Evaluation of Red-Light Running Cameras in Virginia Beach

by Semuel Rompis 12

Submission date: 18-Aug-2020 03:56PM (UTC+0700)
Submission ID: 1370945015
File name: Evaluation_of_Red-Light_Running_Cameras_in_Virginia_Beach.pdf (977.16K)
Word count: 3212
Character count: 16515

International Conference on Sustainable Engineering Practices

"Toward Innovative Practices for Sustainable Engineering"

IConSEP2018

BOOK OF ABSTRACT

November 8th – 9th 2018
Faculty of Engineering, Sam Ratulangi University
Manado, North Sulawesi - Indonesia

International Conference on Sustainable Engineering Practices
Faculty of Engineering, Sam Ratulangi University
Manado, Indonesia, 8 – 9 November 2018

Evaluation of Red-Light Running Cameras in Virginia Beach

Semuel Rompis[1]

[1]Sam Ratulangi University, Dept. of Civil Engineering, Indonesia
e-mail: semrompis@fulbrightmail.org, semrompis@unsrat.ac.id

Abstract

Red light running cameras (RLRC) is a safety treatment in an intersection. However instead of improving safety sometimes the installation of RLRC leads to increase certain types of accident. This study was conducted to evaluate the effectiveness of installing red light camera in Virginia Beach, VA. The number of crashes from several types of collision where taken from 13 intersections with the RLRC in the city. Before and after study was employed for the analysis with the control of confounding factors. The confounding factors in this study are traffic count (AADT) of the intersections and geometric variables such as number of lanes, number of driveway and ramp. The result showed that the installation of RLRC overall has improved safety and the confounding factors contributed a lot to the safety performance of those intersection.

Keywords : camera, collision, confounding

1. Introduction

Intersection is a vital part of transportation network where two or more links cross each other. In order to be functioned effectively, traffic management should be applied in this part of transportation network. Those management tools are priority intersection which set up yield/give way sign, roundabout, signalized intersection and sometimes interchange when needed. All this traffic management is aimed to manage the traffic so that the transportation problems such as delay, traffic jam and even safety problem could be overcome.

Transportation safety is an initial issue in transportation network including signalized intersection. Several treatments have been done to solve safety problem, however sometimes instead of solving the problems, those treatments had caused declining in safety aspect or even trigger the accident to happen. For this reason a proper study should be done in order to evaluate performance of any treatment applied in an intersection.

This study was inspired by the need to evaluate safety improvement effort in signalized intersection which is the installation of red light enforcement cameras in Virginia Beach's intersection, VA. Those cameras were set up in 2004, but for some reasons they were turned off in July 2005. In 2009, they were turned on again.

This study will use 5 years of crash data, traffic flow and violation rate data starting with 2006 data. This research will prove if there is any connection between installing the camera and the number of rear-end

crashes, the number of angle crashes, whether they are increasing or decreasing after the camera enforcement.

Safety is one of the most important factors in transportation. Thus any treatment for safety issue should be evaluated. The objectives of this study are, evaluating the effectiveness of red light camera in improving safety and observing the influence of these cameras in increasing and decreasing any types of accident that happened in the object of the study.

2. Literature Review

Red Light Running (RLR) camera is a transport safety treatment which has been used widely in develop countries such as US, Australia and some European countries. The idea is, this camera can identified violators and then fine tickets were sent to their address. It is hoped that those will improve driver's compliance, not only in the location of signalized intersection with red light running camera but also they will make drivers to behave better at other signal in the same jurisdiction which is known as spillover effect. In the end those camera were intended to reduce crashes and improve safety. However, several recent studies have shown that Red Light Running cameras has negative impact to the safety, or in other words instead of reducing crashes, Red Light Running cameras are increasing them. These facts have become the reason for conducting studies about Red Light Running camera. Those studies were mainly aimed to examine all of at least one of these factors (Kent et al, 2005) :

- Technical Feasibility : to monitor and detect if the installment of those cameras meet legal standard, good accuracy to be accepted by the community
- Fiscal Feasibility : to observe this safety program was feasible financially
- Operational Feasibility : to examine if this schema meet its aim which is to improve safety.

Previous Studies on Red Light Running camera Enforcement

Many studies have been carried out to examine the effectiveness of Red Light Running Cameras installment. Some researchers have come to conclusion that Red Light Running camera has gain benefit in transportation safety, while some others have found the other way around. Table 1 shows previous studies on Red Light camera enforcement.

Table 1 Previous studies on Red Light camera enforcement

Author	Objective	Methods	Key finding
Retting et al (1999)	Evaluation of Red Light Running Camera in Fairfax	Before and After Study	RLRC reduce Red Light infringement
Fox (1996) as in Garber et al (2005)	Evaluation of Red Light Camera Enforcement in Portland	Before and After Study	Significant improvement on safety specially on angle crash
Aeron and Hess (2009)	Evaluation of Red Light Camera	Before and After Study	Red light cameras are effective in reducing total casualty crashes
Burkey and Obeng	Evaluation of Red Light	Before and After	RLRC were related to

Author	Objective	Methods	Key finding
(2009) as in Orban et al (2008	Camera	Study	- Accident rates increase significantly (40%) - Possible injury crashes increase significantly (40-50%) - No reduction in severe crashes
Andreassen (1995)	Long term study on Red Light Cameras in Australia	Before and After Study	Rear end crashes and adjacent approaches accidents increase
Kent et al (1995)	Evaluation of Red Light Camera	Before and after study	Observed rate of violation in camera and non-camera approaches were not different

3. Conceptual Structure

Factors influence the dependent variables are the effect after implement the treatment and also the confounding factor which are traffic counts and geometric aspect. In this study there are 3 hypotheses which are established to be tested statistically. Those hypotheses are shown in table 2 below.

Table 2 Hypothesis

No.	Type	Hypothesis
1	H0	There is no effect of RLRC installation to number of crash
	H1	There is effect of RLRC installation to number of crash
2	H0	RLRC decrease Rear End crash
	H1	RLRC increase Rear End crash
3	H0	RLRC decrease Angle Side crash
	H1	RLRC increase Angle Side crash

The red-light running camera installation is aimed to improve safety, in this case to decrease the total crash, however previous studies have found that this treatment will end up in decreasing the angle side crash but increasing the rear end crash. In the first hypothesis the important thing that one need to know whether this installation affected the total number of crash or not. If this RLRC decreasing or increasing number of crash then it means that the alternate hypothesis is true. However, this is not enough, one would need to know what kind of crash will be decreasing and also decreasing, thus hypothesis 2 and hypothesis 3 need to be examined.

Similar to the literature review, this study has been implemented the confounding factor such as traffic count and geometric aspects as control to the before and after effect however this study did not put into account the regression to the mean effect. Also since there are only very limited amount of the crash data, this study did not take into account analysis for the comparison group as suggested in the literature review.

4. Methods

This study was conducted by modeling using Poisson regression model. This model was chosen since the dependent variables are not continuous variables, in fact they are discrete / count variables.

There are two kinds of data to accomplish this study, the first is the data for dependent variables and the second is the data for independent variables. For dependent variables, the data are 4 years of before-data from 2006 to 2009, and 1 year after-data which is 2010 year data. This data is provided by Dr. A. Khattak and available on the blackboard for Transportation Safety course (2011). The data include crash frequencies of rear end, angle, sideswipe, hit fixed object, other crash and the total crash data.

For independent variables the data are traffic counts which is traffic volume entering the intersection, this data are available on line, and could be found on url address : http://www.ms2soft.com/tcds/tsearch.asp?loc=Vbgov&mod= . However some work and some judgments need to be done to have the complete data regard on the incomplete, missing and inaccurate data that might occur since the traffic counter is not located exactly on the intersection. The 'movement counts' on the intersection was only available for one year, thus they were not utilizable. The others independent data are the number of approaching/entering lanes, the number of departing/exit lanes, the number of transit stop in 2000 feet radius, the number of driveway in 2000 feet radius and the number of ramp in the intersection. These data were obtained from the google maps by counting them manually. The other independent variables is a dummy variables to represent the before and after period effect. The 'before period' is represented by 0 and the 'after period' is represented by 1.

In this study the dependent variables are the number of rear end collision, the number of angle collision, the number of sideswipe collision, the number of fixed object collision, the number of other types of collision and the number of total collisions. While the independent variables are, the dummy variable representing before and after red-light running cameras installation, total approaching volume (for every 1000 vehicles), total approaching/entering lanes, total departing/exit lanes, the number of transit stop in 2000 feet radius, the number of driveway in 2000 feet radius and the number of ramp in the intersection

5. Results

5.1. Descriptive Statistics

The first step to represent the data is by using descriptive statistic. Table 3 showed the descriptive statistic for both dependent and dependent variables.

Table 3 Descriptive Statistic of dependent and independent variables

Dependent Variables		RE	Angle	Sideswipe	FO	Other	Total
N	Valid	65	65	65	65	65	65
	Missing	0	0	0	0	0	0
Mean		15.7077	5.7385	2.4154	.7077	.3692	24.9385
Median		15.0000	5.0000	2.0000	1.0000	.0000	25.0000
Mode		12.00	3.00[a]	2.00	.00	.00	19.00
Std. Deviation		6.12812	4.25836	2.23532	.82392	.54684	8.68346
Range		29.00	20.00	11.00	3.00	2.00	39.00
Minimum		4.00	.00	.00	.00	.00	7.00
Maximum		33.00	20.00	11.00	3.00	2.00	46.00

Independent Variables		BA	Voltotal	AlanesTot	DlanesTot	TransitStop	Driveway	Ramp
N	Valid	65	65	65	65	65	65	65
	Missing	0	0	0	0	0	0	0
Mean		.2000	74.1164	20.5385	11.1538	2.0000	6.3846	1.1538
Median		.0000	70.9328	21.0000	12.0000	2.0000	6.0000	1.0000
Mode		.00	90.56	20.00[a]	12.00[a]	1.00	2.00[a]	.00
Std. Deviation		.40311	13.28562	4.60325	2.55704	1.31101	4.39350	1.30181
Range		1.00	48.71	19.00	10.00	5.00	16.00	4.00
Minimum		.00	49.13	9.00	6.00	.00	1.00	.00
Maximum		1.00	97.84	28.00	16.00	5.00	17.00	4.00

Table 3 shows that in all intersection the rear end collision always happen since the minimum value is 4, while the others type of collision have chance never happen since the minimum value is 0. That table also shows that the rear end collision was the most frequent type of collision occurred, since this kind of collision has the highest maximum value. Rear end collision also has the largest variability because this variable has the greatest range and the highest standard deviation.

From the descriptive statistic for independent variables, it is shown that the highest volume entering the intersection is about 97840 vph while the lowest is about 49130 vph. The intersection seems to have more approaching lanes than departing lanes since the approaching lanes variable ranged from 9 to 28 while the departing lanes ranged from 6 to 16.

Table 4 The Final Model

Dependent Variable	R^2	Significant Independent Variable	Sign	Effect
Rear End	13.43%	Approaching lanes	+	13.20%

		Departing lanes	-	20.10%
		Transit Stop (Sig. = 0.073)	-	5.90%
Angle	22.97%	Before Period	+	40.00%
		AADT (Sig. = 0.062)	-	1.30%
		Transit Stop	+	19.40%
		Driveway	+	6.50%
Sideswipe	8.78%	Before Period	+	59.40%
		AADT	+	1.70%
Fixed Object	12.64%	AADT	+	4.70%
		Approaching lanes (Sig. = 0.064)	+	20.90%
Other	6.24%	Model do not fit		
Total	13.28%	Before Period	+	14.50%
		Approaching lanes	+	9.80%
		Departing lanes	-	14.30%

5.2. Modeling

The Poisson Regression has been employed to have the modeling for this study. This model was used since the dependent variables were count data / discrete, thus the Poisson Regression is assumed to be more suitable than other type of regression model. The result of Poisson Regression can be seen in appendix 1 and 2. The final model which was summarized from the result are shown in table 4. The R^2 shows the goodness of fit of the model. While the significant independent variables are the ones that have significant value < 0.05 (or near this value which are indicated in the table)

The result in table 4 can be interpreted as follows,

1. RLRC have positive impact to safety especially for angle crash, the Sideswipe and also the total crash. The result has shown that the crash in before period is 40% higher than in after period. The sideswipe crash in before period is 59.4% higher than in after period while for all kind of crash the number of crash before the installation of those cameras is 14.5% higher than after the treatment.
2. Addition on approaching lanes, will increase the rear end for 13.20%, fixed object (20.90) and total crash (9.80%).
3. Addition on departing lanes, will decrease the rear end (20.10%) and total crash (14.30%)
4. Addition on Transit Stop will decrease rear end (5.90%) crash but will increase angle crash (19.40%)
5. Addition on Driveway will increase angle crash (6.50%) and addition on AADT will increase sideswipe (1.70%) and fixed object crash (4.70%) but will decrease angle crash (1.30%).

6. Limitation of the study

There are some limitations of the study that need to be aware such as,

- There is only very limited amount data for after period which is just 2010 year data. The result will be better if the before and after data are equal in quantities. Also the only crash data available were data from 13 intersections with the treatment, thus analyzing using comparison group for other intersections was not possible
- This study did not put into account the regression to the mean effect
- There are issues about the accuracy on Traffic Flow/Count Data since the traffic count data were estimated from data collector that were positioned in the midblock.

7. Conclusion

This study has examined the effect of the implementation of red light running camera at selected intersections in Virginia Beach. This study also tried to discover the association between several variables with several types of collision. The variables are traffic flow variables which is 'approaching volume' and geometric variables which are 1) number of approaching lanes, 2) number of departing lanes, 3) number of transit stop in 2000 feet radius, 4) number of driveway in 2000 feet radius and number of ramp in the intersections. Also in statistical analysis a dummy variable was added as a predictor to examine the effect of the treatment.

The result of statistical analysis has shown that RLRC have positive impact to safety especially for angle crash, sideswipe crash and all kinds of crash as a unity. Addition on approaching lanes, will increase the rear end, fixed object and total crash. Addition on departing lanes, will decrease the rear end and total crash. Addition on Transit Stop will decrease rear end crash but will increase angle crash. Addition on Driveway will increase angle crash and addition on AADT will increase sideswipe and fixed object crash but will decrease angle crash. Overall it can be concluded that the installation or RLRC has improve safety. Another conclusion is that the confounding factors were contributing significantly both positively and negatively to the number of certain crash and also the number of total crash.

Unfortunately, the statistical analysis cannot be done with the comparison group, since the crash data for comparison group were not available and also the crash data available for this study do not categorize the exact location of the collision, whether the collision happened on the arm of intersection within red light camera treatment or not. The data for other intersection without the treatment located in the same jurisdiction were not available. This is the reason the spillover effect that supposed to be triggered by this treatment cannot be evaluated. This study is also ignored the effect of heavy vehicle as there is no sufficient data for that. All of these facts have happened to be the limitation of the study. The limitation of this study can become consideration for conducting a future study.

References

_____, 2009, Before and After Study, Technical Brief, Institute of Transportation Engineers, Transportation Safety Council

Aeron, T.A. and Hess, S., 2009, Red-Light Cameras for the Prevention of Road Traffic Crashes (Review), John Willey & Sons, Ltd

Andreassen, D, 1995, A Long Term Study of Red Light Cameras and Accidents, Australian Road Research Board, Ltd

Council, F. M., et al, 2005, Safety Evaluation of Red-Light Cameras, Publication No. FHWA-HRT-05-048, US Department of Transportation, FHA

Elvik, R, 2002, The importance of confounding in observational before-and-after studies of road safety measures, Accident Analysis and Prevention 34 (2002) 631 - 635

Garber, N. J., et al, 2005, An Evaluation of Red Light Camera (Photo-Red) Enforcement Programs in Virginia : A Report in Response to a Request by Virginia's Secretary of Transportation, Virginia Transportation Research Council

Kicks, P. and Matsoukis, E, 2005, Red Light Running, a Significant Road Safety Problem at Signalized Intersection.

Orban, B. L, et al, 2008, Red Light Running Cameras : Would Crashes, Injuries and Automobile Insurance Rates Increase if They Are Used in Florida? Florida Public Health Review, 2008;5:1-7

Retting, R. A. 1999, Evaluation of Red Light Camera Enforcement in Fairfax, VA, USA. ITE Journal/August 1999.

Evaluation of Red-Light Running Cameras in Virginia Beach

ORIGINALITY REPORT

12%	9%	6%	1%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	repo.unsrat.ac.id Internet Source	5%
2	Tommy Jansen. "Comparing Nearshore Wave Parameters in Amurang Bay location using MIKE-21 Spectral Wave Model", Journal of Sustainable Engineering: Proceedings Series, 2019 Publication	2%
3	www.dontflashmebro.com Internet Source	1%
4	S. M. S. Mahmud, L. Ferreira, A. Tavassoli. "Traditional Approaches to Traffic Safety Evaluation (TSE): Application Challenges and Future Directions", Bridging the East and West, 2016 Publication	<1%
5	Submitted to Universitas Negeri Semarang Student Paper	<1%
6	docplayer.net Internet Source	<1%

7	Submitted to Nottingham Trent University Student Paper	<1%
8	www.thecochranelibrary.com Internet Source	<1%
9	www.motorists.org Internet Source	<1%
10	thenewspaper.com Internet Source	<1%
11	ar.scribd.com Internet Source	<1%
12	eatoncountyroad.com Internet Source	<1%
13	en.wikipedia.org Internet Source	<1%
14	Tomás E. Lindheimer, Eric J. Fitzsimmons, Steven D. Schrock. "Evaluation of Confirmation Lights on Red Light Running Violations by Time-into-Red Phase", Transportation Research Record: Journal of the Transportation Research Board, 2018 Publication	<1%
15	Theo Kurniawan Sendow. "Modelling of Air Pollution Caused by Traffic Flows in Manado City, Indonesia", Journal of Sustainable Engineering: Proceedings Series, 2019	<1%

Publication

16	Richard Tay, Alex de Barros. "Should traffic enforcement be unpredictable? The case of red light cameras in Edmonton", Accident Analysis & Prevention, 2011 Publication	<1%
17	www.nevadadot.com Internet Source	<1%
18	Eric J. Fitzsimmons, Shauna L. Hallmark, Massiel Orellana, Thomas McDonald, David Matulac. "Investigation of Violation Reduction at Intersection Approaches with Automated Red Light Running Enforcement Cameras in Clive, Iowa, Using a Cross-Sectional Analysis", Journal of Transportation Engineering, 2009 Publication	<1%

Exclude quotes	On	Exclude matches	Off
Exclude bibliography	On		