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Evaluation of automated speed enforcement on Loop 101 freeway in Scottsdale, Arizona

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ABSTRACT

Speed cameras can reduce speeding and injury crashes, but in many communities they are confined to low-speed settings such as residential streets and school zones. In 2006 the city of Scottsdale, Arizona, implemented a 9-month pilot program to evaluate the feasibility and effects of highly visible speed camera enforcement on a busy urban freeway. This was the first use of fixed speed cameras on a major US highway. Deployment of six cameras along an 8-mile corridor was associated with large declines in mean speeds and an 88% decrease in the odds of vehicles traveling 11 mph or more above the 65 mph limit. Traffic speeds increased soon after the pilot program was suspended. In addition to reducing speeding along the enforcement corridor, speed cameras were associated with large reductions in speeding on the same highway but 25 miles away from the camera installations. However, traffic speeds were fairly stable on urban freeways in Scottsdale that were not part of the study road. Public opinion surveys found widespread concerns about speeding on the Loop 101 freeway and high levels of support for speed camera enforcement on this road.

1. Introduction

Speeding violations are common. A 2003 survey of traffic speeds on urban freeways in four US states found 11–78% of drivers exceeded the 55 mph speed limits by 15 mph or more. In two states with 75 mph limits on rural interstates, 10–24% of drivers traveled faster than 80 mph (Insurance Institute for Highway Safety (IIHS), 2003). In Europe an estimated 10–20% of drivers routinely exceed speed limits by more than 10 km/h (6.2 mph) (European Road Safety Observatory, 2006). In a survey of US drivers, one-third of respondents agreed with the statement "I enjoy the feeling of speed," and more than half said they often get impatient with slower drivers (National Highway Traffic Safety Administration, 2002). About one-quarter of European drivers admit to violating motorway speed limits often, very often, or always (SARTRE Consortium, 2004). Drivers often underestimate the risks of traveling at high speeds and overestimate their driving capabilities (Transportation Research Board, 1998).

Because speeding is common and viewed as acceptable behavior by many drivers, it is a major factor in motor vehicle crashes, especially those resulting in serious injuries (Elvik, 2005). In the United States speeding was a contributing factor in about 30% of fatal crashes in 2005, resulting in more than 13,000 deaths (IIHS, 2007). In a high-speed crash a passenger vehicle is subjected to forces so severe that the vehicle structure cannot maintain survival space in the occupant compartment, and restraint systems cannot keep forces on occupants below severe injury levels. There are limits to the amount of crash energy that can be managed by current passenger vehicles, restraint systems, and roadway hardware such as barriers and impact attenuators. The higher the crash speed the more likely these energy limits will be exceeded.

Publicized police enforcement can reduce vehicle travel speeds and crashes (Stuster, 1995). However, many enforcement agencies do not have sufficient resources to mount effective speed enforcement programs. Staffing levels have not kept pace with the growth in motor vehicle travel. Between 1995 and 2005 the estimated number of vehicle miles traveled in the United States increased by 23% (Federal Highway Administration, 2007), but the number of municipal law enforcement officers grew by 12% (Federal Bureau of Investigation, 2007). Traditional enforcement of speed limits can be difficult, if not hazardous, at some locations and times of the day and during periods of heavy traffic. High-speed pursuit of speeding motorists can endanger police officers and the public.

Photo enforcement technology can supplement traditional police enforcement. Speed cameras, also known as photo radar, monitor traffic speeds and photograph drivers traveling above specified speeds, usually well above the speed limits. There are two methods for deploying speed cameras: mobile cameras accompanied by enforcement officers that may be moved among various locations, and fixed cameras unaccompanied by officers that

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monitor speeds at specific locations. Most speed cameras use low-powered Doppler radar signals to detect speeding vehicles and trigger a motor-driven camera and flash unit to photograph vehicles traveling faster than the set speed. The date, time, location, and speed are recorded along with a photograph of the offending vehicle. About 60% of US drivers support the use of this technology (Insurance Research Council, 2007).

Speed cameras can substantially reduce speeding violations and injury crashes. A systematic review of studies of speed camera effectiveness, based mostly on European and Australian studies, reported 50–60% reductions in the proportion of vehicles exceeding speed limits by more than 15 km/h (9.3 mph) (Wilson et al., 2006). Crash reductions associated with speed camera enforcement ranged from 14 to 72%, with 8–46% reductions in injury crashes and 40–45% reductions in fatalities and serious injuries. In the United States, where speed camera use has been more limited, two evaluations have been published. Six months after mobile speed cameras were deployed in the District of Columbia, mean vehicle speeds declined 14%, and the proportion of vehicles exceeding the speed limit by more than 10 mph declined 82% (Retting and Farmer, 2003). In Garland, Utah, highly publicized speed camera enforcement reduced mean speeds in a 20 mph school zone from 36 to 22 mph (IIHS, 1991).

The present study evaluated the effects on vehicle speeds of the first use of fixed speed cameras on a major US highway. The study examined effects in the vicinity of camera enforcement as well as spillover effects at sites located on the same highway but distant from the camera deployments.

2. Methods

In 2006 the city of Scottsdale, Arizona, implemented a 9-month pilot program to evaluate the feasibility and effects of fixed speed camera enforcement on an 8-mile stretch of the Loop 101 freeway running through Scottsdale. The six-lane Loop 101 encircles the Phoenix metro area; traffic volume is approximately 150,000 vehicles per day, and the speed limit is 65 mph.

Six speed camera sites were constructed, three in each direction. Conspicuous traffic signs warned drivers of camera enforcement, and the camera housings were located in plain view (Fig. 1).

Motorists traveling 11 mph or more above the 65 mph speed limit were photographed and cited for speeding. Vehicle speed was determined using a time-distance calculation based on the length of time it took for a vehicle to travel across a series of sensors embedded in the pavement. The cameras photographed the fronts and rears of speeding vehicles to obtain images of rear license plates and drivers. Citations were mailed to registered vehicle owners if the driver's face was visible in the violation photograph and matched the description (e.g., gender, age range) of the registered vehicle owner. In cases where the photographed driver did not match the description of the registered owner, and for violations involving commercial vehicles, a notice of violation was mailed to the registered vehicle owner in lieu of a citation. Because only the actual driver can be held responsible, the notice of violation asked the registered owner to identify the driver. If police could not identify and charge the actual driver within 120 days of the speeding violation, the notice of violation was dismissed. The penalties for photo enforcement citations were three driver's license penalty points and fines of $162 for driving 11–15 mph above the speed limit, $182 for driving 16–20 mph above the limit, and $206 for driving 21 mph or more above the limit.

The pilot program began in January 2006 with a 30-day warning period during which warning notices were mailed to registered vehicle owners in lieu of citations. Full enforcement took place from February 2006 through October 2006.

2.1. Analyses of traffic speeds

Speed data were collected at three study locations. The first was along the 8-mile Scottsdale enforcement corridor on Loop 101 and comprised four data collection sites, two northbound and two southbound. The sites were situated between speed enforcement cameras at distances ranging from 0.5 to 2 miles from the closest camera (Fig. 2). The second location was on Loop 101 in the vicinity of the city of Glendale, approximately 25 miles west of Scottsdale (as measured along Loop 101), and comprised four comparison data collection sites, two northbound and two southbound. At the Glendale sites, there were no changes in traffic enforcement procedures during the study period, and no traffic signs were posted warning drivers of speed camera enforcement in Scottsdale. Given prominent warning signs and obvious fixed camera structures along the Scottsdale section of Loop 101, as well as the substantial distance between Scottsdale and Glendale, it was hypothesized that camera enforcement in Scottsdale would not substantially affect traffic speeds on the Glendale section of Loop 101. Average annual daily traffic volumes were similar on both sections of Loop 101, ranging from 103,000 to 118,000 at the Scottsdale sites, and from 115,000 to 129,000 at the Glendale sites (Arizona Department of Transportation, 2007).

At the Scottsdale and Glendale sites, five rounds of data were collected: approximately 2 months prior to camera enforcement; on three occasions during camera enforcement (approximately 6 weeks, 5 months, and 8 months into the pilot program); and approximately 6 weeks after camera enforcement ended (Table 1).

Results from the first two rounds of data collection during camera enforcement (6 weeks and 5 months into the program) indicated large speed reductions on the Glendale section of Loop 101. Consequently, data collection was expanded to include a third location comprised of non-Loop 101 sites, where two subsequent rounds of data were collected: in September 2006, approximately 8 months after camera enforcement began, and in December 2006, approximately 6 weeks after the camera program ended. The non-Loop 101 speed measurements were made at four sites on 65 mph limited-access highways in the Scottsdale area: Routes 202 and 51.

Fig. 1. Warning signs and fixed camera structures.

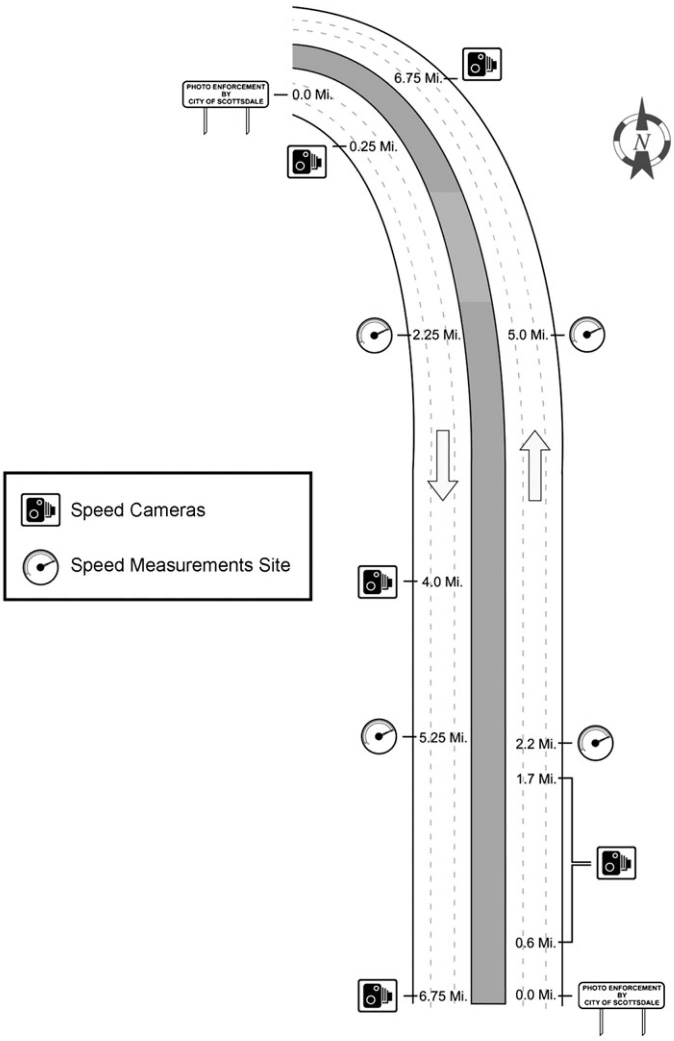

Fig. 2. Approximate locations of speed cameras and speed measurement sites on Loop 101 in Scottsdale.

Speed data were collected using covert photo radar positioned on tripods on the roadside, out of view of passing motorists. The equipment electronically recorded the speeds of all passing vehicles, but photographs were not taken. The equipment also provided a crude classification of passenger vehicles and large trucks based primarily on vehicle length. Speed data collections were scheduled for up to 4 h at each location on weekdays and Saturdays. Data collections conducted during the enforcement and post-enforcement periods were matched to the times of day and days of week for the baseline period.

Because traffic speeds at the non-Loop 101 sites were not measured during the first three rounds of data collection, additional data were obtained for these sites from the Arizona Department of Transportation (ADOT), which maintains permanent monitoring stations in the vicinity of the study data collection sites. ADOT continuously records and archives traffic volume and mean traffic speeds per hour on these roads using inductive loop detectors embedded in the pavement. However, the ADOT data did not classify vehicles by type, nor was it possible to determine from these data the proportions of vehicles exceeding specific speeds. Therefore, the mean speeds for all vehicles were used to compare speed trends between Loop 101 and non-Loop 101 expressways in the area. When data for the final two study periods were collected at the non-Loop 101 sites using photo radar, mean speeds from these data were within 1 mph of the mean speeds from the ADOT data.

Table 1
Study timeline

Date	Event
December 2005	Baseline data collection
February 2006	Start of speed camera enforcement
April 2006	Data collection 6 weeks after start of camera enforcement
July 2006	Data collection 5 months after start of camera enforcement
September 2006	Data collection 8 months after start of camera enforcement
October 2006	End of speed camera enforcement
December 2006	Post-enforcement data collection

Multivariate logistic regression models were used to quantify the effect of cameras on speed limit violations. For these models, data were restricted to the photo radar data and did not include data from the ADOT monitoring stations. A series of analyses evaluated effects of camera enforcement on speeding on the Scottsdale section of Loop 101 versus the Glendale section of Loop 101, the Glendale section of Loop 101 versus non-Loop 101 roads, and the Scottsdale section of Loop 101 versus non-Loop 101 roads. For all models the dependent variable was the proportion of drivers exceeding the 65 mph speed limit by 11 mph or more. Independent variables were treatment (Scottsdale section of Loop 101 vs. comparison sites); vehicle type (passenger vehicle vs. large

Table 2
Mean traffic speeds (mph) at study locations during study period

	Scottsdale Loop 101			Glendale Loop 101			Non-Loop 101 (ADOT)		
	Passenger vehicles	Large trucks	Total	Passenger vehicles	Large trucks	Total	Passenger vehicles	Large trucks	Total
Baseline	70	69	70	69	68	69	–	–	69
6 weeks after start of camera enforcement	64	63	63	64	65	64	–	–	68
5 months after start of camera enforcement	65	65	65	67	65	67	–	–	69
8 months after start of camera enforcement	64	64	64	67	65	67	–	–	68
After camera enforcement ended	69	69	69	70	69	70	–	–	69

truck); presence of camera enforcement (January–October 2006 vs. otherwise); day of week (weekday vs. Saturday); peak hours (weekdays 6:30–9:30 a.m. and 4–7 p.m. vs. Saturdays and other weekday times); and two-factor and three-factor interactions of these variables.

2.2. Telephone surveys

Telephone surveys of Scottsdale residents concerning the Loop 101 speed camera program were conducted during two periods: December 2005, approximately 2 months before camera enforcement began, and September 2006, approximately 8 months after. Telephone surveys of residents in the larger Phoenix metro area also were conducted approximately 8 months after camera enforcement began.

Random-digit-dialing methods were used to select representative samples of licensed drivers ages 18 and older. For the Scottsdale surveys, 300 interviews were completed during each time period. For the Phoenix metro area survey, 400 interviews were completed among drivers who were aware of the Loop 101 speed cameras.

3. Results

3.1. Traffic speeds

A total of 407,891 speed measurements were recorded at all sites during all phases of data collection. About 3% of the observations were excluded due to missing passenger vehicle/large truck classification (11,882 observations). An additional 2416 vehicles (less than 1% of all observations) were excluded because data were collected during heavily congested time periods, as identified through analyses of speed data. Restricting the analyses to the exact same times of day at each site in all data collection periods resulted in the loss of an additional 58,290 speed measurements, leaving 335,303 observations (82% of the original sample).

Table 2 lists the mean traffic speeds at the three study locations for the five data collection periods. At the Scottsdale sites, mean speeds for all vehicles combined declined from 70 mph during the baseline period to 63 mph soon after camera enforcement commenced, and then remained around 65 mph during camera enforcement. Mean speeds increased to 69 mph soon after camera enforcement was suspended. Passenger vehicles and large truck speeds showed similar patterns of change. At the Glendale sites, mean traffic speeds for all vehicles combined (which were similar to those at the Scottsdale sites during the baseline period) declined by 5 mph soon after camera enforcement commenced and remained below the baseline mean speeds until camera enforcement ended. At the non-Loop 101 sites, mean traffic speeds fluctuated between 68 and 69 mph. Note that data for mean speeds on non-Loop 101 roads were from ADOT.

The reduction in mean speeds in Scottsdale translated into large reductions in speeding drivers (Table 3). The proportion of vehicles exceeding 75 mph declined from 15% during the baseline period to 1–2% during camera enforcement. Large declines were seen for both passenger vehicles and large trucks. Soon after camera enforcement was suspended, 12% of drivers were exceeding 75 mph. A similar but smaller reduction in the proportion exceeding the speed limit by 11 mph or more was observed at the Glendale sites. At the non-Loop 101 sites, the proportion of vehicles traveling faster than 75 mph was known only for the final two periods, which also indicated an increase in speeding after camera enforcement was suspended, but one much smaller in magnitude. Camera enforcement had little effect on speed variance; standard deviation in traffic speeds in the Scottsdale section ranged from 4.9 to 5.6 mph during enforcement, compared with 5.9 mph during the baseline period.

Table 4 provides results of the series of logistic regression analyses. Using the Glendale Loop 101 comparison sites as controls, camera enforcement on the Loop 101 in Scottsdale was associated with a 77% decrease in the odds of drivers exceeding 75 mph. The likelihood ratio test indicated that inclusion of predictors strongly improved the model fit ($\chi(12) = 16299.64$, $p < 0.0001$). Despite this large effect, there were strong indications of spillover effects at the Glendale sites. To test for spillover, a regression model was run with Glendale sites considered as treatment sites and non-Loop 101 sites considered as controls. At the Glendale sites, speed cameras were associated with a 78% decrease in the odds of drivers exceeding the speed limit by 11 mph or more. The likelihood ratio test indicated that inclusion of predictors strongly improved the model fit ($\chi(12) = 9885.02$, $p < 0.0001$). In the third stage of the analysis, which considered the non-Loop 101 sites as controls for the Scottsdale sites, larger effects were observed—camera enforcement was associated with a 95% decrease in the odds of drivers exceeding 75 mph. The likelihood ratio test indicated that inclusion of predictors strongly improved the model fit ($\chi(12) = 11023.99$, $p < 0.0001$).

Table 3
Percentage of vehicles exceeding 75 mph at study locations during study period

	Scottsdale Loop 101			Glendale Loop 101			Non-Loop 101		
	Passenger vehicles	Large trucks	Total	Passenger vehicles	Large trucks	Total	Passenger vehicles	Large trucks	Total
Baseline	16	9	15	14	7	13	–	–	–
6 weeks after start of camera enforcement	1	0	1	5	3	4	–	–	–
5 months after start of camera enforcement	2	1	2	6	2	6	–	–	–
8 months after start of camera enforcement	2	1	2	6	2	5	11	18	12
After camera enforcement ended	12	10	12	17	9	16	16	10	15

Table 4
Estimated percentage reduction in the odds of exceeding 75 mph associated with camera enforcement and other predictors for different combinations of study sites

	Scottsdale 101 vs. Glendale 101	Glendale 101 vs. Non-Loop 101	Scottsdale 101 vs. Non-Loop 101
Overall	77	78	95
Effect for large trucks on weekends	84	83	97
Effect for large trucks on weekdays	83	93	99
Effect for passenger vehicles on weekends	68	28	77
Effect for passenger vehicles on weekdays	66	71	90

Table 5
Logistic regression to estimate odds of exceeding 75 mph associated with camera enforcement and other predictors, using Glendale and non-Loop 101 sites as controls

	Point estimate	95% CI
Treatment vs. comparison (absent camera enforcement)	1.09	1.03–1.15
Passenger vehicle vs. large truck	1.41	1.36–1.46
Weekend vs. weekday	1.34	1.32–1.37
Off peak vs. peak	1.21	1.18–1.24
Period (April, July, and September 2006 vs. December 2005 and December 2006)	0.54	0.51–0.57
Camera effect	0.12	0.09–0.15
Treatment by weekend	0.77	0.75–0.80
Period by weekend	1.38	1.34–1.43
Period by passenger vehicle	0.71	0.67–0.75
Treatment by passenger vehicle	0.85	0.80–0.90
Camera (weekend vs. weekday)	1.07	0.99–1.15
Camera (passenger vehicle vs. large truck)	2.29	1.83–2.86

Table 5 provides results of logistic regression analyses that estimated the odds of drivers exceeding 75 mph in Scottsdale versus all comparison sites combined (Glendale and non-Loop 101). All variables and interactions were highly significant ($p < 0.01$). Absent camera enforcement, the odds of speeds exceeding 75 mph were slightly higher at treatment sites than at comparison sites (odds ratio (OR) = 1.09, confidence interval (CI) = 1.03–1.15). Overall, such high speeds were more likely for passenger vehicles than for large trucks, more likely on weekends, and more likely during non-rush hours. The key odds ratio, "camera effect," equaled 0.12 and was highly significant (CI = 0.09–0.15), indicating speed cameras were associated with an estimated 88% decrease in the odds of drivers exceeding the speed limit by 11 mph or more. This effect was not uniform across different vehicle types and days of the week, as indicated by the "camera (weekend vs. weekday)" and "camera (passenger vehicle vs. large truck)" interactions. The former was less than 1, indicating a stronger effect of cameras on weekends than on weekdays. The latter was greater than 1, indicating cameras were less effective at reducing the proportion of passenger vehicles exceeding 75 mph than they were for large trucks.

To obtain the odds ratio for a given subpopulation, the odds ratio for the camera effect was multiplied or divided by the odds ratio for the corresponding interactions. For example, the estimated odds ratio for the camera effect on passenger vehicles during weekends equals $0.12 \times 1.07 \times 2.29 = 0.29$; hence, cameras reduced the odds of speeding by passenger vehicles on weekends by 71%. For large trucks on weekends, the estimated odds ratio equals $0.12 \times 1.07/2.29 = 0.06$, meaning that cameras reduced the odds of speeding by large trucks on weekends by 94%. Similarly, cameras were 95% effective at reducing speeding by large trucks. On weekdays, speed cameras were 75% effective at reducing speeding by passenger vehicles.

3.2. Telephone surveys

Drivers in Scottsdale were surveyed by telephone about the speed camera program on Loop 101 both before and during camera enforcement. When asked if speeding was a problem on Loop 101, about 80% of drivers said it was (Table 6). Drivers also were asked if speed cameras currently were in use on Loop 101 (table not shown). Before camera enforcement, 62% of drivers responded correctly that speed cameras were not in use (speed cameras were in use during the baseline period on other, secondary streets in Scottsdale). During enforcement, about 90% of drivers responded correctly that speed cameras were in use, with fairly consistent responses across age and gender.

Drivers were asked their opinions about the use of speed cameras on Loop 101 in Scottsdale based on whether or not they thought cameras were in use (Table 7). Those who thought cameras were in use were asked "Do you favor the use of cameras to enforce laws against speeding on the 101 freeway?" Those who thought cameras were not in use were asked "Would you favor the use of cameras. . .." Results in Table 8 were combined for both groups of drivers. The proportion of drivers who favored speed cameras increased from 63% before camera enforcement to 77% during enforcement. Support for cameras increased markedly among drivers ages 35–64 (from 55% before enforcement to 78% after) and declined among younger drivers ages 18–34 (from 53% before enforcement to 40% after). In both surveys, male and female drivers had somewhat similar opinions, and older drivers were most in favor of speed cameras (before enforcement: $\chi^2 = 24.5$, $p < 0.001$, d.f. = 4; during enforcement: $\chi^2 = 37.1$, $p < 0.001$, d.f. = 4).

In the survey conducted during camera enforcement, drivers were asked if the speed cameras had caused them to reduce their speeds when traveling on Loop 101 in Scottsdale; 54% said they had (table not shown). Drivers who said speed cameras had caused them to reduce their speeds on the Scottsdale section ($n = 163$) were asked if the cameras had caused them to reduce their speeds when traveling on other sections of Loop 101; 61% said they had.

After speed reductions on the Glendale section of Loop 101 were identified during the first two rounds of data collection during cam-

Table 6
Responses of Scottsdale drivers concerning whether or not speeding is a problem on Loop 101 (percent)

	Before enforcement				During enforcement			
	N	Yes	No	Do not know	*N*	Yes	No	Do not know
Overall	300	81	17	2	300	79	18	2
Ages 18–34	30	73	27	0	35	66	31	3
Ages 35–64	169	76	21	2	178	82	17	2
Ages 65+	94	93	5	2	87	80	16	3
Male	136	76	20	4	107	76	23	1
Female	164	85	15	1	193	81	16	3

Table 7
Responses of Scottsdale drivers concerning whether or not speed cameras should be used on Loop 101 (percent)

	Before enforcement				During enforcement			
	N	Yes	No	Do not know	*N*	Yes	No	Do not know
Overall	300	63	31	6	300	77	20	3
Ages 18–34	30	53	40	7	35	40	51	9
Ages 35–64	169	55	40	5	178	78	19	3
Ages 65+	94	82	12	6	87	91	9	<1
Male	136	62	34	4	107	75	24	1
Female	164	65	29	7	193	78	18	4

era enforcement (6 weeks and 5 months into the pilot program), the survey research was expanded to explore awareness of and reactions to camera enforcement on Loop 101 among drivers in the larger Phoenix metro area. Eight months after cameras were installed, Phoenix-area drivers were asked if speed cameras were in use on Loop 101; 81% said they were (table not shown). Drivers who were aware of camera enforcement were asked if they knew on which sections of Loop 101 cameras were used; about 85% correctly indicated cameras were in use on the Scottsdale section.

Drivers then were asked if they approved of speed cameras on Loop 101 (Table 8). Overall, 71% were in favor. Support increased with driver age ($\chi^2 = 15.0$, $p < 0.01$, d.f. = 4) and was somewhat higher among female drivers ($\chi^2 = 3.3$, $p = 0.19$, d.f. = 2).

Drivers were asked if the use of speed cameras on Loop 101 in Scottsdale caused them to reduce their speeds when traveling on that section of road; 44% said they did. Drivers who said speed cameras had caused them to reduce their speeds on the Scottsdale section ($n = 176$) were asked if speed cameras caused them to reduce their speeds when traveling on other sections of Loop 101; 60% said they did.

4. Discussion

The present study provides strong evidence that highly visible automated speed enforcement can substantially reduce speeding violations on urban freeways. The finding that speed reductions on Loop 101 extended beyond the immediate vicinity of enforcement sites is important because a principal objective of automated enforcement is to promote generalized changes in driver behavior that occur beyond the specific roadway segments where cameras are placed. Even taking into account speed reductions observed on the Glendale section of Loop 101 and most likely attributed to spillover effects, camera enforcement had a large and highly significant effect on speed limit violations in Scottsdale.

This study did not evaluate crash outcomes because of the short duration of the pilot program and relatively small crash sample along the 8-mile enforcement corridor (47 injury crashes and 1 fatal crash in 2005). However, the effects of speed cameras on crashes have been the subject of considerable prior research, as summarized in two recent systematic reviews. Pilkington and Kinra (2005) reviewed 14 studies that found various crash reductions in the immediate vicinities of camera sites, ranging from 5 to 69% for all crashes, 12–65% for injury crashes, and 17–71% for fatal crashes. Wilson et al. (2006) reviewed 21 studies that found reductions ranging from 14 to 72% for all crashes, 8–46% for injury crashes, and 40–45% for crashes involving fatalities and serious injuries. A recent evaluation of automated speed enforcement on Spain's Barcelona beltway reported a 27% decrease in crashes following installation of speed cameras, equivalent to preventing an estimated 364 collisions and 507 people injured during the 2-year study period (Pérez et al., 2007).

This study also did not evaluate the appropriateness of the speed limit posted on Loop 101, which was limited by Arizona law to a maximum of 65 mph (Insurance Institute for Highway Safety, 2008), and was among the fastest urban freeway speed limits in the United States. The primary purpose of speed limits is to regulate driving speeds to achieve an appropriate balance between travel time and risk (Transportation Research Board, 1998). Although higher limits might decrease the proportion of drivers traveling 11 mph or more above the speed limit, increasing expressway speed limits has been found to increase travel speeds (Najjar et al., 2000; Retting and Greene, 1997) and motor vehicle fatalities (Farmer et al., 1999; Patterson et al., 2002).

One factor that may have contributed to the large spillover effects well beyond the 8-mile enforcement corridor was extensive media coverage of the Loop 101 pilot program. Scottsdale and other cities in the Phoenix metro area had used speed cameras for some time prior to the Loop 101 effort, but use had been limited to secondary roads, not freeways or interstates. Use of speed cameras on a high-volume urban freeway generated substantial media attention. Many newspaper headlines referred to speed cameras on Loop 101 without specific reference to Scottsdale. Even though 85% of drivers in the Phoenix metro area knew which section of Loop 101 had speed cameras, large numbers of drivers said they still reduced their speeds when traveling on other sections of Loop 101 as a result of the Scottsdale speed camera program.

Public opinion regarding speed cameras is an important factor in the formulation of traffic laws and enforcement policies. There were high levels of public support after speed cameras had been in use for 8 months. The finding that younger drivers expressed the least support for speed cameras after 8 months of enforcement is consistent with other research that found younger drivers were more likely to travel far in excess of posted speed limits (Williams et al., 2006), most likely to self-report driving 10 mph or more above posted speed limits (National Highway Traffic Safety Administration, 2002), and least likely to favor increased enforcement of speed limits (Insurance Research Council, 2007). In the present study, public support for camera enforcement coincided with concerns about speeding. Support for camera enforcement may be lower in settings where speeding is not perceived to be a big problem.

Several months after the 9-month pilot program ended, the city of Scottsdale obtained approval from Arizona officials to reinstate speed camera enforcement on Loop 101, which resumed in February 2007.

Table 8
Responses of Phoenix-metro area drivers concerning approval of speed cameras on Loop 101 (percent)

	N	Favor	Oppose	Do not know
Overall	400	71	25	4
Ages 18–34	76	57	37	7
Ages 35–64	228	71	25	4
Ages 65+	96	83	14	3
Male	176	68	29	3
Female	224	74	21	5

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