Sustained and Halo Effects of Various Speed Reduction Treatments in Highway Work Zones

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This paper analyzes the speed reductions achieved with the use of an automated speed photo–radar enforcement (SPE) system in highway work zones. A comparison with the following three traditional treatments used to reduce speeds is also presented: (*a*) a speed feedback trailer (trailer treatment), (*b*) a police patrol car (police treatment), and (*c*) the combination of a police patrol car and a speed feedback trailer (police–trailer treatment). The results indicated that the SPE system and police–trailer treatments reduced the mean speed of both the general traffic stream and free-flowing vehicles by about 5 to 7 mph. The magnitudes of the speed reductions while the treatments were deployed were sustained over time. Police presence alone also reduced the speed significantly but to a lesser degree, and the effects of the trailer treatment alone were limited. The frequency and the degree of speeding were also influenced by the treatments to various degrees. The proportion of drivers speeding by more than 10 mph was reduced by 8.7% by the SPE system treatment and by 8.9% by the police–trailer and police treatments, which brought the rate of speeding down to 0.2% for the SPE system treatment and 0% for the police–trailer and police treatments. These treatments also reduced the frequency of speeding by 10 mph or less by 36% to 46%. The halo effect for the SPE system after the treatment was removed was limited to a reduction in the mean speed of 2 mph or less, and that for the police treatments was not significant.

Drivers are typically required to travel at lower speeds in roadway work zones because of the less-than-ideal prevailing conditions of the roadway itself or the proximity of work areas. Given the temporary nature of the speed reductions, which normally extend over several miles down a road, speeding is a common issue. This may result in the need for the use of speed reduction techniques that are aimed at reductions in both the frequency and the degree of speeding in the work zone. Such techniques are diverse and can range from educational campaigns to direct speed enforcement.

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The study described in this paper centers on the speed reductions obtained in highway work zones in the state of Illinois with an automated speed photo–radar enforcement (SPE) system, as well as the following three traditional treatments: (*a*) a speed feedback trailer (trailer treatment), (*b*) a stationary police patrol car with the emergency lights off (police treatment), and (*c*) the combination of a police patrol car with a speed feedback trailer (police–trailer treatment).

An SPE system is an alternative speed reduction treatment that uses innovative technology to solve some of the challenges of speed enforcement in work zones. The Illinois SPE system is self-contained inside a van that can be safely parked outside of the lanes in which vehicles traveled and parallel to the roadway. When it is deployed, the top of the van with the SPE system has a speed feedback board (which uses conventional down-the-road radar) that is visible to oncoming drivers. The system is also equipped with a more-sophisticated across-the-road radar that measures the speed of vehicles when they are about 150 ft upstream of the van. This radar operates at a specified angle to the path of the vehicles and obtains accurate speed estimates by consideration of angle effects. Finally, when a speeding vehicle is detected, two onboard cameras are activated by the radar to take pictures of the vehicle from the back of the van and also from the front of the van (as the vehicle is leaving the van location). The pictures are then analyzed by police officers trained to use the SPE system, and after approval, speeding citations are sent to the registered vehicle owner by mail.

In general, SPE systems have been used as a speed control and enforcement tool in more than 40 countries around the world (*1*), and they have been found to be an effective way to reduce speeding on residential roads and freeway systems (*2–5*). Previous studies have also shown the potential benefits of the use of an SPE system for speed enforcement in work zones (*6*), but field evaluations and comparisons with traditional law enforcement methods are limited. In fact, Illinois was the first state in the United States to allow an automated enforcement system to be used in highway work zones. More recently, other states, including Washington and Arizona, have followed this initiative and have already approved the use of the SPE system.

The implementation and field evaluation of the Illinois SPE system were presented by Benekohal et al., who showed that the system significantly reduced the average speed and increased the rate of compliance with the speed limit (*7, 8*). Benekohal et al. (*9*) and Hajbabaie et al. (*10*) evaluated other speed control treatments in comparison with the SPE system and found that the police–trailer and SPE system treatments were, in general, the most effective

ways to reduce mean speeds. They also presented some of the halo effects of the SPE system, after it departed the data collection location. In addition, Medina et al. investigated the spatial effects (about 1.5 mi downstream of the treatment location) of the SPE system, trailer, police, and police–trailer treatments and found that the SPE system consistently reduced the downstream speed of vehicles and that police also had spatial effects, but to a lesser degree (*11*).

The aim of the study described here was to complement the previous analyses of the Illinois SPE system with data not included in previous studies and also to explore different aspects of the treatment effects, such as the stability of the speed reductions over time. Specific results are provided for the general traffic stream, free-flowing vehicles, and drivers speeding by more than 10 mph (excessive speeders), who were separated from drivers speeding by 10 mph or less (moderate speeders). In addition, the halo effects of both the SPE system and police treatments at two work zones are also analyzed.

DATA COLLECTION

Two work zones on Interstates 64 and 55 in Illinois were selected for this study, and a total of three data sets were obtained: (*a*) Data Sets 1 and 2, data for which were collected on I-64 east of East St. Louis, Illinois, in the summer of 2006 during a.m. off-peak hours (Data Set 1) and p.m. off-peak hours (Data Set 2) and (*b*) Data Set 3, data for which were collected on I-55 near Joliet, Illinois, a southwestern suburb of Chicago, in the summer of 2007 during p.m. off-peak hours. At both locations, the work area was located in the median (because of the addition of a third lane) and was separated from the traffic by concrete barriers. In addition, bridge deck repair was taking place on I-55. Two lanes with a normal-width right shoulder remained open to traffic. The posted speed limit in both work zones was 55 mph, which is a reduction of 10 mph from the 65-mph speed limit under normal conditions.

On I-64, the work zone was about 7 mi long. It started at Milepost 9, and the treatments were deployed at Milepost 14. Similarly, the work zone on I-55 was about 7 mi long and started at Milepost 255. The treatments were deployed at Milepost 259.

Data were collected with a video recorder and two markers that were placed outside of the roadway, as illustrated in Figure 1. The video images were recorded at a location a few hundred feet downstream from where the treatment was deployed. Placement at this location allowed drivers enough travel distance to react and adjust their speed. In addition, the treatments were placed in highway sections that were approximately straight and clear of obstacles, so that they were easily visible to approaching drivers. All speed reduction treatments were easily observable by motorists from at least 500 ft upstream of the deployment location. In addition, "Speed Photo Enforced" signs were posted at the beginning of the work zone that was upstream of the treatment location. During the data collection period, when the van with the SPE system or police were present in the work zone, no ticket was issued and the police were asked to do what they routinely do while they are parked on a highway, except for issuance of a ticket.

The recorded video images were time stamped with a precision of 1/30 s (one stamp per video frame); thus, it was possible to determine precisely the time that every vehicle needed to travel the distance between the two markers and, consequently, to calculate the speed accurately. Additional information, such as vehicle type (car or truck), the lane in which the vehicle traveled (shoulder lane or median lane), and whether the vehicle was traveling under a free-flow condition or in a platoon, was also collected. Free-flowing vehicles were defined as those that had the freedom to travel at their desired speed (they were not closely following another vehicle). A 4-s headway criterion was used to distinguish free-flow vehicles from vehicles in a platoon.

Data were initially collected without the presence of any of the speed reduction treatments and were used as a reference (or base data). The data for each of the four selected treatments were then collected at the same location, and variables such as time of day and day of the week were controlled for. Thus, all data used to complete a full data set were obtained during the same hours on weekdays. The traffic volumes and traffic compositions of the three data sets for the base condition and for the four treatments are shown in Table 1.

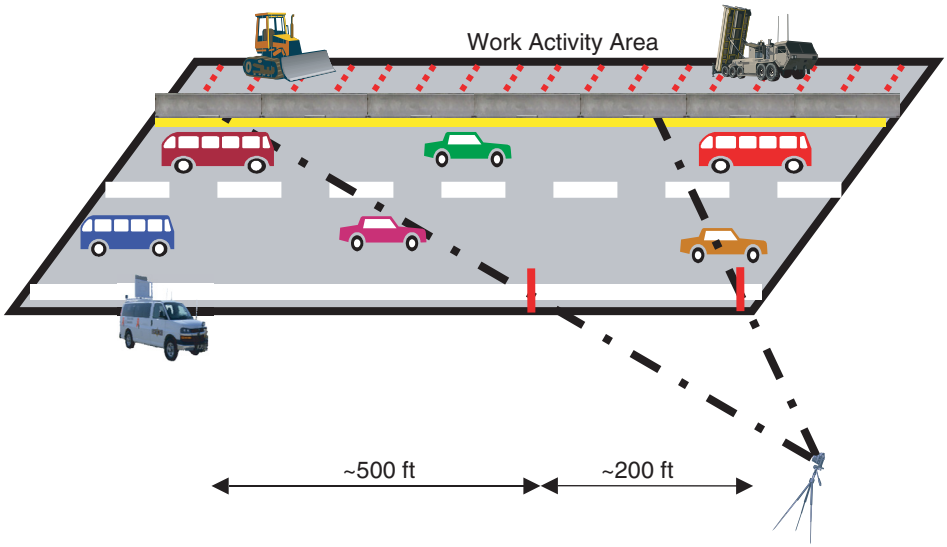

FIGURE 1 Schematic diagram of data collection setup.

TABLE 1 Distribution of Volumes for Different Treatments for Both Lanes

	Treatment				
	Base	Trailer	Police (lights off)	Police (lights off) + Trailer	SPE Van
Data Set 1					
Volume (vph)	1,510	1,540	1,300	1,500	1,510
% of trucks	19	17	13	17	18
% in shoulder	46	86	71	53	71
Data Set 2					
Volume (vph)	2,190	1,830	No data	1,710	1,830
% of trucks	12	22	No data	20	15
% in shoulder	66	33	No data	55	45
Data Set 3					
Volume (vph)	2,240	2,274	2,145	2,405	2,005
% of trucks	28	24	21	20	22
% in shoulder	53	58	59	58	58

METHODOLOGY

The analysis was conducted with data for multiple subgroups of the traffic stream on the basis of the vehicle type (cars and trucks), the lane in which the vehicle traveled (median and shoulder), and whether the driver was traveling at his or her desired speed (or under free-flow conditions). Therefore, it was possible to determine the effect of each treatment on the different subgroups of traffic and to perform comparisons more detailed than those performed only for the whole traffic stream.

All vehicles traveling at free-flow speed were included in the analysis, whereas the general traffic stream was systematically sampled by measurement of the speed of every fifth vehicle regardless of the vehicle type or the lane in which the vehicle traveled. This random sampling is expected to provide an unbiased representation of the prevailing speeds of all traffic subgroups.

The effects of the treatments were evaluated on the basis of the changes in the mean speed, the changes in the speed distribution, and the changes in the percentage of speeding drivers (for both excessive and moderate speeders).

The statistical significance of these changes was estimated by the following techniques: (*a*) *t*-tests, to evaluate the changes in the mean speeds; (*b*) least-significant-difference tests, to determine if the speeds changed after the treatments were deployed and removed; and (*c*) chi-square and Kolmogorov–Smirnov tests, to determine if the speed distributions for two different treatments were the same.

In addition, the effects of the treatments on the mean speeds were determined over time to establish whether the effects decreased immediately after the treatments were removed from the work zone or were stable. To determine the effects, a moving average of the general traffic stream (when the treatment was present) was calculated every 5 min and plotted over time.

DATA ANALYSIS

Effects of Treatments on Mean Speed

This section presents the effects of the four treatments described above according to the changes in the mean speed of traffic that resulted. Figure 2 shows the mean, minimum, and maximum speeds found for the general traffic stream (sampled vehicles) and for free-flowing vehicles in the three data sets. The mean speeds were noted to be reduced by all treatments, and some treatments were found to be more effective than others. For Data Sets 1 and 2, for which the mean speeds were already below the speed limit in the base case, the speed reductions in the general traffic stream varied from 1 mph (with the trailer treatment) to 5.9 mph (with the police–trailer treatment). Comparable speed reductions were also observed for free-flowing vehicles. The mean speed in the base case for Data Set 3, however, was higher than the 55-mph speed limit (58.8 mph), and the greatest speed reduction was obtained with the SPE system (7.2 mph), with which the mean speed was reduced to 51.6 mph. For Data Set 3, three of the four treatments reduced the mean speed of the general traffic below the speed limit (the trailer treatment did not). Comparable speed reductions were also found for free-flowing vehicles.

The effects on the mean speed were also analyzed in more detail for each of the traffic subgroups. Table 2 shows the mean speeds according to the two vehicle types, the two lanes in which the vehicles traveled, and whether the vehicles were free flowing or in the general traffic stream obtained with data from Data Set 3, as well as the results of statistical comparisons for these elements with the base case. Data Set 3 provided the best example with which to illustrate the differences between subgroups because the mean speeds in the base case were higher than the speed limit.

All treatments except the trailer treatment significantly reduced the speeds of all subgroups, and the reductions with the police–trailer and SPE system treatments were the highest. In addition, the mean speeds of cars were, in general, higher than those of trucks, as expected; and the speed reductions were also higher for cars than for trucks.

Similar findings for the relative effectiveness of the treatments were found for Data Sets 1 and 2, but the speed reductions were lower. More specifically, the police–trailer treatment produced the greatest speed reductions for all subgroups, closely followed by the SPE system and police treatments. The trailer treatment did not have a significant effect.

Effects of Treatments on Speed Distribution

The general traffic stream was sampled by the systematic selection of every fifth vehicle traveling through the data collection area. The

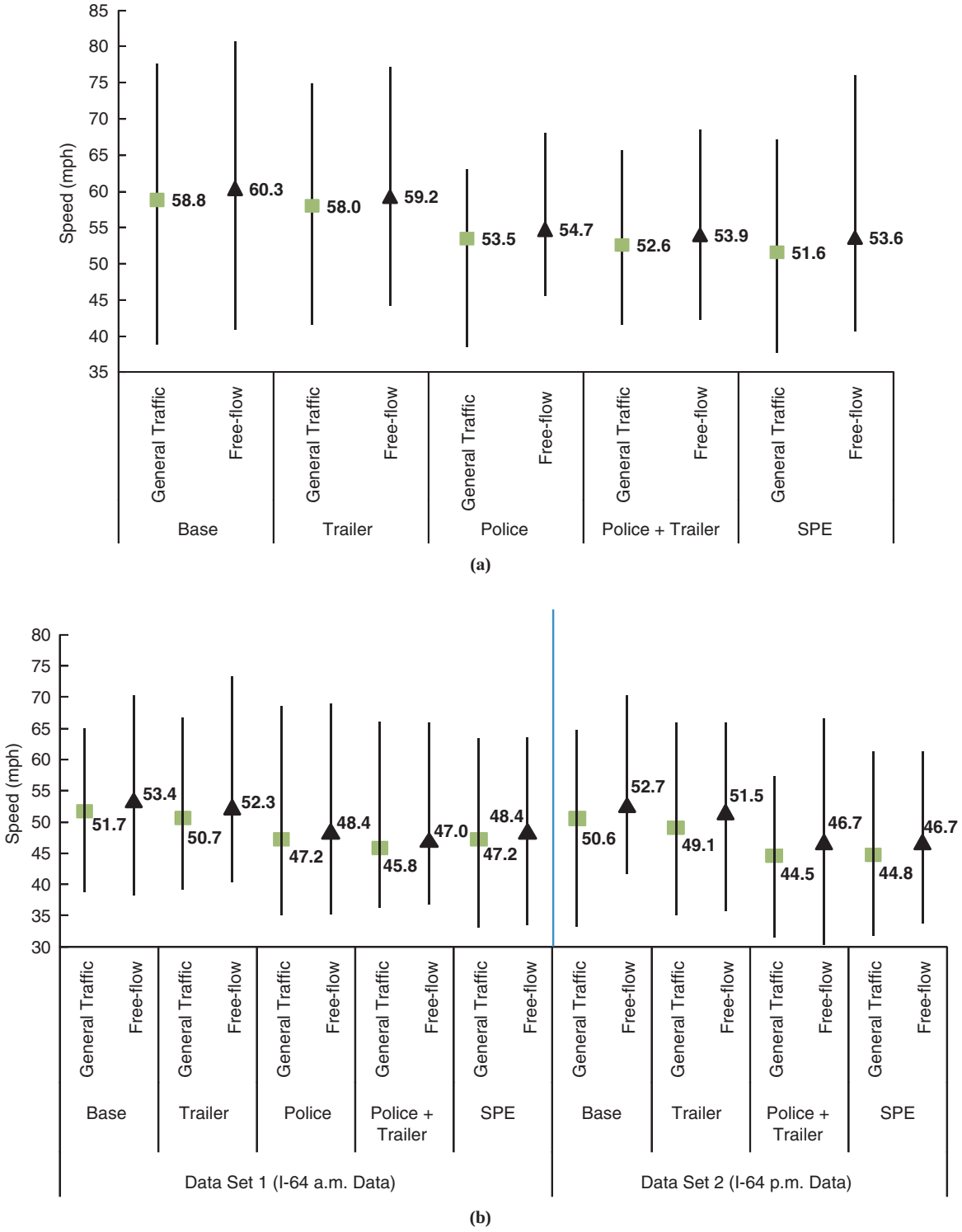

FIGURE 2 Mean speeds for general traffic and free-flow vehicles: (*a*) Data Set 3, I-55 work zone, and (*b*) Data Sets 1 and 2, I-64 work zone.

TABLE 2 Detailed Mean Speed Reductions from Data Set 3

		Free-Flow					General Traffic (sampled vehicles)				
Vehicle Type	Treatment	Sample Size	Mean Speed (mph)	SD (mph)	Mean Speed Reduction (mph)	*P*-Value	Sample Size	Mean Speed (mph)	SD (mph)	Mean Speed Reduction (mph)	*P*-Value
Median Lane											
Cars	Base	106	63.7	5.5	—	—	153	60.6	5.5	—	—
	Trailer	103	61.7	5.4	2.0	.009	116	59.2	5.0	1.5	.025
	Police lights off	100	55.9	3.4	7.8	<.001	114	53.8	4.3	6.8	<.001
	Trailer + police lights off	81	56.4	4.2	7.2	<.001	163	53.0	3.8	7.6	<.001
	SPE	102	55.9	5.4	7.8	<.001	142	52.7	4.8	7.9	<.001
Trucks	Base	119	56.2	3.9	—	—	96	56.1	4.4	—	—
	Trailer	91	57.0	2.9	–0.8	.100	51	55.8	3.5	0.3	.670
	Police lights off	95	54.1	2.7	2.1	<.001	62	53.8	2.5	2.3	<.001
	Trailer + police lights off	98	52.9	3.2	3.3	<.001	95	51.7	3.5	4.4	<.001
	SPE	99	52.3	3.5	3.9	<.001	61	50.6	5.0	5.5	<.001
Shoulder Lane											
Cars	Base	204	61.5	5.2	—	—	223	59.3	4.6	—	—
	Trailer	163	59.7	4.6	1.8	<.001	187	58.1	4.1	1.2	.007
	Police lights off	208	54.7	3.6	6.8	<.001	226	53.3	3.7	6.0	<.001
	Trailer + police lights off	181	53.7	3.4	7.7	<.001	310	52.7	3.3	6.7	<.001
	SPE	219	53.6	4.3	7.8	<.001	226	51.6	4.5	7.7	<.001
Trucks	Base	40	57.0	3.6	—	—	44	56.1	3.5	—	—
	Trailer	38	56.2	4.6	0.7	.420	43	56.5	4.3	–0.5	.590
	Police lights off	31	52.6	3.5	4.4	<.001	31	53.1	3.1	2.9	<.001
	Trailer + police lights off	30	51.8	3.8	5.2	<.001	29	52.5	3.4	3.5	<.001
	SPE	43	51.2	4.2	5.8	<.001	48	49.4	4.6	6.6	<.001

NOTE: SD = standard deviation; — = not applicable.

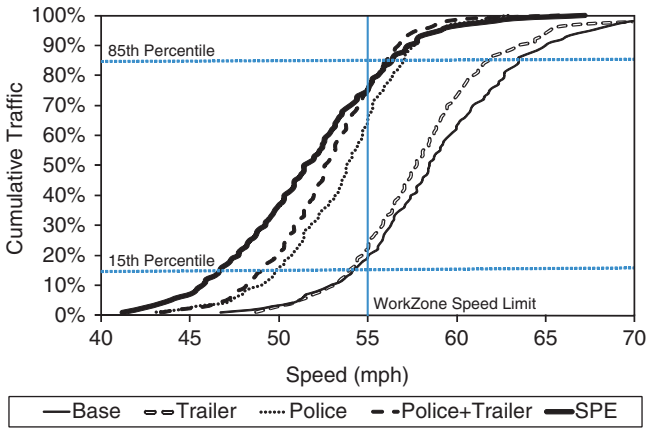

FIGURE 3 Speed distribution for Data Set 3, I-55 work zone (general traffic stream).

speeds of the individual vehicles were also used to analyze the cumulative speed distributions and to determine the extent of the speed changes for vehicles traveling at higher speeds (e.g., at the 85th percentile) and lower speeds (e.g., at the 15th percentile).

Figure 3 shows the cumulative speed distribution of the general traffic stream for Data Set 3 for all four treatments and the base case. In general, the percentages of vehicles traveling at speeds below the speed limit were similar for the base case and the trailer treatment. However, a slight decrease in the severity of the speeding was found for the trailer treatment. The results of chi-square and Kolmogorov-Smirnov tests supported this finding because they showed that the speed distributions of the base case and the trailer treatment were not significantly different (at the 95% confidence level).

A clear shift of the whole distribution was found for the SPE system, police, and police–trailer treatments at both low and high speeds. Chi-square and Kolmogorov–Smirnov tests showed significantly different speed distributions when the base case was compared with the SPE system, police, and police–trailer treatments at the 95% confidence level. The effects of these three treatments were comparable for the top 15th percentile (above 85% in the cumulative curve), for which the speeds were reduced by more than 5 mph. This result indicates that even though not all speeders were eliminated, drivers significantly lowered their speeds and reduced the overall risks involved with excessive speeds. At the lower end of the distribution, however, the SPE system treatment resulted in greater speed reductions than the police and police–trailer treatments.

The cumulative speed distributions for Data Sets 1 and 2 were also analyzed and are shown in Figure 4. A finding different from that for Data Set 3 was that most vehicles were not speeding at these locations. Limited effects from use of the trailer treatment were observed, with slight speed reductions noted for vehicles traveling at higher speeds for Data Set 1 and slight reductions noted at the lower end of the curve for Data Set 2.

For the other three treatments, the speed distributions for the SPE system, police, and police–trailer treatments were shifted toward lower speeds, similar to the observations for Data Set 3. In addition, the police–trailer treatment was slightly more effective than the SPE system and police treatments for Data Sets 1 and 2, especially for drivers traveling at higher speeds (for the top 15th percentile).

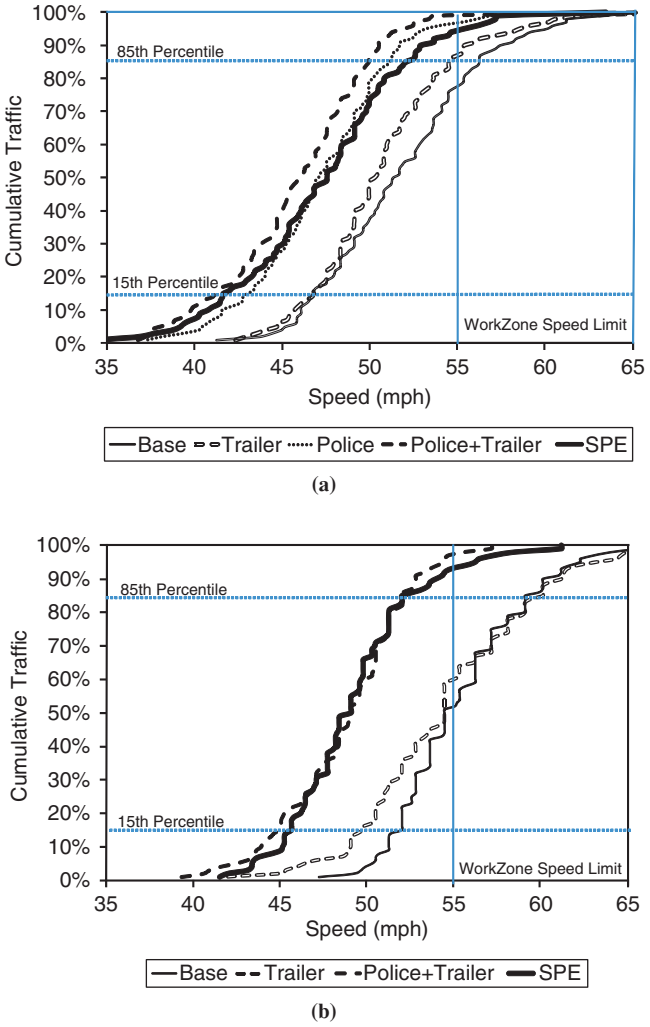

FIGURE 4 Speed distributions for (*a*) Data Set 1, I-64 work zone, and (*b*) Data Set 2, I-64 work zone (general traffic stream).

Effects of Treatments on Speeding Drivers (Excessive and Moderate Speeding)

The effects of the four treatments were also quantified on the basis of reductions in the proportions of moderate speeders (speeding by 10 mph or less) and excessive speeders (speeding by more than 10 mph). Figure 5 shows the percentage of speeders and nonspeeders for the general traffic stream for the three data sets.

The results in Figure 5*a* indicate that about 80% of the drivers in the base case were speeding for Data Set 3, and of those drivers, 8.9% were excessive speeders. These percentages were greatly reduced by the SPE system and police–trailer treatments, which lowered the proportion of speeders to about 25% and which resulted in almost no excessive speeders (0.2%, which corresponds to one vehicle). The police treatment also showed significant effects, but to a lesser degree, for a total of 34% speeders and no excessive speeders. The trailer treatment, however, had limited effects and did not reduce the frequency of speeding or its degree in any practical sense.

A separate analysis based on free-flow vehicles from Data Set 3 (data not shown in Figure 5) also indicated that the SPE system,

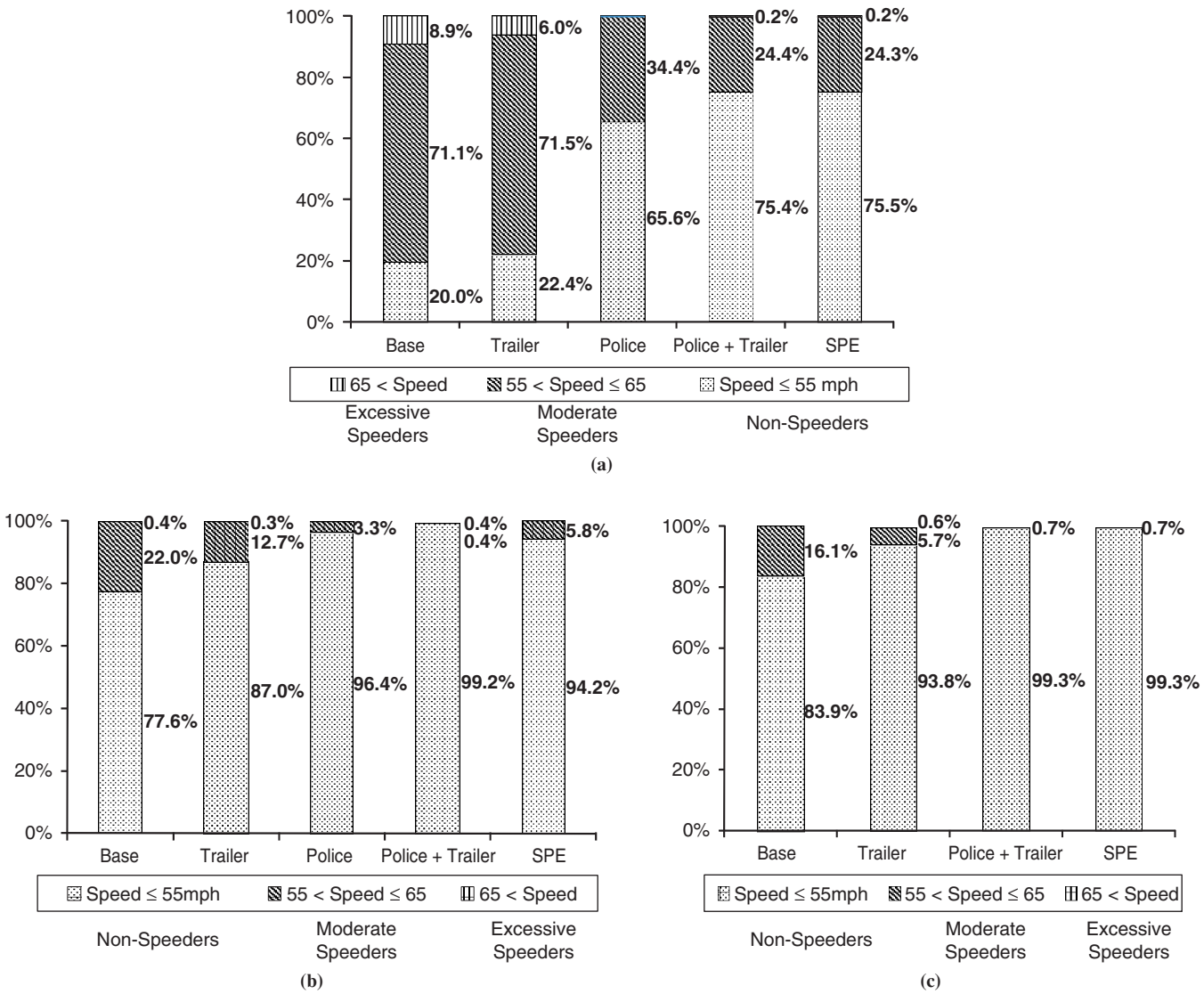

FIGURE 5 Percentage of speeding drivers in general traffic stream: (*a*) Data Set 3, I-55 work zone; (*b*) Data Set 1, I-64 work zone; and (*c*) Data Set 2, I-64 work zone.

police–trailer, and police treatments had significant effects on the frequency and degree of speeding. Specifically, in the base case, 17.4% of the drivers were excessive speeders, and this proportion was reduced to 1.7% with the SPE system and to 0.5% with the police and police–trailer treatments.

In addition, the percentages of speeders in the general traffic stream are shown in Figures 5*b* and 5*c* for Data Sets 1 and 2, respectively. Practically no excessive speeding occurred in the base case or with any of the treatments for these two data sets, and 22% of the drivers for Data Set 1 and 16% for Data Set 2 were traveling over the speed limit in the base case. All four treatments had some effects and reduced the proportion of speeders; but the SPE system, police–trailer, and police treatments were the most effective because these treatments lowered the proportions of speeders to less than 1% for Data Set 2 and to less than 5.8% for Data Set 1 (for this data set, the police–trailer treatment reduced the proportion of speeders the most, down to 0.4%). For free-flowing vehicles (data not shown in Figure 5), the proportion of speeding drivers was reduced from 34% in the base case to 4% with the police treatment, about 2% with the police–trailer treatment, and about 7% with the SPE system.

Effects of Treatments over Time

Five-minute moving averages were used to determine the effects of the treatments over time. The systematic sample obtained for the general traffic stream from Data Set 3 (from I-55) was used to illustrate these effects (Figure 6). The data obtained in the first 5 min after the treatments were deployed were not used in the analysis because that period of time was considered part of the transition from the no-treatment condition. Figure 6 shows that the mean speed in the base case varied significantly over time and ranged from 61 to about 54 mph during the analysis period. Similar fluctuations were also observed for the SPE system, police, and police–trailer treatments; but at all times, the moving-average speed was less than the speeds observed for the base case. The speeds for the trailer treatment, however, were

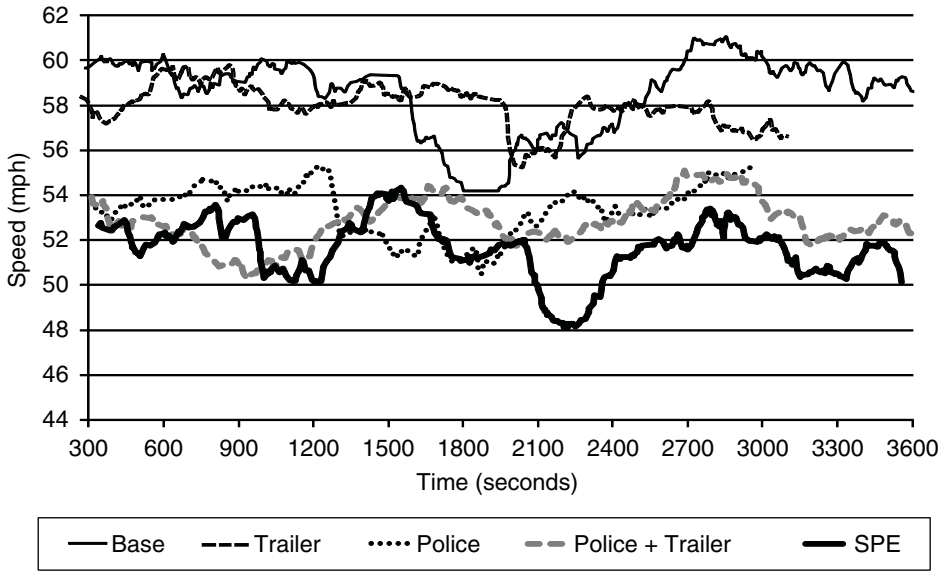

FIGURE 6 Effects of different treatments over time, Data Set 3, I-55 work zone (general traffic stream).

within the speed fluctuations of the base case at all times and showed no significant change. These data also indicate that the speed reductions achieved with the SPE system, police–trailer, and police treatments did not fade after the treatments were deployed.

Halo Effects of Treatments

Retention of the speed reductions even after the treatments have been removed (a halo effect, according to time) is highly desired because the work zones can benefit from semipermanent treatments whose locations may be rapidly changed to maintain lower speeds over extended areas. The two treatments that could provide this service were the police and the SPE system, because they were an effective way to reduce the speeds of vehicles and they could also be quickly redeployed at nearby locations. Two data sets (Data Sets 2 and 3), one from each work zone, were selected for this analysis because no data were available from Data Set 1 after the treatments departed.

Data were collected for approximately 40 to 50 min after removal of the treatments from the data collection site. To analyze the temporal variation in speed after the treatments departed, individual vehicle speeds were grouped into 5-min intervals and the average speed for each interval was determined. The same procedure was applied to data collected during the last 50 min when the treatments were present. These averages were then compared by least-significant-difference tests to determine if the results obtained under the two conditions were statistically significantly different. Only the speeds of free-flowing vehicles were selected for use in these comparisons to ensure that the analysis represents the desired speeds of drivers and not in-platoon speeds.

Figure 7 shows the variation of the 5-min average speeds for cars and trucks when the treatments were present and after they departed.

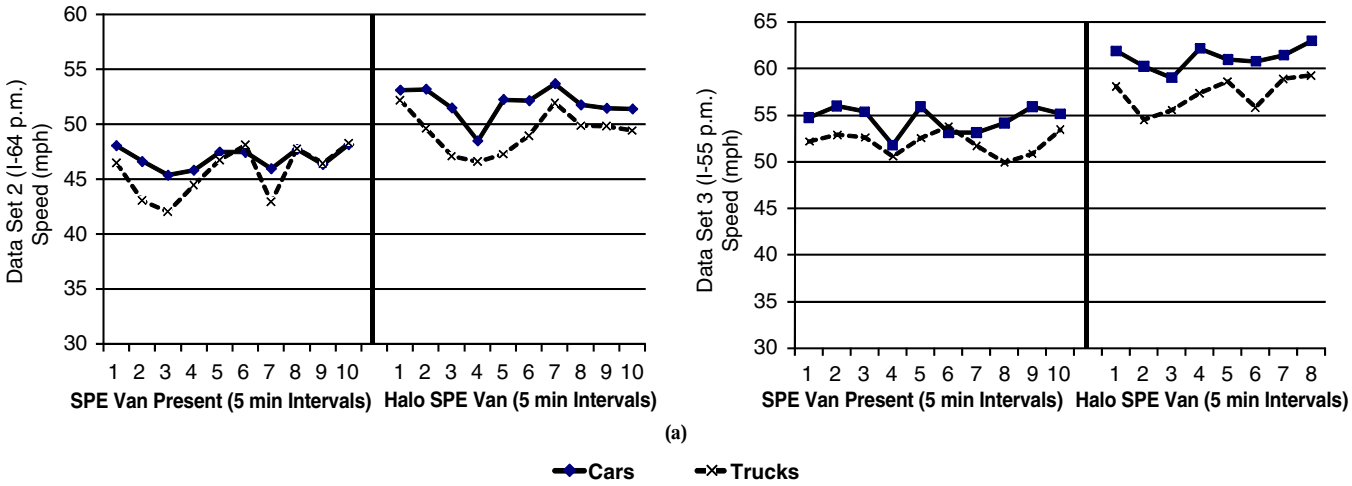

FIGURE 7 Five-minute-interval average speed distributions when treatment was present and not present after it had been deployed: (*a*) SPE system van treatment.

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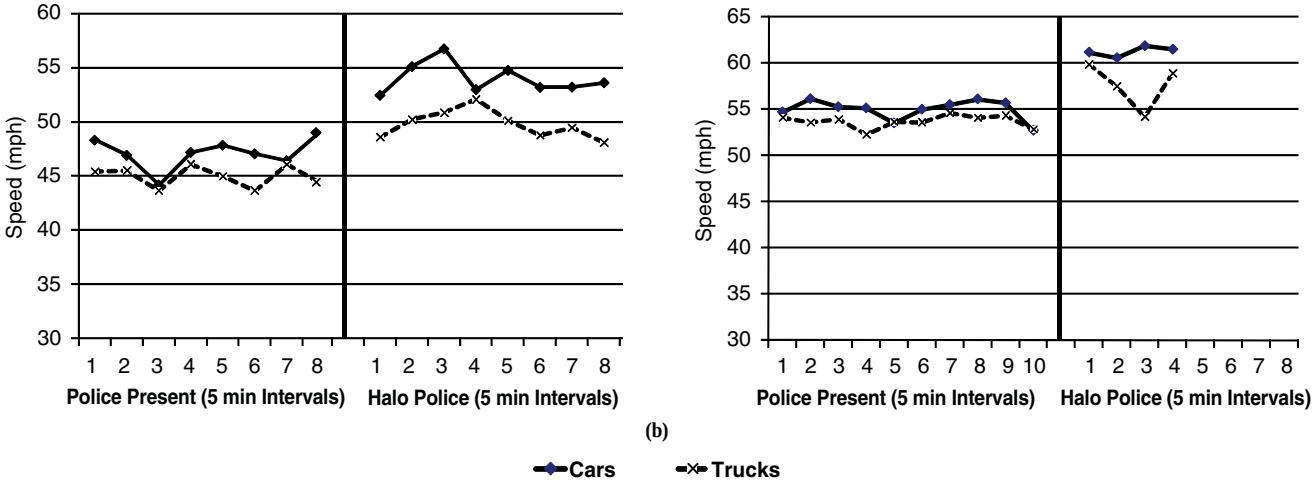

FIGURE 7 *(continued)* Five-minute-interval average speed distributions when treatment was present and not present after it had been deployed: (*b*) police treatment.

For the two treatments, an increase in the speeds of both cars and trucks was observed immediately after removal of the treatments from the work zones.

However, this increase does not necessarily indicate that speeds were at the same level that they were before the treatment was deployed. In fact, the expectation is that the speeds increased after the treatments were removed because some of the drivers never realized that they were deployed in the first place. Thus, the three conditions (base, treatment, and halo) were compared by least-significant-difference tests with a 95% confidence level (Table 3).

The average speeds and sample sizes for cars and trucks for Data Sets 1 and 3 are presented separately in Table 3 for the SPE system and police treatments. For each case, the average speeds for the base case, treatment case (either SPE system or police presence), and halo condition (after the treatment was removed) are shown. In each case, a letter is shown for each scenario (i.e., base, treatment, and halo) in Table 3. Similar letters for two scenarios indicate that the average speeds were similar, and different letters indicate that they were significantly different. For example, for Data Set 3, for cars traveling in the median lane, the average speed for the base case was similar to the average speed for the halo condition, and the average speeds for both of these conditions are statistically significantly different from the average speed for the SPE system.

In summary, in the I-64 work zone, the average speeds of cars detected in the base case were not significantly different from those detected after the van with the SPE system departed. However, for heavy vehicles, they were significantly lower (by 2.7 mph on the median and 1.8 mph on the shoulder), which indicates that the SPE system has limited halo effects on both lanes. No halo effects were found for the police treatment on I-64.

In the I-55 work zone, no halo effects were observed, except for a small speed reduction in cars on the shoulder lane with the SPE system (1.2 mph), but this reduction can be considered not significant in practice.

Thus, overall, the SPE system and police treatments had few or no effects after they departed the work zone, and the speeds quickly went back to the levels before the treatments were deployed.

CONCLUSIONS

This paper presented an analysis of the effects of four work-zone speed reduction treatments on the general traffic stream and free-flowing vehicles. The treatments included an automated SPE system, trailer, police, and police–trailer.

In general, for the three data sets analyzed, the SPE system, police–trailer, and police treatments significantly reduced the mean speed by 5 to 7 mph for the general traffic stream and free-flowing vehicles. However, the SPE system and police–trailer treatments were more effective than police treatment alone, and limited effects were found for the trailer treatment. In addition to the reduced mean speeds, the SPE system, police–trailer, and police treatments significantly reduced the frequency and degree of speeding. Excessive speeding (by more than 10 mph) was reduced to almost zero, and moderate speeding (by up to 10 mph) was significantly reduced when these three treatments were used. Overall, the treatments had similar effects on cars and trucks and on vehicles traveling in the median lane and the shoulder lane.

The speed reductions obtained with the treatments were sustained over time, as long as the treatments remained deployed in the work zone. However, their effects disappeared almost entirely as soon as the treatments were removed from the work zones (the halo effect of the SPE system was 2 mph or less, and the police treatment had no halo effect).

On the basis of the operational characteristics of these treatments, the deployment and operation of the SPE system could offer some advantages over the more traditional treatments because police officers are not directly exposed to a live traffic stream (they do not leave the van at any point). In addition, enforcement activities could be more effective with the SPE system because of the shorter time required to issue a citation. However, the SPE system would require more support structure, including legislation, training, and financial commitments for leasing or purchase of the equipment.

TABLE 3 Least-Significant-Difference Comparison Results of Free-Flowing Speeds When Treatment Was Present and Not Present After It Had Been Deployed

SPE Van								Police Car							
Cars				Trucks				Cars				Trucks			
Group	Mean	*N*	Treatment	Group	Mean	*N*	Treatment	Group	Mean	*N*	Treatment	Group	Mean	*N*	Treatment
Data Set 2 (I-64 p.m.)															
Median lane															
A	55.5	133	Base	A	53.6	20	Base	A	56.2	124	Halo	A	53.6	20	Base
A	54.8	106	Halo	B	50.9	22	Halo	A	55.5	133	Base	A	51.6	10	Halo
B	49.0	126	SPE	C	47.2	16	SPE	B	48.7	93	Police	B	45.5	25	Police
Shoulder lane															
A	50.5	87	Halo	A	49.1	32	Base	A	51.2	95	Halo	A	49.6	34	Halo
A	50.4	102	Base	B	47.3	30	Halo	A	50.4	102	Base	A	49.1	32	Base
B	44.9	94	SPE	C	44.7	34	SPE	B	45.8	90	Police	B	44.7	34	Police
Data Set 3 (I-55 p.m.)															
Median lane															
A	63.7	106	Base	A	57.4	60	Halo	A	63.7	106	Base	A	57.7	22	Halo
A	63.5	76	Halo	B	56.2	119	Base	A	62.6	30	Halo	B	56.2	119	Base
B	56.6	80	SPE	C	52.5	80	SPE	B	55.7	81	Police	C	54	82	Police
Shoulder lane															
A	61.4	204	Base	A	57.7	22	Halo	A	61.5	204	Base	A	58.8	12	Halo
B	60.2	156	Halo	A	57.4	40	Base	A	60.6	59	Halo	A	57	40	Base
C	53.7	185	SPE	B	50.7	23	SPE	B	54.7	175	Police	B	52.3	21	Police

NOTE: *N* = number of vehicles.

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