The Red Light Camera Program in the City of Toronto

Introduction

The red light camera program started in the City of Toronto in 2000. The aim of this program was to increase safety on the roads by reducing red light running. Red light running is the cause of injury and death to so many pedestrians and drivers alike, not to mention costing the taxpayer millions of dollars for emergency-response situations. On the other hand, it costs millions of taxpayer dollars to put this sort of program into place. That is why it is important to understand the cost-benefit analysis of such a program for any city who decides to put a pilot project of this sort into place.

The first phase of this program in Toronto was in the year 2000 and saw 10 red light cameras go up in selected intersections around the city. The second phase of the program, 2007-2016, saw 77 red light cameras go up. As of March, 2018 there were still 77 cameras in Toronto. The cameras work by capturing an image of a vehicle which has **entered an intersection against a red traffic light** as the camera is triggered when a vehicle enters the intersection after the traffic signal has turned red. The photograph is evidence that assists authorities in their enforcement of traffic laws, helping them issue fines to the red light runners, thereby attempting to deter drivers from this sort of activity and behaviour.

Literature Review and Background

Many cities, large and small, in Canada and the United States have implemented red light camera programs. Still many others are looking at implementing such a program in the hopes that this type of program will indeed make their streets safer. However, reading through the studies and literature on red light camera programs and their effectiveness in making city streets safer, we see there are two camps, one that is for these programs and thinks that there are benefits and one that is against these programs and thinks that the effect of these cameras is actually opposite to what is intended. In fact, some cities, especially in the United States have implemented these programs and then reversed that decision. The argument here is that although red light cameras probably do decrease the number of angle (T-bone) accidents at those intersections, other types of accidents, such as rear-ending, may actually increase. Drivers who are trying to avoid being fined and brake suddenly to avoid entering the intersection could cause the vehicle behind them to rear-end them and maybe even cause a chain reaction with

cars behind. So what the opponents of red light camera programs are saying is that the angle of the accidents are changing with no evidence that there is a reduction in total number of accidents or injuries.

A study, featured in Scientific American in August of 2018, was done by Justin Gallagher, Assistant Professor of Economics, Case Western Reserve University, and co-author Paul J. Fisher, an economist. All police-recorded traffic accidents for three large Texas cities over a 12-year period were examined. One of these cities was Houston, Texas. Houston operated a large red light camera program at 66 intersections between 2006 and 2010. In November of 2010, however, the city of Houston held a referendum on these red light cameras and the termination of this program was passed. When the Houston cameras were removed, angle accidents increased by 26 percent. However, all other types of accidents decreased by 18 percent. Approximately one-third of all Houston intersection accidents are angle accidents. This suggests that the program's drawbacks cancelled out its benefits. Overall, in this study, no evidence that red light cameras improve public safety was found. According to this study, they don't reduce the total number of vehicle accidents, the total number of individuals injured in accidents or the total number of incapacitating injuries that involve ambulance transport to a hospital.

On the other side of the debate, proponents of red light camera programs argue that manual enforcement methods are resource intensive and high risk, whereas red-light cameras can operate 24 hours a day and do not involve high-speed pursuits. A study conducted by Amy Aeron-Thomas and Stephane Hess in April of 2005 used data from several countries, Australia, U.K., Singapore, and the U.S.A. They concluded that red light cameras are effective in reducing total casualty crashes but that the evidence is less conclusive on total collisions, specific casualty collision types and violations.

Research Question

Our question in this project is:

Do the 77 red light cameras installed around the City of Toronto reduce the number of red light running accidents in the areas surrounding those intersections?

Data and Methodology

The data that was sourced for this project came from the following open data sites:

1. https://portal0.cf.opendata.inter.sandbox-toronto.ca/dataset/red-light-cameras/ found on the City of Toronto Open Data Catalogue website. This datasets contains detailed information on each of the 77 red light cameras located in the City of Toronto, including the geopoint location and the names of the two streets that form the intersection where the camera is located.

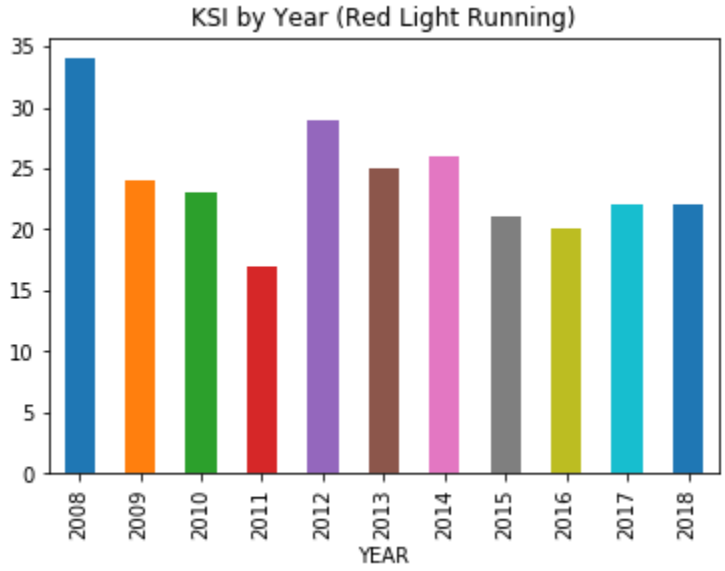
2. Data with details of accidents in the City of Toronto found at Toronto Police Service Public Safety Data Portal, http://data.torontopolice.on.ca/ .
   Specifically, we looked at the subset of the KSI (Killed and Seriously Injured) dataset that contains the details of accidents directly attributed to red light running, http://data.torontopolice.on.ca/datasets/red-light/data. These events include any serious or fatal collision where red light running played a role in the collision. All the KSI datasets have data collected from 2008 to 2018.

The methodology used in this project was:

1. Exploratory data analysis of both datasets to ascertain insights into the data.
2. Spatial analysis using interactive maps to visualise the intersections with cameras with respect to the accidents that are still occurring around them.
3. Defining a catchment area around each camera intersection in order to understand how many accidents fall within this catchment area, thereby getting an empirical idea on the effectiveness of each red light camera.

Results

The EDA (exploratory data analysis) of the data tells us the following:

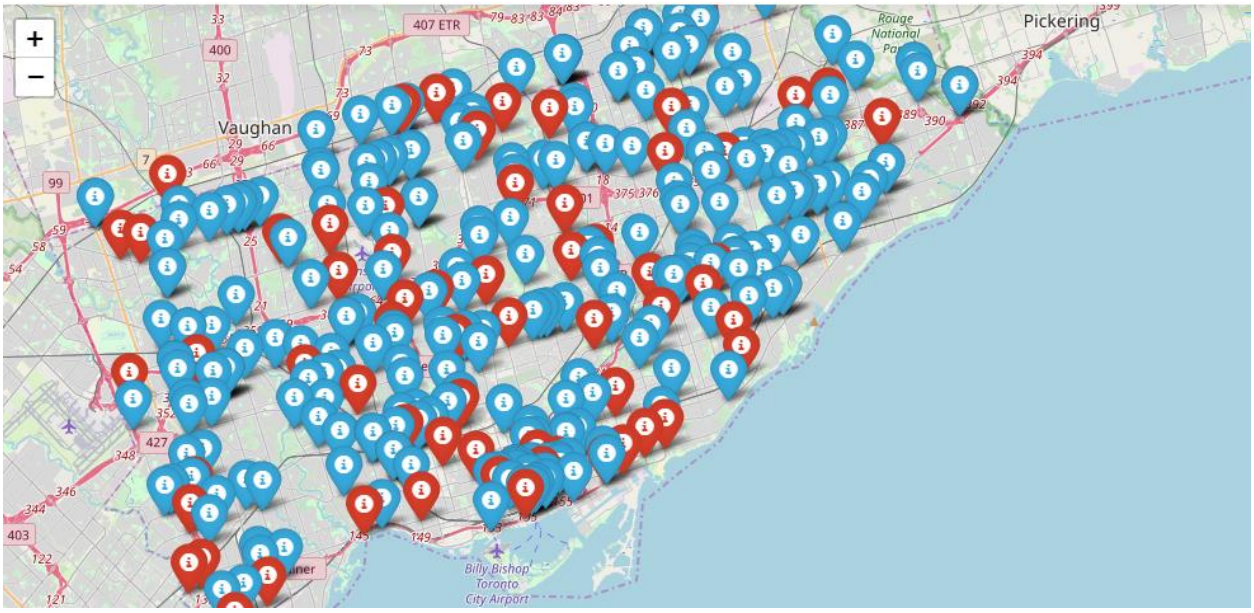


If we look at the total KSI incidents by year from 2008 to 2018, we see that overall the KSI incidents due to red light running is going down. From a high of 34 in 2008 going down to a low of 17 in 2011 and then increasing to 29 in 2012 but then slowly decreasing and settling at 22 KSI incidents for 2017 and 2018.

Additional information obtained from the EDA are as follows:

1. By visualising the hour of day for each accident we see that peak times are at 4pm and 6pm. There is a higher number of accidents at these times during the day.
2. By visualising the age group of the parties involved for each accident we see that there are peaks in the 20-24 and 45-49 age groups. But clearly traffic accidents effect all age groups from infants and toddlers to seniors, and red light running is no different.
3. By visualising impact type for each accident we see that at least half of the red light running accidents are classified as angle impact type accidents, as we would expect.
4. By visualising the injury type for each accident we see that 80 out of the 263 red light running accidents resulted in either fatalities or serious injury. This is 30% of the total accidents, which is not an insignificant percentage looking at the cost of human life in these situations.

The red light cameras were plotted on an interactive map alongside the red light accidents (cameras with red markers, the accidents with blue markers) as follows:



The results from the analysis of the accidents within our defined catchment area of 1km in conjunction with the interactive map (above) tell us the following:

1. Of the 263 red light running accidents, 98 of them are within a distance of 1km of the red light camera intersection, that is 37% of all red light running accidents occur within 1km of the intersection with a red light camera. This is a significant percentage. If we were to widen the catchment area, we probably would catch even more accidents in the catchment area.
2. Out of the 77 red light camera intersections, 3 of those intersections account for almost 25% of the accidents within the defined catchment area, as the following table reflects:

Camera ID	Intersection	Number of Accidents in Catchment Area	% of Total Accidents In Catchment Area
1255	Lower Jarvis St The Esplanade	10	10%
1249	King St E Jarvis St	8	8%
1259	York St Lake Shore Blvd W	6	6%

3. If we add another intersection to the above list, camera id 1242 at Ellesmere Rd & Kennedy Rd with 5 accidents in the catchment area, these 4 intersections would account for almost 30% of the accidents within the defined catchment area.
4. Out of the 77 red light cameras installed currently, 37 of them had 0 accidents reported in the catchment area. The number of cameras reporting 1-10 accidents is 40 with 29 intersections having just 1 or 2 accidents at those sites, as is shown in the following table:

Number of Accidents	Number of Intersections
10	1
8	1
6	1
5	1
4	4
3	3
2	15
1	14

Discussion and Conclusions

The interactive map of the red light camera markers alongside the accident markers shows us that out of the 77 red light camera intersections, 37 of those sites showed 0 accidents in the catchment area of 1km. There are a lot of red light running accidents recorded for the areas east, west, and north of the city where there are no red light cameras. Using the interactive map, we can drill down to those intersections and we can get an idea of the exact intersections having no red light cameras in the area, that are having problems with red light running. In addition, our distance calculation report tells us that another 29 red light camera intersections show only 1 to 2 accidents in the catchment area. Further investigation into the dynamics in these areas, as well as the areas in which we see 3 to 4 accidents in the catchment area, could be undertaken. The biggest takeaway from this analysis, however, is that the downtown core of Toronto is a hotspot for accidents occurring in close vicinity of red lights cameras. In corroboration with the distance calculations we can see 3 important intersections in the downtown core caught in this process are:

1. King & Jarvis

2. Lower Jarvis & Esplanade

3. York & Lake Shore Blvd W

Through our process, we have pinpointed an area of concern where the red light cameras are not working as well as compared to other areas in the city. These areas should be further researched and investigated in order to arrive at some solutions to decrease the incidents of red light running there. One solution may be to have a police presence in these areas to further deter drivers from running the red lights.

Next Steps

The following recommendations for follow-up to this project are:

1. A feature that should be added to the red light camera dataset is the installation date for each camera. The KSI datasets all have date and time features so with an installation date feature added to the red light camera dataset we could do some analysis of the accidents over time.
2. A follow-up analysis to this project should be an analysis of the accidents from the full KSI dataset (data.torontopolice.on.ca/datasets/ksi) with respect to all accidents that happened around the red light camera intersections. In particular, what impact types do these accidents report? Are we seeing an increase in the rear-end collisions that other jurisdictions have reported around these intersections? A similar methodology could be used in defining a catchment area.

References

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