# Traffic Safety Barriers to Walking and Bicycling

## Analysis of CA Add-On Responses to the 2009 NHTS

NHTS Users Conference—June 2011

Robert Schneider, Swati Pande, & John Bigham, University of California Berkeley

Safe Transportation Research & Education Center (SafeTREC)

# Community Goals vs. Perceived Pedestrian & Bicycle Safety Barriers

- **Goal: Increase walking & bicycling**

- **Goal: Improve pedestrian & bicycle safety**

# Community Goals vs. Perceived Pedestrian & Bicycle Safety Barriers

- **Goal: Increase walking & bicycling**
  - "If there was less traffic…I would probably walk even more."
    --Male, Age 30, San Francisco Fillmore Street
  - "Bicycling itself…I would do it if I wasn't right up next to cars."
    --Female, Age 52, South SF
- **Goal: Improve pedestrian & bicycle safety**
  - "There are definitely certain intersections that I'm very cautious about because I have seen drivers do crazy things…"
    --Female, Age 52, South SF
  - "Sometimes I feel scared for [bicyclists]…sometimes it is very hard to see them…and sometimes they have no protection."
    --Male, Age 30-39, Berkeley

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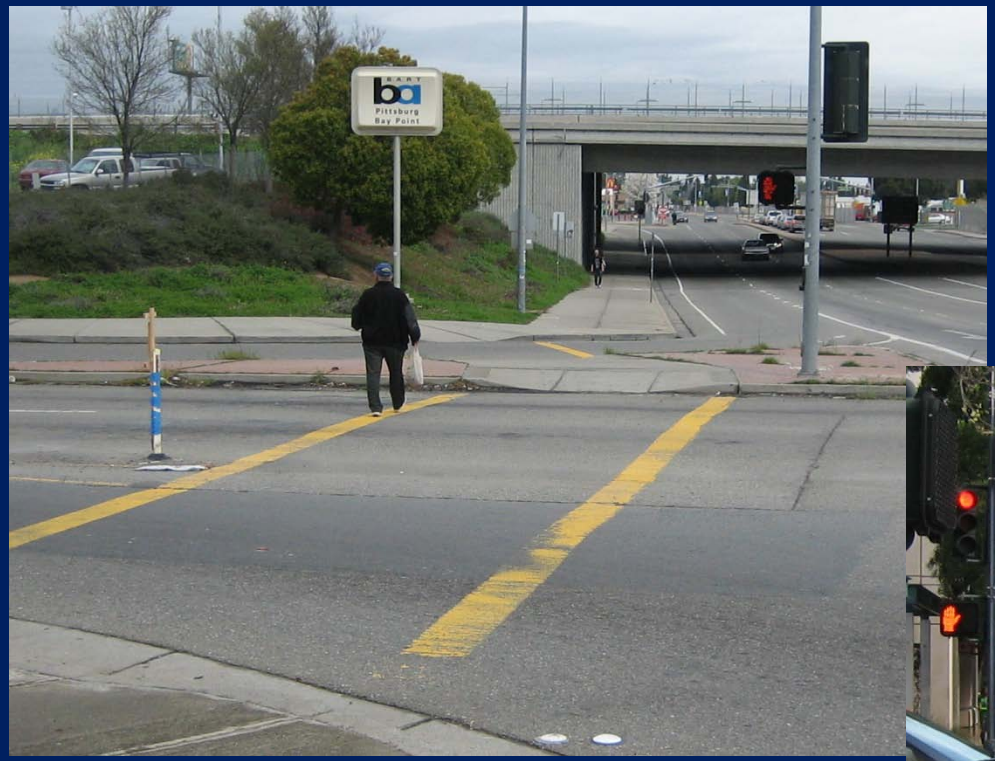
    --Male, Age 30-39, Berkeley

# What Factors are Associated with Perceived Pedestrian & Bicycle Safety Barriers?



# 2009 NHTS California Supplement Person File

All people
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*(in 21,225 households)*

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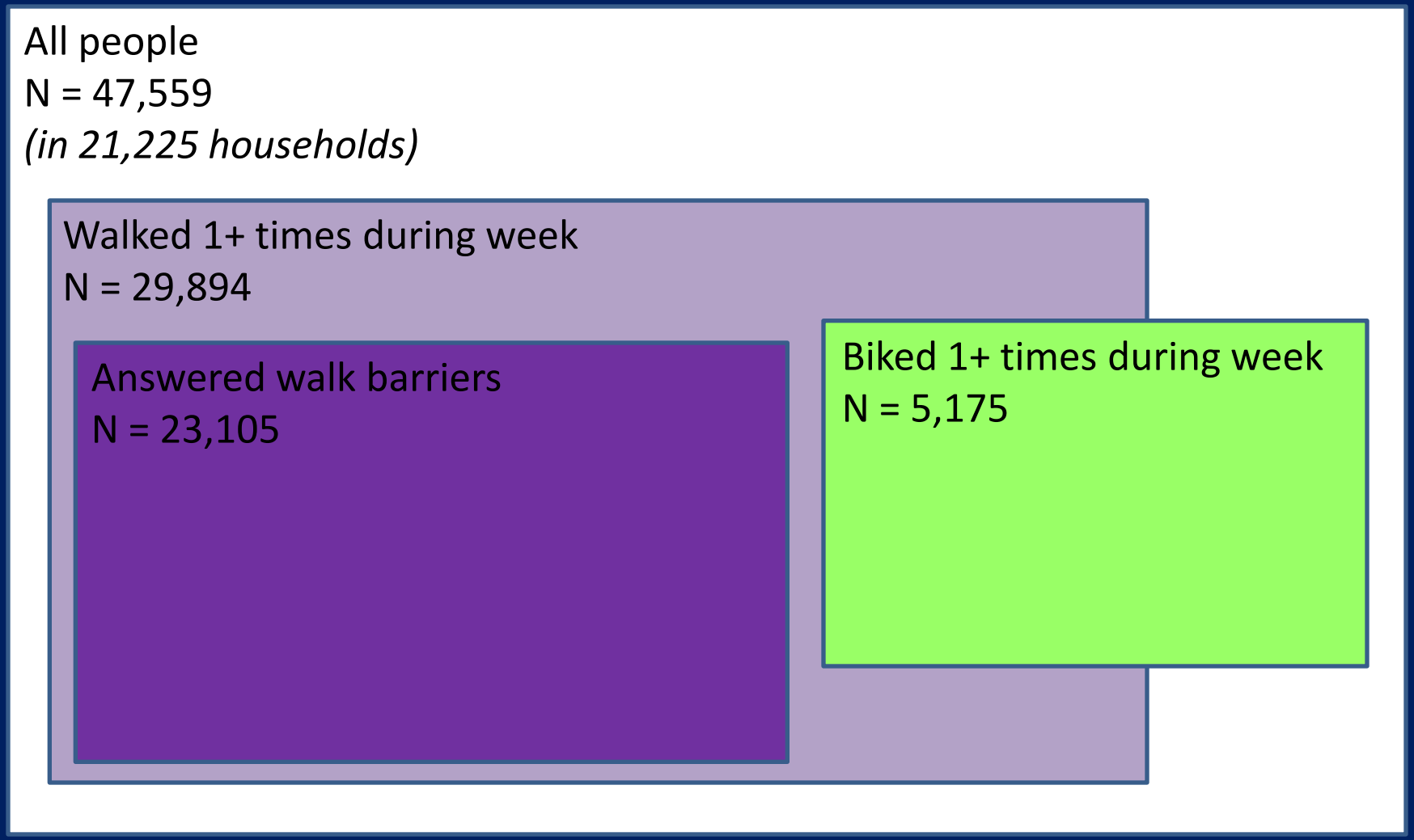
Answered walk barriers
N = 23,105

# 2009 NHTS California Supplement Person File



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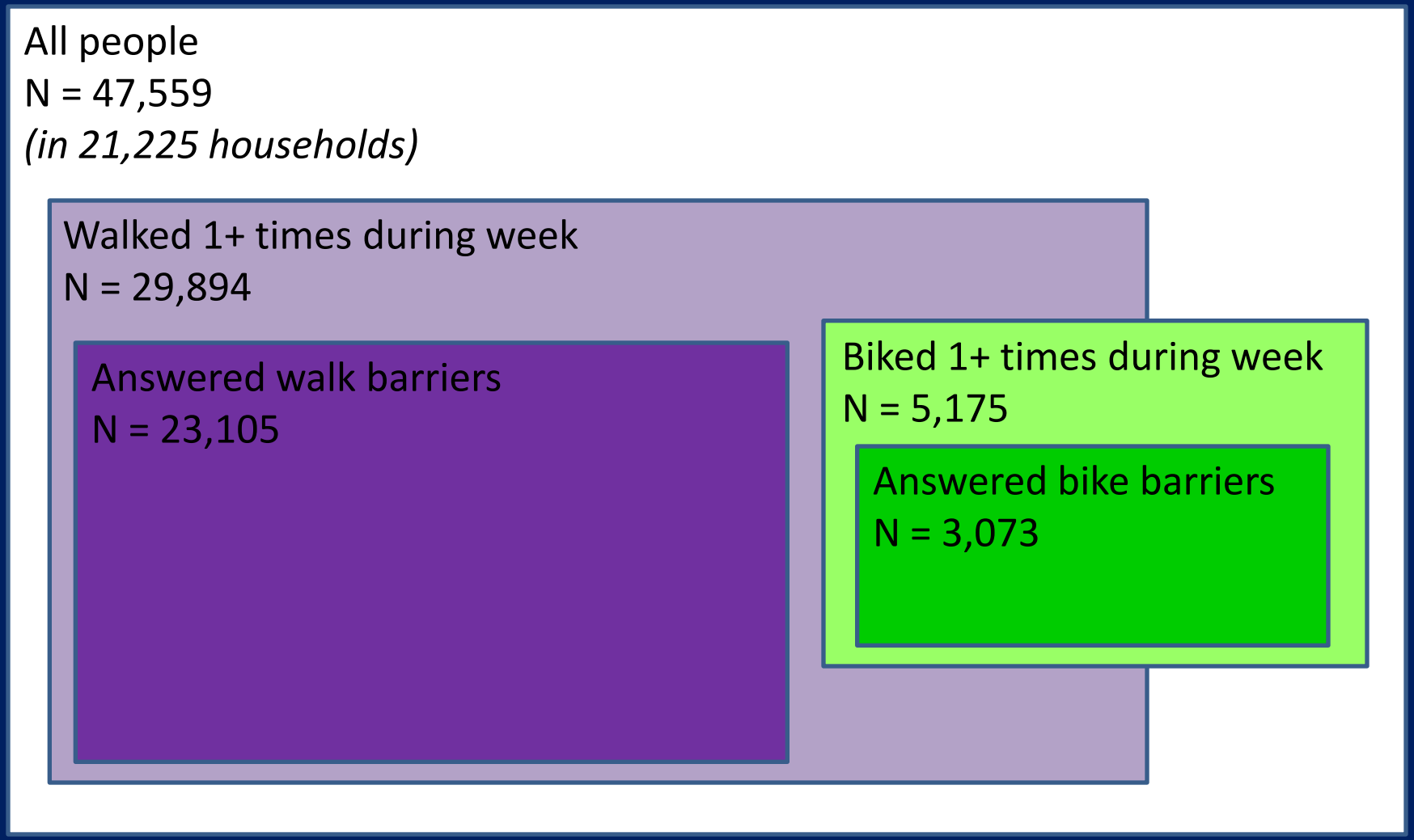
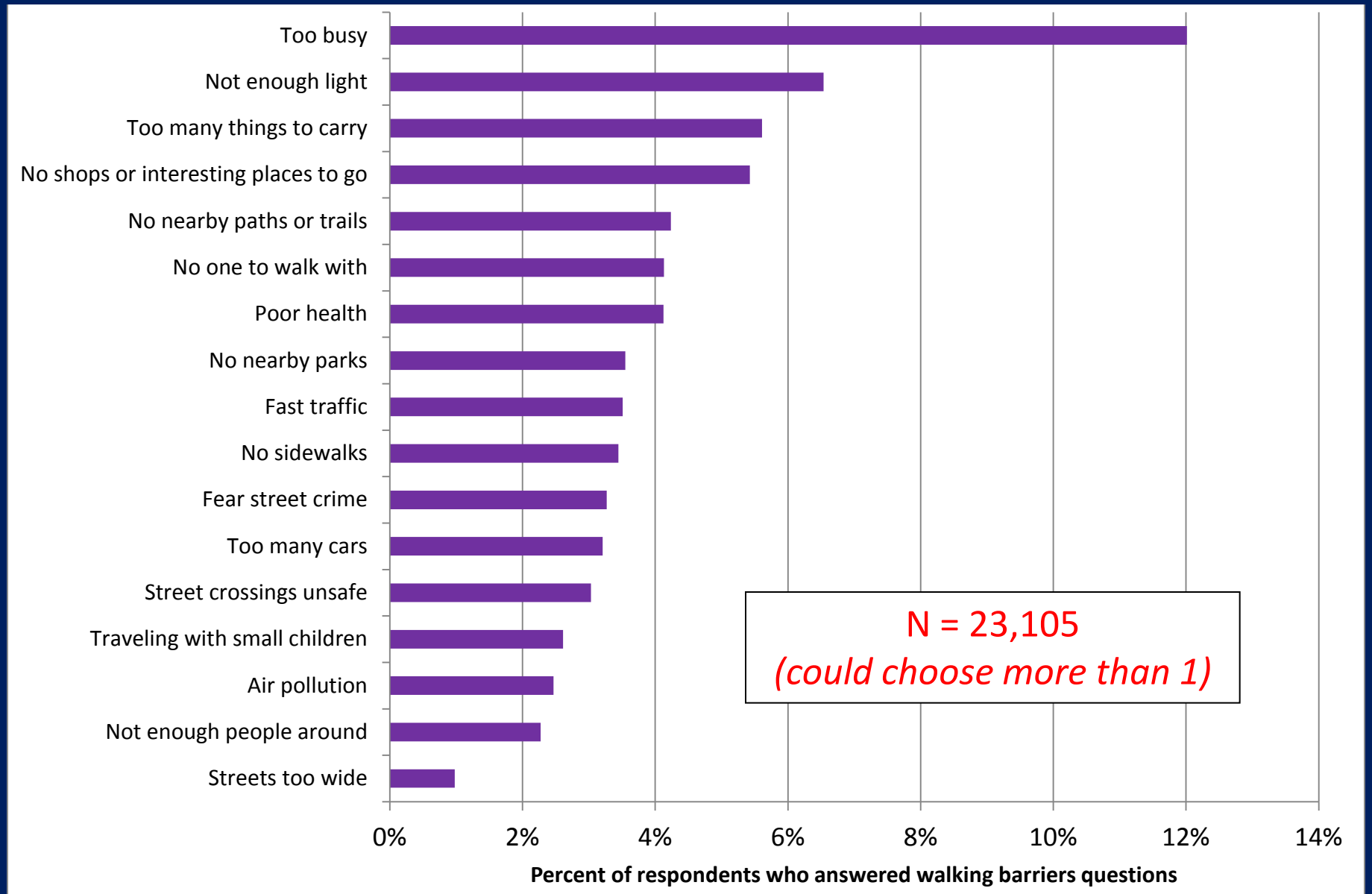


# 2009 NHTS California Supplement:

***Please tell me if any of the following keep you from doing more walking…***



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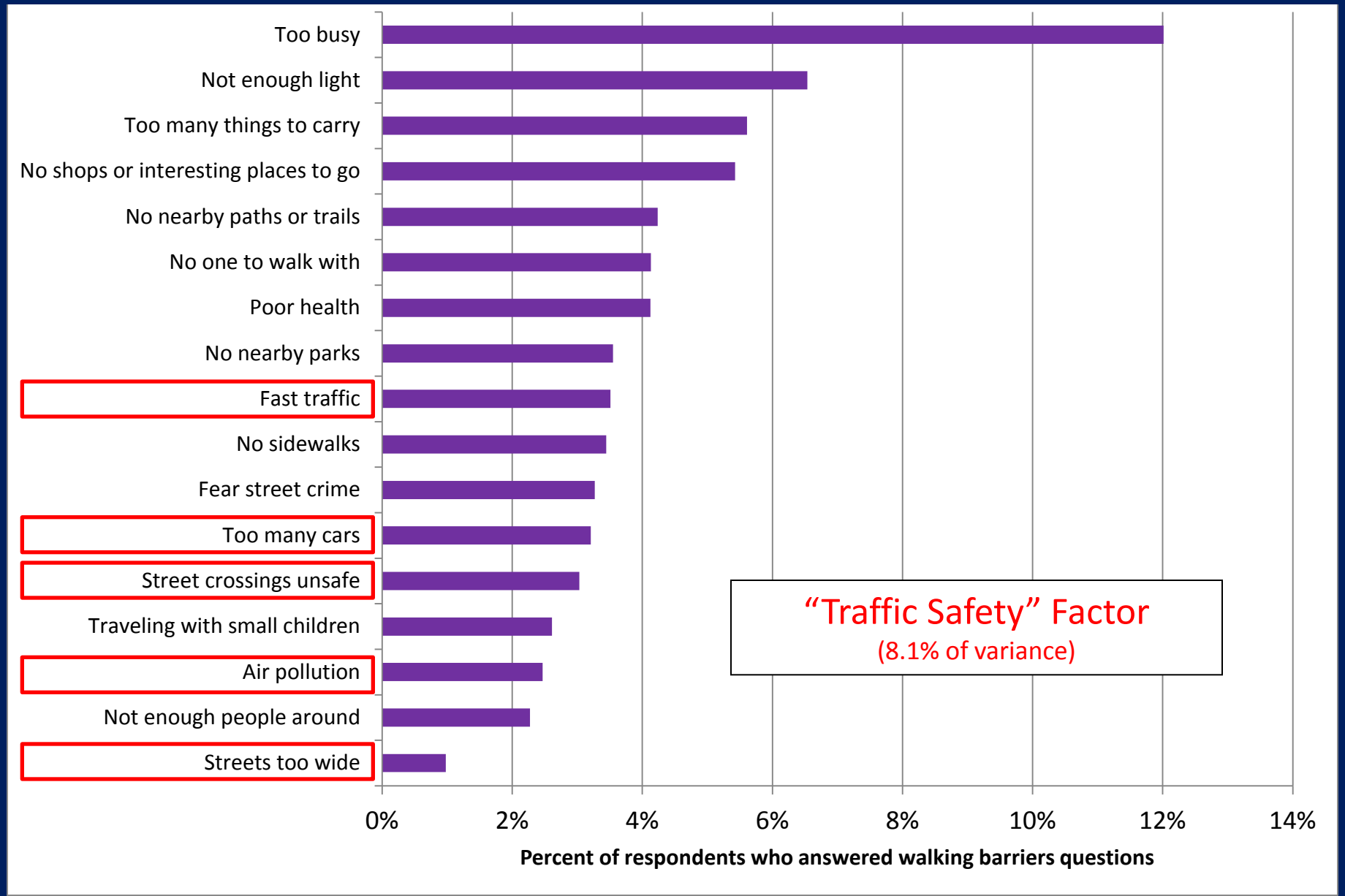

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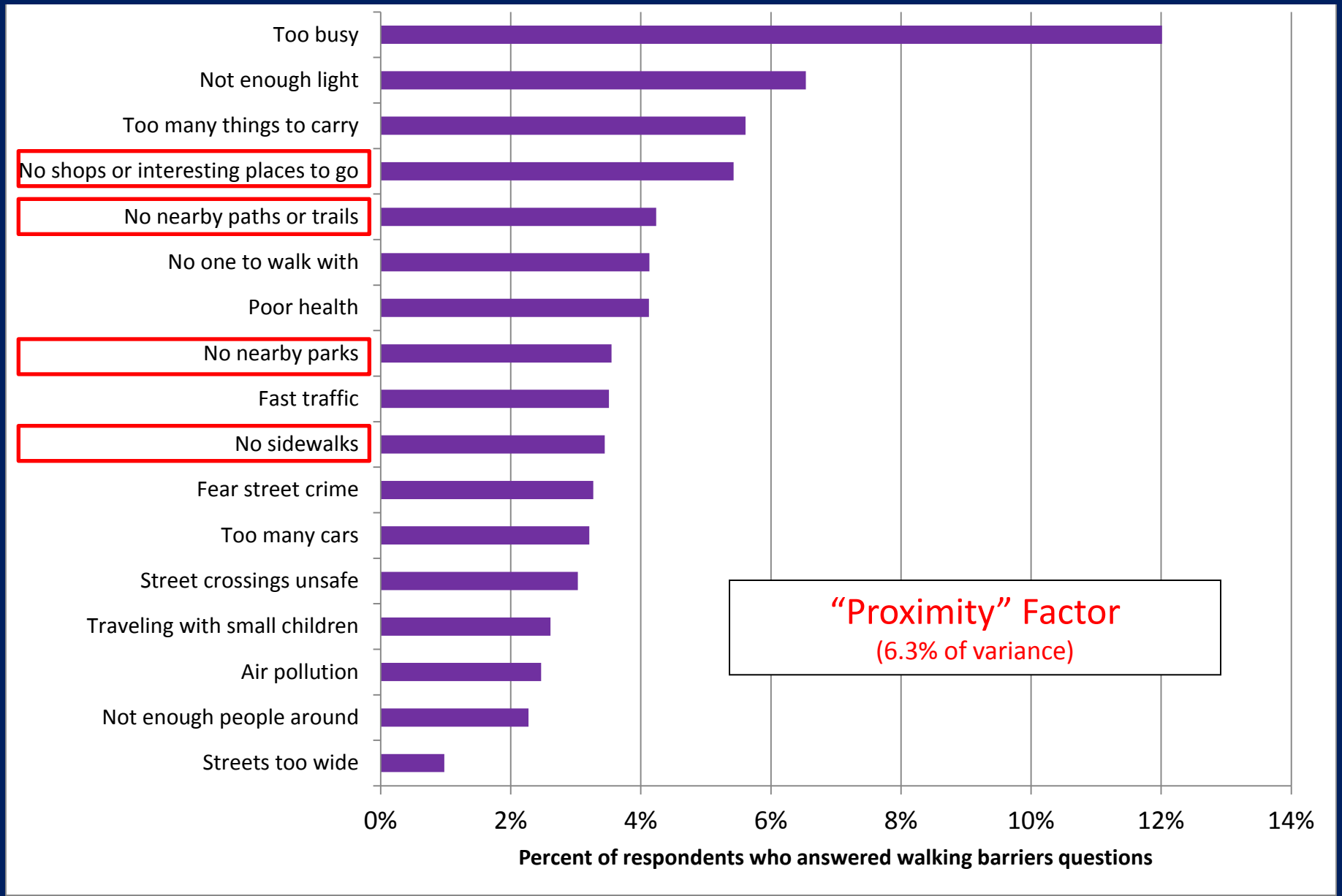

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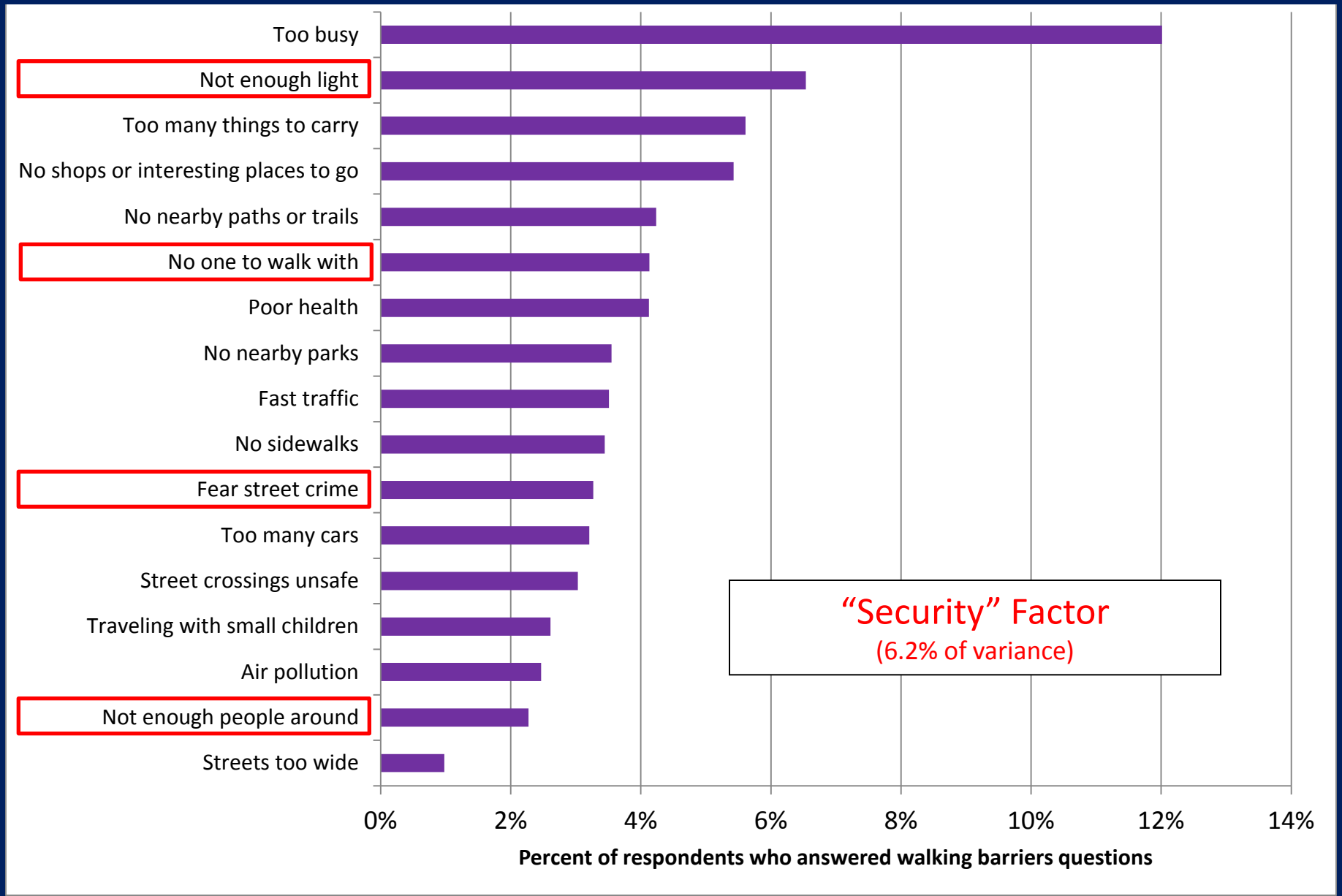

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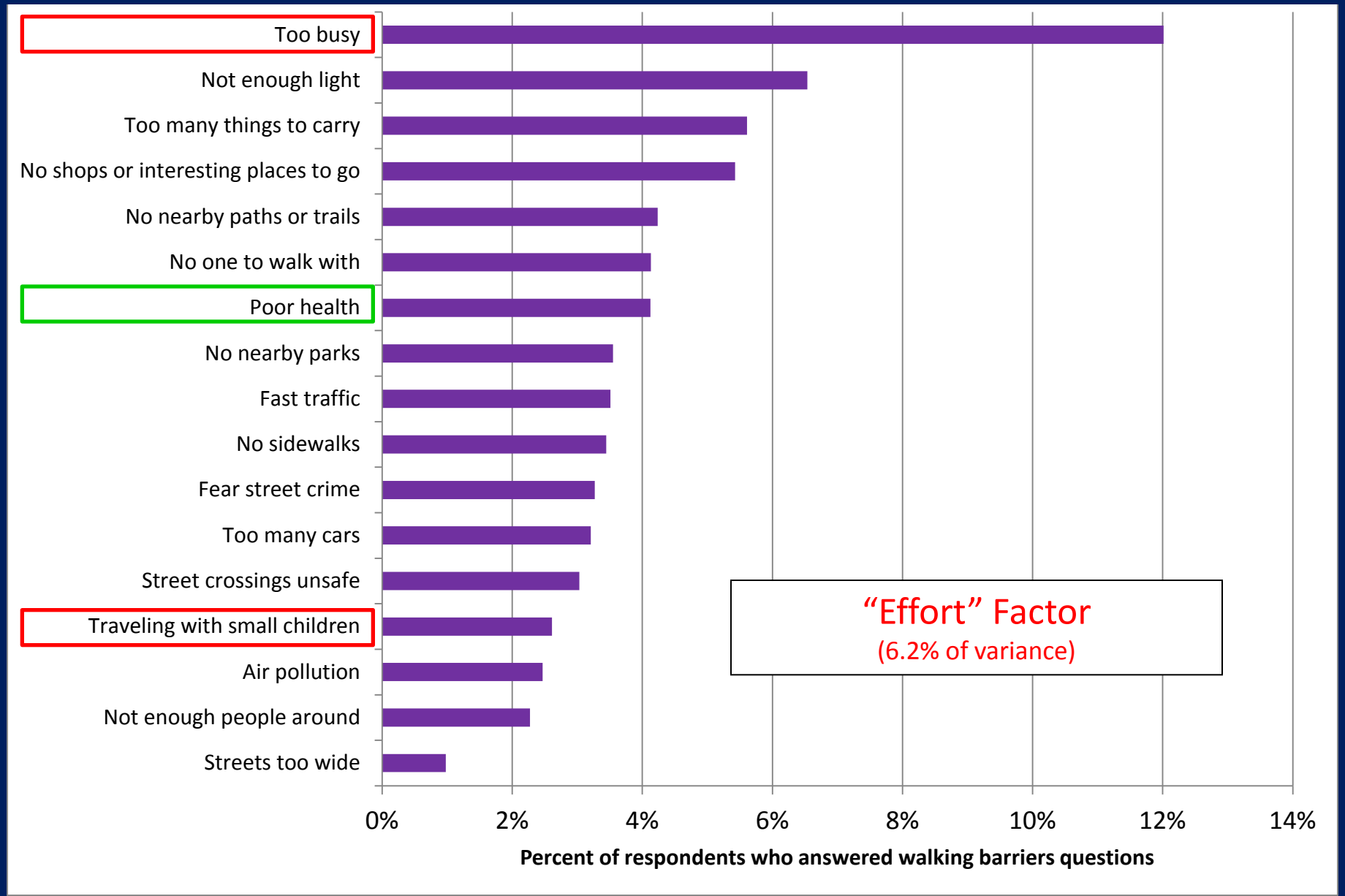
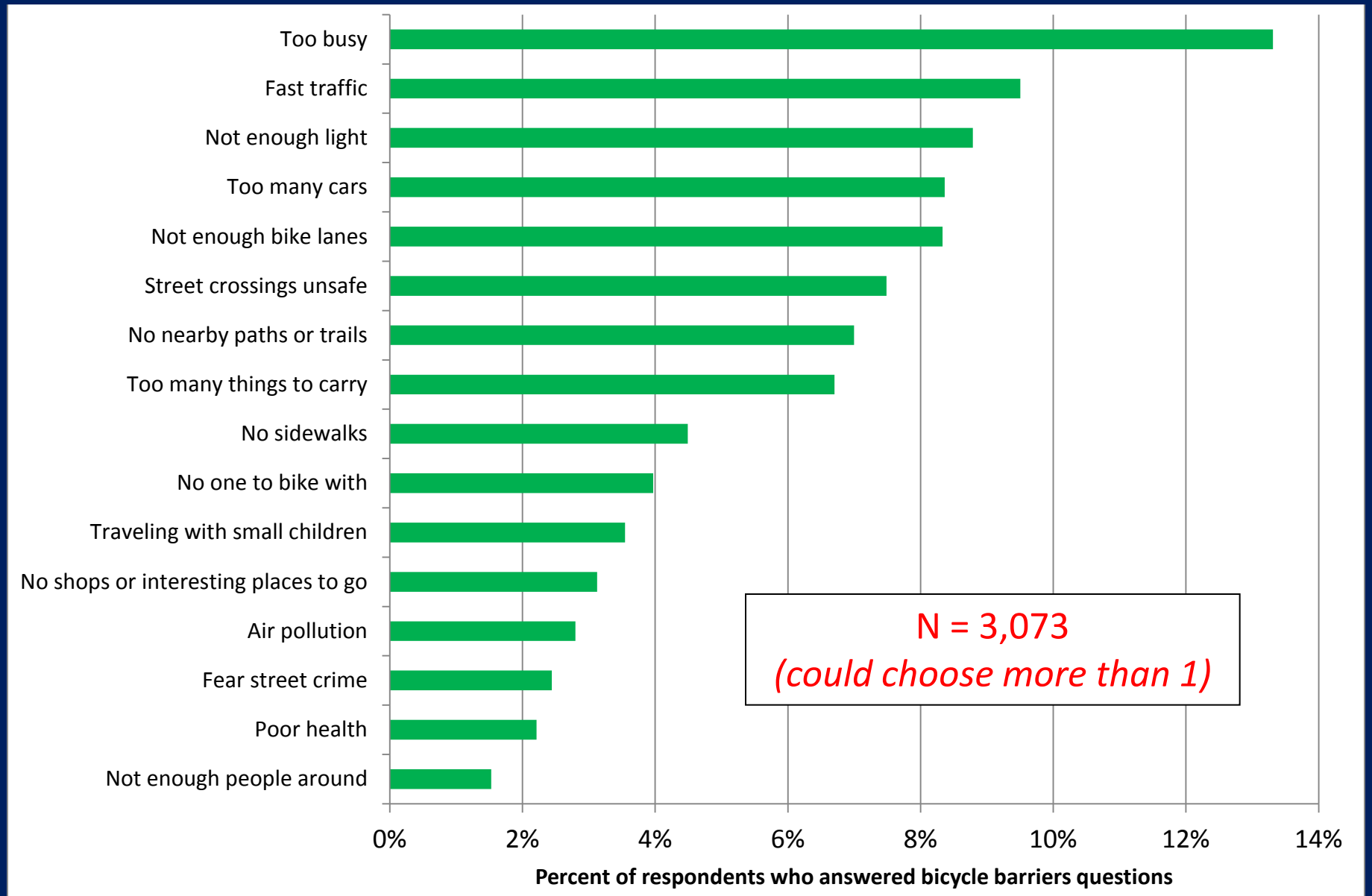


# 2009 NHTS California Supplement:

***Please tell me if any of the following keep you from doing more biking…***



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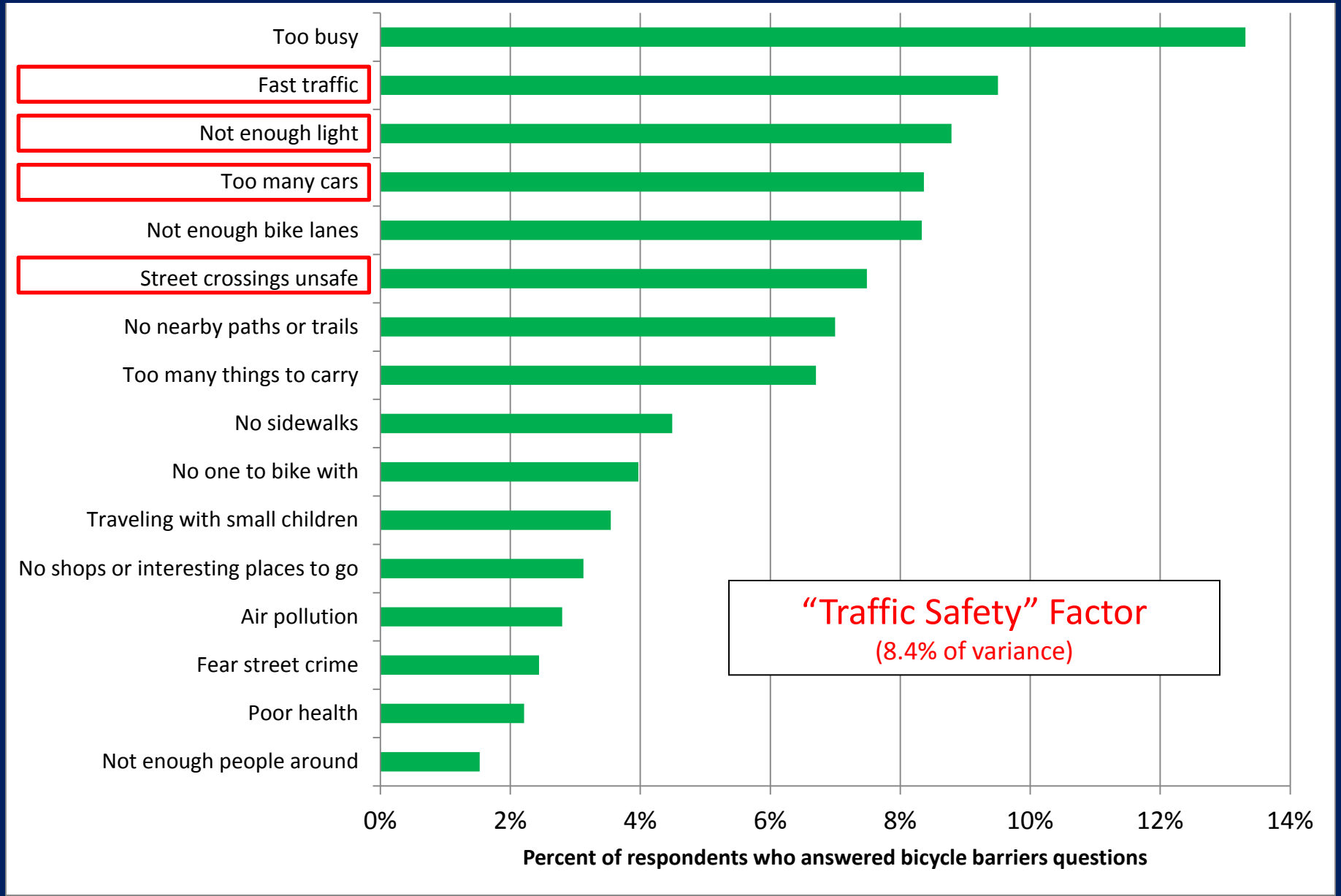

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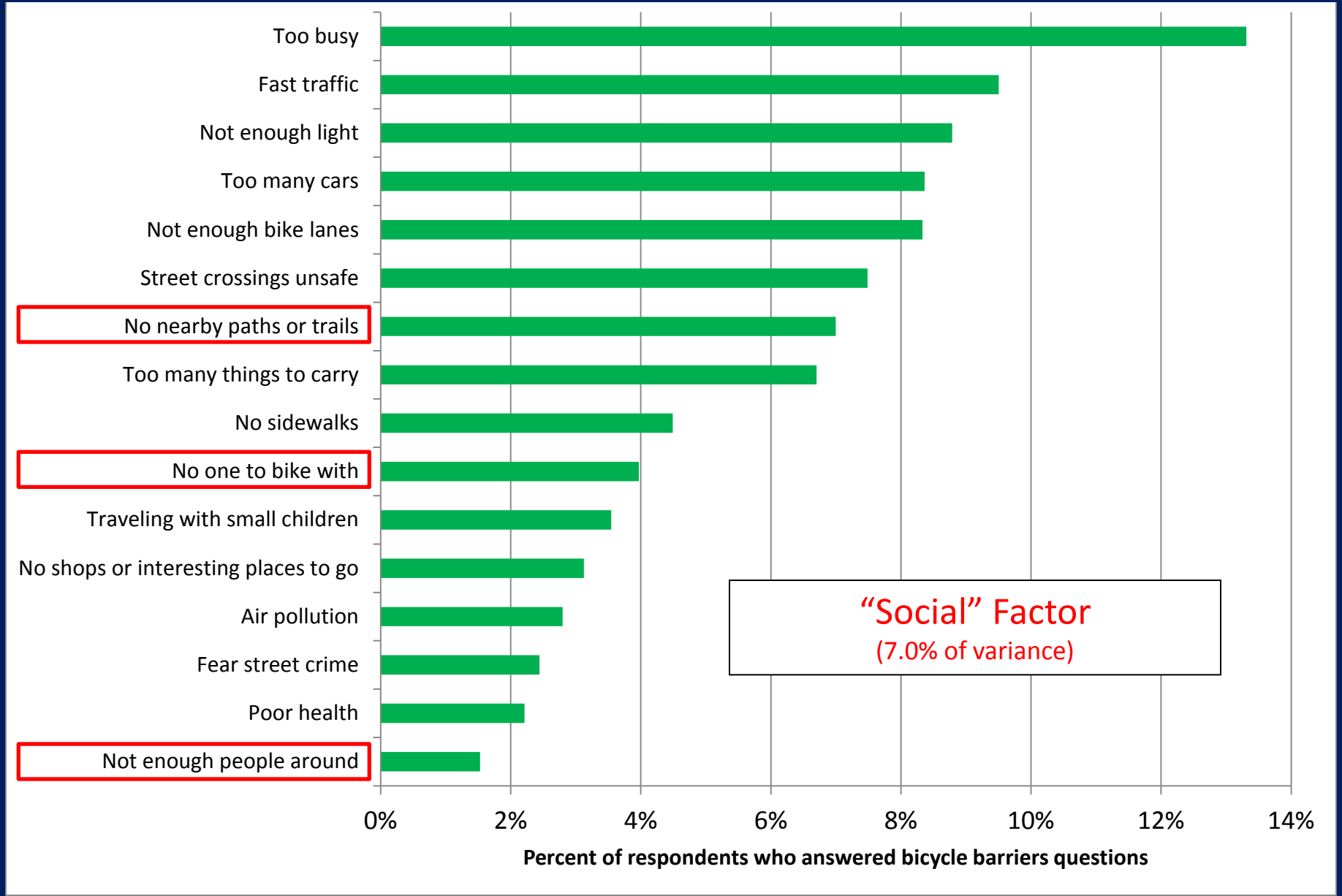

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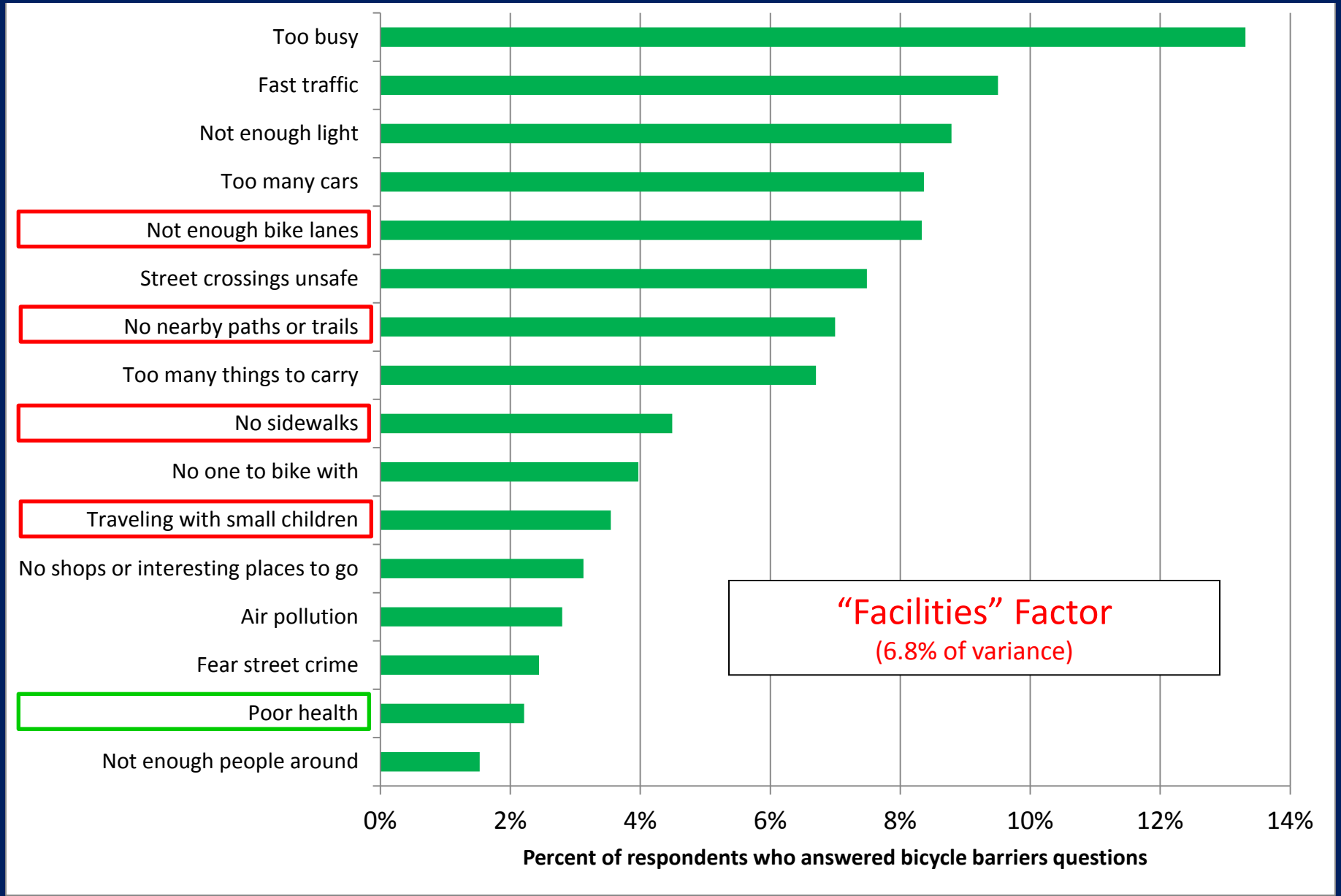
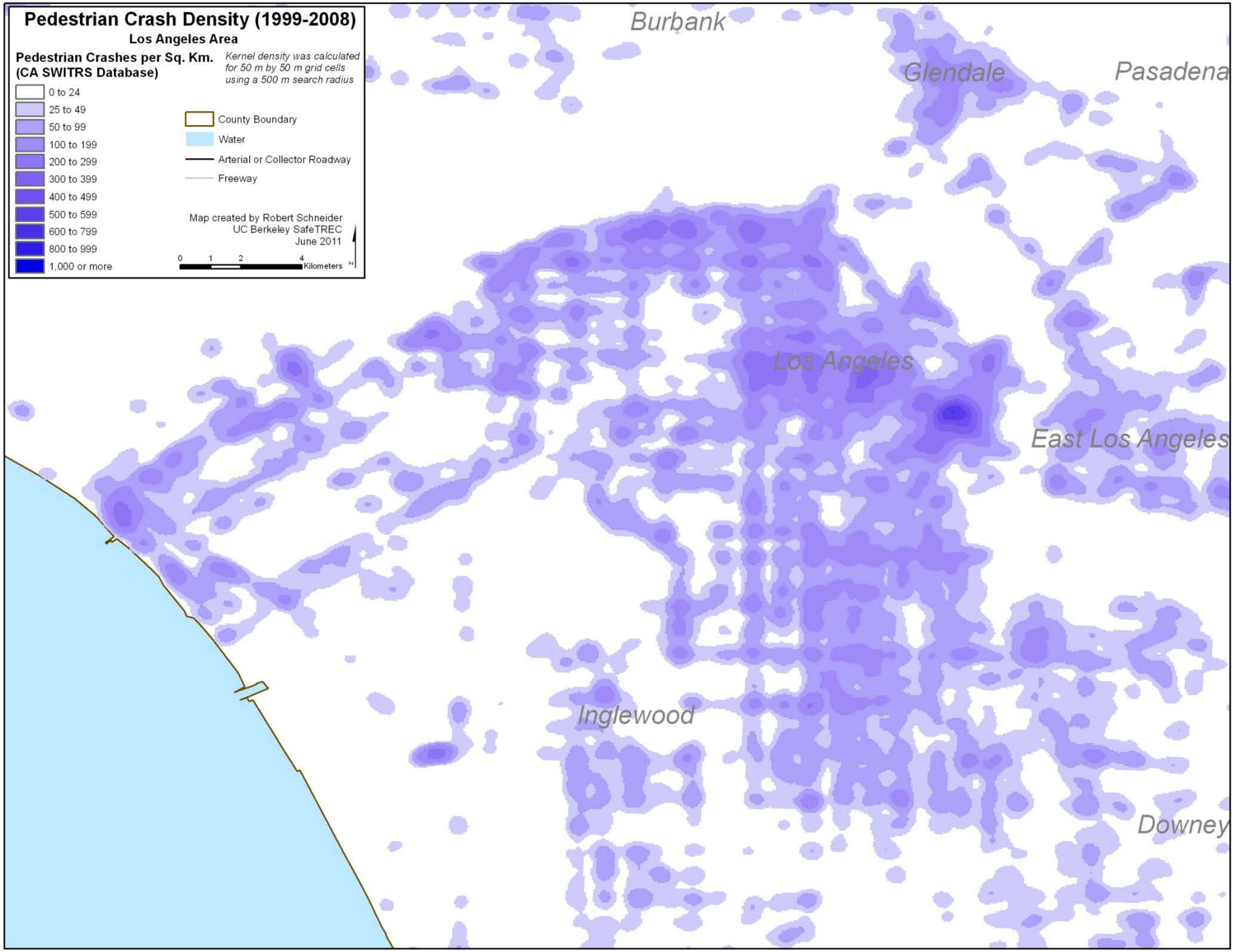


# Dependent Variables

- Walk “Traffic Safety” Barrier factor score
  - Too many cars
  - Street crossings unsafe
  - Fast traffic
  - Streets too wide
  - Air pollution
- Bicycle “Traffic Safety” Barrier factor score
  - Fast traffic
  - Street crossings unsafe
  - Too many cars
  - Not enough light
  - Have enough time

# What Characteristics are Associated with Perceived Pedestrian & Bicycle Safety Barriers?

→ “Traffic Safety” Factor for each Respondent


Pedestrian Crash Density (1999-2008)
Los Angeles Area
Pedestrian Crashes per Sq. Km.
(CA SWITRS Database)
Kernel density was calculated for 50 m by 50 m grid cells using a 500 m search radius
0 to 24
25 to 49
50 to 99
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Map created by Robert Schneider
UC Berkeley SafeTREC
June 2011
0 1 2 4
Kilometers
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Burbank
Glendale
Pasadena
Los Angeles
East Los Angeles
Inglewood
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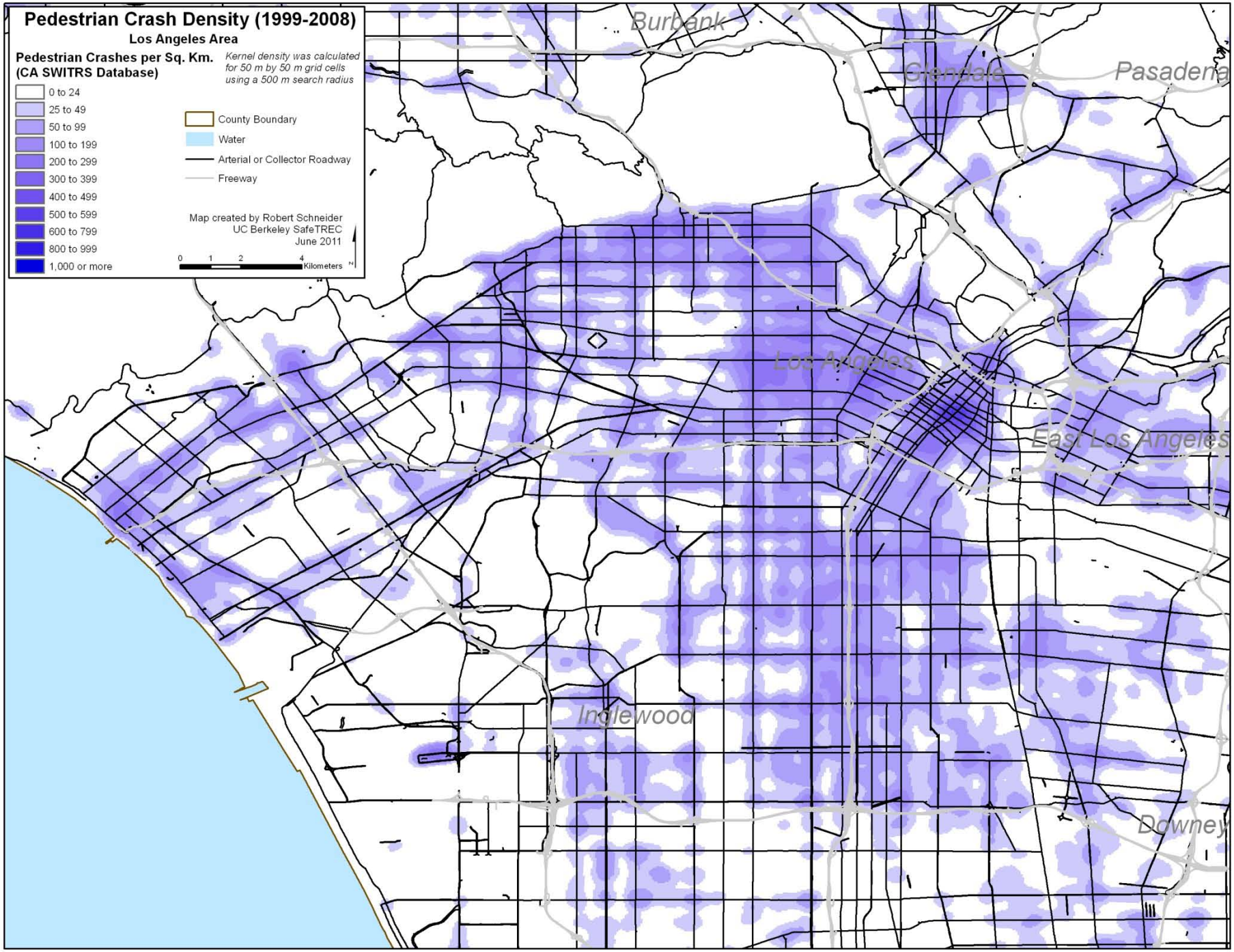
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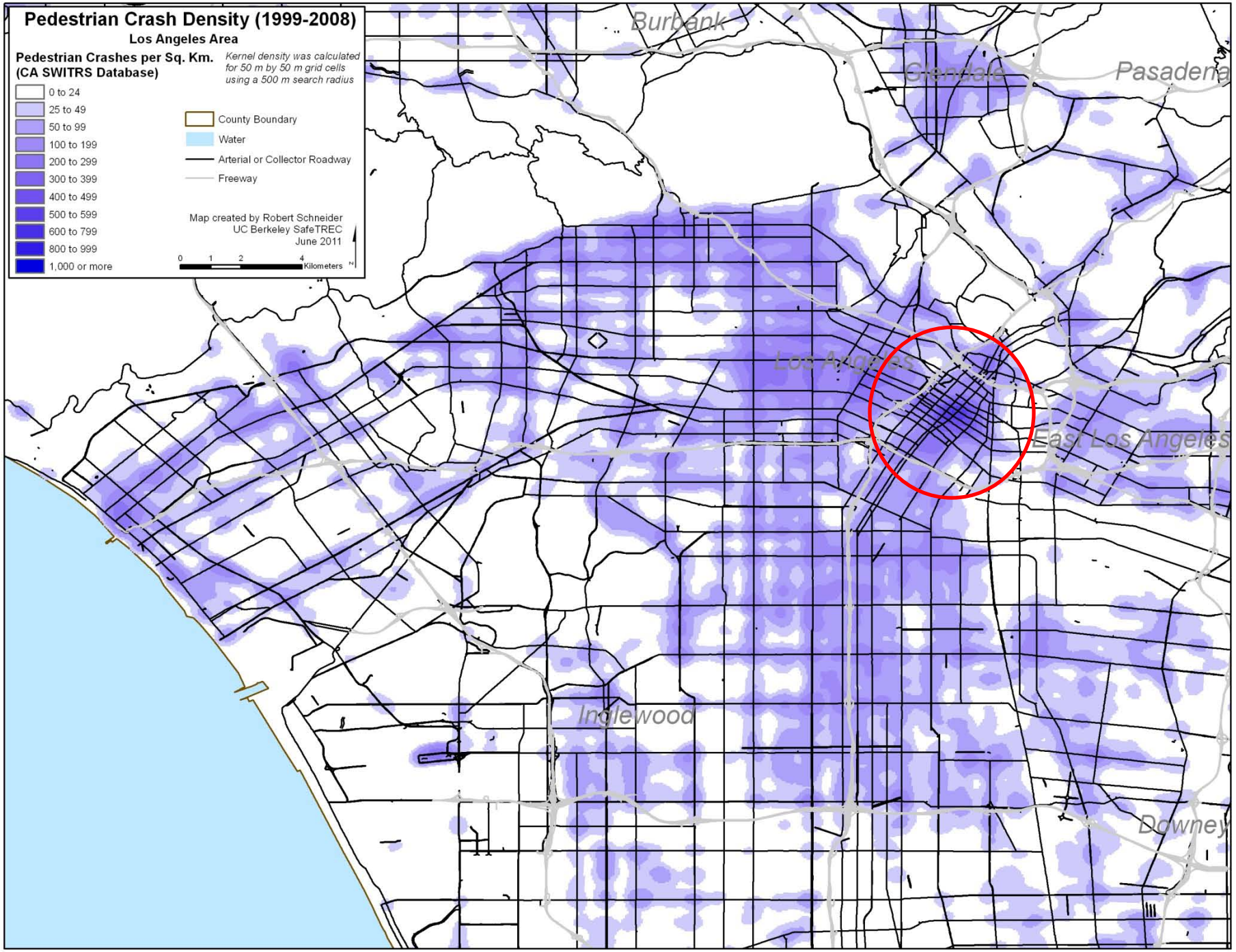
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# What Characteristics are Associated with Perceived Pedestrian & Bicycle Safety Barriers?

→ "Traffic Safety" Factor for each Respondent

| Roadway System & Design | Land Use & Surrounding Environment | Reported Crashes | Travel Behavior | Individual & Household |
|---|---|---|---|---|

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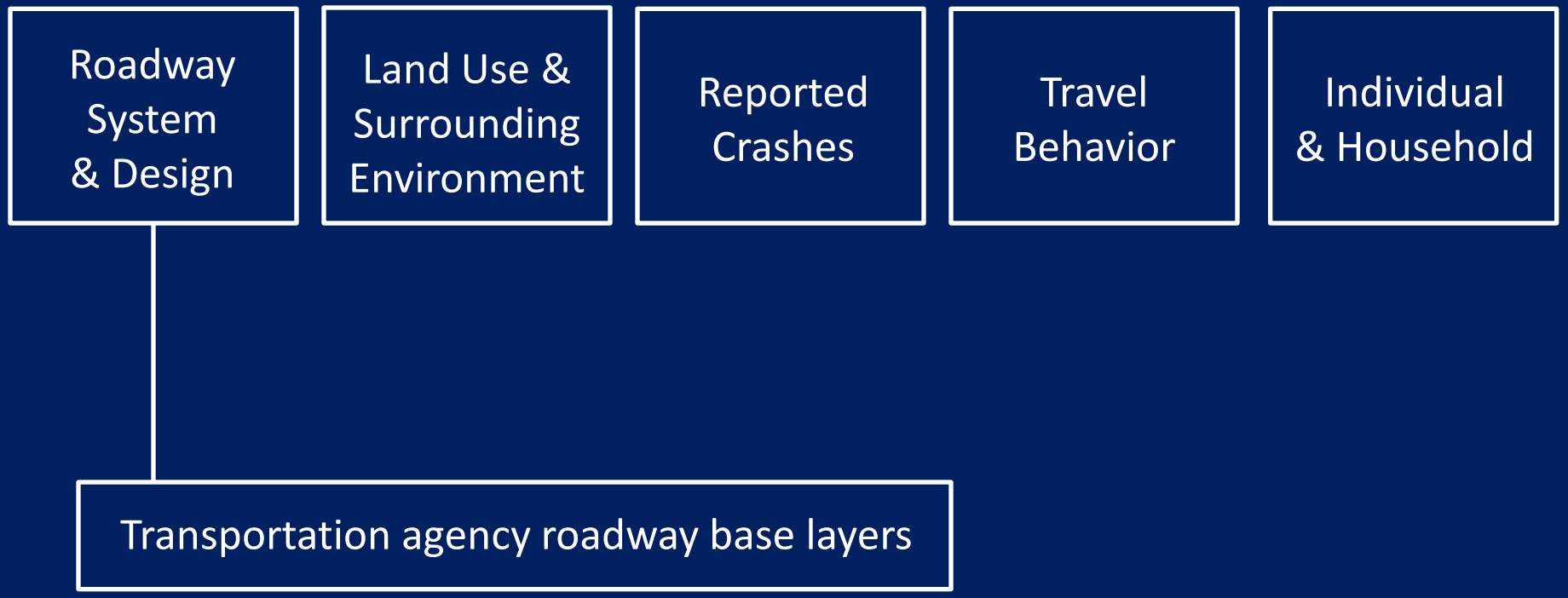

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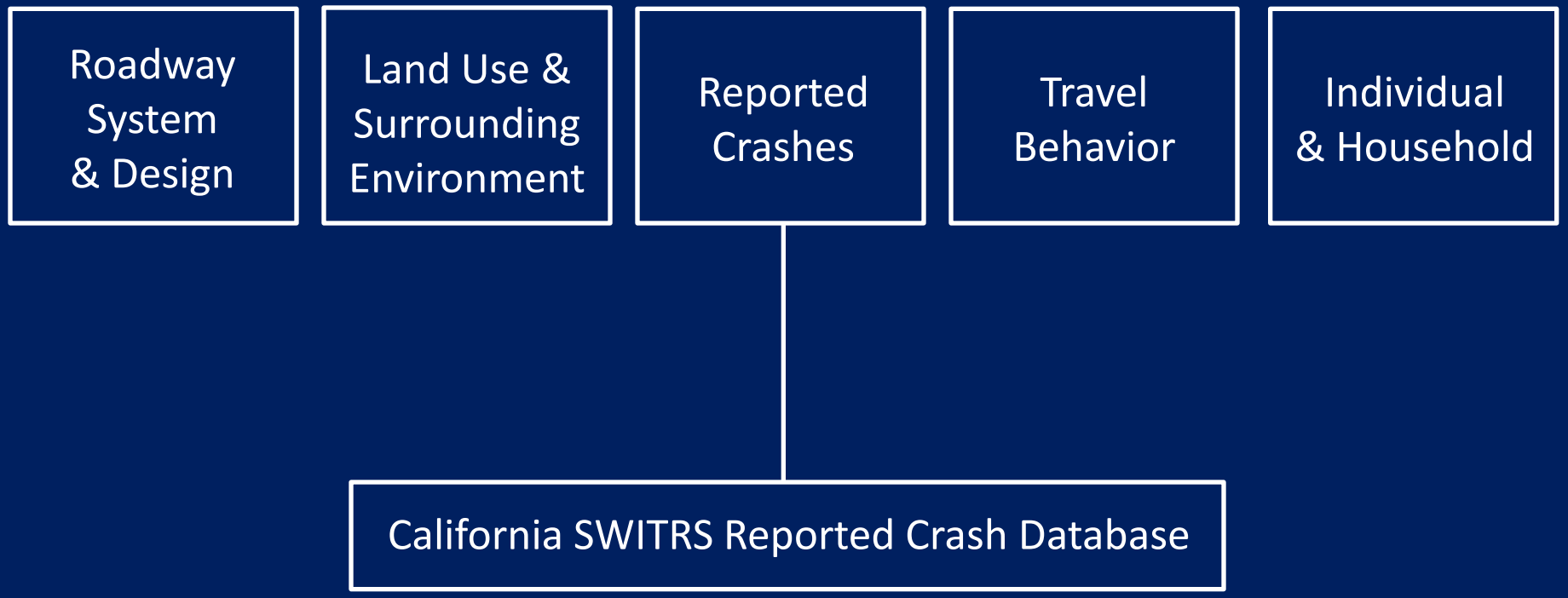

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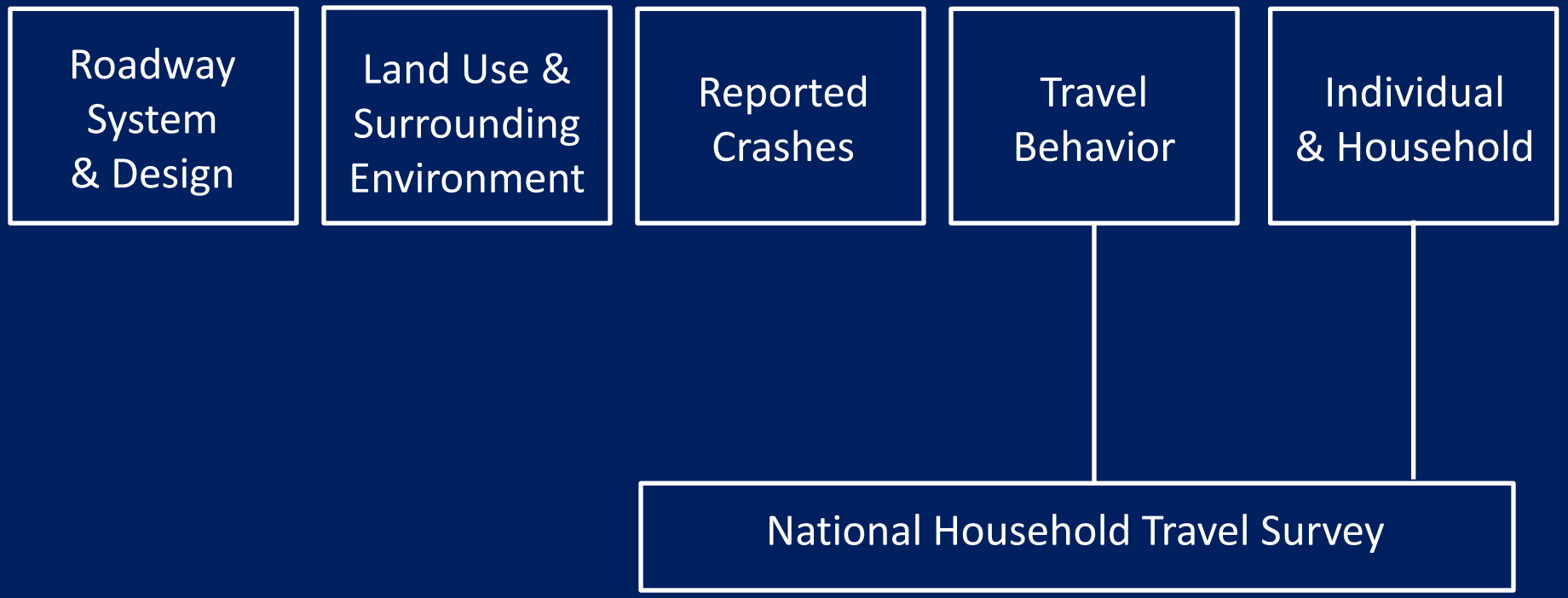

# Linear Random-Intercept Model

The models for the pedestrian or bicycle traffic safety barrier factor score $y_{ij}$ of person $i$ in household $j$ were specified as:

$$y_{ij} = \beta_1 + \beta_2 x_{2ij} + \cdots + \beta_p x_{pij} + \zeta_j + \varepsilon_{ij}$$

Explanatory variables and associated parameters

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Unobserved correlated error between people in the same household (normal)

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Unobserved error across all people (normal)

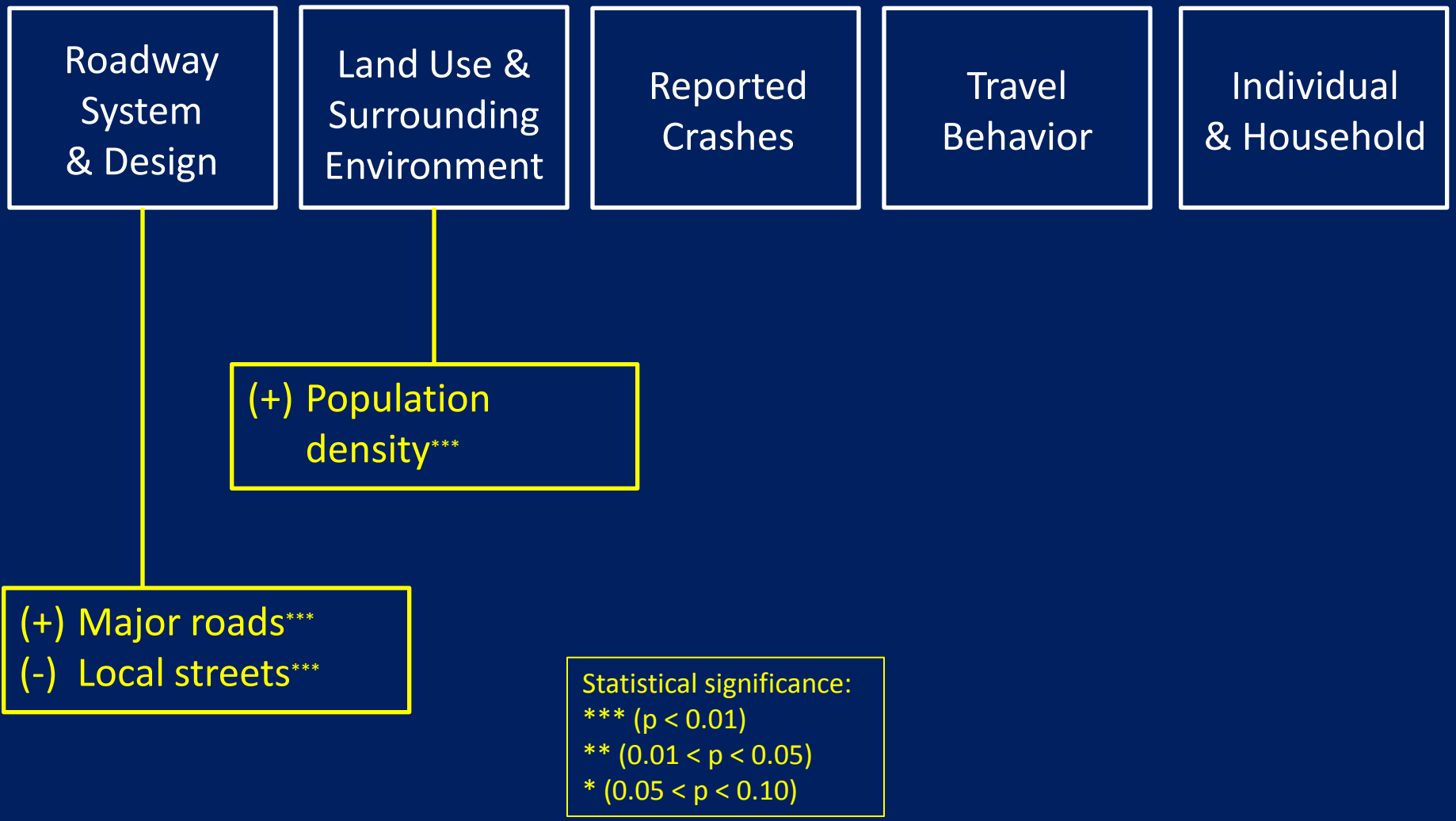
**Linear random intercept model for 2009 CA NHTS survey respondents[1]**

| | Variable | *Parameter Est.* | *p-value* |
|---|---|---|---|
| | Constant | 0.26 | 0.00 |
| Roadway & Land Use | Major road miles within 100 m | 0.45 | 0.00 |
| | Local street miles within 400 m | -0.037 | 0.00 |
| | Population within 400 m | 0.000032 | 0.00 |
| Travel & Socioeconomic | Walked for recreation only | -0.085 | 0.00 |
| | Number of walking trips in previous week | 0.0024 | 0.03 |
| | Male | -0.11 | 0.00 |
| | White | -0.15 | 0.00 |
| | Number of children in household under age 18 | 0.071 | 0.00 |
| | Is an automobile driver | -0.11 | 0.00 |
| | Medical condition preventing travel | 0.12 | 0.00 |
| | Lower household income (< $30,000/yr) | 0.15 | 0.00 |
| **Random Effects** | | | |
| Household-level error standard deviation | | 0.34 | |
| Person-level error standard deviation | | 0.92 | |
| **Overall Model** | | | |
| Sample Size (Number of people) | | 23105 | |
| Sample Size (Number of households) | | 15836 | |
| Log-Likelihood (Constant) | | -32702 | |
| Log-Likelihood (Restricted Model)[2] | | -32623 | |
| Log-Likelihood (Full Model) | | -32329 | |

**Linear Random-Intercept Model (15836 households 23105 people)**

Pedestrian "Traffic Safety" Barriers Factor

# Characteristics Associated with Perceived Pedestrian Traffic Safety Barriers



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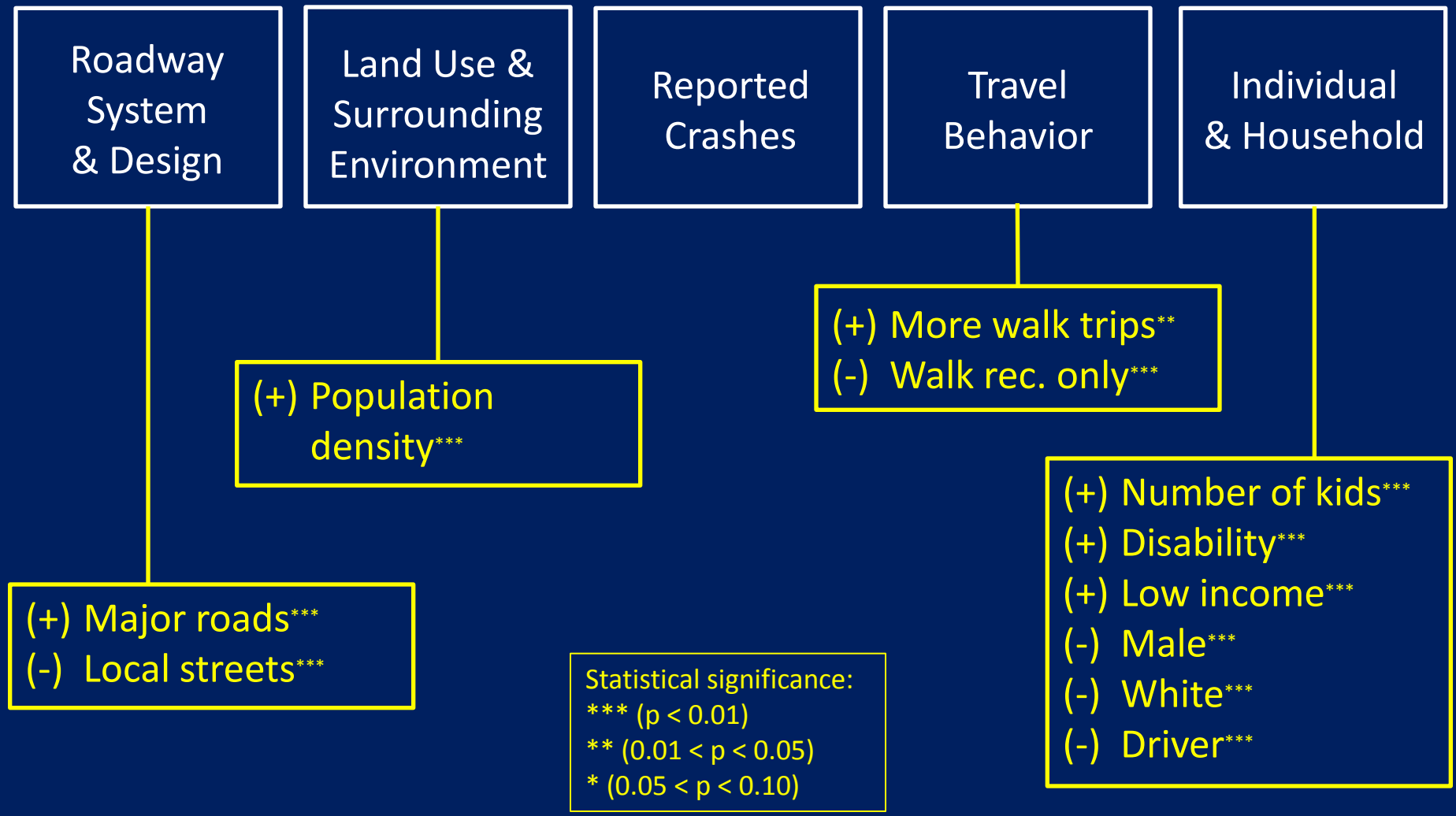


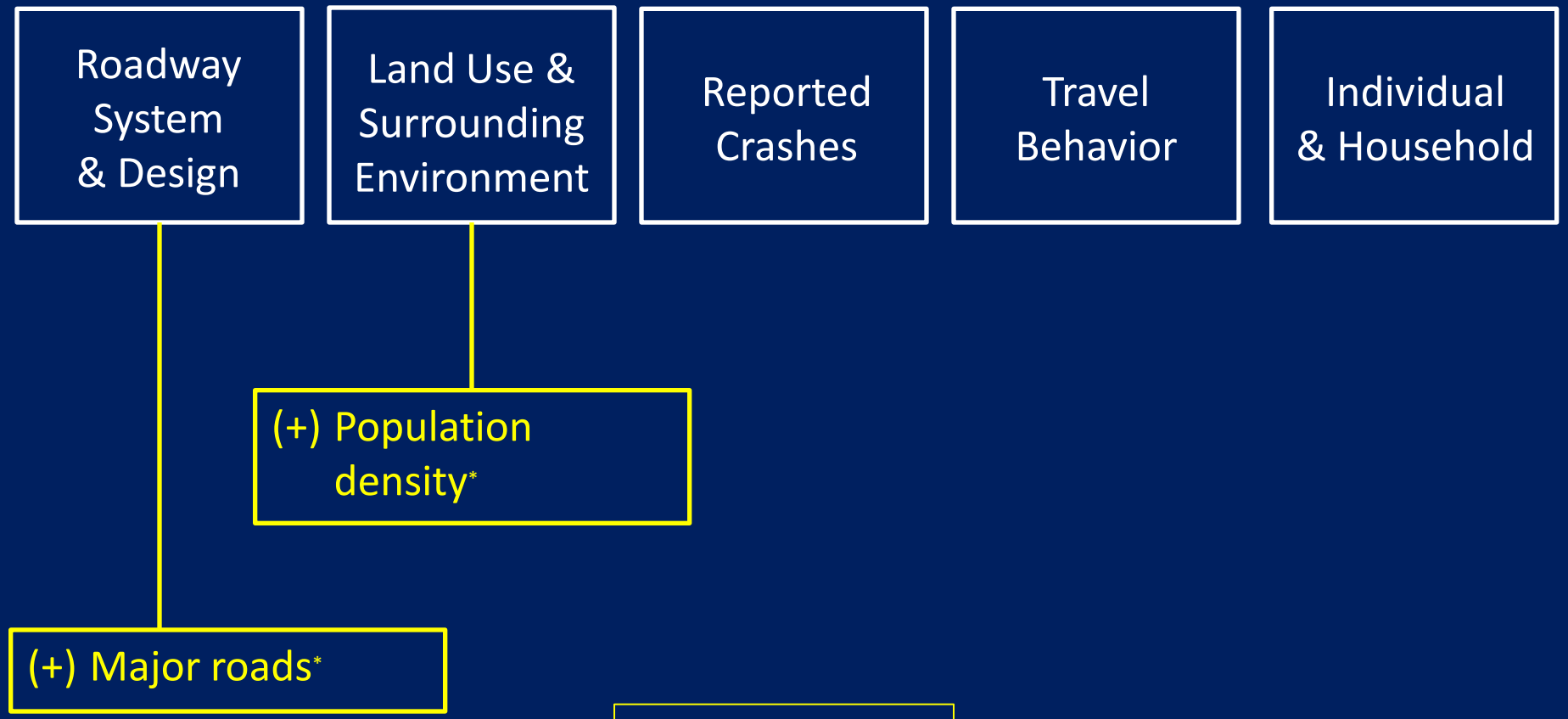
**Linear random intercept model for 2009 CA NHTS survey respondents[1]**

| | Variable | *Parameter Est.* | *p-value* |
|---|---|---|---|
| | Constant | 0.20 | 0.01 |
| Roadway & Land Use | Major road miles within 100 m | 0.59 | 0.09 |
| | Local street miles within 400 m | -0.0093 | 0.61 |
| | Population within 400 m | 0.000035 | 0.07 |
| | Household is in a Bicycle Friendly Community | -0.098 | 0.31 |
| Travel & Socioeconomic | Bicycled for recreation only | -0.085 | 0.03 |
| | Number of bicycling trips in previous week | -0.0081 | 0.14 |
| | Male | -0.15 | 0.00 |
| | White | -0.08 | 0.09 |
| | Medical condition preventing travel | 0.15 | 0.14 |
| **Random Effects** | | | |
| Household-level error standard deviation | | 0.31 | |
| Person-level error standard deviation | | 0.94 | |
| **Overall Model** | | | |
| Sample Size (Number of people) | | 3073 | |
| Sample Size (Number of households) | | 2570 | |
| Log-Likelihood (Constant) | | -4358 | |
| Log-Likelihood (Restricted Model)[2] | | -4352 | |
| Log-Likelihood (Full Model) | | -4339 | |

**Linear Random-Intercept Model (2570 households, 3073 people)**

Bicycle "Traffic Safety" Barriers Factor

# Characteristics Associated with Perceived Bicycle Traffic Safety Barriers



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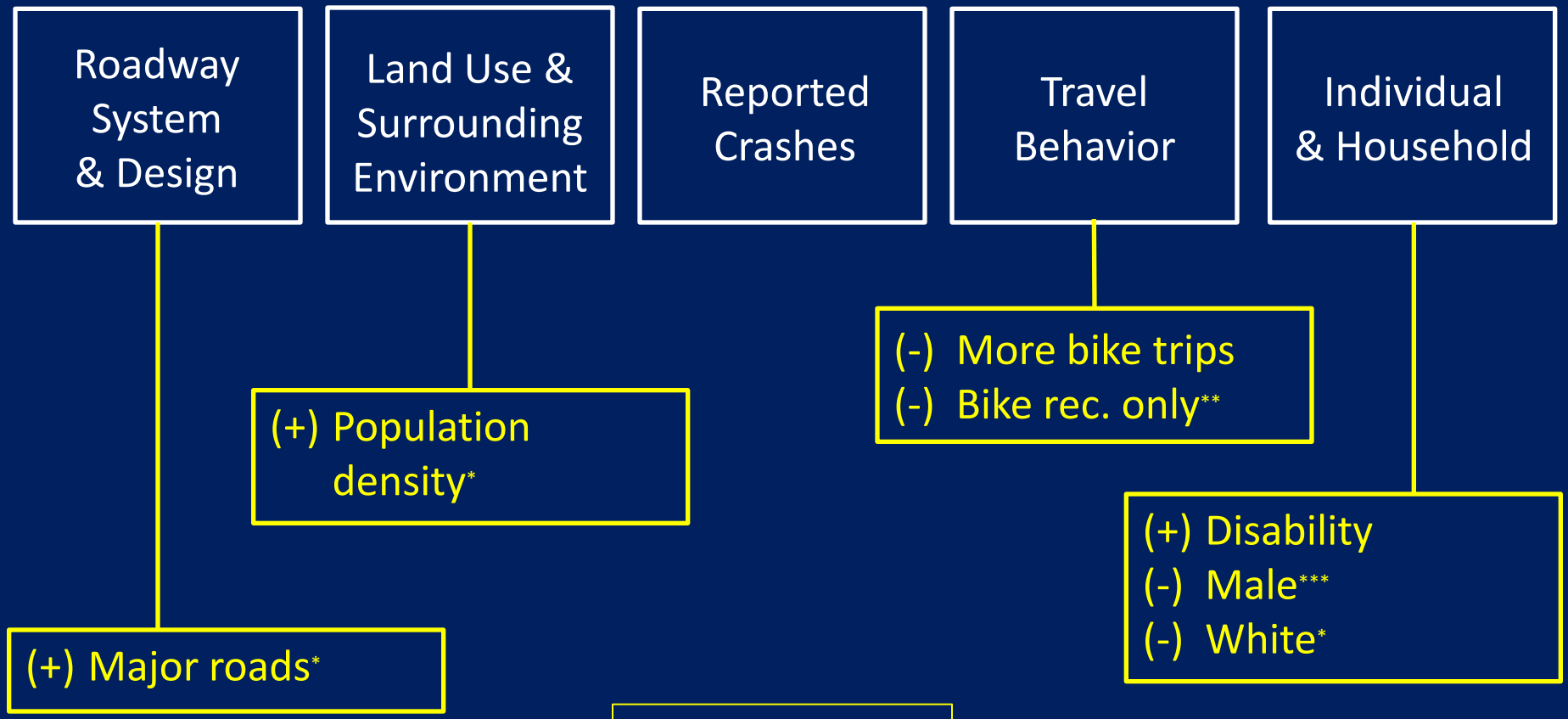
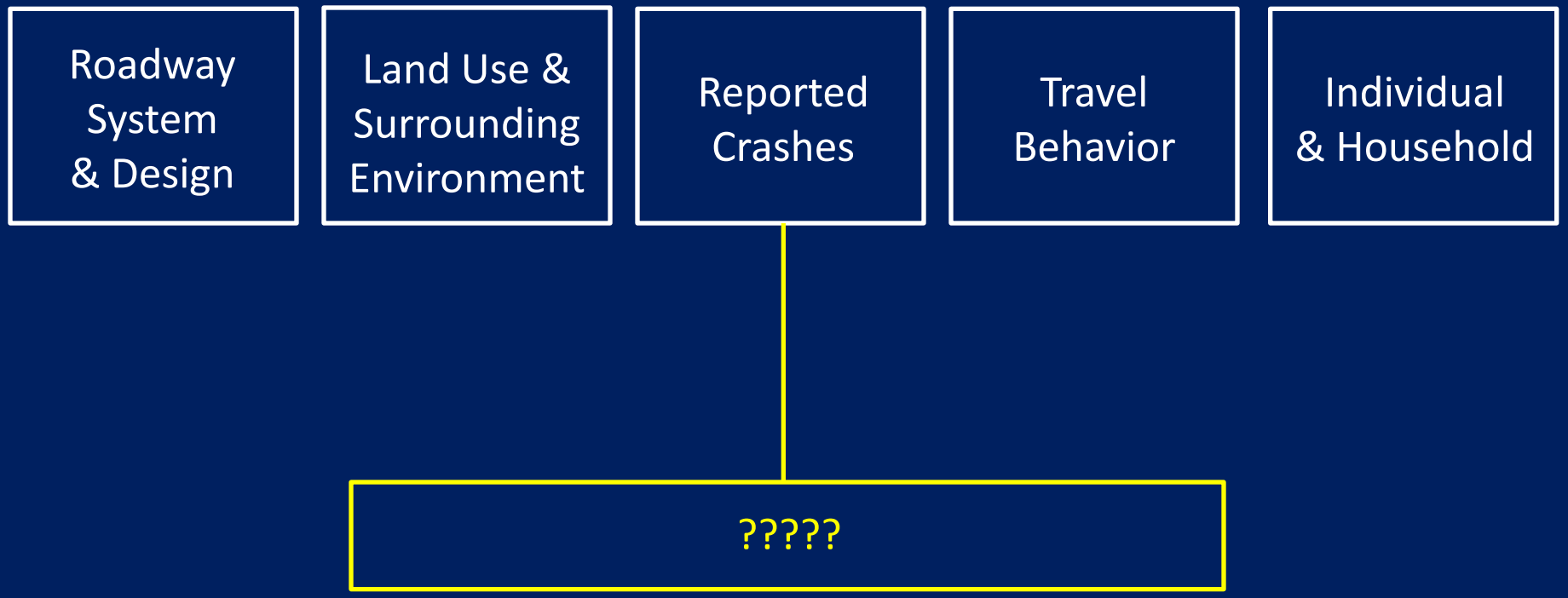
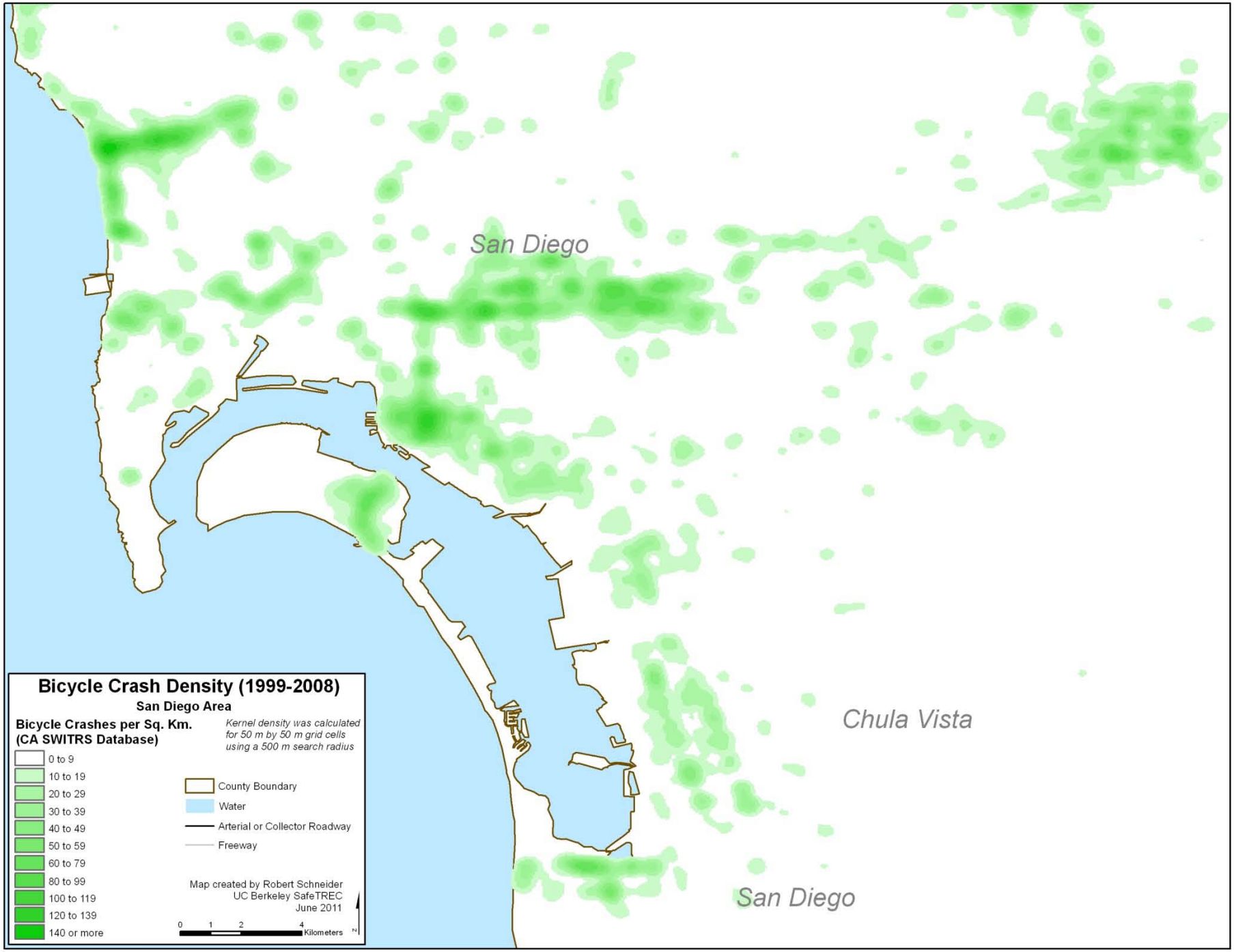



Statistical significance:
*** ($p < 0.01$)
** ($0.01 < p < 0.05$)
* ($0.05 < p < 0.10$)

# What about the relationship between reported crashes & perceived traffic safety risk?




San Diego
Chula Vista
San Diego
Bicycle Crash Density (1999-2008)
San Diego Area
Bicycle Crashes per Sq. Km.
(CA SWITRS Database)
Kernel density was calculated for 50 m by 50 m grid cells using a 500 m search radius
0 to 9
10 to 19
20 to 29
30 to 39
40 to 49
50 to 59
60 to 79
80 to 99
100 to 119
120 to 139
140 or more
County Boundary
Water
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Freeway
Map created by Robert Schneider
UC Berkeley SafeTREC
June 2011
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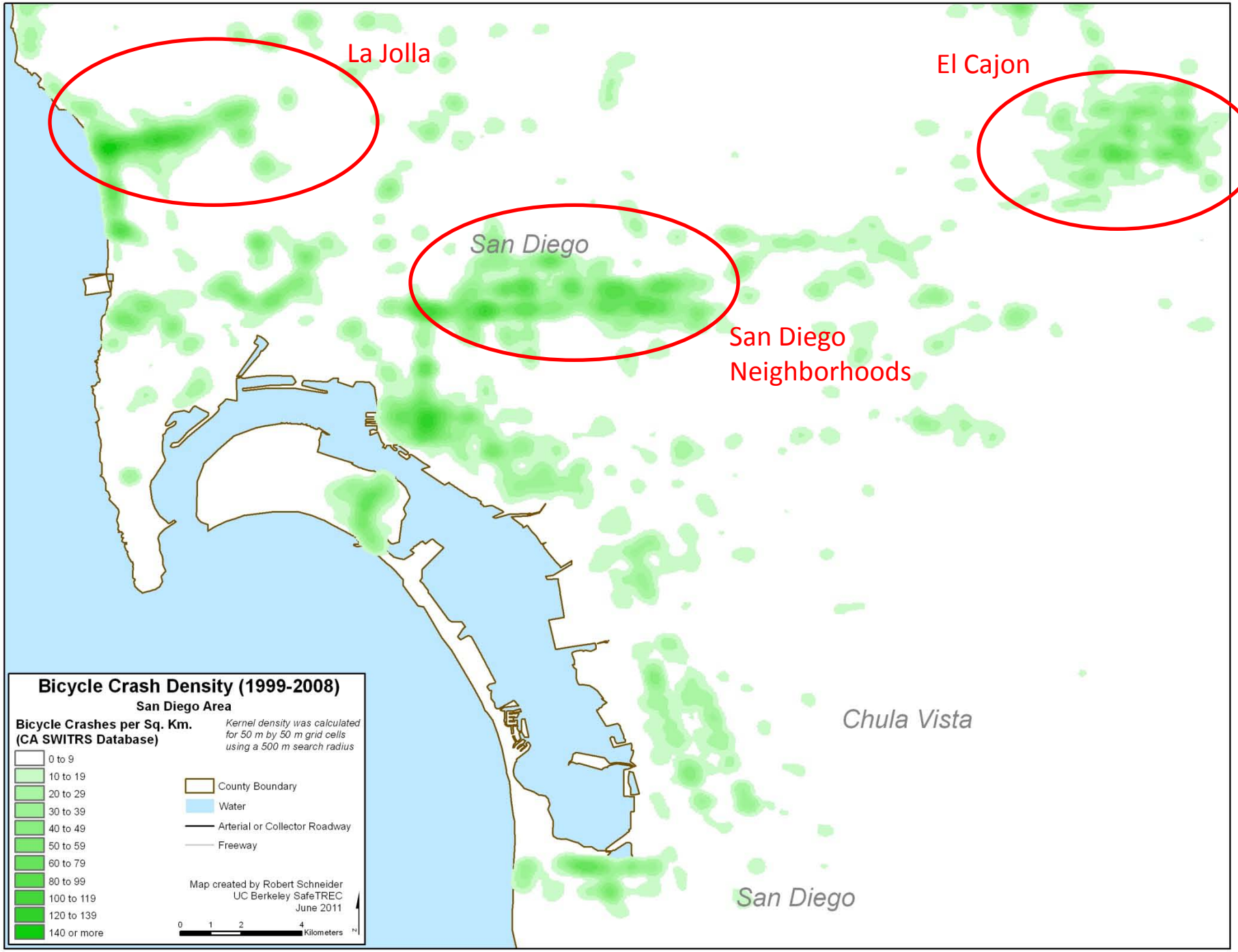
Kilometers
N


La Jolla
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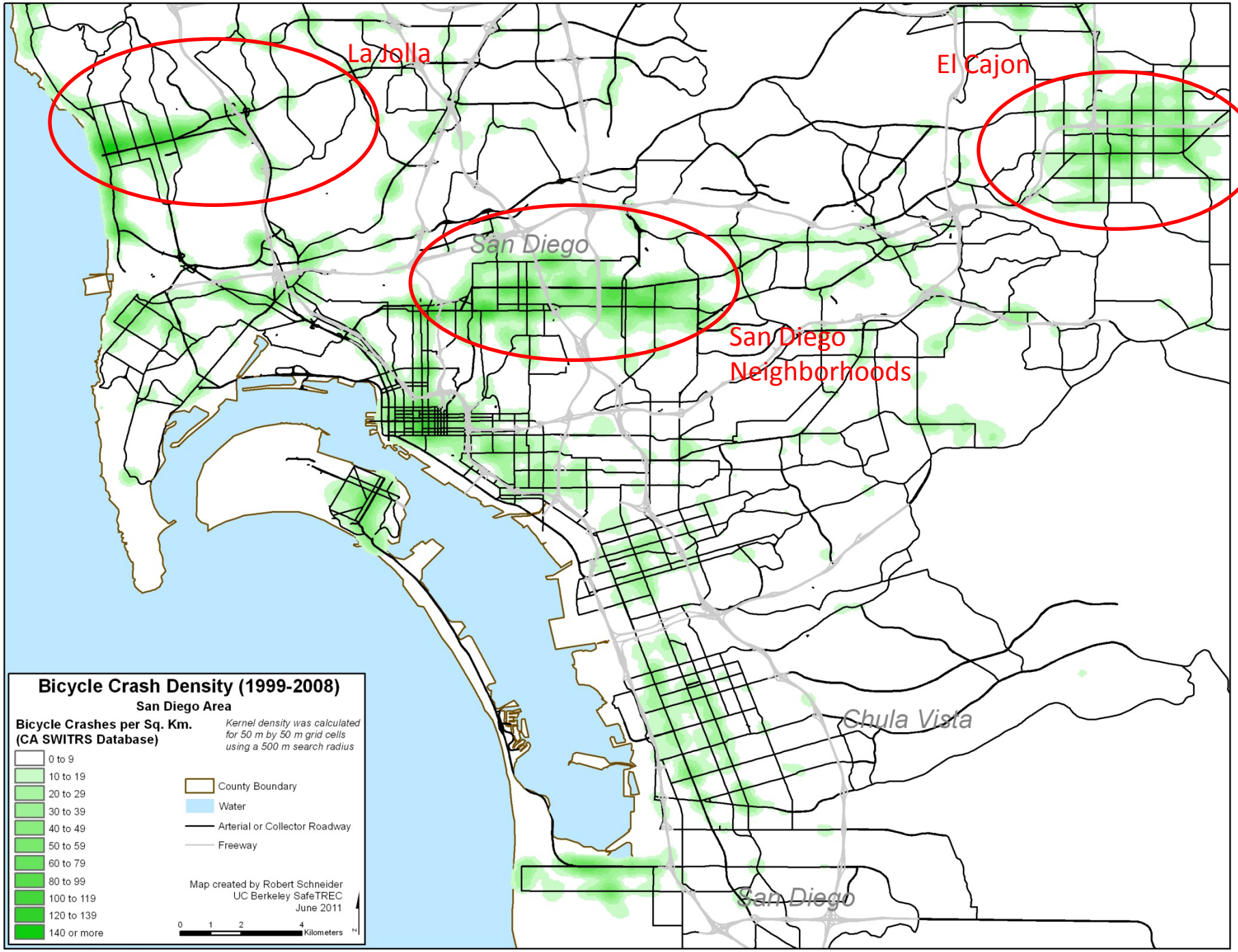
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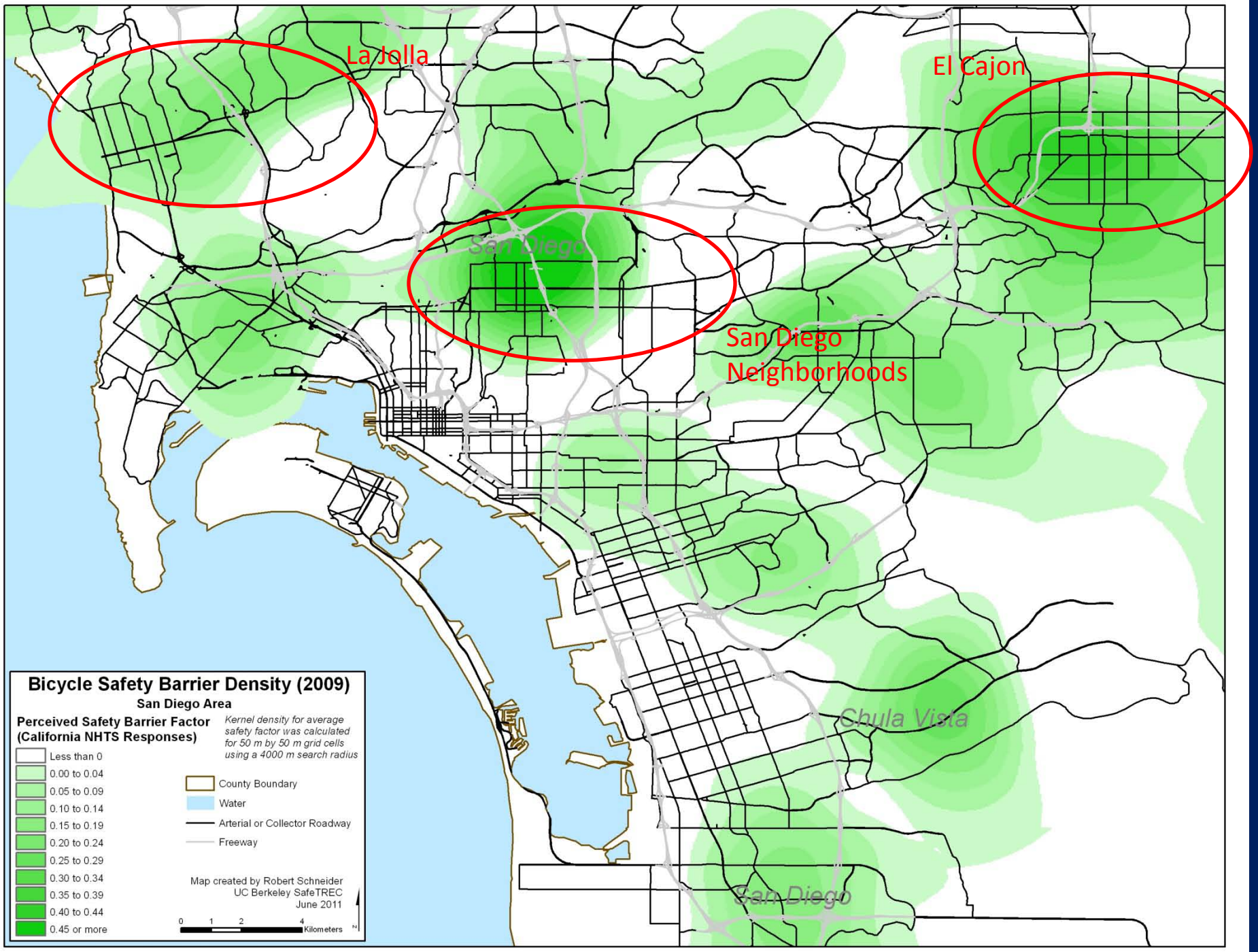
La Jolla
El Cajon
San Diego
San Diego
Neighborhoods
Chula Vista
San Diego
Bicycle Safety Barrier Density (2009)
San Diego Area
Perceived Safety Barrier Factor
(California NHTS Responses)
Kernel density for average safety factor was calculated for 50 m by 50 m grid cells using a 4000 m search radius
Less than 0
0.00 to 0.04
0.05 to 0.09
0.10 to 0.14
0.15 to 0.19
0.20 to 0.24
0.25 to 0.29
0.30 to 0.34
0.35 to 0.39
0.40 to 0.44
0.45 or more
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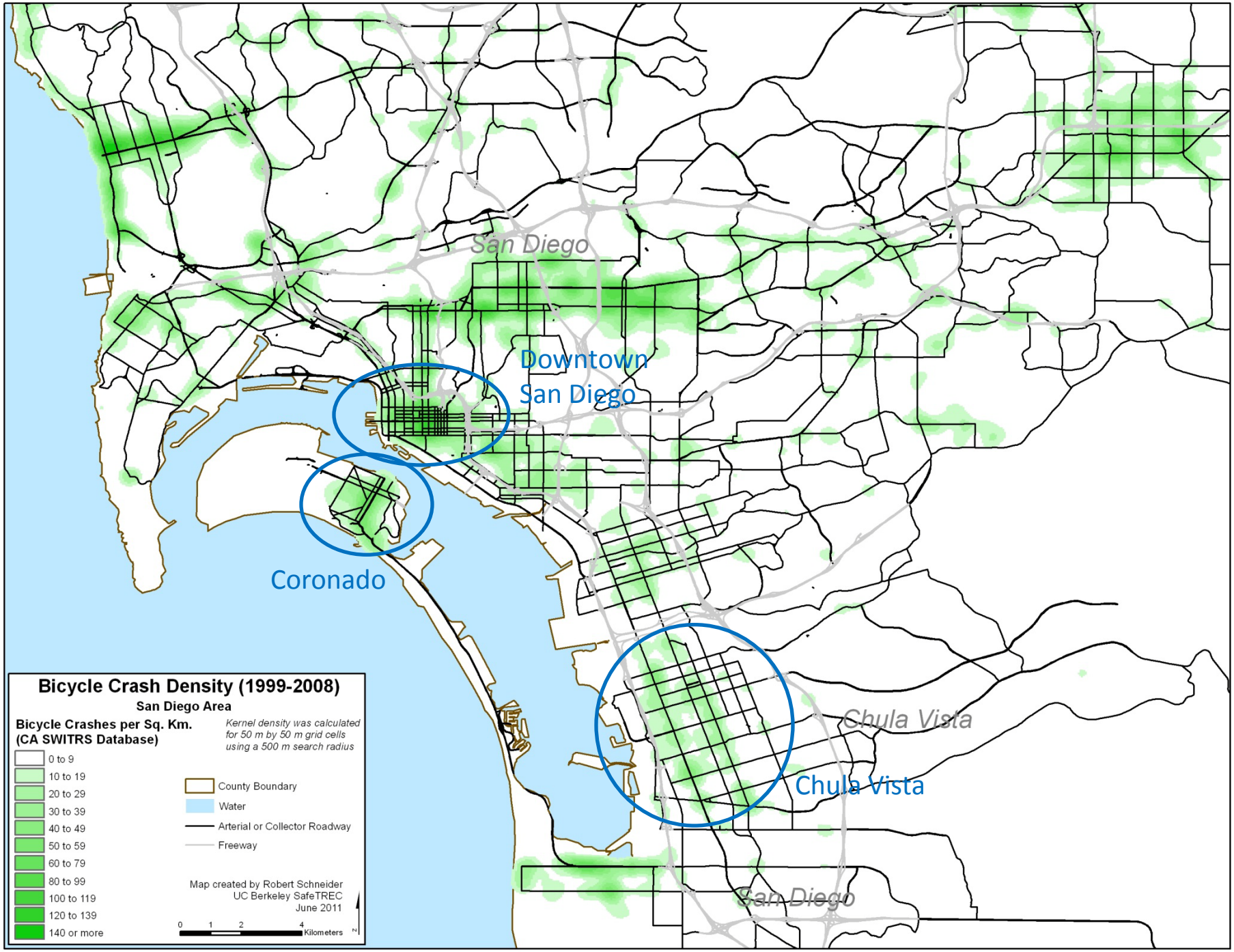
San Diego
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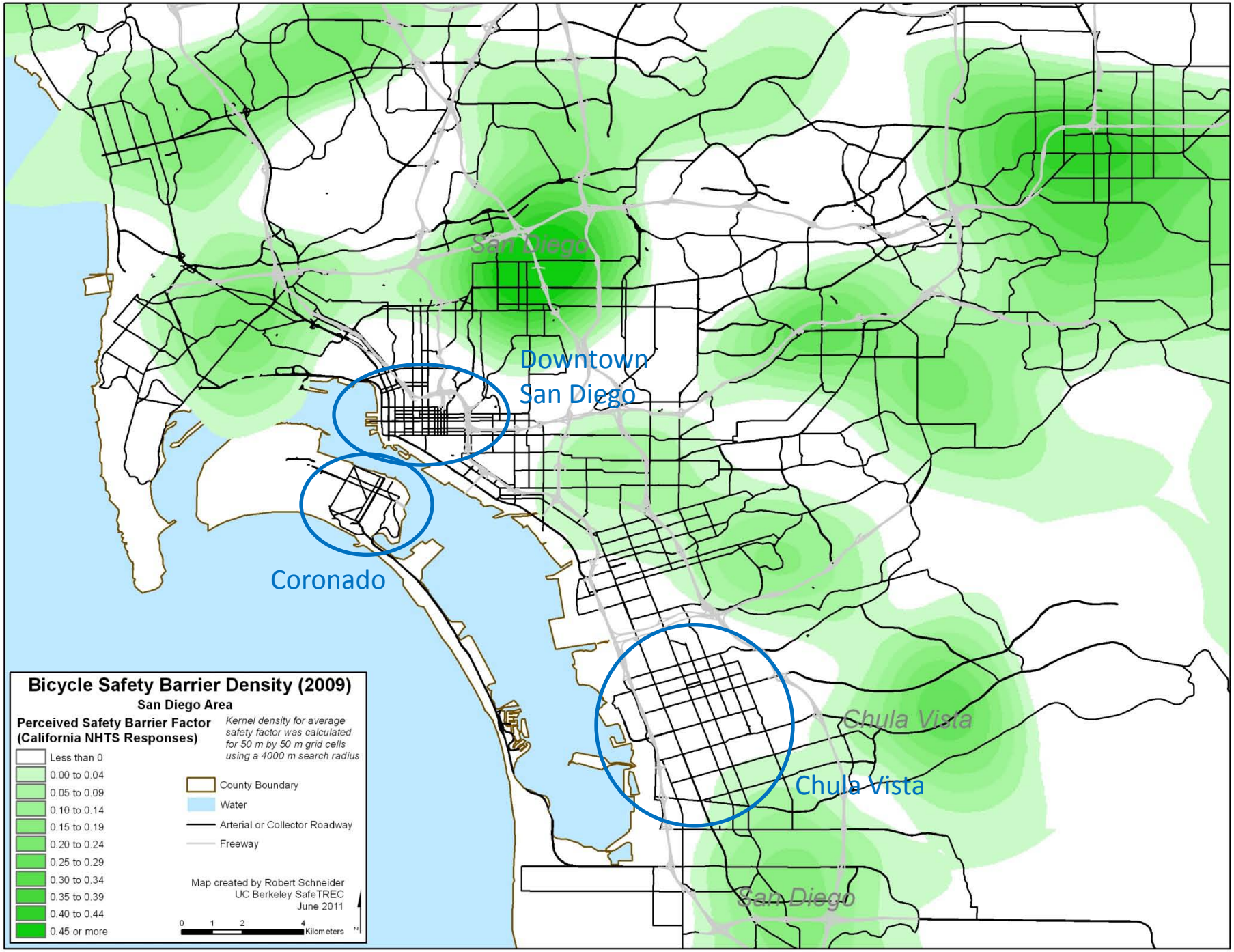
UC Berkeley SafeTREC
June 2011
0 1 2 4
Kilometers
N


San Diego
Downtown
San Diego
Coronado
Chula Vista
Chula Vista
San Diego
Bicycle Safety Barrier Density (2009)
San Diego Area
Perceived Safety Barrier Factor
(California NHTS Responses)
Kernel density for average safety factor was calculated for 50 m by 50 m grid cells using a 4000 m search radius
Less than 0
0.00 to 0.04
0.05 to 0.09
0.10 to 0.14
0.15 to 0.19
0.20 to 0.24
0.25 to 0.29
0.30 to 0.34
0.35 to 0.39
0.40 to 0.44
0.45 or more
County Boundary
Water
Arterial or Collector Roadway
Freeway
Map created by Robert Schneider
UC Berkeley SafeTREC
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0 1 2 4
Kilometers
N

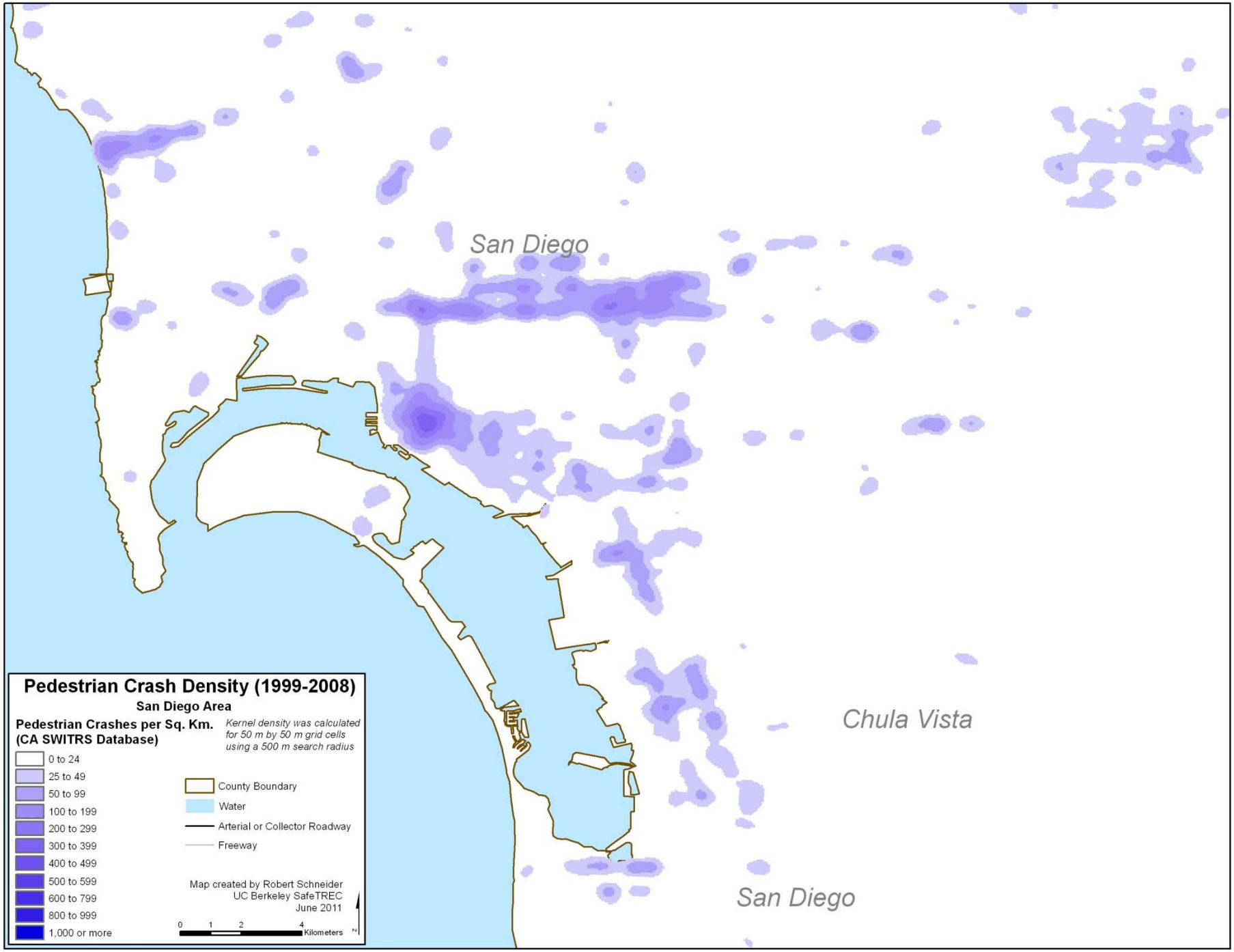
# Conclusions

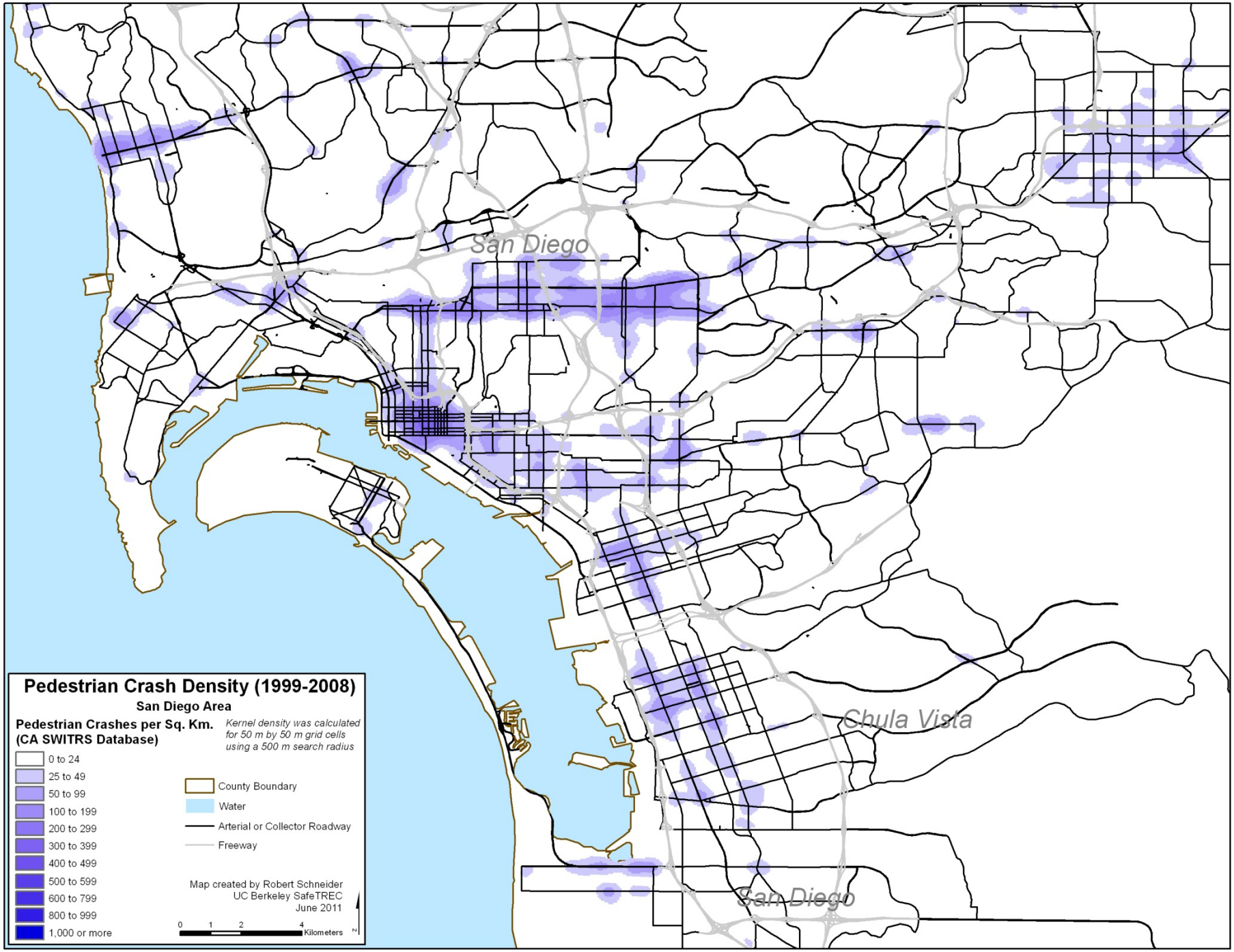
- NHTS travel behavior & socioeconomic data improves understanding of traffic safety barriers and suggests comprehensive set of interventions
  - Major roadways, population density
    → slower automobile speeds, mode shift strategies
  - Utility travel, more walk trips, fewer bike trips
    → "Complete Streets" for all modes
  - Disabilities, female, minority, low-income, more kids
    → accessibility improvements, Safe Routes to School, targeted education & encouragement

# Considerations & Future Research

- Greater understanding of barriers to people who already walk & bike, *but not people who don't*
- Not all major roads are alike
- Could analyze respondent tours
- Could ask more detailed questions about traffic safety barriers instead of factor analysis
- Need more research on perceived vs. actual pedestrian & bicycle safety risk

# Questions & Answers


San Diego
Chula Vista
San Diego
Pedestrian Crash Density (1999-2008)
San Diego Area
Pedestrian Crashes per Sq. Km.
(CA SWITRS Database)
Kernel density was calculated for 50 m by 50 m grid cells using a 500 m search radius
0 to 24
25 to 49
50 to 99
100 to 199
200 to 299
300 to 399
400 to 499
500 to 599
600 to 799
800 to 999
1,000 or more
County Boundary
Water
Arterial or Collector Roadway
Freeway
Map created by Robert Schneider
UC Berkeley SafeTREC
June 2011
0 1 2 4
Kilometers
N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0 to 24
25 to 49
50 to 99
100 to 199
200 to 299
300 to 399
400 to 499
500 to 599
600 to 799
800 to 999
1,000 or more
County Boundary
Water
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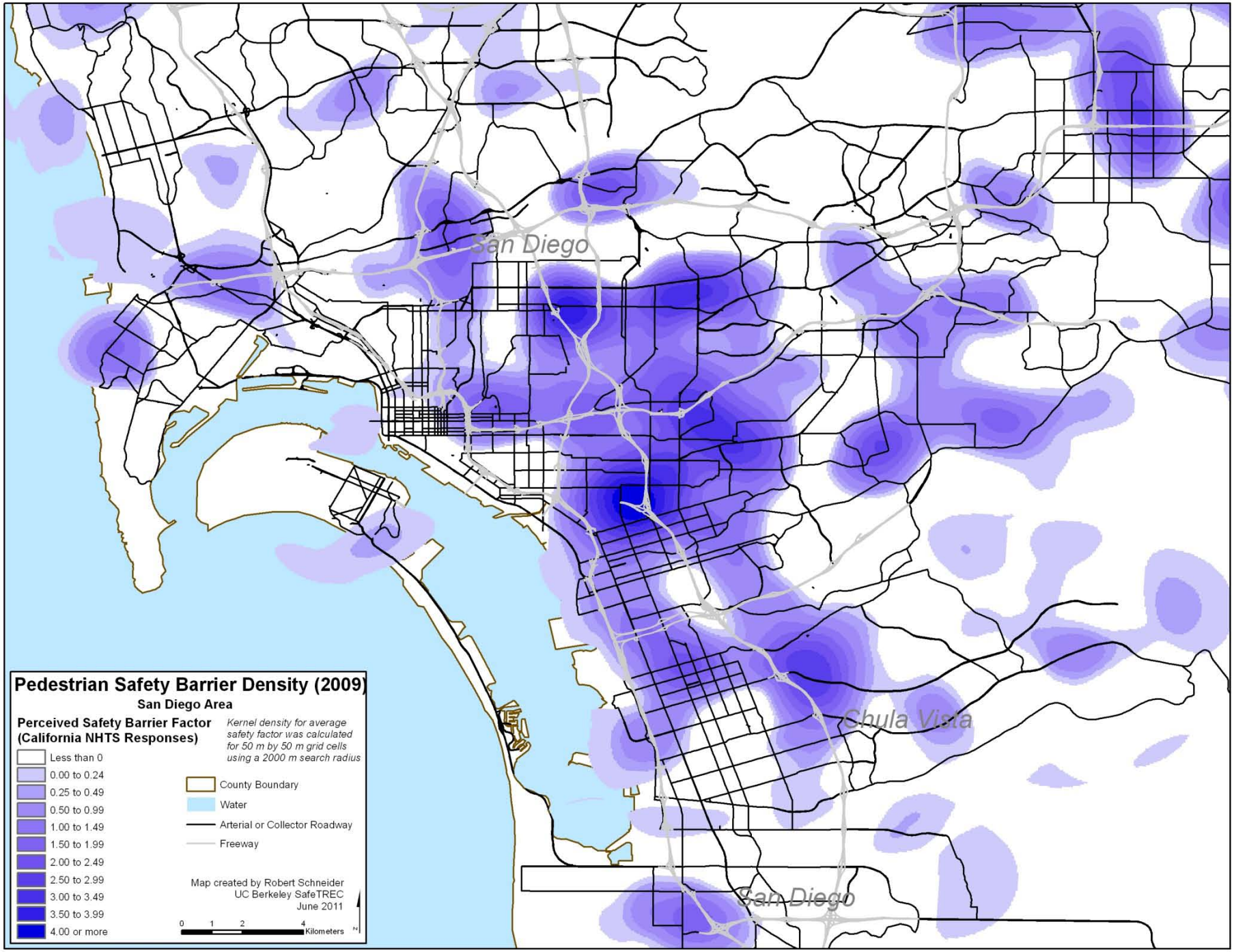
San Diego
Chula Vista
San Diego
Pedestrian Safety Barrier Density (2009)
San Diego Area
Perceived Safety Barrier Factor
(California NHTS Responses)
Kernel density for average safety factor was calculated for 50 m by 50 m grid cells using a 2000 m search radius
Less than 0
0.00 to 0.24
0.25 to 0.49
0.50 to 0.99
1.00 to 1.49
1.50 to 1.99
2.00 to 2.49
2.50 to 2.99
3.00 to 3.49
3.50 to 3.99
4.00 or more
County Boundary
Water
Arterial or Collector Roadway
Freeway
Map created by Robert Schneider
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June 2011
0 1 2 4
Kilometers
N

TOYOT

Walgreens
PHARMACY
Brewer's Karate
Lee's Donuts
Dentistry

## Contact Information:

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