

## **Annotated Bibliography of Research on Automated Enforcement of Traffic Laws**

November 2007

Aeron-Thomas, A.S. and Hess, S. 2005. Red-light cameras for the prevention of road traffic crashes. *Cochrane Database of Systematic Reviews* 2005, Issue 2. Art. No.: CD003862. DOI: 10.1002/14651858.CD003862.pub2. Oxfordshire, United Kingdom: The Cochrane Collaboration.

The objective of this study was to quantify the impact of red light cameras on the incidence and severity of road crashes and casualties, and the incidence of red light violations. Major databases were searched (TRANSPORT, NTIS, TRIS, IRRD, TRANSDOC), Cochrane Injuries Group Specialized Register, Cochrane Controlled Trials Register, MEDLINE, EMBASE, and the Australian Transport Index, as well as the reference lists of relevant papers. Randomized or quasi-controlled trials and controlled before and after studies of red light cameras were identified. For crash impact evaluation, the before and after periods had to be at least one year. For violation studies, the after period had to occur at least one year after camera installation. Two reviewers independently collected the data from the studies. Five studies in Australia, Singapore and the US all found that use of red light cameras cut the number of crashes in which there were injuries. In the best conducted of these studies, the reduction was nearly 30 percent

Council, F.M.; Bhagwant P.; Eccles, K.; Lyon, C.; and Griffith, M.S. 2005. Safety evaluation of red-light cameras. Report no. FHWA-HRT-05-048. Washington, DC: Federal Highway Administration.

The purpose of this study was to estimate the crash and associated economic effects of red light camera systems and specially derived rear end and right-angle unit crash costs for various severity levels. Before-and-after research from seven jurisdictions across the United States at 132 treatment sites were analyzed using empirical Bayes procedures. Crash effects detected were consistent with those found in many previous studies: decreased right-angle crashes and increased rear end ones. The economic analysis examined the extent to which the increase in rear end crashes negates the benefits for right-angle crashes. The analysis showed an aggregate crash cost benefit of RLC systems. A disaggregate analysis found that the greatest economic benefits are associated with the highest total entering average annual daily traffic, the largest ratios of right-angle to rear end crashes, and with the presence of protected left turn phases. Weak indications of a spillover effect point to a need for a more definitive study of this issue.

Decina, L.E.; T. Libby; Srinivasan, R.; and L. Staplin. 2007. Automated enforcement: a compendium of worldwide evaluations of results. Report no. DOT-HS-810-763. Washington, DC: National Highway Traffic Safety Administration.

This compendium details automated enforcement systems (AES) implemented around the world and characterizes the safety impacts of such deployments, based on available scientific evaluations of the outcome measures. For automated speed enforcement, key studies reported significant reductions in estimated crashes following program implementation, but only a few studies were well-controlled. Speed reductions documented in about half of the studies provided support for a relationship between the treatments and crash reductions. Enforcement intensity of mobile enforcements, site-specific differences (e.g., sample area, roadway characteristics), and statistical anomalies may play a role in AES effects. Recommendations for future studies include the use of empirical Bayes procedures, careful selection and examination of comparison groups, and consideration of traffic flow effects and possible crash migration due to the treatment, in order to improve the accuracy of treatment safety effect estimates. For red light running enforcement, the key studies support the assertion that RLCs can reduce crash severity at high red

light running intersections. Consistent with previous reports, this review attributes a decrease in right angle crashes with an increase in rear-end crashes to RLC implementations, together with a decrease in red light running violations. Recommendations for future studies of RLC effects include the use of controlled and randomized experiments whenever feasible.

Freedman, M.; Williams, A.F.; and Lund, A.K. 1990. Public opinion regarding photo radar. *Transportation Research Record* 1270:59-65. Washington, DC: Transportation Research Board.

A telephone survey was conducted among residents of two communities (Paradise Valley, Arizona, and Pasadena, California) where photoradar is being used; residents of nearby communities were also surveyed. Considerable awareness of the use of photoradar was found, especially in Paradise Valley, where 72 percent of the people surveyed mentioned it spontaneously. In all areas, 58 percent either approved or strongly approved its use; residents of Paradise Valley and Pasadena were more likely to approve than residents of nearby communities. Two-thirds of those who approved of photoradar thought its use should be increased. Almost half of the respondents who knew that photoradar was being used said that they were driving more slowly as a result.

Pilkington, P. and S. Kinra. 2005. Effectiveness of speed cameras in preventing road traffic collisions and related casualties: systematic review. *British Medical Journal* 330:331-34.

To assess whether speed cameras reduce road traffic collisions and related casualties, the authors examined controlled trials and observational studies assessing the impact of fixed or mobile speed cameras on collisions and casualties. Fourteen observational studies met the inclusion criteria. Most studies were before-after studies without controls (n = 8). All but one of the studies showed effectiveness of cameras up to three years or less after their introduction; one study showed sustained longer term effects (4.6 years after introduction). Reductions in outcomes across studies ranged from 5 to 69 percent for collisions, 12 to 65 percent for injuries, and 17 to 71 percent for deaths in the immediate vicinity of camera sites. The reductions over wider geographical areas were of a similar order of magnitude. The authors concluded that existing research consistently shows that speed cameras are an effective intervention in reducing road traffic collisions and related casualties. Controlled introduction of speed cameras with careful data collection may offer improved evidence of their effectiveness in the future.

Retting, R.A.; Ferguson, S.A.; and Hakkert, A.S. 2003. Effects of red light cameras on violations and crashes: a review of the international literature. *Traffic Injury Prevention* 4:17-23.

The present study reviewed and evaluated available evidence in the international literature regarding the effectiveness of cameras to reduce both red light violations and crashes. Camera enforcement generally reduces violations by an estimated 40-50 percent. In terms of crash effects, most studies contain methodological flaws that, to varying degrees, either overestimate (failure to adjust for regression to the mean) or underestimate (comparison with nearby signalized intersections affected by cameras) crash effects. Mindful of these limitations, the research generally indicates that camera enforcement can significantly reduce injury crashes at signalized intersections, in particular right-angle injury crashes. Most studies reported increases in rear-end crashes following camera installation. Taken together, the studies indicate that, overall, injury crashes, including rear-end collisions, were reduced by 25-30 percent as a result of camera enforcement.

Retting, R.A.; Ferguson, S.A.; and Farmer, C.M. 2007. Reducing red light running through longer yellow signal timing and red light camera enforcement: results of a field investigation. *Accident Analysis and Prevention*, in press.

Two principal methods used to reduce red light running involve lengthening the duration of yellow change intervals and automated red light enforcement. This study evaluated the incremental effects on red light running of first lengthening yellow signal timing, followed by the introduction of red light cameras. At six approaches to two intersections in Philadelphia, Pennsylvania, yellow change intervals were increased by about 1 second, followed several months later by red light camera enforcement. The number of red light violations was monitored before changes were implemented, several weeks after yellow timing changes were made, and about 1 year after commencement of red light camera enforcement. Similar observations were conducted at three comparison intersections in a neighboring state where red light cameras were not used and yellow timing remained constant. Results showed that yellow timing changes reduced red light violations by 36 percent. The addition of red light camera enforcement further reduced red light violations by 96 percent beyond levels achieved by the longer yellow timing. This study shows that the provision of adequate yellow signal timing reduces red light running, but longer yellow timing alone does not eliminate the need for better enforcement, which can be provided effectively by red light cameras.

Retting, R.A. and Kyrychenko, S.Y. 2002. Reductions in injury crashes associated with red light camera enforcement in Oxnard, California. *American Journal of Public Health* 92:1822-25.

This study estimated the impact of red light camera enforcement on motor vehicle crashes in one of the first U.S. communities to employ such cameras, Oxnard, California. Crash data were analyzed for Oxnard and for 3 comparison cities. Changes in crash frequencies were compared for Oxnard and control cities and for signalized and nonsignalized intersections by means of a generalized linear regression model. Overall, crashes at signalized intersections throughout Oxnard were reduced by 7 percent and injury crashes were reduced by 29 percent. Right-angle crashes, those most associated with red light violations, were reduced by 32 percent; right-angle crashes involving injuries were reduced by 68 percent.

Retting, R.A. and Williams, A.F. 2000. Red light cameras and the perceived risk of being ticketed. *Traffic Engineering and Control* 41:224-25.

The purpose of this study was to examine public awareness of, and support for, red light cameras and to determine the extent to which drivers in cities with camera enforcement perceive a greater risk of being ticketed for red light running than drivers in cities without cameras. Most drivers support the use of red light cameras (80 percent in cities with cameras and 76 percent in cities without cameras). Drivers in cities with camera enforcement perceive a greater risk of being ticketed for red light running than those in cities without cameras. Still, one-third of drivers in cities with camera enforcement said it is unlikely that someone who runs a red light in their city will receive a ticket, suggesting a need for continuing efforts to strengthen the deterrent aspects of camera enforcement.

Retting, R.A.; Williams, A.F.; Farmer, C.M.; and Feldman, A.F. 1999. Evaluation of red light camera enforcement in Oxnard, California. *Accident Analysis and Prevention* 31:169-74.

Red light cameras are being used to supplement police enforcement efforts to deter red light violations—a substantial contributing factor in urban motor vehicle crashes. A before/after quasi-experimental design with controls was employed to evaluate the influence of a red light camera

enforcement program on red light violation rates in the city of Oxnard, CA. A total of 14 intersections (nine camera sites, three non-camera sites, and two control sites) were studied. Overall, the red light violation rate was reduced approximately 42 percent several months after the enforcement program began. Increases in driver compliance with red lights were not limited to the camera-equipped intersections but spilled over to nonequipped intersections as well. Results of public opinion surveys conducted approximately 6 weeks before, 6 weeks after, and 6 months after the camera enforcement program began indicated that nearly 80 percent of Oxnard residents support using red light cameras as a supplement to police efforts to enforce traffic signal laws.

Retting, R.A.; Williams, A.F.; Farmer, C.M.; and Feldman, A.F. 1999. Evaluation of red light camera enforcement in Fairfax, VA, USA. *ITE Journal* 69:30-34.

This study found a large and highly significant reduction in red light violations one year after implementation of a red light camera enforcement program in Fairfax, VA. Most Fairfax residents knew about the cameras, and the violation rate across the camera and noncamera sites was reduced approximately 40 percent one year after the camera enforcement began.

Retting, R.A.; Ulmer, R.G.; and Williams, A.F. 1999. Prevalence and characteristics of red light running crashes in the United States. *Accident Analysis and Prevention* 31:687-94.

About 40 percent of motor vehicle crashes occur at intersections. In the late 1990s, the number of crashes at traffic signals increased considerably. A major cause of such crashes is drivers disregarding traffic signals. Despite concerns about the frequent occurrence of red light violations and the significant crash consequences, relatively little is known about the overall prevalence and characteristics of red light running crashes. This study examines the prevalence of red light running crashes on a national basis and identifies the characteristics of such crashes and the drivers involved. Cities with especially high rates of fatal red light running crashes are identified. Countermeasures to reduce red light running crashes based on collision patterns and characteristics of drivers involved are discussed. It was estimated that about 260,000 red light running crashes occur annually in the United States, of which approximately 750 result in fatalities. Comparisons were made between red light running drivers and drivers deemed not to have run red lights in these same crashes. As a group, red light runners were more likely than other drivers to be younger than age 30, male, have prior moving violations and convictions for driving while intoxicated, have invalid driver's licenses, and have consumed alcohol prior to the crash. Comparisons also were made between characteristics of red light runners involved in daytime and nighttime crashes. Nighttime red light runners were more likely than daytime runners to be young, male, and have more deviant characteristics, 53 percent having high blood alcohol concentrations.