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Effects of red light running camera systems installation and then deactivation on intersection safety

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A B S T R A C T

The primary objective of this paper is to evaluate the safety impacts of red-light running camera (RLC) system installation and then deactivation at 48 intersections in Houston, Texas. The second objective is to evaluate the spillover effect at nearby non-treated intersections in Houston after the deactivation. To accomplish study objectives, an Empirical Bayes (EB) before-after analysis was used. The results indicate statistically significant collision reductions on all red-light running (RLR) crash types (37%) as well as right-angle RLR crashes (47%) at the treated intersections after RLC activation. By way of comparison, the RLC deactivation analysis indicated that crashes increased by 20% for all RLR crash types and by 23% in right-angle RLR crashes at the formerly treated intersections. After deactivation, all severity RLR crashes increased more than expected at nearby non-treated intersections, which indicates the possibility of an adverse spillover effect. However, fatal/injury crashes associated with rear-end decreased after deactivation at both formerly treated and non-treated intersections, although those rear-end crashes account for smaller proportions when compared to all crash types/right-angle crashes. Overall, removing RLC treatments results in a negative reaction to the safety benefits that the treatment provides when it is in place and actively working and to the nearby intersections where the treatment has not been implemented. This study helps define the effects that RLCs have on safety at signalized intersections after installation and deactivation.

1. Introduction

In 2012, there were approximately 30,000 crashes at intersections due to drivers disregarding stop signs or traffic signals in Texas (Texas Department of Transportation (TxDOT), 2012a). Disregarding a stop sign or red-light running (RLR) is one primary contributing factor for crashes at signalized intersections. With the purpose of reducing RLR violations, red light enforcement cameras (RLCs) have been generally used as an enforcement treatment to improve intersection safety. RLC systems detect a vehicle that passes a stop line and proceeds through the intersection after a traffic signal has turned red. In addition, the system takes a series of photographs and/or video images of the red light violation, as well as records the information such as date, time, and time elapsed since the beginning of the red signal (Texas Department of Transportation (TxDOT), 2012b).

The state of Texas is beginning to see a reduction in the number of communities using RLC systems as safety treatments. In 2010, Texas had 42 communities that operated RLC systems that monitored 389 signal controlled intersections. In 2011, there were 50 communities using RLC systems that monitored 398 signal controlled intersections. In 2012, only 39 communities operated RLC systems at 341 signalized intersections in Texas. While there is significant evidence that suggests RLC improve intersection safety by reducing crashes, fewer communities are adopting the practice of installing RLCs as a safety treatment. In addition, many more communities are removing the RLCs that were once in place as a result of mounting public pressure and formal municipal referendum elections.

On August 24, 2011, local news announced the ordinance publicly that the City of Houston deactivated their RLC systems at 66 individual intersections as a result of a municipal referendum election that abolished the use of RLCs in the city. In the later stages, systems were physically removed at the intersections in the city gradually. This action provided a valuable opportunity to assess the impact that removing RLC treatments had on traffic safety, most notably crash frequency and injury severity post-removal. The objectives of this study were to:

1. Evaluate the performance of RLC systems (after installation) using an Empirical Bayes (EB) before-after analysis (Phase I and Phase II as illustrated in Fig. 1).
2. Evaluate intersection safety (i.e., the changes of RLR crashes and severity) using an EB before-after analysis after RLC deactivation at the formerly treated intersections (Phase II and Phase III in Fig. 1).

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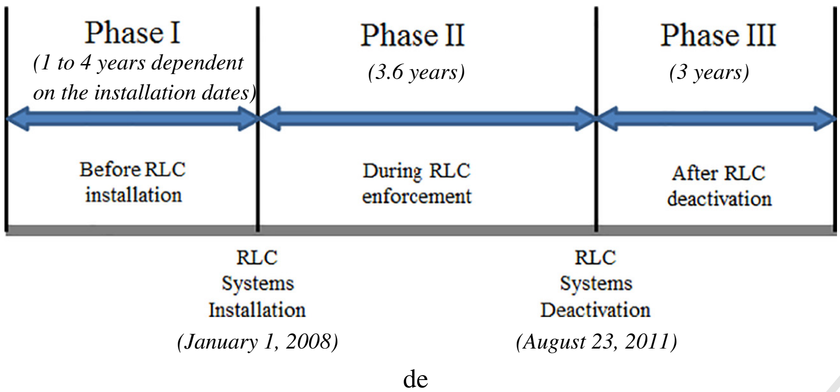

Fig. 1. Illustration on the phases used in the research.

3. Evaluate the spillover effect (i.e., the cameras influence on safety of locations where cameras have not been installed) on RLR crashes and severity at nearby non-treated intersections in Houston after the RLCs were deactivated (Phase II and Phase III in Fig. 1)

While there have been many studies performed on the safety benefits of installing RLC systems to increase intersection safety, few have addressed the safety impact that deactivation has on intersection safety by just analyzing the RLR violations. This study analyzed the safety effects of RLC installation and then deactivation using the traffic crashes occurred at the same intersections in different periods. This study uses an EB methodology to address regression-to-mean (RTM) bias. RTM phenomenon suggests that there is a possible tendency for a fluctuating characteristic of the treatment site to return to a typical value in the period after an extraordinary value has been observed (Hauer, 1997). The EB method was used to estimate intersection safety at targeted sites based upon reference sites with similar traits and where RLC systems were not installed.

2. Background

Previous research provides varied and meaningful viewpoints in understanding the impact that RLC treatments have on intersection safety. Table 1 provides a summary list of research results regarding RLC.

Table 1
Summary of research studies on the RLC installation and deactivation.

Category	Study	Method	Crash/violation change percentage[a] (crash type)	Notes
After RLC	Erke (2009)	Meta-analysis	• +15% (all crashes) • +40% (RE) • −10% (RA)	Control for RTM and Spillover effect
	Hoye (2013)	Meta-analysis	• +6% (all crashes) • +13% (all injury) • −33% (RA) • +39% (RE)	
	Ng, Wong, and Lum (1997)	CG method	• −7% (all type) • −8% (RA)	No control for RTM and Spillover effect
	Retting and Kyrychenko (2002)	Generalized linear regression model	• −7% (all type) • −32% (RA) • +3% (RE)	Control for RTM and Spillover effect, but the results are based on city-wide effects, not just at RLC sites
	Persaud, Council, Lyon, Eccles, and Griffith (2005)	EB method	• −25% (RA) • +15% (RE)	Control for RTM and Spillover effect
	Washington and Shin (2005)	EB method	• −20% (RLR angle) • −45% (RLR left turn) • +41% (RLR RE)	Control for RTM and Spillover effect
	Walden, Geedipally, Ko, Gilbert, and Perez (2011)	CG method	• −26% (all RLR type) • −19% (RLR RA) • +44% (RLR RE)	Partial control for RTM and Spillover effect
	Ko, Geedipally, and Walden (2013)	EB method	• −20% (all RLR crashes) • −24% (RLR RA) • +37% (RLR RE)	Control for RTM and Spillover effect
Spillover effect	Hoye (2013)	Meta-analysis	• −7% (RA) • +8% (RE)	Non-RLC intersections
	Persaud et al. (2005)	EB method	• −8.5% (RA) • +1.8% (RE)	Non-RLC intersections
	Washington and Shin (2005)	EB method	• −17% (RLR RA) • −40% (RLR left turn) • +45% (RLR RE)	Other approaches at RLC intersections
After RLC turning off	Walden et al. (2011)	Relative risk	• +200% (RLR violation): one year later after turning off	
	Porter, Johnson, and Bland (2013)	Relative risk	• +300% (RLR violation): immediately after turning off • +400% (RLR violation): one year later after turning off	

Note: RA stands for right-angle crash type; RE stands for rear-end crash type.
[a] Negative values represent decrease in crashes/violations after the treatment installation/deactivation.

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