

Special issue: automated enforcement

STATUS REPORT

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Modernizing traffic law enforcement through automation: U.S. lags behind

Automated enforcement of traffic laws is routine in many countries. Motorists take for granted that cameras will spot them if they run a red light or exceed the speed limit. But camera enforcement is catching on more slowly in the United States. This special *Status Report* summarizes evidence from around the world about the effectiveness of automated enforcement.



Results vary, but studies find red light cameras reduce injuries

Red light running results in an estimated 260,000 crashes each year in the United States, and 750 of the crashes are fatal. Cameras that detect red light running deter violations. The findings of numerous studies suggest that photo enforcement also reduces injury crashes at intersections. However, the results of these studies vary widely in terms of the extent of the crash reductions. An Australian study found an injury crash reduction of 7 percent, another Australian study found a reduction of 46 percent, and an Institute study found a 29 percent reduction.

The Institute has critically reviewed crash-based studies of red light camera programs, virtually all of which have reported reductions — some large, some relatively small — in injury crashes. The variability of the findings reflects methodological problems evident in many of the studies. Such problems may have led researchers to either over- or underestimate the crash effects of the cameras.

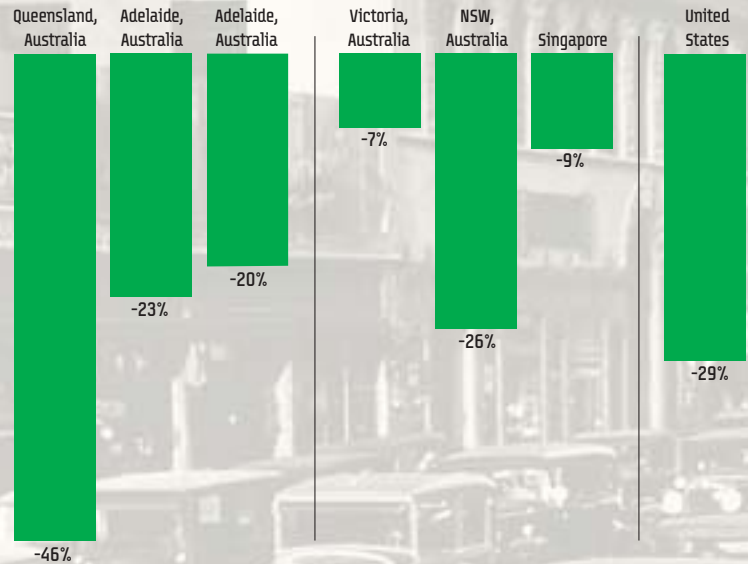
Most studies also reported increases in rear-end crashes. This isn't surprising. The more people stop on red, the more rear-end collisions there will be if motorists behind them are following too closely or not paying attention.

Despite this effect, the body of evidence indicates that red light cameras are beneficial. "Although rear-end crashes tend to go up, when you look at all crash types — in particular those involving injury — photo enforcement leads to significant overall reductions in crashes," says Susan Ferguson, the Institute's senior vice president for research.

Studies conducted in Australia, the United States, and Singapore met the criteria for the Institute's review. To be included, a study had to present crash data for intersections before and after red light cameras were installed. The studies had to include data from comparison sites without cameras.

During the review, Institute researchers found that many of the studies had methodological weaknesses, including failure to control for the statistical tendency known as regression to the mean. This happens when red light cameras are applied to the worst intersections with the highest crash frequencies, and then the intersections are compared with ones that haven't been treated. "If crashes are already (continues on p.7)

Injury crash reductions attributed to red light cameras in Australia, Singapore, and the United States



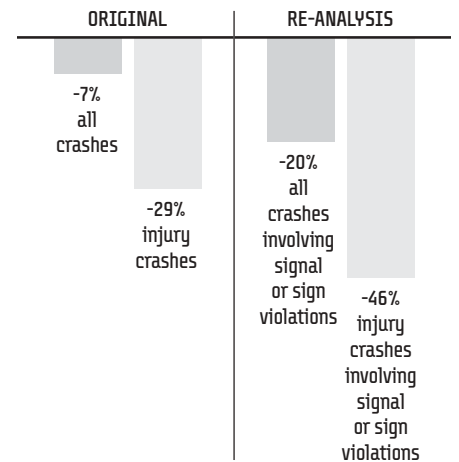
Note: The first 3 studies [Queensland and 2 in Adelaide, Australia] did not control for regression to the mean or spillover. The next 3 studies [Victoria and New South Wales, Australia, plus Singapore] controlled for regression to the mean but not spillover. The 7th study, conducted in the United States [Oxnard, California], controlled for both effects.



Institute findings confirmed:
 red light cameras
reduce crashes
 including serious ones

One red light camera study cited in the Institute's review (see facing page) was conducted in Oxnard, California. A question was raised at California state hearings about the study's findings of 7 percent fewer crashes overall and 29 percent fewer injury crashes at signalized intersections after red light cameras were introduced. A state senator said the Institute researchers who conducted the study should have taken into account what police said about the causes of the intersection crashes — whether they were or weren't caused by red light running. The problem is that the California data about crash causation at intersections include violations other than red light running. Still,

Reductions in intersection crashes in Oxnard, as first reported by the Institute and according to a re-analysis suggested by a California legislator



most violations at signalized intersections are likely to involve red light running, so the researchers followed the senator's suggestion and re-analyzed the Oxnard data. This time the findings showed even greater effects of cameras — 20 percent fewer crashes and 46 percent fewer injury crashes that police said involved violations at signalized intersections. So any way you look at it, red light cameras cut crashes and prevent injuries.

All these studies have reported reductions — some large, some relatively small — in injury crashes. The variability of the findings reflects methodological problems evident in many of the studies. Such problems may have led researchers to either over- or underestimate the crash effects of the cameras. The body of evidence indicates that red light cameras are beneficial.

Automated traffic law enforcement is in use worldwide

The use of cameras to enforce traffic laws isn't new. The two most common applications — speed cameras and red light cameras — have been used for years in Canada, Australia, and a number of countries in Europe. Automated enforcement is common in these countries, and it's becoming more sophisticated as technology progresses. New applications are continually being tested.

Police have turned to technology because traditional enforcement alone isn't enough to curb violations. There are only so many officers on patrol. Even on dedicated patrols, each officer is likely to observe and ticket only a handful of violators. The main limitation of traditional enforcement is thus manpower. Drivers know the risk of being detected is small.

This is where cameras come in. They can be placed in many locations to operate around the clock and identify virtually every offender. The deterrent effect is obvious — drivers are discouraged from violating the laws because they know the risk of detection goes up when cameras are in use.

"The goal of automated enforcement, with its huge capacity, is to significantly increase the objective and perceived chances of being caught, thus creating a change in behavior that will translate into a crash reduction, whether it applies to speeding, running red lights, or tailgating," says Shalom Hakkert, a visiting Institute scholar who has been studying automated enforcement practices around the world.

Speed cameras: Also called photo radar, speed cameras are the most widely used form of automated enforcement in the world. They're in Australia, Austria, Israel, the Netherlands, Norway, and the United Kingdom. Between tens and hundreds of sites in each country have speed cameras.

The cameras aren't functioning as a small adjunct to traditional police enforcement. They're generating the majority of all

speeding tickets in some countries. For example, in the United Kingdom almost half of all speeding tickets result from automated enforcement. In contrast, photo radar has never been used extensively in the United States. It's being tried now in a few communities including Washington, D.C. (see p.6), and early results indicate fewer speeders. However, such programs are exceptions.

Two camera types are in use. One takes single "spot" measurements of vehicle speeds, using either radar or cables buried in the roadway to measure the speeds. When a speeding vehicle is detected, a camera snaps two photos of the license plate, typically the rear plate. Another type of camera system measures average vehicle speeds over given distances.

"The rationale for taking an average is essentially to give a driver the benefit of the doubt," Hakkert says. "It avoids the complaint that sometimes arises with ordinary speed cameras, which is that a single spot measurement could somehow be unfair."

The Netherlands is testing a system that uses sets of three speed cameras installed over a three-kilometer stretch of highway. Vehicles are digitally photographed as they pass below each camera. The images are stored only long enough to enable the system to search for matches. When a match is found, the vehicle's average speed is calculated, and if it exceeds the limit the images of that particular vehicle and license plate are stored as evidence of a violation.

Red light cameras: Like speed cameras, red light cameras are in use around the world including Australia, Canada, many European countries, Israel, Singapore, South Africa, and Taiwan. In the United States, at least eight major cities and a num-



ber of smaller communities use red light cameras. However, the extent of use in U.S. communities doesn't approach the use being made of red light cameras in Australia, for example, where their use dates back to 1981. In the Melbourne area alone, 35 red light cameras are being rotated among 132 sites.

The basic technology has been around since the 1960s. Cameras are set up to photograph vehicles that enter intersections after signals have turned red. Detection of an offense is made by sensors that are



Courts in San Diego and elsewhere find no constitutional flaws

Relatively few U.S. jurisdictions use red light cameras or photo radar, compared with other countries. But the numbers are growing, even as a small but outspoken contingent of camera critics complains to the courts that cameras invade privacy or otherwise are unconstitutional.

A highly publicized lawsuit was brought in 2001 in San Diego, California, over the city's use of red light cameras. The Superior Court judge deciding the case issued a ruling that eventually led to the dismissal of about 300 tickets. Camera opponents hailed this as a landmark but, in fact, the judge specifically upheld the constitutionality of the camera program. The tickets were dismissed because of defects in how the program was operated. Specifically, the city was found to be at fault for allowing the contractor excessive control and for paying the contractor according to the number of paid tickets.

Institute senior transportation engineer Richard Retting says "to gain public trust, camera programs must be operated in ways above any suspicion of a profit motive. When a contractor runs a program and gets paid per ticket, that's a flawed business model, especially because the objective should be to deter offenders and, therefore, write no tickets. The good thing about San Diego is that government agencies now have judicial guidance on what to avoid when they set up the administrative aspects of their programs."

Court challenges also have forced changes in Denver, Colorado's camera program, which has been halted while the city reassesses its administration. The city dismissed all outstanding photo radar tickets after a district court judge ruled that the program illegally gave police powers to a private contractor. The policy of compensating a contractor based on ticket volume also was found to violate state law. Retting notes that the flaws were technicalities, "but technicalities are important, and they have to be handled properly if automated law enforcement is going to succeed."

buried in the pavement and connected to the traffic signals and camera. Some newer systems use video instead of 35 mm film.

One video system can predict red light violations several seconds before they occur. Then the system automatically extends the all-red signal to prevent collisions from occurring.

Other applications: Automated enforcement isn't limited to speed cameras and red light cameras. In the United States, photo enforcement is being used to monitor illegal railway crossings and violations of laws

requiring vehicles to stop for school buses. In the Netherlands and Israel, cameras monitor tailgating.

Multiple application systems are another new development. One currently being tested in London monitors for red light runners and speeders at the same time. Other camera uses include checking for overweight trucks, illegal use of bus and high occupancy traffic lanes, and toll violations.

Future of automation: Most current systems aren't fully automated. Only the detection and recording of offenses is auto-

matic. The ticketing part of the process still is done manually by reviewing the photographic evidence.

Fully automated systems may be in the future. Digital cameras already exist that can recognize license plates, link to motor vehicle registration databases, and issue tickets. The speed enforcement system being tested in the Netherlands has this capability. However, many technical, legal, and political issues will have to be worked out before completely automated enforcement is widely accepted.

Cameras reduce speeding on D.C. streets

Speed cameras in use for more than 20 years in numerous countries (see. p.4) are reducing travel speeds. Now the same benefit is accruing from photo radar in a U.S. community, new research shows.

Washington, D.C. implemented a city-wide speed camera program beginning last summer. The police department has deployed five vehicles equipped with cameras, moving them among 60 enforcement zones throughout the city. Residential streets, major arteries, highways, and school and work zones are being targeted.

The cameras snap pictures of the rear license plates of vehicles exceeding the speed limit by more than a set amount, usually 10 mph, and violators are ticketed by mail. After a 30-day warning period during July 2001, police began mailing violation notices to the owners of speeding vehicles identified by the cameras. Fines range from \$30 to \$200 per violation, depending on how much faster than the speed limit a vehicle was traveling.

Institute researchers measured travel speeds on seven neighborhood streets before the cameras were deployed and again at the same sites six months after deployment. At all of the sites, the proportion of motorists going fast enough to warrant getting a ticket went down. The reductions ranged from 38 to 89 percent.

At the same time, the proportion of motorists going more than 10 mph faster than the speed limit at eight sites in Baltimore, Maryland, stayed about the same or increased slightly. Cameras aren't being used in Baltimore.

"It's a very clear finding. It's an across-the-board benefit for the District's camera program," says Richard Retting, the Institute's senior transportation engineer. He explains that the city's speed cameras "aren't fixed in place at locations around town. They're mounted on unmarked police cars and operated by officers who set up



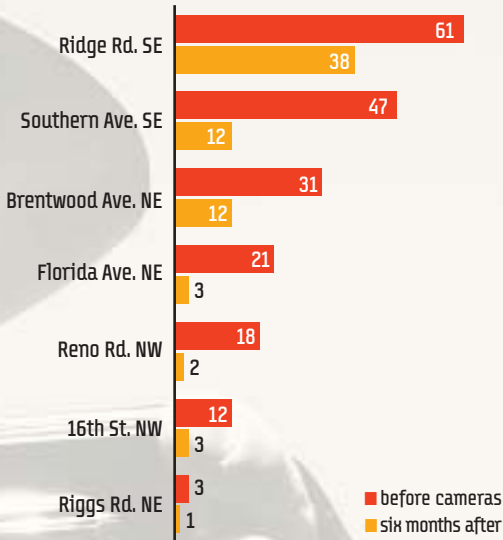
the cameras and monitor them while they're operating. An officer can shut down camera operation if traffic conditions warrant. That's one of the advantages of this kind of system."

Another advantage is that the vehicle-mounted cameras are easy to move from one location to another. "By moving the cameras around, there's a general influence on vehicle speeds across the city, including where the cameras aren't operating," Retting notes.

Lt. Patrick Burke, traffic coordinator of the police department, says "the goal isn't to ticket motorists." This is why "there are in excess of four dozen signs that say 'traffic law photo enforced' posted around the city. The idea is to get people to think twice because they might get their license plate snapped if they speed."

Unlike conventional radar equipment, which police aim at a stretch of road on which numerous vehicles may be traveling, the speed cameras in use in the District of

Percent of vehicles going more than 10 mph faster than the speed limit before and after speed cameras in Washington, D.C.



Columbia pinpoint particular vehicles. This method removes potential confusion about which vehicle was speeding.

About 75 countries rely on cameras to enforce speed limits (see *Status Report*, June 19, 1999; on the web at www.highwaysafety.org). The cameras have reduced both high travel speeds and crashes. But cameras aren't yet in use in many U.S. communities.

"Using cameras would enhance safety," Retting points out. "Research conducted in Canada, Australia, Europe, and now in the District of Columbia indicates that motorists are less likely to speed in communities where camera enforcement is employed."

(continued from p.2) unusually high at a given location, over time they're likely to decline or normalize with or without intervention," Ferguson explains. "Studies that didn't compare sites with comparably high crash rates and didn't adequately control for regression to the mean probably overestimated the crash reductions."

Another common bias was not adequately controlling for the spillover effects of cameras on other intersections. Photo enforcement tends to produce generalized changes in driver behavior, so violations and crashes decline throughout the area where cameras are used, not just at the specific intersections equipped with cameras. In fact, many jurisdictions structure their programs to promote a perception of community-wide camera enforcement. The studies that only looked at crashes within the same area and, therefore, didn't control for spillover probably understated crash reductions.

To account for these methodological weaknesses, Institute researchers segregated the studies into groups and compared findings among groups:

1. The first group of studies, all from Australia, didn't control for either regression to the mean or spillover effects. Combined results from this group indicate an overall 39 percent drop in injury crashes at camera sites. A study from Queensland, Australia, reported the largest injury crash reduction (46 percent) of all the studies reviewed. Two studies from Adelaide, South Australia, also reported injury crash reductions.

2. The second group of studies partially controlled for regression to the mean by using comparison sites similar to the camera sites. But these studies didn't control for spillover, which means they probably underestimated the crash reductions. Combined findings of this group indicate a statistically nonsignificant 10 percent reduction in injury crashes. Included among these are two studies from Australia and one from Singapore, site of one of the few red light camera evaluations conducted outside Australia.

3. The sole study conducted in the United States, in Oxnard, California, controlled for both regression to the mean and spillover effects. Researchers looked not only at crashes at Oxnard's camera-equipped sites but also at overall changes in crashes at intersections with signals throughout Oxnard compared with nonsignalized intersections. Comparisons then were made with three other California cities without cameras. The finding of this Institute study was a 29 percent reduction in injury crashes for all 125 signalized intersections in Oxnard (see *Status Report*, April 28, 2001; on the web at www.highwaysafety.org).

Studies in all three groups found increases in rear-end crashes at camera-equipped sites. "To the extent they encourage more stopping, red light cameras may exacerbate rear-end crashes," Ferguson says. She adds that "when you put the available research together, the evidence indicates that red light cameras reduce injury crashes by about 25 to 30 percent, and that's after accounting for some small increases in rear-end crashes." Ferguson concludes that "automated enforcement cameras work, and the international evidence is consistent when you consider the different methodological weaknesses of the various studies."

For a copy of "Effects of red light cameras on violations and crashes: a review of the international literature" by A.S. Hakkert et al., write: Publications, Insurance Institute for Highway Safety, 1005 North Glebe Road, Arlington VA 22201.

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