Spatial Distribution of Pedestrian-Motor Vehicle Collisions Before and After Pedestrian Countdown Signal Installation in Toronto, Canada

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INTRODUCTION

• Pedestrian countdown signals (PCS) have been installed in many cities over the last 15 years
• 95% of Toronto signalised intersections received a PCS between November 2006 and November 2009
• Traditional walk/don’t walk signals were changed
  • Initiation of walk-time when the vehicle green light phase begins
  • Then a 9 to 18 second displayed countdown signal
  • Ends as the vehicle light phase changes from green to yellow
Evidence regarding PCS effectiveness has been inconclusive.

- Most have examined driver and pedestrian behaviour
- Small studies of pedestrian-motor vehicle collisions (PMVC)

2013 study of 1,965 installations found a 26% increase in PMVC after installation (Richmond et al)

It is important to consider the spatial distribution of PMVC and the relationship to PCS installation

The impact of pedestrian countdown signals on pedestrian-motor vehicle collisions: a reanalysis of data from a quasi-experimental study

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OBJECTIVES

• To compare point densities of PMVC pre and post PCS installation for
  • Intersections with PCS
  • Roadways and smaller intersections without PCS

• To determine whether there were differences in spatial point densities of PMVC related to PCS installation
  • Overall
  • By age
METHODS

- PCS intersections (n = 1864) and police-reported PMVC (2000-2013) were mapped, delineating the downtown pre-amalgamated City of Toronto versus the inner suburbs.
METHODS

- PCS PMVC
  - within 30 m radius of a PCS intersection

- Non PCS PMVC
  - outside 30 m, including mid-block collisions and collisions at smaller intersections without pedestrian signals
METHODS

• Step 1: Kernel density estimation
  • Interpolate the spatial density of PMVC in a raster (matrix of pixels) by considering distance to points nearby
  • Each collision point is given a weight according to a kernel function
  • The output of this process: a matrix of 30-meter X 30-meter pixels covering the study area

• **Typical event**: collisions
• **Bandwidth**: radius of the window to search for nearby points (here: 1 km)
• **Kernel**: function giving the highest weight to the central point

*(Bailey & Gatrell, 1995)*
METHODS

• STEP 2: Simple point pattern density within a raster
  • Examined areas of higher or lower point density, pre to post installation at PCS and non PCS locations overall and by age

• STEP 3: Z-scores within a raster
  • Tested significant changes (increase or decrease) in PMVC. Only significant pixel values +/- 3 standard deviations at a 5% level were mapped
Total Collisions 2000-2013  
\( n = 31,636 \)

Exclusions:  
Location:  \( n = 4,284 \)  
Date:  \( n = 12,441 \)

Overall analysis  
\( n = 14,911 \)

Exclusions:  \( n = 16,725 \)

Location:  \( n = 4,284 \)  
Date:  \( n = 12,441 \)

Pre Installation  
\( n = 3,878 \)  
Post Installation  
\( n = 3,839 \)

Pre Installation  
\( n = 4,037 \)  
Post Installation  
\( n = 3,157 \)

Pre Installation  
\( n = 3,726 \)  
Post Installation  
\( n = 3,743 \)

Pre Installation  
\( n = 3,903 \)  
Post Installation  
\( n = 3,057 \)

Children  
\( n = 471 \)  
Adults  
\( n = 2,613 \)  
Older Adults  
\( n = 642 \)

Children  
\( n = 308 \)  
Adults  
\( n = 2,738 \)  
Older Adults  
\( n = 697 \)

Children  
\( n = 745 \)  
Adults  
\( n = 2,473 \)  
Older Adults  
\( n = 685 \)

Children  
\( n = 386 \)  
Adults  
\( n = 2,011 \)  
Older Adults  
\( n = 660 \)

 PCS location  
\( n = 7,717 \)

Non-PCS location  
\( n = 7,194 \)

Age stratified analyses  
\( n = 14,429 \)

Exclusion:  
Missing age:  \( n = 482 \)
Kernel-density estimates (collision/km²) for collision locations (2002-05, 2009-13)

Legends are showing the upper boundary of collision density (per sq km) for each age group:
Sources:
Motor Vehicle Collision Reports (Toronto Police Services)
Toronto Centreline Data (City of Toronto)
Significant change in PMVC density comparing before and after PCS installation
Significant change in PMVC density before and after PCS installation period by age group
DISCUSSION

• The effect of PCS varied by age and location
• The installation of PCS may result in increased PMVC; non-PCS locations showed more consistent reductions
• Effectiveness varies within a city, therefore, likely to vary across cities
DISCUSSION

• The strongest spatial patterns were in adults, varied effects by age expected
• Effect of co-interventions
• Exposure should be considered; however, good exposure data for pedestrians and cars does not exist
DISCUSSION

• Pedestrians may misuse the information to cross quickly, rather than to cross safely
  • Confusion re: Ontario Highway Traffic Act
• We believe that PCS can improve pedestrian safety
  • Could changes in signal timing, or vehicle turning restrictions, yield desired safety benefits?

➢ Age and location effects of PCS need to be fully understood to consistently improve pedestrian safety
QUESTIONS?

WHAT IF INTERSECTION CROSSINGS WERE DESIGNED FOR PEDESTRIANS NOT VEHICLES?

Source: http://shadeparadenashville.blogspot.ca/2015_08_01_archive.html