Where Is It Safe to Ride?
A Cycling Hazard Index for Cambridge, MA

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Outline

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Introduction

Question: How many of you have ever considered riding a bicycle to work?

Why or why not?

Often cited reasons:

• Too Far
• Too Lazy
• Too Dangerous

Introduction

Either way, it’s on the rise:

Bicycling in Cambridge, MA has increased 150% since 2002 (City of Cambridge 2011)

Part is demand, part is supply

• Realization of environmental costs
• High cost of gas
• Rising public transportation costs
• Better public facilities such as bike lanes, bike trails and lock stands
**Objective**

To show which roads are the most hazardous to ride a bicycle on in Cambridge, MA by creating a road hazard index map, using automobile accident and volume data as proxy for bicycle similar bicycling data.

**Factors considered** (suggested by Allen-Munley and Daniel 2006 and Aultman-Hall et al. 1998) (ideal and actually used):

- Rate of accidents (Crashes per year per car volume)
- Presence of painted bike lanes
- Presence of bike trails
- Speed limit (ideal)
- Width of road (ideal)
Study Area

Cambridge, Massachusetts in Relation to the Greater Boston Area

Created by Robert Ainslie for GPH 903

Note: Created from automobile crash data from the year 2009
Methods

Data Acquisition:

• Background imagery from MassGIS (30 cm color orthophotos)

• Automobile crash and volume data from Mass DOT, (crash by mail request) Used 2009 crash points

• NAVTEQ road layer from Salem State DGL servers

• Bicycle trails layer from MassGIS

• Bicycle lanes by ArcGIS selection of road layer using Google Maps as a reference

• Massachusetts’ Towns layer from MassGIS
Data Preparation

• Crash points plotted by x,y geographic coordinates

• Roads, Bike Lanes and Bike Trails clipped by Cambridge town outline

• NAVTEQ streets and State Roads merged to combine unlike street types (i.e. Rt 2 and Massachusetts Ave in different tables)

• Road layer then dissolved to group small line segments
Data Preparation (Cont.)

• Traffic volume counts table was summarized and average for road segments to create 1 volume count per road
• Traffic volume counts joined to road layer by street name
• Bike lanes and trails had a “dummy” field of 1 added to aid in conversion to raster (to show presence)
GIS Analysis

Hazard Index Creation:

• Road layer converted to raster to aid in classification for indexing using traffic volume count as the cell value field

• Bike trail and lane layers converted to raster using “dummy” field for cell value

• Crash points converted to raster by kernel density function with 5 meter cell size (see next slide)
Automobile Accidents in Cambridge in 2009

Note: Created from automobile crash data from the year 2009

Created by Robert Ainslie for GPH 903
Density of Automobile Accidents in Cambridge, MA in 2009

Created using kernel density function with points and a cell size of 5 meters

Created by Robert Ainslie for GPH 903

Note: Created from automobile crash data from the year 2009
Hazard Index Creation (Cont.)

- Raster calculator was used, dividing crash density raster by traffic volume raster, creating roads with crash rate (so we can know how dangerous a road is)
  - Reclassified using Jenks Natural Breaks with 5 divisions
  - Reconverted to vector layer, each segment now assigned a grid value of 1-5
- Trail and lane layers reconverted to vector after being assigned a cell value of 1
The Final Method Step...

• Finally, all three vectors were combined to one layer using “Feature to Line”, creating one layer with grid code values for:
  • Normalized Crash Rate
  • Presence of Bike Trail
  • Presence of Bike Lane

• Field calculator created index using the expression: Hazard Index = (crash rate) – (trail + lane)

• Now...the map!!
Results

• Highest bicycle hazard is on Massachusetts Ave., and near Harvard and Central Squares

• Results make intuitive sense: areas with more cars and near high traffic intersections are the most dangerous areas to ride a bicycle

• Now to see the map...
The assumptions must be examined:

- How dangerous it is for cars is probably fairly similar to danger for bikers, but we don’t know
- A main flaw: automobile volume rates are not the same as bicycle rates, so crash rates are VERY different
- However, the most dangerous intersections for cars are probably also the most dangerous for bikers
- Crash rate was crashes per year per car volume per month, not car volume per year (a mistake)
- It would be nice to know all roads, not just roads with volume data


