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Effects of Red Light Camera Enforcement on Red Light Violations in Arlington County, Virginia

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Abstract

Objectives: In June 2010, Arlington County, Virginia, installed red light cameras at four heavily traveled signalized intersections. Effects of camera enforcement on red light violations were examined.

Methods: Traffic was videotaped during the 1-month warning period and 1 month and 1 year after ticketing began at the four camera intersections, four non-camera “spillover” intersections in Arlington County (two on travel corridors with camera intersections, two on different corridors), and four non-camera “control” intersections in adjacent Fairfax County. Violation rates per 10,000 vehicles were computed. Logistic regression models estimated changes in the likelihood of violations at camera and spillover intersections, relative to expected likelihood without cameras, based on changes at control intersections.

Results: At camera intersections, there were significant reductions 1 year after ticketing in odds of violations occurring at least 0.5 second (39%) and at least 1.5 seconds (86%) after lights turned red, relative to expected odds without cameras, and a marginally significant 48% reduction in violations occurring at least 1 second into red. At non-camera intersections on corridors with camera intersections, odds of violations occurring at least 0.5 second (14%), 1 second (25%), and 1.5 seconds (63%) into the red phase declined compared with expected odds, but not significantly. Odds of violations increased at the non-camera intersections located on other Arlington County travel corridors.

Conclusions: Consistent with prior research, red light violations at camera-enforced intersections declined significantly. Reductions were greater the longer after the light turned red, when violations are more likely to cause crashes. Spillover benefits were observed only for nearby intersections on travel corridors with cameras and were not always significant. This evaluation examined the first year of Arlington County’s red light camera program, which was modest in scope and without ongoing publicity. A larger, more widely publicized program likely is needed to achieve community-wide effects.

Keywords: Red light cameras; Red light running; Red light violations

1. Introduction

In the United States in 2011, more than 2.2 million police-reported motor vehicle crashes occurred at intersections or were intersection-related (Insurance Institute for Highway Safety, 2013). These crashes accounted for 43% of all police-reported crashes and more than 67,000 serious non-fatal injuries and 7,296 deaths. About one-third of the deaths occurred at intersections with signal lights.

Red light violations are common. A study conducted at five busy intersections in Fairfax, Virginia, found that, on average, a motorist ran a red light every 20 minutes at each intersection (Retting, Williams, Farmer, & Feldman, 1999a). Similarly, a study of 19 intersections in four states reported an average of 3.2 red light violations per hour per intersection (Hill & Lindly, 2003). In a 2011 national telephone survey, 94% of drivers said it is unacceptable to go through a red light if it is possible to stop safely, but 37% reported doing so in the past 30 days (AAA Foundation for Traffic Safety, 2012).

The safety consequences of running red lights are considerable. In 2011, 714 people were killed and an estimated 118,000 were injured in crashes in which police were able to establish that drivers ran red lights. Over half of the deaths were pedestrians, bicyclists, and occupants of other vehicles hit by red light runners (Insurance Institute for Highway Safety, 2013).

Motorists are more likely to comply with traffic laws if they perceive a high likelihood of being ticketed. Red light cameras can supplement traditional methods of enforcement at intersections, especially at times of the day and on roads where traditional enforcement can be difficult or hazardous. Studies in Oxnard, California, and Fairfax City, Virginia, reported reductions in red light violation rates of about 40% after the introduction of red light cameras (Retting et al., 1999a, Retting, Williams, Farmer, & Feldman, 1999b); reductions occurred not only at camera-equipped sites but also at other signalized intersections without cameras. Studies also have found reductions in injury crashes (Retting & Kyrychenko, 2002; Aeron-Thomas & Hess, 2005) and fatal crashes (Hu, McCartt, & Teoh, 2011) associated with camera enforcement.

As of September 2013, 521 communities use red light cameras. A 2011 survey of drivers in 14 large cities with longstanding red light camera programs found that two-thirds of drivers supported their use (McCartt & Eichelberger, 2012). An earlier national survey found that 75% of drivers supported red light cameras (Royal, 2004). However, in some jurisdictions, camera programs have been controversial.

A case in point is Virginia. From July 1995 through June 2005, Virginia law permitted selected municipal governments to establish red light camera enforcement programs. The state legislature allowed the law to expire effective July 1, 2005, but effective July 1, 2007, a new law permits localities with more than 10,000 residents to implement, by ordinance, red light camera programs. The law establishes operating guidelines. For example, the selection of intersections for cameras should consider crash rates, number of violations, pedestrian traffic, and the difficulty of conducting traditional enforcement. An engineering safety study must be conducted, and communities must make reasonable location-specific safety improvements, including adding signs and pavement markings, if indicated. The length of the yellow signal phase should be based on the recommended methodology of the Institute of Traffic Engineers. Warning signs must be conspicuously placed within 500 feet of the intersection. In determining violations, there must be a minimum grace period of 0.5 second after the signal turns red. Drivers cannot be photographed; images of vehicles must be taken before and after entering the intersection. A police officer must affirm all violations based on inspection of photographs or video. Citations are mailed to registered owners of vehicles, but drivers are liable for a fine of no more than \$50. Citations are not applied to driver records and cannot be used for insurance purposes.

Under the original Virginia law on red light camera enforcement, Arlington County conducted red light camera enforcement during August 25, 1998-July 1, 2005. On June 21, 2010, Arlington County reinstated the use of red light cameras. This study examines the effects of Arlington's current red light camera program on red light violations.

2. Methods

The main analysis focused on the effect of the camera enforcement program on the probability of red light violations at intersections with cameras. Given prior evidence of spillover effects of cameras at signalized intersections without cameras in a community, potential spillover effects of the cameras were examined at signalized intersections without cameras in Arlington County.

2.1. Arlington County program

Located in northern Virginia across the Potomac River from the District of Columbia, Arlington County is a small (26 square miles), densely populated, self-governing county. Many of the county's roadways are heavily traveled and often congested, and there are areas of heavy pedestrian traffic.

On June 21, 2010, Arlington County activated videocameras to enforce red light violations on a single approach at four busy signalized intersections. Following a 30-day warning period, citations carrying fines of \$50 began to be issued on July 21. In keeping with Virginia's law, citations are issued only if at least 0.5 second has elapsed after the light turns red. The camera technology used to flag potential red light violations is unable to determine whether vehicles have come to a full stop before turning right on red, as required by law. Therefore, camera citations are issued to drivers turning right on red while traveling more than 10 mph, subject to review by police officers. Traffic in right-turn slip lanes is not camera-enforced.

The county issued two press releases at the outset of the program in summer 2010, announcing first the installation of the cameras and then the initiation of ticketing. As required by Virginia law, there are signs on the camera-enforced approaches alerting drivers to the camera enforcement. There are no additional signs about the camera enforcement on other roads throughout the county.

2.2. Study intersections

For this study, data on red light violations were collected at 12 signalized intersections (Figure 1). There were eight study intersections in Arlington County. In addition to the four intersections with red light cameras (camera group), these included two intersections without cameras located on the same travel corridors as the four camera intersections (corridor spillover group), and two intersections without cameras located on different travel corridors (non-corridor spillover group). Four intersections without red light cameras were located in adjacent Fairfax County (control group), also a densely populated county with heavily traveled roadways. The control sites were intended to account for the presence of potentially confounding factors such as changes in state traffic laws, weather conditions, or general economic conditions that could affect red light violations at the treatment sites over time.

All the study intersections were located on major thoroughfares in urbanized areas with similar traffic compositions, including low levels of truck traffic. At all the intersections, weekday traffic peaked during the morning (about 7-9 a.m.) and afternoon (about 4-6 p.m.) rush hours.

At each of the 12 intersections, traffic was videotaped for 11 hours (7 a.m.-6 p.m.) on each of two weekdays during the 30-day warning period (June 28-July 19, 2010), about 1 month after ticketing began (August 23-September 1, 2010), and about 1 year after ticketing began (August 22-August 31, 2011). Videotaping was not conducted during rainy conditions. The videocameras were mounted on tripods positioned to provide a clear view of the traffic signals and the stop lines and crosswalks and to allow recording the traffic approaching and entering the intersections. The cameras were located so as to be as unobtrusive as possible and not noticeable to passing traffic, for example, hidden behind the entranceway to a building. Traffic was videotaped on the camera-enforced approach at the camera intersections and on one approach at the other intersections.

Two technicians observed the traffic videotapes to tally counts of vehicles and identify violations. For the purposes of the study, red light violations were defined as vehicles entering an intersection at least 0.5 second after the signal light turned red. A jog and shuttle controller was used to view the videotape by frame (1/30th of a second) when a violation was detected to determine the elapsed time after red. The coded violations then were reviewed by the supervising researcher. At all 12 intersections, coding of red light running included vehicles traveling straight through the intersection and vehicles turning left (where permitted). Right-turn-on-red violations were excluded at intersections where vehicles can turn right on red, including intersections with slip lanes and intersections without slip lanes. Right-turn-on-red violations were excluded at the latter intersections because it could not be determined definitively from the videotape whether or not a driver stopped before turning right. Right-turn-on-red violations were coded at one camera-enforced intersection where turning right on red is prohibited.

2.3. Analysis

At each intersection, the rates of red light violations per 10,000 vehicles were calculated for each of the three observation periods by seconds elapsed after the signal light turned red (≥ 0.5 second, ≥ 1 second, and ≥ 1.5 seconds). Percentage changes were calculated for violation rates 1 month after

ticketing began compared with the warning period and for rates 1 year after ticketing began compared with the warning period.

Logistic regression models were used to estimate the effects of red light cameras on the odds of red light violations at the camera intersections, using the SAS LOGISTIC procedure (SAS Institute Inc., 2011). This procedure allows the input of binary response data that are grouped, as follows:

```
Proc logistic;  
Model r/n = x1, x2, ....;  
Run;
```

where r represents the number of events (i.e., number of red light violations) and n represents the number of trials (i.e., number of vehicles passing through the intersection).

In the dataset input into the SAS program, observations of individual vehicles were grouped by intersections and study periods so that for each intersection in each study period there was a count of all red light violations, a count of vehicles passing through the intersection, and counts of violations by time-into-red. When specifying the logistic regression models, the response variable in the model statement takes the form of the number of red light violations (r , number of events) divided by the number of vehicles passing through the intersections during the same time period (n , number of trials). This generated the same results as if a binary response variable had been specified.

Separate models were built for violations occurring at least 0.5 second, 1 second, and 1.5 seconds after the signal light turned red. The independent variables were individual intersection and study period (after vs. warning period) indicator variables. Individual intersection indicators instead of study group indicators were included in the models to account for the differences among intersections. Although all the study sites were busy intersections, differences in traffic volumes were observed (Table 1). The modeling results accounted for these differences by including traffic counts as part of the dependent variable. An interaction variable for camera group and study period also was included as the primary measure of effectiveness of the cameras. It tested whether changes in the probability of red light violations (after vs. warning period) differed between the camera intersections and control intersections. For example, if the parameter for the interaction term between the camera vs. control group and the 1-

year after vs. warning period is -0.4873, the percentage change in the odds of a red light violation is calculated as $([\exp(-0.4873)-1] \times 100)$, a 38.6% reduction. P values less than 0.05 were considered statistically significant.

Similarly, potential spillover effects were examined with interaction variables that tested whether changes in the probabilities of red light violations differed between the corridor spillover intersections and control intersections and between the non-corridor spillover intersections and control intersections.

3. Results

Table 1 provides traffic counts at the 12 study intersections when measured during the warning period and 1 month and 1 year after ticketing began. The traffic flows measured 1 year after ticketing began were higher than the traffic flows measured during the warning period at eight intersections (range 2% to 15%), lower at three intersections (range 2% to 8%), and essentially unchanged at one intersection.

The rates of observed red light running violations per 10,000 vehicles occurring at least 0.5 second, at least 1 second, and at least 1.5 seconds after the light turned red were computed for each intersection for each study period. Table 2 shows these rates as well as the percentage changes in the violation rates for 1 month and for 1 year after ticketing began, relative to the rates during the warning period.

For the Arlington County camera intersections, the rates of violations generally declined in the two study periods after ticketing began for violations occurring at least 0.5 second, 1 second, and 1.5 seconds after the signal light turned red. For the camera intersection group, relative to the rates during the warning period, the rates 1 year after ticketing were 24%, 30%, and 50% lower, respectively.

The results differed for the two intersections in the spillover intersection group located on the same travel corridors as the camera intersections, with violation rates generally going up at one intersection and generally down at the other 1 month and 1 year after ticketing began. For the two spillover intersections not located on the travel corridors with cameras, the rates for both intersections were much higher 1 month and 1 year after ticketing began. The rates for the Fairfax County control intersections were not always consistent across the intersections but were generally higher 1 month and 1 year after ticketing began.

To estimate the effects of the cameras on violation rates, the changes in violation rates at the camera and potential spillover intersections are considered relative to the changes occurring at the control intersections, where rates increased. For example, for violations occurring at least 0.5 second into the red signal phase, the violation rate after 1 year of camera enforcement was 42% lower for the camera intersection group (i.e., $100[(100-24)/(100+30)-1]$), 20% lower for the corridor spillover intersection group, and 118% higher at the non-corridor intersection group, relative to the change at the control intersection group.

3.1. Results of logistic regression models

To estimate the effects of the cameras more rigorously, logistic regression models examined changes in the odds of violations at the camera and spillover intersections relative to the changes at the control intersections. For each model, the parameters for the interaction terms for study group and study period can be used to derive the percentage change in the odds of red light violations associated with camera enforcement, relative to the odds that would have been expected in the absence of the cameras. These estimates are provided in Table 3. Of most interest was any effects of the cameras observed 1 year after ticketing began.

Relative to the odds of red light violations that would have been expected in the absence of the cameras, the odds of red light violations occurring at least 0.5 second after the light turned red at the camera-enforced intersections were 18% lower 1 month after ticketing began and 39% lower 1 year after. The latter change was significant. The odds of red light violations occurring at least 1 second after the light turned red were 16% lower than expected 1 month after ticketing began and 48% lower 1 year after. The latter change was marginally significant ($p = 0.07$). The odds of red light violations occurring at least 1.5 seconds into the red signal phase were 83% lower 1 month after ticketing began and 86% 1 year after. Both these changes were significant.

The estimated effects of the camera enforcement at the potential spillover intersections were mixed. Relative to the odds of red light violations that would have been expected without the camera enforcement, the odds of violations after 1 month of ticketing for the spillover intersections located on the camera corridors were lower for violations occurring at all three intervals into the red signal phase. The changes were significant for violations occurring at least 0.5 second and at least 1.5 seconds after the

light turned red. After about 1 year of ticketing, there were non-significant reductions in the odds of violations occurring at least 0.5 second (14%), 1 second (25%), and 1.5 seconds (63%) into the red signal phase. The lack of significance for these changes likely reflects the fact that, as noted above, the violation rate went up at one of the corridor spillover intersections and down at the other.

At the spillover intersections located on non-camera corridors, the odds of red light violations were larger for all three time intervals into the red signal phase for both 1 month after ticketing and 1 year after ticketing, relative to the odds of violations that would have been expected without the camera enforcement. Some of the estimated percentage increases were very large, including a marginally significant 128% increase in the odds of running a red light at least 0.5 second after the red signal phase 1 year after ticketing began, and a significant 477% increase in the odds of a red light violation at least 1 second after the signal turned red.

4. Discussion

Consistent with prior research on red light camera programs, Arlington County's use of red light cameras led to significant reductions in red light violations at camera-enforced intersections 1 year after ticketing began, compared to what would have been expected without cameras, based on violation patterns at the control intersections. Prior studies of the effects of red light camera enforcement found large reductions in red light violation rates not only at the intersections with cameras but also at signalized intersections without cameras (Retting et al., 1999a, 1999b). In the current study, spillover benefits, estimated relative to the pattern of changes in violations at the control intersections, were observed only for the intersections located in Arlington County on the same travel corridors as the camera intersections. These effects were smaller than those at the camera intersections and not always statistically significant. There were increases in violations at intersections located on different travel corridors, compared with expected rates based on the control intersections.

The main analyses focused on the effects of the camera enforcement measured at the end of the first year of the program. The scope of the program during this period was modest, with only four cameras. Although there was substantial media coverage surrounding the initiation of the camera enforcement, this largely dissipated. Whereas some communities place signs alerting drivers to the presence of automated enforcement on roads throughout the counties and at county borders, Arlington

County placed signs only at the camera-enforced intersections. Given the small number of cameras and signs, it is likely that many Arlington drivers did not know about the camera enforcement, whereas those who were aware likely knew the cameras were limited to a few locations. Given these factors, it is not surprising that the effects of the cameras declined as the distance from the camera intersections increased. Especially in populous, heavily traveled communities like Arlington County, a larger, more widely publicized red light camera program likely is needed to achieve substantial community-wide effects. The county plans to activate five additional cameras in other areas of the county in 2013. Broader effects would be expected to emerge after this planned expansion.

Few prior studies of red light cameras have looked at violations committed at varying lengths of time after the signal light turns red. In the current study, there were reductions at the camera intersections in violation rates occurring at least 0.5 second, 1 second, and 1.5 seconds into the red signal phase. The longer the time elapsed after the red signal, the larger the reduction. This is important because the longer after the red signal a vehicle enters an intersection, the more likely a crash will occur. The effects of Arlington County's red light camera enforcement on crashes will be the subject of future research.

It is a limitation of this research that relatively short-term effects were examined. Insofar as possible, spillover and control intersections were sought that were similar to the camera intersections. Identifying suitable control intersections always is challenging. In the current study, the location of control sites in a densely populated county adjacent to Arlington County minimized the presence of potentially confounding factors such as changes in state traffic laws, weather conditions, or general economic conditions that may have affected the treatment sites. However, the sites were imperfect matches. For instance, the speed limits varied somewhat across the intersections (range 30-45 mph). However, no clear trend was observed between speed limits and the red light violation rates during the baseline warning period. For example, the red light violation rates at intersections with the highest speed limit (45 mph) were among the lowest, and the highest violation rates occurred at the intersection with 35 mph speed limit. In a study of intersections equipped with red light cameras in Sacramento, California, Yang and Najm (2006) reported that no obvious trend was observed between the posted speed limit and red light violation rates. The inclusion of an intersection indicator variable in the logistic regression models

was intended to account for differences in intersection characteristics. Violation rates were lower at both of the non-corridor spillover intersections relative to intersections in the other study groups during all three study periods, and violation rates showed different trends at the two spillover intersections located on the same travel corridors as the camera intersections. It is not clear why red light violation rates generally increased at the non-corridor spillover intersections and at the control intersections in Fairfax County. It is possible these reflect an improving economy.

In sum, the current research reinforces earlier research on the effectiveness of red light camera enforcement in reducing violations at camera-enforced intersections, with particularly large decreases for the most dangerous violations, those happening 1.5 seconds or longer after the light turned red. Some spillover benefits were observed at intersections located on the same travel corridors as the camera-enforced intersections, but these were smaller and not always statistically significant. At intersections on other travel corridors, the odds of red lighting running increased, compared with the expected odds based on the control intersections. Larger, well-publicized red light camera programs likely are needed to produce community-wide spillover effects.

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Table 1

Left-turning and through counts of vehicles at study intersections based on videotapes of one direction of traffic during 7 a.m.-6 p.m. on two weekdays

	Warning period	1 month after ticketing began	1 year after ticketing began
Arlington County intersections with red light cameras			
Southbound Fort Meyer Dr at Westbound Lee Hwy	26,019	29,993	29,558
Northbound N Lynn St at Eastbound Lee Hwy	24,385	27,183	27,272
Northbound N Glebe Rd at N Fairfax Dr	22,109	22,063	22,112
Westbound Washington Blvd at Lee Hwy	19,796	19,452	19,351
Total	92,309	98,691	98,293
Arlington County corridor spillover intersections			
Westbound Lee Hwy at N Kirkwood Rd	15,017	15,722	15,569
Northbound N Glebe Rd at Washington Blvd	17,051	18,533	18,843
Total	32,068	34,255	34,412
Arlington County non-corridor spillover intersections			
Westbound Arlington Blvd at Manchester St	38,012	39,903	40,170
Eastbound Columbia Pike at S George Mason Dr	15,842	15,537	14,531
Total	53,854	55,440	54,701
Fairfax County control intersections			
Southbound Backlick Rd at Braddock Rd	11,238	11,935	11,619
Southbound Rolling Rd at Old Keene Mill Rd	15,817	17,349	18,214
Westbound Burke Center Pkwy at Roberts Rd	16,503	15,161	16,216
Northbound Route 123 at Braddock Rd	20,593	20,683	20,994
Total	64,151	65,128	67,043

Table 2

Observed red light violation rates per 10,000 vehicles by time into red and percentage changes 1 month and 1 year after red light camera ticketing compared with warning period

	Violation rates per 10,000 vehicles by time (seconds) into red									Percent change in rates compared with warning period					
	Warning period			1 month after ticketing			1 year after ticketing			1 month after ticketing			1 year after ticketing		
	≥0.5 sec	≥1 sec	≥1.5 sec	≥0.5 sec	≥1 sec	≥1.5 sec	≥0.5 sec	≥1 sec	≥1.5 sec	≥0.5 sec	≥1 sec	≥1.5 sec	≥0.5 sec	≥1 sec	≥1.5 sec
Arlington County intersections with red light cameras															
Southbound Fort Meyer Dr at Westbound Lee Hwy	10.0	6.5	4.6	12.3	8.0	3.0	8.5	4.7	2.0	23	22	-35	-15	-28	-56
Northbound N Lynn St at Eastbound Lee Hwy	13.1	5.7	1.6	13.2	4.4	1.5	8.1	2.9	1.5	1	-23	-10	-39	-49	-11
Northbound N Glebe Rd at N Fairfax Dr	16.3	6.3	4.1	12.7	2.7	0.5	13.6	6.8	1.8	-22	-57	-89	-17	7	-56
Westbound Washington Blvd at Lee Hwy	7.1	4.5	1.5	6.7	2.1	1.0	5.2	1.6	0.5	-6	-55	-32	-27	-66	-66
Total	11.7	5.8	3.0	11.6	4.7	1.6	8.9	4.1	1.5	-1	-20	-47	-24	-30	-50
Arlington County corridor spillover intersections															
Westbound Lee Hwy at N Kirkwood Rd	36.6	20.0	8.7	22.9	11.4	5.1	31.5	16.7	11.6	-37	-43	-41	-14	-16	34
Northbound N Glebe Rd at Washington Blvd	4.1	1.8	1.2	3.8	2.7	1.6	10.6	4.8	1.6	-8	53	38	159	171	36
Total	19.3	10.3	4.7	12.6	6.7	3.2	20.1	10.2	6.1	-35	-35	-31	4	-1	30
Arlington County non-corridor spillover intersections															
Westbound Arlington Blvd at Manchester St	1.8	0.5	0.5	4.3	2.0	1.0	5.5	3.2	1.7	131	281	91	197	515	231
Eastbound Columbia Pike at S George Mason Dr	1.3	0	0.0	4.5	1.9	1.9	2.8	2.1	1.4	257	—	—	118	—	—
Total	1.7	0.4	0.4	4.3	2.0	1.3	4.8	2.9	1.6	159	434	240	184	688	343
Fairfax County control intersections															
Southbound Backlick Rd at Braddock Rd	1.8	0.9	0	0.8	0	0	4.3	2.6	0.9	-53	-100	—	142	190	—
Southbound Rolling Rd at Old Keene Mill Rd	20.2	8.2	1.3	25.4	8.6	4.6	22.0	11.5	5.5	25	5	265	9	40	334
Westbound Burke Center Pkwy at Roberts Rd	3.6	1.2	0.6	2.6	1.3	0.7	1.2	0.6	0.6	-27	9	9	-66	-49	2
Northbound Rte 123 at Braddock Rd	1.9	1.0	0.0	3.4	0.5	0.5	6.2	1.0	0.0	74	-50	—	219	-2	—
Total	6.9	2.8	0.5	8.6	2.8	1.5	8.9	4.0	1.8	25	-2	228	30	44	283

EB=eastbound, WB=westbound, NB=northbound, SB=southbound

Table 3

Summary of results from logistic regression models of changes in the odds of red light violations 1 month and 1 year after red light camera ticketing compared with warning period and relative to control non-camera intersections

Study Group	Study period	Violations 0.5 second or more after red		Violations 1 second or more after red		Violations 1.5 seconds or more after red	
		Percent change in odds of violation	p value	Percent change in odds of violation	p value	Percent change in odds of violation	p value
Effect of red light cameras at camera intersections (interaction between camera vs. control intersections and after vs. warning period)	1 month after ticketing	-17.7	0.423	-16.5	0.644	-83.3	0.014
	1 year after ticketing	-38.6	0.047	-48.4	0.073	-86.1	0.006
Effect of red light cameras at corridor non-camera intersections (interaction between corridor spillover vs. control intersections and after vs. warning period)	1 month after ticketing	-44.9	0.036	-29.4	0.418	-77.9	0.049
	1 year after ticketing	-14	0.569	-24.8	0.465	-62.6	0.178
Effect of red light cameras at non-corridor non-camera intersections (interaction between non-corridor spillover vs. control intersections and after vs. warning period)	1 month after ticketing	116.8	0.079	467.6	0.038	8.4	0.938
	1 year after ticketing	127.5	0.059	477.4	0.03	22.2	0.843

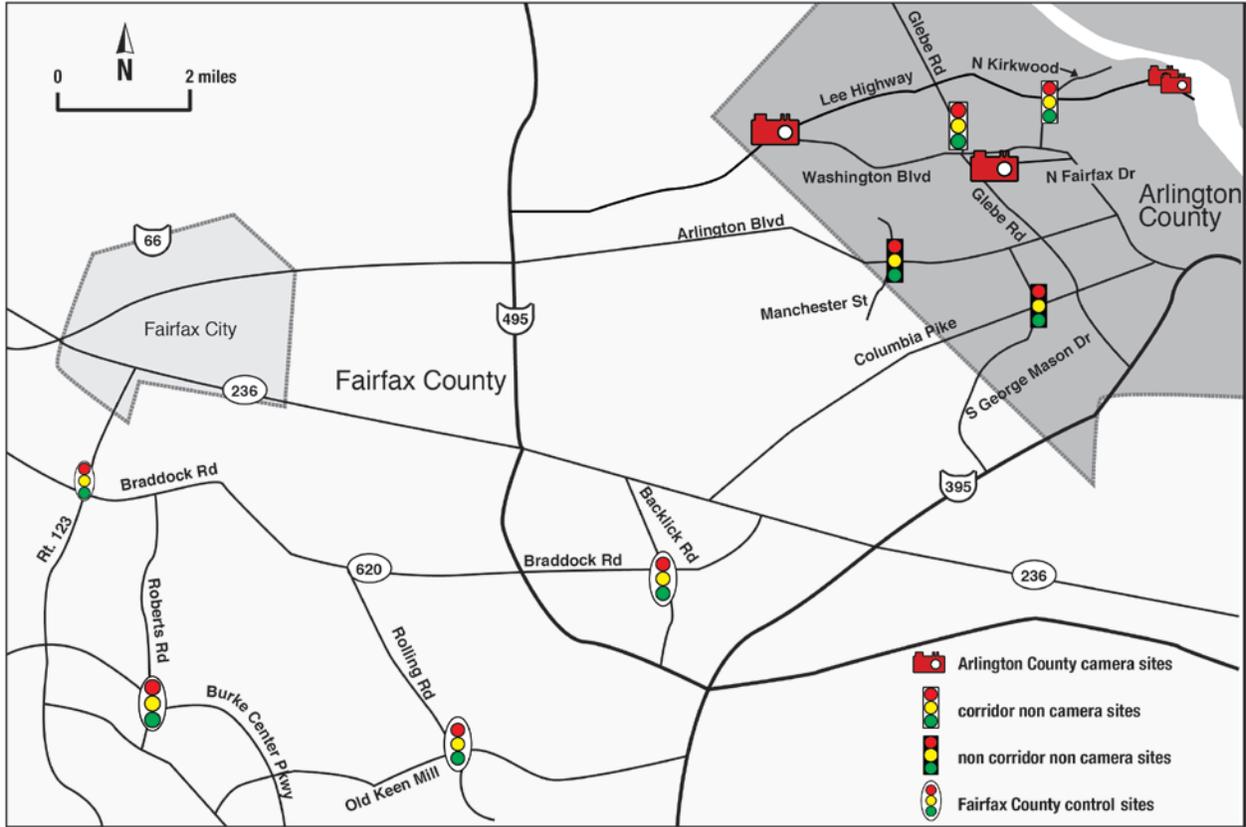


Figure 1. Map of study intersections in Arlington County, Virginia, and control intersections in Fairfax County, Virginia