher User Variable counts, it had a relatively high quality of Design Variables.

To elaborate on the higher **User Variables** for the Shattuck segment, the effect of larger counts for each of the variables on pedestrian and bicyclist safety must be explained in detail. The traffic speed was between 20 mph - 40 mph for the Shattuck segment, while on Milvia the speed was 10 mph - 25 mph. Higher vehicle speeds lead to more costly collisions, and with an estimated 2300 vehicles and 225 bicyclists per hour per intersection on Shattuck (compared to Milvia's 163 vehicle 245 bicyclist rate), there is a higher chance of such collisions. Another effect of the traffic on Shattuck was the poor noise and air quality.

While the Shattuck segment had 5 minute sporadic intervals of vehicles parking, FedEx cars loading and unloading, and various buses stopping at their respective stops, the Milvia segment had none such occurrences during the audit. These variables disrupt traffic flow and interrupt bicyclists as they are forced to ride unsafely around these obstacles. Furthermore, Shattuck had about 300 people and 500 vehicles disobeying the traffic rules and regulations per hour per intersection; many vehicles will make turns just

(The pedestrian has not even finished crossing while the car passes into the intersection)

feet away from a pedestrian without properly waiting for them to safety get onto the sidewalk.

In terms of the **Design Variables**, Shattuck had about 9 feet wide sidewalks and up to 18 feet crosswalks, while Milvia had 8 feet wide sidewalks with only 7 feet wide crosswalks. Although Milvia had drastically less traffic, it is cluttered by plants and trees that narrow the sidewalk and make those areas pedestrian unfriendly. Also, while Milvia contained several bulbouts, many were coupled with large flora, almost defeating the visibility purpose of bulbouts. Milvia ultimately had better markings, striping, signage and general aesthetics.

Although both segments had good numbers of ramps and truncated domes, the streets still had some accessibility issues. The crosswalks perpendicular to Shattuck are about 75 feet long, and senior citizens have a traveling speed around 2-3 feet/sec. With a green phase time of 24 seconds, a senior citizen will not be able to cross the street completely. Looking at Milvia, there were several areas of cracked and hilly pavement that would make the trip for a person in a wheelchair challenging. On Shattuck bicyclists would have to ride on the street around relatively fast vehicles and cross four lanes to make a turn while on Milvia the vehicles are sparse as the street carries only local traffic, and bicyclists need to only cross up to one lane to make a turn. Also, the

markings and signage indicate clearly that Milvia is a Bike Boulevard, a type of roadway intended to optimize a bicyclist's mobility.

A lot of the aspects were similar in terms of **Regulatory Variables** except for traffic calming on Milvia; it has three speed limit signs and 2 speed bumps per block, as well as caution signs warning vehicles of nearby children.

Milvia did better in the **Stochastic Variable** area as there was a street on Shattuck currently going under construction and caused a lot of challenges in terms of pedestrian safety and mobility. Had the construction related to the pavement damage done by heavy loads on the road, this variable would be related to the high volume user aspect.

(Construction on Shattuck temporarily narrows the sidewalk width, making it harder and more dangerous for pedestrians to travel through the street)

E. Checking the Results

To validate the results, a second round of surveys (Appendix E) was given out to pedestrians on both segments. The survey responses generally fell into line with my results – many pedestrians believed Shattuck to be dangerous because of the high speed of vehicles and the large amount of traffic while on Milvia pedestrians felt safe because of the low traffic count and careful vehicles.

To support Milvia Street better promoting pedestrian activity, many pedestrians responded to the survey saying they were on Milvia for the purpose of walking their dog, taking their baby on a stroll, getting exercise, or some other recreational activity while people on Shattuck had more obligatory business related trips.

Some errors in the methodology can be attributed to the entirety, or lack thereof, of the sampling space and phrasing of the questions. The volume and frequency data are only snippets of the traffic flow on the streets and therefore can deviate greatly from the total average flows.

Conclusion

Overall, it seems that the User Variables were the greatest cause of concern for pedestrians on Shattuck; vehicles go at high speeds, make frequent stops, and disobey the traffic rules and regulations. For Shattuck, it is recommended that the citizens in Berkeley be more aware of the dangers of the speed and inpatient behaviors of the vehicles. To lower the speed on Shattuck, minor traffic calming tools can be utilized such as the boards that display a passing vehicle's current speed or signs that show the fee of speeding as alerts. An attempt to divert some traffic away from Shattuck may lessen the load on the pavement and lower the delays and traffic volumes. The issues on the Milvia segment seem to only be related the visual obstruction caused by too many plants and trees, as well as the cracked pavement issue. Some proper maintenance and plant removals will make Milvia an even safer street.

APPENDIX A – Street Segment Choice Survey

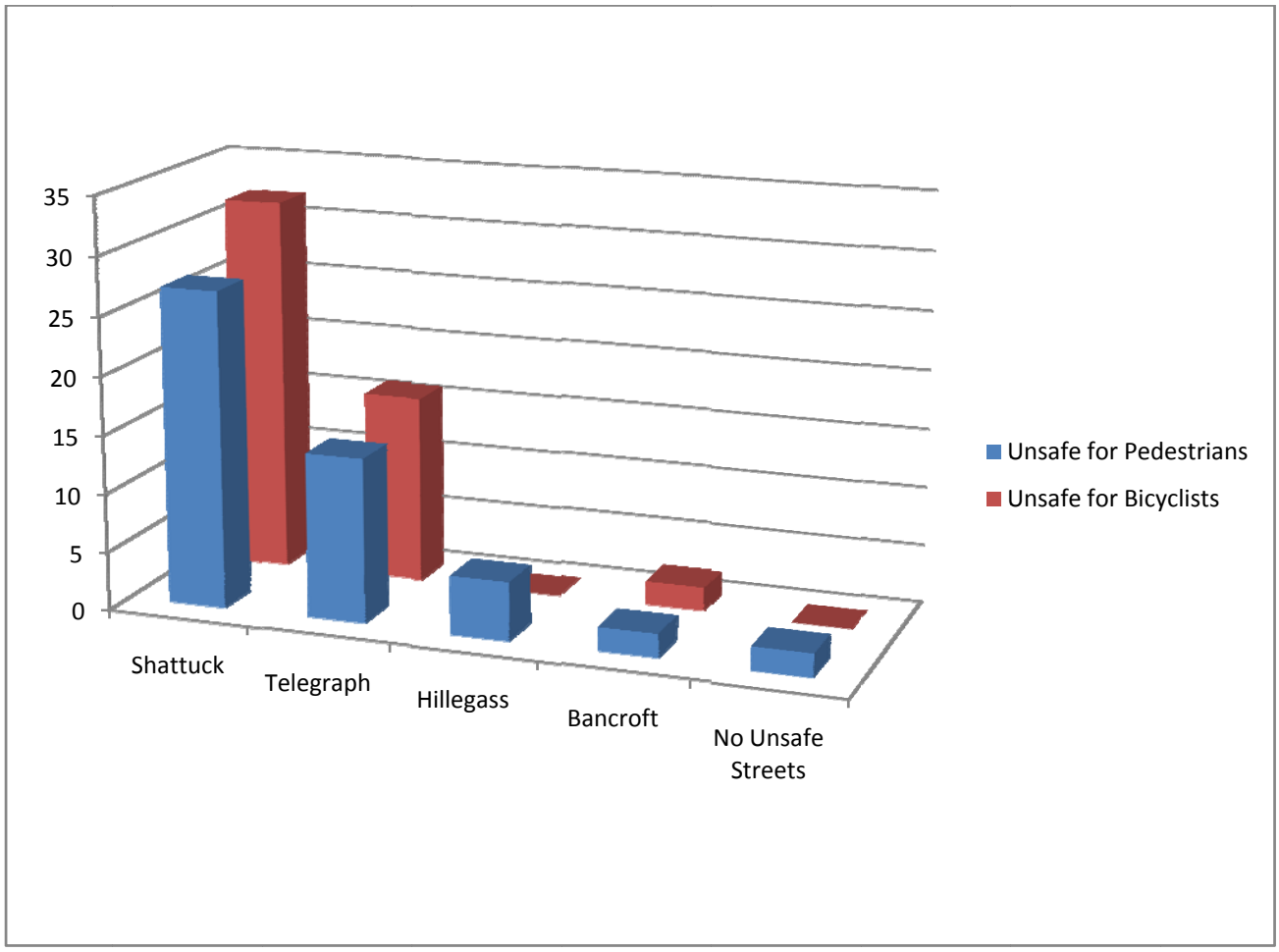
1. Do you believe you have at least one hour of total walking time an average weekday?

2. Do you believe you have at least 30 minutes of total biking time an average weekday?

3. Which streets in Berkeley do you find “unsafe” as a pedestrian? Why?

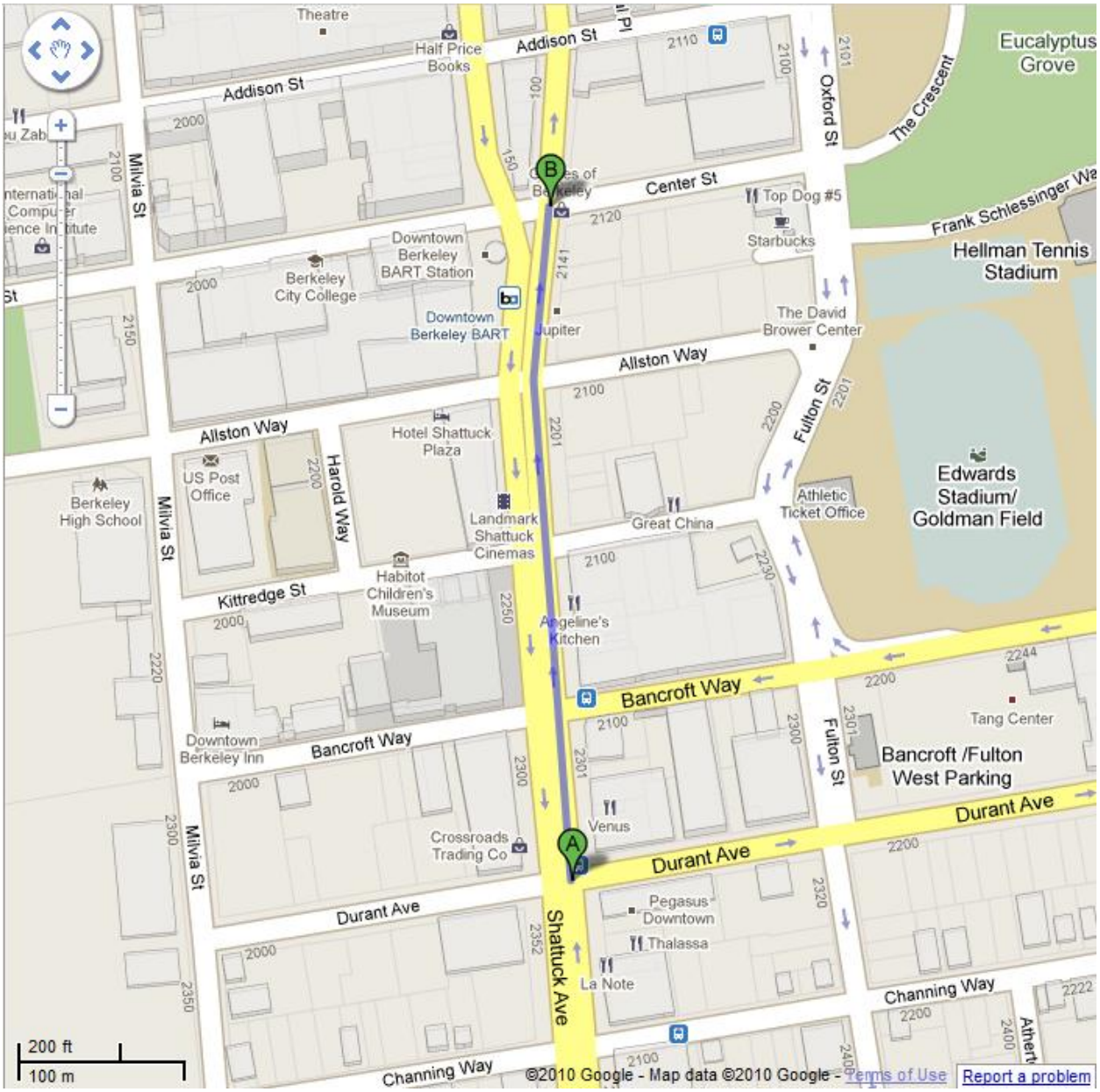
4. Which streets in Berkeley do you find “unsafe” as a bicyclist? Why?

APPENDIX B – Graphical Representation and Tallied Responses for Survey Questions 3 & 4

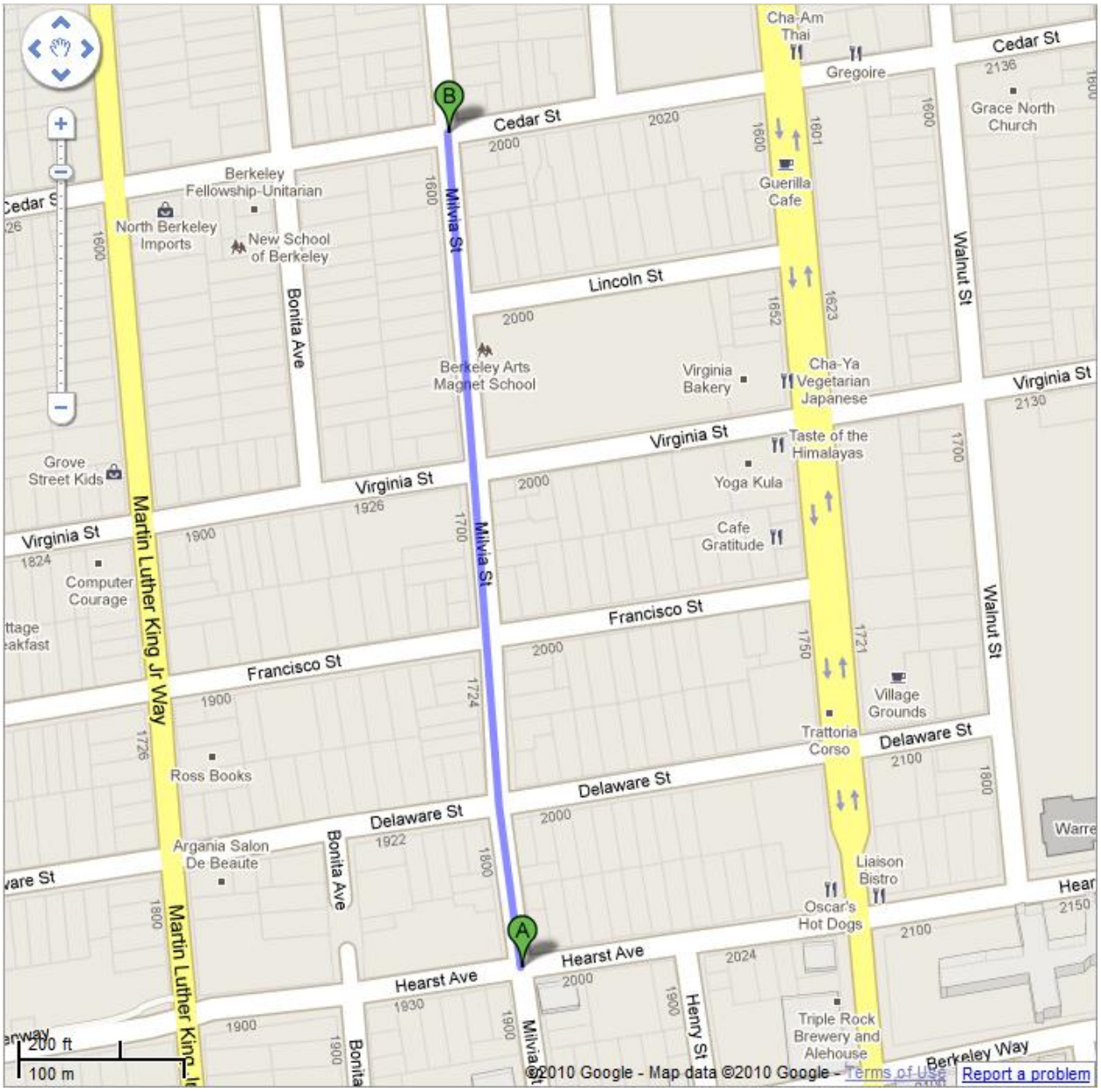


Street Name	Unsafe for Pedestrians	Unsafe for Bicyclists
Shattuck	27	32
Telegraph	14	16
Hillegass	5	0
Bancroft	2	2
No Unsafe Streets	2	0

APPENDIX C – MAP OF SHATTUCK: DURANT - CENTER



APPENDIX D – MAP OF MILVIA: HEARST - CEDAR



APPENDIX E – WALKING PURPOSE/STREET SAFEY SURVEY

1. Would you say you walk or bike more than you drive?

2. What is the purpose of your travel today?

3. Do you find this street safe?

4a. If yes, why?

4b. If no, why not?