White Paper Series

An Overview of Automated Enforcement Systems and Their Potential for Improving Pedestrian and Bicyclist Safety

December 2012

Bryan Poole, UNC HSRC/PBIC

For:
Federal Highway Administration
DTFHGI-11-H-00024

This material is based upon work supported by the Federal Highway Administration under Cooperative Agreement No. DTFH610110H-00024. Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the Author(s) and do not necessarily reflect the view of the Federal Highway Administration.

Introduction

The following paper takes a widespread look at automated enforcement systems, specifically red-light cameras (RLC) and automated speed enforcement (ASE) systems. Initially exploring the detrimental consequences of drivers running red lights and speeding, the paper will define automated enforcement systems, the impact these systems have, the issues they raise, the question of legality and the ongoing battle of public perception. Using this information, it will explore the implications that automated enforcement systems can have on pedestrian and bicycle safety.

The final section discusses how automated enforcement systems should be seen as one potential tool to aid crash prevention, rather than a comprehensive and final solution. It also cautions against the implementation of automated enforcement systems primarily for the generation of revenue. Seeing the systems as part of a broader campaign to make streets and intersections safer is the best way to prevent legal challenges, and garner public support, so automated systems can achieve their intended purpose of preventing traffic crashes and saving lives.

Consequences of Red Light Running/ Speeding

The costs of speeding and running red lights are substantial. These actions do not only endanger the motorist and the passengers in their car, but also other motorists, bicyclists and pedestrians. Injuries and deaths caused by speeding and running red lights negatively impact the physical and emotional health of individuals, families, and communities. They also produce major economic losses for society through property damage, emergency response services and law enforcement services. In 2009, drivers running red lights resulted in 676 fatalities in the United States, accounting for 10 percent of all intersection-related fatalities and two percent of all roadway fatalities(1). Sixty-four percent of these fatalities were not the driver of the car running the red light, but rather passengers, other occupants of other vehicles, pedestrians, and bicyclists (2). Additionally, an estimated 130,000 people were injured in crashes involving a driver that ran a red light (1). The 2011 Traffic Safety Culture Index by AAA found that ninety-four percent of drivers consider it unacceptable to drive through a red light when they could have stopped safely, yet 37 percent admit to having run a red light in the last 30 days (3). Finally, a 2005 study found the monetary impact to society of crashes resulting from the running of red lights in the United States is approximately $14 billion annually (4).

Speeding accounts for an even greater number of traffic crashes and fatalities. In 2010, speeding was a contributing factor in 32 percent of all fatal crashes, and 10,395 lives were lost as a result of speeding (5). In 2009, just in United States highway work zones there were 667 fatalities and 40,000 injuries recorded (6). Finally, the economic cost to society of these speeding-related crashes is estimated to total $40.4 billion per year (7).

Red light running and speeding behaviors are related, as red light runners are more likely to also be speeders (8). Reducing the number of traffic crashes caused by running red lights and speeding is vital to diminish the numerous costs and increase the safety of roads for

motorists as well as pedestrians and bicyclists. Unfortunately, it is impossible for communities to have continual enforcement of red light running and speeding through physical police enforcement. As a result, one tool that was developed to consistently enforce established traffic laws and deter dangerous driver behaviors at selected locations are systems of automated enforcement.

Automated Enforcement Systems: Definition and History

An automated enforcement system is an electronic camera used to enforce traffic laws through the electronic detection of infraction and photo documentation of the vehicle at fault. Two of the most common types of systems are automated speed enforcement cameras and red light cameras. The Federal Highway Administration (FHWA) and National Highway Traffic Safety Administration (NHTSA) promote automated enforcement systems as a valuable countermeasure within a comprehensive approach to intersection safety and speed management, one that also involves engineering and education (4). Following is a description of red light cameras and automated speed enforcement systems.

Red Light Cameras (RLC) – Red light cameras take photographs of vehicles entering intersections after the traffic signal has turned red. In most instances, offenses are detected by sensors in the pavement, which are tied to a timing system that connects the traffic signal and pole-mounted camera. Photographs of the vehicle, the license plate number, and/or the driver are taken, usually when the vehicle enters the intersection on red as well as while it is in the intersection (8). The photos are subsequently reviewed by the local jurisdiction, and the vehicle owner or driver may then receive a citation. RLCs are used throughout the world, though most comprehensively in Australia, Canada, Europe, Singapore, and the United States (8). They have been in place in the United States for 20 years, and are estimated to be in use in 552 cities as of June 2012 (10).

A RLC in Springfield, Ohio in 2006.

Automated Speed Enforcement Cameras (ASE) – Automated speed enforcement cameras generally use image capture technology to monitor and/or enforce posted speed limits (8). ASE systems include: fixed cameras, which continually monitor traffic speeds without an operator; mobile camera operations, most often deployed in vehicles by law enforcement agents; and "speed-over-distance" systems that photograph vehicles and measure speeds at both starting and ending points on roadways. In all of these, a computer-controlled camera takes a photograph of the vehicle and license plate, as well as the time, date, location and speed. A citation is then mailed to the owner of the vehicle, who may be required to pay a fine or identify the offending driver. ASE technology has been utilized for more than 30 years in more than 75 countries, and as of May 2012, was in use in 111 United States jurisdictions (11).

A van with photo radar in Illinois in 2004.

Safety Impact of Automated Enforcement Systems

While a number of studies have examined the safety impacts of automated enforcement systems, many have used different methodologies and/or have not been well-controlled. This makes it difficult to adequately determine the safety effect of automated

enforcement systems. In response, a 2007 NHTSA study by Decina, et. al. titled "Automated Enforcement: A Compendium of Worldwide Evaluations of Results" produced a compendium of automated enforcement systems worldwide, critically reviewing studies through 2005 that have attempted to evaluate the impact of these systems (12). Narrowing the results to evaluations focusing on study methods and effects, seven were chosen regarding RLCs, and thirteen key studies were chosen in the area of ASE. See Table 1 and 2 below for a description of the studies chosen.

Table 1 – Automated Red Light Running Enforcement Studies

Citation	Location of Intervention
Council, Persaud, Eccles, Lyon, Griffith (2005)	7 jurisdictions, United States
Washington & Shin (2005)	Phoenix, Arizona, United States Scottsdale, Arizona, United States
Cunningham & Hummer (2005)	Raleigh, North Carolina, United States
Garber, Miller, Eslambolchi, Khandelwal, Mattingly, Sprinkle, & Wachendorf (2005)	8 cities, Virginia, United States
Burkey & Obeng (2004)	Greensboro, North Carolina, United States High Point, North Carolina, United States
Synectics (2003)	6 cities, Ontario, Canada
Butler (2001)	Howard County, Maryland, United States Bucks County, Pennsylvania, United States

Table 2 – Automated Speed Enforcement Studies

Citation	Location of Intervention	Type of Deployment
ARRB Group (2005)	New South Wales, Australia	fixed
Cunningham, Hummer, & Moon (2005)	Charlotte, North Carolina, United States	mobile
Goldenbeld & van Schagen (2005)	Friesland Province, the Netherlands	mobile
Gains, Heydecker, Shrewsbury, & Robertson (2004)	Nationwide, United Kingdom	fixed and mobile
Hess (2004)	Cambridgeshire, United Kingdom	fixed
Mountain, Hirst, & Maher (2004)	Great Britain, United Kingdom	fixed
Christie, Lyons, Dunstan, & Jones (2003)	South Wales, United Kingdom	mobile
Newstead & Cameron (2003)	Queensland, Australia	mobile
Chen, Meckle, & Wilson (2002)	British Columbia, Canada	mobile
Chen, Wilson, Meckle, & Cooper (2000)	British Columbia, Canada	mobile
Tay (2000)	Christchurch, New Zealand	mobile
Elvik (1997)	Norway	fixed
Cameron, Cavallo, & Gilbert (1992)	Victoria, Australia	mobile

In general, the review found RLC's and ASE led to substantial reductions in injury crashes. Regarding RLCs, the general conclusion was that cameras reduce crash severity at high red-light running intersections. Yet the studies also discovered that while RLC

implementation led to a decrease in right-angle crashes and red light running violations, there was an increase in rear-end crashes. For automated speed enforcement, the key studies reported a significant reduction in estimated crashes following implementation of the program, and around half the studies documented speed reduction. The compendium noted, however, that only a few studies were well-controlled, and the degree to which the improvements resulted from the treatment as opposed to regression to the mean or other factors could not be determined due to methodological limitations (12).

Studies and articles released following the compendium have generally supported the results of its review on the impact of automated enforcement systems. A safety evaluation conducted by the Federal Highway Administration found that while broadside collisions were reduced by 25 percent at RLC intersections, there was a 15 percent increase in rear-end collisions (13). A 2010 report by Hallmark, et. al. on red light running in Iowa, using Bayesian statistical before-and-after analysis, found RLCs were effective in reducing total crashes as well as red light running crashes (14). Interestingly, the report found that rear-end crashes did not increase at intersections with RLCs. A 2011 report by Hu, et. al. concluded that the decline of fatal red light running crashes was larger for cities with red light camera enforcement programs than for cities without programs (35% vs. 14%), and the rate of fatal red-light running crashes during 2004-2008 for cities with camera programs was 24% lower than what would have been expected without cameras (15).

Regarding automated speed enforcement, a follow-up report by Thomas, et. al. on the compendium results, using evidence from the best-controlled evaluation studies, found injury crash reductions in the range of 20% to 25% for fixed camera ASE programs (mobile speed enforcement programs was limited to only two studies, but was also in the range of 20% to 25%) (16). A 2008 study by Retting, et. al. found that speed cameras significantly reduced the mean speed of automobiles, and led to an 88 percent decrease in the odds of vehicles travelling 11 mph or more above the 65 mph speed limit (17). A 2010 report by Moon and Hummer on ASE cameras deployed in Charlotte, NC during the years 2004-2006, found a significant reduction in collisions on the corridors with cameras in place (18). These reductions continued when the cameras were removed, though collisions slowly returned to pre-deployment levels (18). Finally, a 2011 report by Tobias concluded ASE reduced the speed of cars and trucks by 3-8 mph in work zones (6).

In response to these studies, a number of organizations have recognized the potential of automated enforcement systems to reduce traffic crashes and fatalities. Among these are: the American Association of State Highway and Transportation Officials (AASHTO) Board, AASHTO's Standing Committee on Highway Traffic Safety (SCOHTS), and the International Association of Chiefs of Police (IACP) (8).

Public Opinion

Though the impact of automated enforcement systems on road safety is generally well-documented, citizens still question the need for automated enforcement systems as well as the motives behind their implementation. Some citizens believe automated enforcement systems are a way to generate more revenue for the government, instead of a treatment to prevent crashes. A survey of residents in Chicago, where the use of speed cameras has recently been approved but not yet implemented, found 54 percent of residents oppose the cameras, and 69 percent of respondents believe money rather than safety is the reason the cameras are being installed throughout the city (19). Conversely, if the city loses money on the cameras because of a lack of ticket revenue or other costs, critics argue the cameras are an unnecessary

financial strain on the community (20). Additional oft-cited reasons for opposition are: believing the cameras lead to more crashes; thinking the cameras are prone to errors; preference for officer contact; and feeling they are an invasion of privacy (*2),*(8).. These concerns led citizens in Anaheim, CA, to vote on preemptively denying the installation of automated enforcement systems, and those in Arlington, TX to vote on removing traffic management cameras that could potentially be converted into red light ticketing systems (21).

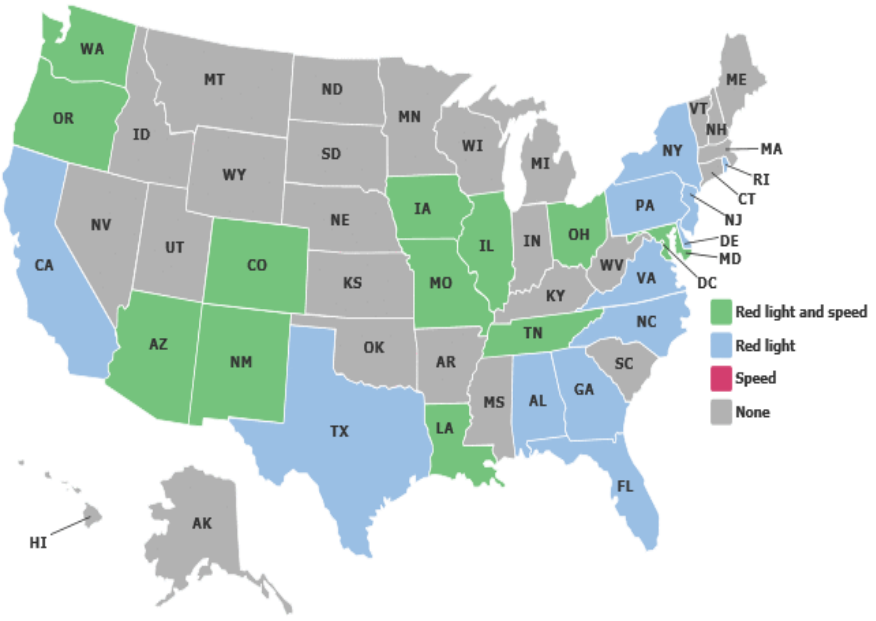
In cities where cameras are already installed, however, there is generally less opposition to their continued use. A survey of 14 major US cities with red light camera programs found two-thirds of drivers favor the use of enforcement, and 59 percent believe the cameras have made intersections safer (2). Another survey conducted by the University of Minnesota's Humphrey School found only when "all roads" were considered for automated enforcement in a community did public support drop below 50% (41). The level of support was extremely high for cameras to be deployed on roads near schools (87%), and large majorities also supported them cameras where people had died, and where many drivers violate the speed limit (41). Nonetheless, critics are forcing cities to continually debate the usefulness of the systems, and cities frequently succumb to this public pressure. Since 1991, citizens have voted on automated enforcement systems 24 times, and only once has a vote been in favor of keeping the systems (22). Other cities, such as Los Angeles, have removed their red-light cameras, at least in part due to pressure from critics (23).

Legal Issues

Even if automated enforcement systems find general support among citizens in communities where they are installed, issues of legality continue to influence their wider implementation. While the courts have consistently rejected Constitutional challenges raised by critics of automated enforcement, some jurisdictions have been drawn into legal battles that forced them to correct operational inconsistencies with their programs (24). This was recently the case in St. Louis, Missouri, where a second court judge ruled the use of red light cameras unconstitutional because of a procedural issue deemed to violate due process rights (25). The issue centered on how the St. Louis ticket contractor mailed out tickets that did not contain a court date or ample notice concerning how the citation could be challenged. Rather than deal with these types of legal challenges, some cities have decided to simply end their contracts with the companies managing the RLC's and/or ASE systems.

Though some states require specific enabling legislation in order to allow the use of automated enforcement systems, others allow their implementation under laws already in existence. Figure 1 displays which states allow each system, and the Insurance Institute for Highway Safety website provides more information on specific details and the laws in individual cities (26). While automated speed enforcement programs have, in the past, been implemented in communities without state level enabling legislation, these programs have been more vulnerable to legal challenges and often contributed to their demise (27).

Figure 1 - States using red light and/or speed cameras



Source: Insurance Institute for Highway Safety, http://www.iihs.org, June 2012

While legislation varies by city and state, certain concerns consistently arise. Some of the main Constitutional challenges raised by critics have been over: due process, equal protection, fourth amendment, "takings clause" of 5th amendment, and privacy (28). Yet each time the issue of constitutionality has been raised, the courts have determined the legality of automated enforcement systems. One challenge that continues to appear in different forms relates to the admissibility of photo evidence. To make sure photos taken by automated enforcement systems are admissible in court, there must be a clear chain of custody established. A 1992 feasibility report, titled "Automated Speed Enforcement Pilot Project for the Capital Beltway: Feasibility of Photo-Radar," suggests jurisdictions establish the following in order to protect evidentiary challenges: time frames for mailing citations to violators, procedures for loading and unloading film, and standards for laboratory processing and storage of photo evidence (28). Without these safeguards, a jurisdiction will be at risk of having the system challenged in court.

Another issue concerns the provision that assigns liability. In most states, liability is assigned to the registered-owner as a civil infraction, and similar to a parking ticket the penalty is a civil fine. In this instance, no decision of guilty or not guilty is required. Yet unlike parking tickets, many states will dismiss the fines if proof is provided by the owner to show they were not driving at the time of the infraction. Some states, however, assign responsibility solely to the driver, and when identification is positively established, the violation can be treated like a moving violation. As a criminal infraction, this violation allows for a number of stiffer penalties: higher fines, demerit points, and the possibility of license suspension. However, driver-liability often requires a positive match be manually established between the photo taken and that of their driver's license. Since obtaining a clear photo is often difficult, it can lead to lower citation rates than owner-liability programs (27).

In order to develop and implement a robust automated enforcement system that avoids and/or withstands potential legal challenges, jurisdictions must have the support of the community, as well as interagency cooperation and involvement. In order to gain support, education is needed to share the benefits of automated enforcement systems and dispel myths commonly associated with them.

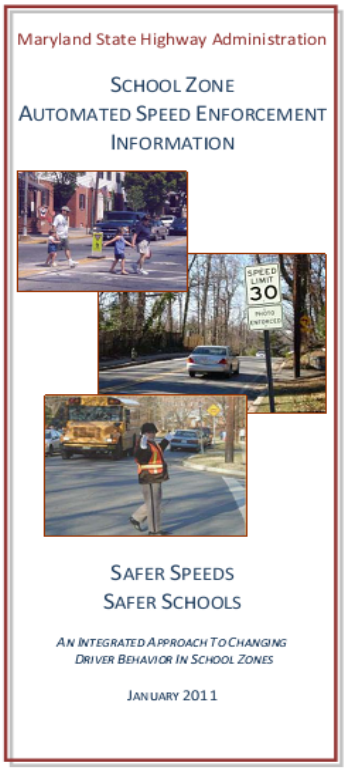
Education

Due to public hesitance toward automated enforcement, a red-light camera program should not be started without a comprehensive public awareness and information campaign. Research has indicated that such campaigns are a key to the success of automated enforcement programs (4). The NHTSA report entitled "Red-Light Camera Systems Operational Guidelines" explains that a successful campaign:

> "Should provide information and data that defines the red-light running problem, explains why red-light running is dangerous, and identifies the actions that are currently being undertaken to reduce the incidence of red-light running. One of the key messages for the red-light running education campaign should be the fatality and injury consequences and resulting emotional and economic toll of red-light running. The emotional toll of red-light running to crash victims and their families is quite obvious; however, the indirect economic costs associated with red-light running related crashes in terms of lost productivity, higher insurance premiums, and medical cost, while significant, are often not understood. The on-going public information and education program should use various media, such as: posters, mailings, hand-outs, public service announcements on radio and television, warning notices, billboards, warning signs, press releases, slogans, and bumper stickers" (4).

Regarding ASE systems, the NHSTA stresses that officials should conduct a similar communications campaign, explaining what the ASE program is, how it works, and why the program is worthwhile for the community (24). Discrediting myths about automated enforcement systems is also important, especially those most commonly cited by critics – that the cameras are a deceptive way for cities to generate revenue and that they are prone to mistakes. In reality, the cameras will generate little, if any, extra revenue. A 2007 study by Rodier, et. al. found that only a few automated enforcement systems in the US actually generate revenue, as most are either revenue-neutral or require a subsidy (27). Regarding the unreliability of the systems, a June 2011 Insurance Institute for Highway Safety Report recommends that cities explain there are safeguards in place to ensure only those who are in clear violation receive citations (2).

For RLCs, education on the meaning of a yellow indication is also necessary, as legal codes differ between states. The permissive yellow law as described in the Manual on Uniform Traffic Control Devices (MUTCD) and Uniform Vehicle Code states a driver can enter the intersection during the entire yellow interval and be in the intersection during the red indication, as long as he or she entered the intersection during the yellow interval (29). As of 2009, 37 states have laws in substantial conformity with the yellow and red indications in the MUTCD and UVC (42). In other states, however, two other types of restrictive yellow laws may apply: vehicles can neither enter the intersection nor be in the intersection on red; or vehicles must stop upon receiving the yellow indication, unless it is not possible to do so safely. Clarifying what the state law is regarding yellow indication must be part of the education campaign preceding implementation of a RLC program.



The front of a brochure used in Maryland. Full brochure can be seen at: http://www.marylandroads.com/OOTS/SZ-ASE%20Brochure.pdf

Automated Enforcement Systems and Engineering/Other Improvements

Regarding the actual implementation of these systems, the National Highway Traffic Safety Administration (NHTSA), along with the Federal Highway Administration (FHWA) and the Federal Motor Carrier Safety Administration (FMCSA), have developed comprehensive guides to assist cities with such an undertaking (4),24). In addition, the National Cooperative Highway Research Program has developed guidelines, along with best practices and case studies, which can be used by cities to start or improve their use of automated enforcement systems (8)**Error! Reference source not found.**. These guides methodically describe the process of adding automated enforcement systems, including planning, program startup, operations, adjudication and evaluation. They also note that, in addition to education and the supplemental enforcement provided by automated enforcement systems, adding engineering countermeasures is the most effective way to minimize crashes from red-light running and speeding.

Some of the engineering improvements suggested to counter red-light running and/or minimize crashes include: increasing the size of traffic signal lamps from 8 to 12 inches; adding additional signal heads; having an all-red clearance interval of 1-3 seconds; having advanced warning signs/flashing lights; adjusting the approach speed; adding a green phase extension for cars in the dilemma zone; removing on-street parking and unwarranted traffic signals; having advanced traffic signals; and having the appropriate timing of yellow lights. These are displayed in Table 3 below.

Table 3 – Recommended Engineering Improvements

Improve Signal Visibility/ Conspicuity	Increase the Likelihood for Stopping	Remove Reasons for Intentional Violations	Eliminate the Need to Stop
Signal for Each Approach Through Lane	Install Signal Ahead Signs	Adjust Yellow Change Interval	Coordinate Signal Operation
Install Backplates	Install Transverse Rumble Strips	Provide or Adjust All-Red Clearance Interval	Remove Unwarranted Signals
Modify Placement of Signal Heads	Install Activated Advance Warning Flashers	Adjust Signal Cycle Length	Construct a Roundabout
Increase Size of Signal Displays	Improve Pavement Surface Condition	Provide Dilemma Zone Protection	
Install Programmable Signal/ Visors or Louvers			
Install LED Signal Lenses			

Source: FHWA-SA-10-005, November 2009

Each of these engineering countermeasures should be considered and employed on an intersection-specific basis, with the intent of increasing overall safety and reducing crashes. For example, regarding the timing of yellow lights, many now suggest cities increase the length of yellow incrementally and let the camera document the results (30). This allows the city to learn the optimal time a light should remain yellow, at each intersection, in order to maximize the safety effects of the automated enforcement systems. Certain cities have been accused of shortening yellow lights in order to increase the amount of revenue generated by cars still in the intersection when the light turns red. Doing so undermines the program, and may actually increase the likelihood of crashes. In order to gain acceptance of automated enforcement systems, jurisdictions must use enforcement, education, and engineering improvements with the primary intent of increasing overall public safety.

Another strategy of many jurisdictions has been to rotate RLCs between multiple intersections, in an attempt to maximize efficiency with a limited amount of camera systems. A study conducted in 2010, however, found that having the cameras fixed at the most problematic intersections was more effective than rotating cameras between different locations (31). The study argues that risk-taking drivers will choose not to obey the law if they are uncertain about enforcement, and thus having consistent enforcement at the most problematic intersections is the way to maximize safety. Rotating cameras can result in more violations, but since cities should not be using the cameras for revenue generation, they should focus instead on the intersections most prone to crashes. Some jurisdictions have even developed a grace time of 0.1 or more seconds before the camera begins taking photos. This can further reduce the number of citations issued and decrease the number of citations contested in court, as well as increase public acceptance of the system (8).

For automated speed enforcement, the document "Speed Enforcement Camera Systems Operational Guidelines," developed by the NHTSA, FHWA, and FMCSA, offers a number of engineering countermeasures that can aid the effectiveness of ASE programs. These include: improved signage, pavement markings, and traffic signals; improved roadway hardware and design features such as guardrails or shoulders and removal of dangerous roadside obstacles to mitigate the effects of road departure crashes; pavement resurfacing; installations of traffic-calming devices such as speed humps and rumble strips; geometric alterations such as roundabouts and roadway realignment; and having appropriate speed limits (24). The guidebook also says the cameras can be rotated among a greater number of "housings," thus deterring speeding among a greater number of locations when cities have a limited amount of cameras. If "dummy housings" are set up, however, cities still must focus principally on high risk roads and zones. A recent policy review found cameras placed in low-risk environments can lead to public skepticism regarding the motive for their use (32). Additionally, many cities have developed a speed tolerance, which is the difference between the posted speed limit and the speed at which tickets are issued. Typical ranges for speed tolerances are from 4-11 mph over the posted speed limit, subject to location and whether or not it is in a school or work zone (8).

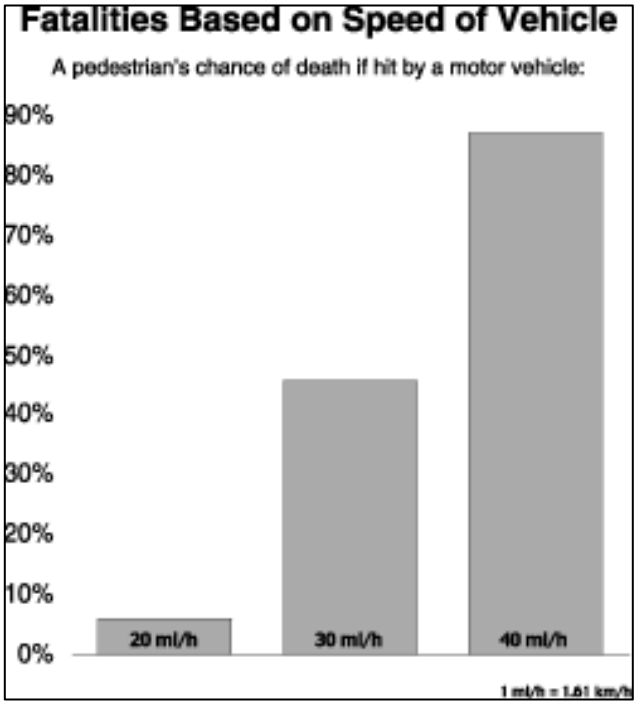
Combining automated enforcement systems with other traffic calming measures has been proven to be most effective. In Portland, a study of ASE conducted in 2005 in school zones around the city found that speed reduction was greatest when ASE was combined with the use of a flashing beacon (33). This combination resulted in an effect on speed reduction twice that of ASE alone. This same study found that the effects of ASE on speed reduction were sustained for, at minimum, a full month at the demonstration sites following camera removal.

Automated Enforcement Systems and Bike/Pedestrian Safety

Because of variance in conditions, it is difficult to acquire precise data on the number of pedestrian and bicyclist injuries and deaths directly caused by automobiles running red lights. Yet according to the NHTSA's Federal Analysis Reporting System (FARS) data, speeding automobiles directly accounted for 368 pedestrian and 64 bicyclist fatalities in 2010 (43). Also, more than two thirds of deaths in crashes caused by red light runners are other drivers, bicyclists, or pedestrians (2). Additionally, data on the total number of cyclist and pedestrian injuries and deaths as a result of traffic crashes reveals a persistent problem. In 2010, 618 cyclists and 4,280 pedestrians in the United States were killed in traffic crashes, and an estimated 70,000 more were injured. (34). This means, on average, a pedestrian was killed every 2 hours and injured every eight minutes in traffic crashes in the U.S. (35). These pedestrian and bicycle crashes accounted for 13 percent of all traffic fatalities and 3 percent of all people injured in traffic crashes.

While the number of direct injuries and deaths to bicyclists and pedestrians by drivers running red lights is uncertain, there is evidence suggesting such an action by drivers has a substantial toll on pedestrians and bicyclists. In 2009, 24 percent of crashes killing pedestrians, and 33 percent of crashes that resulted in cyclist deaths, occurred in intersections (34),35). Additionally, a report done in Boulder, CO found that crosswalks are the most common locations for collisions involving bicyclists (39% of all collisions) or pedestrians (36%) and motor vehicles (36).

In addition to its direct impact on pedestrian and bicyclists, speeding was also a contributing element in 32 percent of all fatal crashes in the year 2010 (5). While less than 10 percent of the vehicle drivers involved when pedestrians were killed had speeding as a contributing factor documented in the crash, speeding does have serious consequences when a pedestrian is involved (37). A report by the U.K Department of Transportation found that a pedestrian hit at 64.4 km/h (40 mi/h) has an 85 percent chance of being killed; at 48.3 km/h (30 mi/h), the likelihood goes down to 45 percent, while at 32.2 km/h (20 mi/h), the fatality rate is only 5 percent. Faster speeds can also increase the likelihood of a pedestrian being hit, since at higher speeds motorists are less likely to see a pedestrian, or be able to stop in time to avoid a collision (38).



Source: U.K. Department of Transportation, Killing Speed and Saving Lives, London, 1987

Traffic speed is also important in perceptions of safety, and a pedestrian or bicyclist's determination regarding whether a street is suitable. Pedestrians and bicyclists may feel comfortable on streets that carry a lot of traffic at low speeds, but can become discouraged if the traffic is travelling at higher speeds. Automated enforcement systems, together with engineering measures and education, can assist in making roads safer and more appealing for pedestrian and bicycle use.

Discussion

Source: Laura Sandt, pedbikeimages.org

The use of automated enforcement systems has been hindered due to confusion among city officials and the general public regarding the motives behind their installation. Automated enforcement systems are likely to face challenges if installed with the primary intent of generating revenue for the city. As mentioned above, few programs actually generate revenue for their cities (27). This reality recently forced two California cities, Emeryville and Yuba City, to end their program out of concern the program was not generating enough revenue and was tying up police resources (39). The absence of revenue generation is the result of a number of factors, including: capital expenses, operation and maintenance costs; administrative costs to courts, police, and departments of motor vehicles resulting from the increased volume of traffic tickets; and laws that limit ticket revenues to local implementing jurisdictions (27). This does not mean, however, there are no financial benefits by having automated enforcement systems in place. When considered alongside the social and financial cost savings from the reduction in injuries and deaths, these benefits are still significant. For this reason many communities have subsidized such systems. Although currently no studies have explored the impact of automated enforcement as it relates to pedestrian and bicycle safety, the reduction of automobile speeds and crash severity as a result of ASE's and RLC's creates a safer environment for vulnerable road users. Using automated enforcement systems to uniformly enforce traffic laws will help keep intersections and roadways, especially those with a high number of crashes, safe for pedestrians, bicyclists, and motorists.

Automated enforcement systems should not be used by cities as an exhaustive solution to address the problem of red light running or speeding. Rather, they should be viewed as a tool of enforcement, to be implemented alongside education and engineering improvements. Educating the public and other key stakeholders allows the program to gain support, and also dispels myths about what these systems are and what they are not. Involving each city department that has a role in traffic safety and planning is also paramount, in order to ensure cooperation and collaboration on the project. Engineering improvements play a significant role in lowering the number of crashes, as well as creating permanent reductions in speed and traffic flow improvements. These 3 E's of Education, Enforcement, and Engineering, create a comprehensive approach to addressing issues of traffic safety, and maximizes the ability of automated enforcement systems to decrease the number of crashes, injuries, and fatalities (40).

Works Cited

1) Hallmark, S., N. Oneyear, and T. McDonald. *Evaluating the Effectiveness of Red Light Running Camera Enforcement in Cedar Rapids and Developing Guidelines for Selection and use of Red Light Running Countermeasures*, 2011, http://www.intrans.iastate.edu/reports/rlr_iii_w_cvr.pdf.

2) McCartt, A.,T, and A. Eichelberger. *Attitudes Toward Red Light Camera Enforcement in Cities with Camera Programs*, 2011, http://www.iihs.org/research/topics/pdf/r1161.pdf.

3) *2011 Traffic Safety Culture Index*. AAA Foundation for Traffic Safety, 2012, http://www.aaafoundation.org/pdf/2011TSCIndex.pdf.

4) *Red-Light Camera Systems Operational Guidelines, Publication FHWA-SA-05-002*. FHWA, U.S. Department of Transportation, January 2005, http://safety.fhwa.dot.gov/intersection/redlight/cameras/fhwasa05002/#toc89679989

5) *Quick Facts – 2010*. National Highway Traffic Safety Administration, http://www-nrd.nhtsa.dot.gov/Pubs/811616.pdf.

6) Tobias, P. *Research Pays Off: Automated Speed Enforcement Slows Down Drivers in Work Zones*. TR News, No. 277, 2011, pp. 29-31, http://onlinepubs.trb.org/onlinepubs/trnews/trnews277rpo.pdf.

7) *National Highway Traffic Safety Administration*. Traffic Safety Facts – 2009 Data, 2012, http://www-nrd.nhtsa.dot.gov/Pubs/811397.pdf.

8) Eccles, Kimberly A; Fiedler, Rebecca; Persaud, Bhagwant; Lyon, Craig; Hansen, Glenn. *Automated Enforcement for Speeding and Red Light Running*. NCHRP Report, Issue 729, 2012, 84p.

9) Adams, J.,S, and B. VanDrasek J. *Automated Enforcement of Red-Light Running & Speeding Laws in Minnesota: Bridging Technology and Public Policy*, 2009, http://www.cts.umn.edu/Publications/ResearchReports/pdfdownload.pl?id=1234

10) *Communities using red light and/or speed cameras*. Insurance Institute for Highway Safety, June 2012. http://www.iihs.org/laws/auto_enforce_cities.aspx.

11) San Francisco Department of Public Health. *Automated Speed Enforcement – September 2011*, www.sfphes.org/component/jdownloads/finish/8/97.

12) Decina, L.,E, L. Thomas, R. Srinivasan, and L. Staplin. *Automated Enforcement: A Compendium of Worldwide Evaluations of Results*, 2007, http://www.google.com/url?sa=t&rct=j&q=automated%20enforcement%20a%20compendium&source=web&cd=1&ved=0CFEQFjAA&url=http%3A%2F%2Fwww.nhtsa.gov%2FDOT%2FNHTSA%2FTraffic%2520Injury%2520Control%2FArticles%2FAssociated%2520Files%2FHS810763.pdf&ei=w5K_T7qAPKKe6AGR3ZCuCg&usg=AFQjCNFSQ1fYo7KN-iJN1cwPiQS6z8aZAA&cad=rja.

13) Council, Forrest M; Persaud, Bhagwant N; Eccles, Kimberly A; Lyon, Craig; Griffith, Michael S. *Safety Evaluation of Red-Light Cameras*. Battelle Memorial Institute; Federal Highway Administration, 2005, 95p.

14) Hallmark, S., M. Orellana, E. Fitzsimmons J, T. McDonald, and D. Matulac. *Red Light Running in Iowa: Automated Enforcement Program Evaluation with Bayesian Analysis*. Transportation Research Record: Journal of the Transportation Research Board, No. 2182, 2010, pp. 48-54, http://dx.doi.org/10.3141/2182-07.

15) Hu, W., A. McCartt T, and E. Teoh R. *Effects of Red Light Camera Enforcement on Fatal Crashes in Large US Cities*. Journal of Safety Research, Vol. 42, No. 4, 2011, pp. 277-282, http://www.sciencedirect.com/science/article/pii/S0022437511000612.

16) Thomas, L.,J, R. Srinivasan, L. Decina E, and L. Staplin. *Safety Effects of Automated Speed Enforcement Programs: Critical Review of International Literature*. Transportation Research Record: Journal of the Transportation Research Board, No. 2078, 2008, pp. 117-126, http://dx.doi.org/10.3141/2078-16.

17) Retting, R.,A, S. Kyrychenko Y, and A. McCartt T. *Evaluation of Automated Speed Enforcement on Loop 101 Freeway in Scottsdale, Arizona*, 2008, http://www.iihs.org/404.aspx?url=http://www.iihs.org/research/topics/pdf/speed_cameras_scottsdale.pdf.

18) Moon, J., and J. Hummer E. *Speed Enforcement Cameras in Charlotte, North Carolina: Estimation of Longer-Term Safety Effects*. Transportation Research Record: Journal of the Transportation Research Board, No. 2182, 2010, pp. 31-39. http://trb.metapress.com/content/0j041871457147r4/fulltext.pdf.

19) Secter, Bob. *Poll: City residents don't want speed cameras*, Chicago Tribune. May 25, 2012, http://www.chicagotribune.com/news/local/ct-met-rahm-emanuel-speed-cameras-20120525,0,6367428.story. Accessed June 15, 2012.

20) Garrick, David. *Losses mount for Escondido's red-light camera program*, North County Times. April 1, 2011, http://www.nctimes.com/news/local/escondido/article_d472489e-1886-595f-bdfa-5de5953bb2ee.html. Accessed June 15, 2012.

21) Thenewspaper.com. *Red Light Cameras Routed at Ballot Box*, November 3, 2010, http://www.thenewspaper.com/news/33/3311.asp. Accessed June 4, 2012.

22) Thenewspaper.com. *List of Public Votes Against Red Light Cameras and Speed Cameras*, December 5, 2011, http://www.thenewspaper.com/news/36/3655.asp. Accessed June 5, 2012.

23) Rubin, Joel. *L.A. traffic cameras may get the red light*, Los Angeles Times. June 8, 2011, http://articles.latimes.com/2011/jun/08/local/la-me-0608-red-light-20110607. Accessed June 5, 2012.

24) *Speed Enforcement Camera Systems Operational Guidelines, Publication DOT-HS-810-916*. FHWA, U.S. Department of Transportation, March 2008, http://ntl.bts.gov/lib/30000/30100/30166/810916.pdf.

25) Thenewspaper.com. *Missouri: Another Court Rules Red Light Cameras Unconstitutional*, May 24, 2012, http://www.thenewspaper.com/news/38/3802.asp. Accessed June 5, 2012.

26) *Automated Enforcement Laws*. National Institute for Highway Safety, June 2012, http://www.iihs.org/laws/automated_enforcement.aspx.

27) Rodier, C.,J, S. Shaheen A, and E. Cavanagh. *Automated Speed Enforcement for California: A Review of Legal and Institutional Issues*. PATH Research Report, 2007, p. 29, http://www.path.berkeley.edu/PATH/Publications/PDF/PRR/2007/PRR-2007-14.pdf.

28) Lynn, C.,W, N. Garber J, W. Ferguson S, T. Lienau K, R. Lau, J. Alcee V, J. Black C, and P. Wendzel M. *Automated Speed Enforcement Pilot Project for the Capital Beltway: Feasibility of Photo-Radar*. Final Report, 1992. http://ntl.bts.gov/DOCS/ase.html.

29) *Engineering Countermeasures to Reduce Red-Light Running*. Publication FHWA-SA-10-005. FHWA, U.S. Department of Transportation, November 2009, http://safety.fhwa.dot.gov/intersection/resources/fhwasa10005/docs/brief_6.pdf.

30) Retting, Richard A; Ferguson, Susan A; Farmer, Charles M. Reducing *Red Light Running Through Longer Yellow Signal Timing and Red Light Camera Enforcement: Results of a Field Investigation*. ITE 2008 Technical Conference and Exhibit; 2008, http://www.stopredlightrunning.com/pdfs/ReduceRedLt_IIHS_.pdf.

31) Tay, Richard; De Barros, Alex. *Should traffic enforcement be unpredictable? The case of red light cameras in Edmonton. Accident Analysis and Prevention*, Volume 43, Issue 3, 2011, pp. 955-961, http://www.sciencedirect.com/science/article/pii/S0001457510003660.

32) Willis, D.,K. *Speed Cameras: An Effectiveness and a Policy Review*. , 2006, http://tti.tamu.edu/documents/TTI-2006-4.pdf.

33) Freedman, M., D. De Leonardis, G. Raisman, D. InyoSwan, A. Davis, S. Levi, I. Rogers, and E. Bergeron. *Demonstration of Automated Speed Enforcement in School Zones in Portland, Oregon*, 2007.

34) *Traffic Safety Facts 2010 Data: Bicyclists and Other Cyclists*. Publication DOT-HS-811-624, FHWA, U.S. Department of Transportation, 2011, http://www-nrd.nhtsa.dot.gov/Pubs/811624.pdf.

35) *Traffic Safety Facts 2010 Data: Pedestrians*. Publication DOT-HS-811-625, FHWA, U.S. Department of Transportation, 2011, http://www-nrd.nhtsa.dot.gov/Pubs/811625.pdf.

36) *Safe Streets Boulder: Striving to Make Boulder Streets Even Safer*. City of Boulder Transportation Division, February 2012, http://www.bouldercolorado.gov/files/Transportation/GO_Boulder/Safe_Street_Boulder_Report.pdf.

37) Chang, D. *National Pedestrian Crash Report, 2008*, http://www-nrd.nhtsa.dot.gov/Pubs/810968.pdf.

38) U.K. Department of Transportation, *Killing Speed and Saving Lives*, London, 1987.

39) Thenewspaper.com, “Two Northern California Cities Dump Red Light Cameras,” May 18, 2012, http://www.thenewspaper.com/news/37/3796.asp. Accessed June 7, 2012.

40) *Ft. Collins, Colorado, Using the Three "E"s to Stop Speeding in Neighborhoods*. The United States Conference of Mayors, http://www.usmayors.org/chhs/traffic/best_traffic_initiative_collins.htm.

41) Munnich Jr, Lee W; Loveland, Joseph D. *Do Americans Oppose Controversial Evidence-Based Road Safety Policies?.* Transportation Research Record: Journal of the Transportation Research Board, Issue 2213, 2011, pp. 9-12.

42) *Red-Light Running*. FHWA/USDOT, PowerPoint Presentation, http://safety.fhwa.dot.gov/intersection/redlight/outreach/marketing/rlr_pps022509/long/. Accessed October 4, 2012.

43) *FARS Encyclopedia*. National Highway Traffic Safety Administration (2010), *http://www-fars.nhtsa.dot.gov/Main/index.aspx*. Accessed October 10, 2012.

Pedestrian and Bicycle Information Center

730 Martin Luther King Jr. Blvd., Suite 300
Chapel Hill, North Carolina 27599-3430
pbic@pedbikeinfo.org
888-823-3977