Collisions in Relation to School Safety Zones in Toronto *

Michel Giese, *400010952*
Justin Brassard, *400181410*
Mohammad Ali, *400079555*
Nathan Walschots, *400192318*

This paper reports our analysis of motor vehicle collisions in Toronto, Canada, and its relationship with the presence of school safety zones. Data were obtained from the City of Toronto open data website, as well as the City of Toronto Transportation Services department, and 311 Toronto.

Keywords: crash, motor vehicle collisions, schools, spatial analysis

---

Introduction

The goal of this project is to explore the relationships between motor vehicle collisions (strictly involving pedestrians), and school safety zones within Toronto. To draw conclusions, data from various sources have been acquired in order to establish trends from previous years. General trends on this relationship were determined before the data were further analyzed. Having an opportunity to examine these data allowed for some rough predictions to be made in terms of the reasons for these incidents occurring more and less frequently within specific areas of Toronto. For instance, the number of collisions in school safety zones should drop where the speed limit is lower. Further analysis is required to determine if this is the case.

This is intended to find ways to reduce these incidents as injury and fatality rates are higher in some areas. If fines can be increased in these areas, along with adding additional traffic enforcement, these incidents may be prevented from occurring in the future. There are likely more conclusions and solutions that will be determined as the data is further analyzed as various other factors will be examined, supplementing this general outlook. Overall, having a better insight on this issue can help generate ideas on how to reduce motor collision incidents within school zones in the City of Toronto.

Background

Canada has shown an improvement in road and transport safety over the years as collision fatalities and injuries have exhibited a declining trend. Nevertheless, vehicular collisions remain a prominent threat to the lives, bodies, bank accounts, and general well-being of Canadians. In 2018, collisions resulted in 1500 fatalities and 152,847 injuries (Transport Canada, 2020). "On-road" collisions have been a majority source of child fatalities for many years in Canada, and despite the lowering rate, these collisions comprise 49% of fatalities affecting children aged 0-14 with only 13% of them occurring when the child is a passenger (Parachute, 2016). This outlines that child pedestrians are at risk of being fatally struck by vehicles. To counteract this, school zones are established to protect children in and around areas they frequently gather (i.e. schools). School zones are strips of road near schools or childcare areas, delineated by a lower maximum speed limit and an inability to pass in either lane. These zones have been shown to effectively reduce the number of fatal and injury inducing crashes by ~4% per a 1km/h decrease in speed limit (Sun et al., 2018, p. 1087).

School zones seem to be effective in idealized scenarios but concerns exist due to unequal zone states in which municipalities and drivers are responsible for creating. Municipalities establish school zones and determine their features (location, length, speed limit, etc) and in the end, drivers must make the effort to consciously follow the rules and make safe choices when in a zone. This is not guaranteed: on average in Toronto 21% of drivers speed while in school zones with percentages climbing as high as 85% in specific zones, which road safety advocates blame partially on infrastructure that promotes fast driving (ex. straight-aways and four-lane traffic) (Rocha & Pelley, 2020). Speeding alone is not the only threat to school zone safety; illegal parking and distracted driving have both been identified as some of the most common unsafe

*Paper submitted to complete the requirements of ENVSOCTY 4GA3 Applied Spatial Statistics.

behaviours demonstrated by drivers in school zones (CAA polling, 2019). If these actions are as common as they are reported to be, then are school zones not uniformly deterring drivers from unsafe behaviours?

In conclusion, school zones are effective, but are they effective unilaterally and are their features optimized for reducing the ever-present threat of collisions for younger generations? This study has value in that it provides a deeper understanding of the efficacy of school zones as it gives insight into the spatial distributions of crashes within them, potentially establishing zones with varying intensities, opposed to taking efficacy averages. Through this, hotspots and trends in school zone contained collisions can be developed, outlining regions that should be addressed.

Predictions

The research question asks if there is a direct relationship between collisions involving pedestrians and the presence of school safety zones. Due to the proven efficacy of safety zones, it is predicted that these areas will experience fewer collisions than areas without safety zones. Conversely, it is probable that areas that experience more collisions than others will be found to lack adequate safety features.

Several factors may affect the reliability and accuracy of the data analysis conducted. If a safety zone was recently established in an area, it is possible that a significant number of collisions occurred there to necessitate its creation, skewing the number of events in this zone. This is solved by comparing the zone implementation date to the collision event date, both of which are fields present in the collisions shapefile. As well, areas with a higher population density and greater traffic flow are more likely to have collisions. The active hours of a safety zone are also of relevance. Some safety signs are turned off after school hours, raising the speed limit to facilitate greater traffic flow. If collisions occurred at this time, this would give the appearance of greater collisions in a safety zone, when in fact the zone was not active. Fortunately, collision time and zone active hours are recorded in the collision and safety zone shapefiles, respectively, solving this issue. Finally, other roadway conditions play a role in collision frequency, such as lighting, road state (icy, dry, etc.), and visibility. If little correlation is found between safety zones and collisions, perhaps one of these fields will prove more significant.

Study area

Toronto has adapted to be a very diverse city over the last 30 years with a mass increase in car usage and general population living near the downtown core. As this high density area has had a dramatic increase in car usage, more collisions are prominent to occur. As Toronto is a city known by all of Ontario, it is beneficial to examine this particular area of study in order to see if there are any trends between car collisions and school safety zones. This is of great benefit to all individuals within the surrounding area.The data will go through a series of tests in order to further analyse trends and determine if any changes need to be made or if solutions can be created to solve/reduce them.

Other cities such as New York, Chicago, Houston, and Los Angeles could have been used, although it was determined that the best choice would be Toronto as it is the area closest to McMaster, and the one that the majority of McMaster students are familiar with. To determine the relationship between collisions and safety zones, sources from the City of Toronto along with transportation trends within the area are examined. Using R-Studio, these data will be plotted on maps and further analyzed to find common trends between the different datasets to determine a conclusion.

It is extremely beneficial to choose an area of study that is significant to the researchers. This will allow connections to be made with the areas affected or specific trends that are seen throughout the analysis. Having background knowledge on a specific area or type of data can always allow for an easier, but more in depth analysis. For this instance, the most beneficial would have been a specific area in Toronto, although all of Toronto was chosen in order to have more variety in trends and to be able to truly see the impacts of collisions and school safety zones.

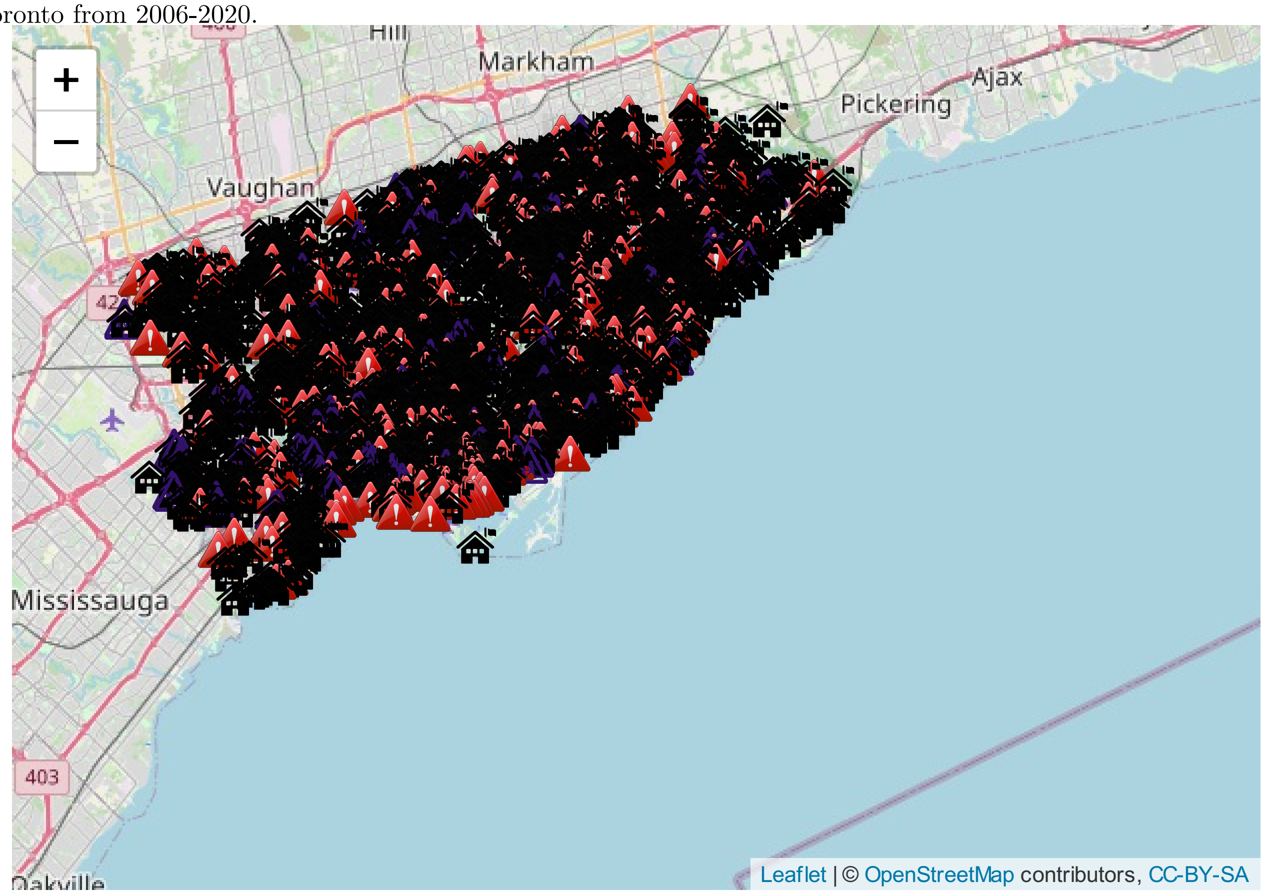
The area of Toronto that will be examined is shown below in Figure. 1

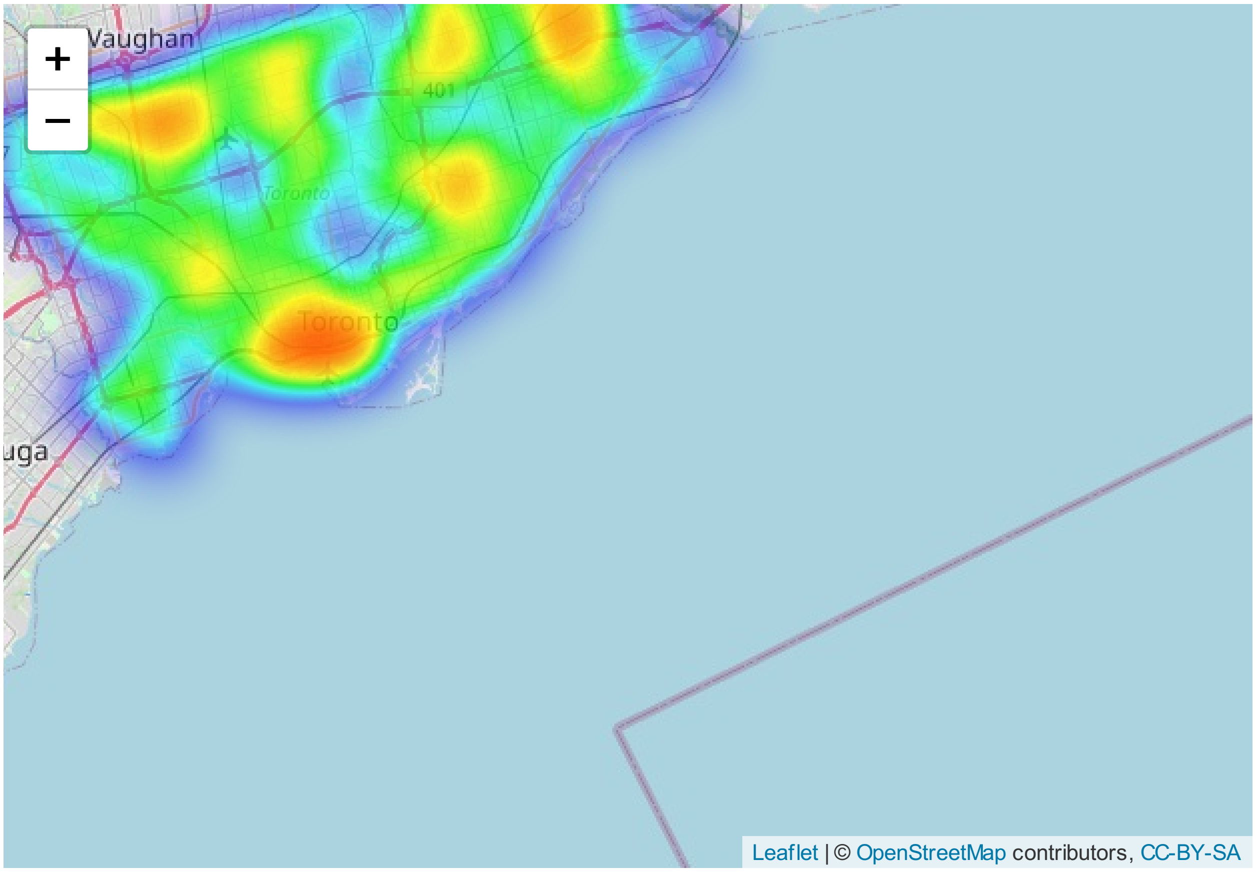
Figure 1: Boundaries of Toronto, Canada (2021)

Data & Methods

Results

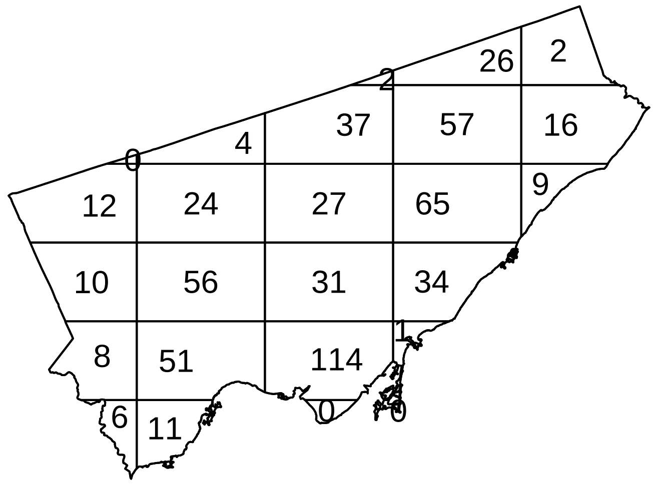
Below is a leaflet map showcasing all accidents (red), schools (black), and speed signs (purple) present in Toronto from 2006-2020.



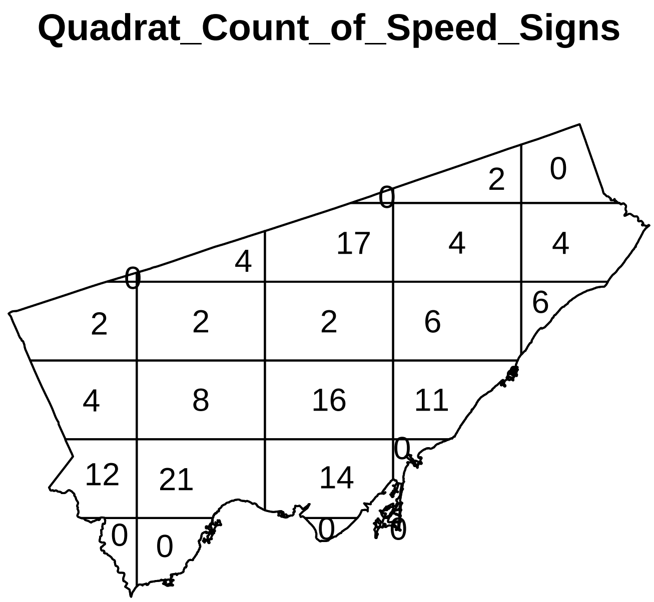



```
## Warning: data contain duplicated points
```

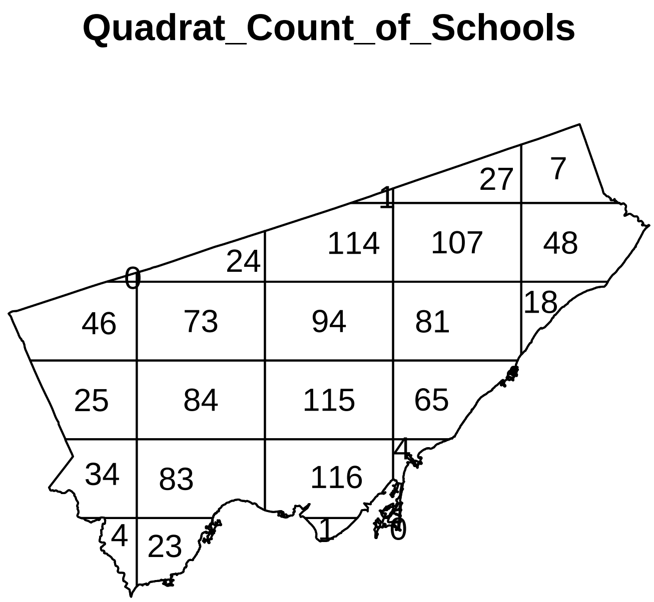
Quadrat_Count_of_Collisions




```
## Warning: Some expected counts are small; chi^2 approximation may be inaccurate

##
##  Chi-squared test of CSR using quadrat counts
##
## data:  collisions.ppp
## X2 = 283.65, df = 24, p-value < 2.2e-16
## alternative hypothesis: two.sided
##
## Quadrats: 25 tiles (irregular windows)
```




```
## Warning: Some expected counts are small; chi^2 approximation may be inaccurate

##
##  Chi-squared test of CSR using quadrat counts
##
## data:  speedsigns.ppp
## X2 = 91.448, df = 24, p-value = 1.658e-09
## alternative hypothesis: two.sided
##
## Quadrats: 25 tiles (irregular windows)

## Warning: data contain duplicated points
```




```
## Warning: Some expected counts are small; chi^2 approximation may be inaccurate

##
##  Chi-squared test of CSR using quadrat counts
##
## data:  Schools.ppp
## X2 = 160.76, df = 24, p-value < 2.2e-16
## alternative hypothesis: two.sided
##
## Quadrats: 25 tiles (irregular windows)
```

Analysis

Conclusion

References

311 Toronto (2019). Toronto District School Board Locations. Retrieved from https://open.toronto.ca/dataset/toronto-district-school-board-locations/

CAA polling (2019). School Zone Safety Statistics. CAA. https://www.caa.ca/schoolzonesafety /statistics/

City Planning, City of Toronto (2021). Ward Profiles, 2014-2018 Wards. Retrieved from https://open.toronto.ca/dataset/ward-profiles-2014-2018-wards/

Information & Technology, City of Toronto (2021). Address Points (Municipal) - Toronto One Address Repository. Retrieved from https://open.toronto.ca/dataset/address-points -municipal-toronto-one-address-repository/

Parachute (2016, June). Unintentional Injury Trends for Canadian Children. Retrieved from https://parachute.ca/wp-content/uploads/2019/06/SKW-Trend-Report.pdf

Rocha, R., & Pelley, L. (2020, October 6). Toronto drivers speeding near schools 21% of the time, city data reveals. CBC. https://www.cbc.ca/news/canada/toronto/toronto-drivers -speeding-near-schools-21-of-the-time-city-data-reveals-1.5751299

Sun, D., El-Basyouny, K., Ibrahim, S., & Kim, A. M. (2018). Are school zones effective in reducing speeds and improving safety? Canadian Journal of Civil Engineering, 45(12), 1084–1092. https://doi.org/10.1139/cjce-2018-0060

Toronto Police Services (2020). Motor Vehicle Collisions involving Killed or Seriously Injured Persons. Retrieved from https://open.toronto.ca/dataset/motor-vehicle-collisions -involving-killed-or-seriously-injured-persons/

Transportation Services, City of Toronto (2020). School Safety Zone Watch Your Speed Program – Detailed Speed Counts. Retreived from https://open.toronto.ca/dataset /school-safety-zone-watch-your-speed-program-detailed-speed-counts/

Transportation Services, City of Toronto(2021). School Safety Zone Watch Your Speed Program – Locations. Retrieved from https://open.toronto.ca/dataset/school-safety-zone-watch -your-speed-program-locations/

Transport Canada (2020, December 1). Canadian Motor Vehicle Traffic Collision Statistics: 2018. Government of Canada. https://tc.canada.ca/en/road-transportation/motor-vehicle -safety/canadian-motor-vehicle-traffic-collision-statistics-2018