LARGE-SCALE REDUCTIONS IN SPEEDING AND ACCIDENTS IN CANADA AND ISRAEL: A BEHAVIORAL ECOLOGICAL PERSPECTIVE

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We assessed the effects of posted feedback and warning ticket programs on speeding and accidents in two cities. In Experiment 1, speeding feedback signs were effective even when 10 were used in Dartmouth, Nova Scotia, and reductions in speeding were associated with reductions in accidents. The effectiveness of the signs was correlated with the number of intersections and residences within 0.5 km beyond them, and the signs had no effect on untreated streets. In Experiment 2, posted feedback and a warning program reduced speeding and accidents on 14 streets in Haifa, Israel.

DESCRIPTORS: accident reduction, police, feedback, speeding, community setting

Researchers have demonstrated that posting the percentage of drivers not speeding on a highway sign can reduce speeding and that these reductions persist for a long time (Van Houten, Nau, & Marini, 1980; Van Houten & Nau, 1981, 1983). However, little is known about the effects of posting several signs in the same community.

We designed two experiments to answer five questions related to the use of several feedback signs. First, would the feedback signs (Van Houten et. al., 1980; Van Houten & Nau, 1981, 1983) and feedback signs plus enforcement program (Van Houten & Nau, 1983) remain effective when used on several streets within the same community? Second, would the use of several feedback signs in one community influence speeding on nearby roads? Third, would the effectiveness of the feedback signs be related to site characteristics? Fourth, would the use of several feedback signs reduce accidents as

well as speeding? Fifth, would the use of several feedback signs and the enforcement program reported by Van Houten and Nau (1983) in Canada reduce speeding and accidents in a different country?

EXPERIMENT 1

METHOD

Drivers and Setting

Drivers traveling along 12 streets in the city of Dartmouth, N.S., on weekdays between 9:00 a.m. and 4:00 p.m. (after the morning and prior to the afternoon rush hours) provided data for the study. No data were collected on holidays. On four of these streets, data were obtained on the speeds of vehicles traveling in each direction. On the remaining eight streets (four of which were selected for treatment and four which were not), data were collected only on vehicles traveling in one direction. All feedback signs in the city of Dartmouth were removed 3 months prior to beginning the experiment.

Apparatus

Vehicle speeds were measured using a Tribar Industries T-3 Muni-quip digital, hand-held radar, which was used and calibrated in the same manner as reported by Van Houten and Nau (1981). The feedback signs used were, in all important respects, the same as those used by Van

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Houten and Nau (1981). The signs read "DRIVERS NOT SPEEDING LAST WEEK ____%. BEST RECORD ____%." Cars traveling less than 15 km/hr over the speed limit on one randomly selected day each week were considered not speeding for the purpose of posting percentages on the sign.

General Procedure

The speeds of 200 vehicles were sampled each day from 9:00 a.m. to 4:00 p.m. on all roads with high traffic volumes, whereas samples were taken for 45 min each day on roads with low traffic volumes. Interobserver agreement on vehicle speed was obtained during at least two sessions per condition at all sites. Interobserver agreement was calculated as reported by Van Houten *et al.* (1980), except that estimates of vehicle speed were considered to be in agreement if they did not differ by 2 km/hr rather than 2 mph. Interobserver agreement ranged from 97% to 100% throughout the study.

Experimental Design

A multiple baseline with reversal design was used. Following baseline, one sign was erected at each of the four inbound paired measurement sites and on one additional site where data were not collected systematically. This site was included to increase the degree of sign saturation in the city. The sites used to measure vehicle speeds in the opposite direction served as control sites to test whether vehicles traveling in the direction opposite the sign would show reductions in speeding. The remaining eight streets remained in the baseline condition.

Next, feedback signs were erected at four of the unpaired measurement sites and at one additional site where data were not collected. The remaining four unpaired measurement streets served as control streets to assess whether the effects of erecting several feedback signs would influence speeding on other city streets where there were no signs.

After the effects of the signs had been assessed on all eight streets, the signs were covered during

a reversal phase and uncovered again during the final feedback condition.

RESULTS AND DISCUSSION

Treated Sites

The mean percentages of motorists traveling 10 km/hr or more, 15 km/hr or more, and 20 km/hr or more over the speed limit averaged across the four paired and the four unpaired treated sites where signs were erected are presented in Figure 1. Introducing feedback signs led to decreases in the average percentages of drivers traveling 10, 15, and 20 km/hr over the speed limit at both paired and unpaired treated sites.

During baseline 2, the percentages of drivers traveling 10, 15, and 20 km/hr over the speed limit increased to the levels obtained during baseline 1 on both sets of treated streets. Introducing the second posting condition led to reductions in the percentages of motorists traveling 10, 15, and 20 km/hr over the speed limit that were similar to those produced during the first posting condition. Results for individual streets were generally consistent with the group data in seven of the eight cases. No substantial change in speeding behavior occurred on the remaining street.

Untreated Sites

The percentage of motorists traveling 10, 15, and 20 km/hr or more over the speed limit averaged across the four paired and four unpaired untreated sites appeared stable throughout the entire experiment and did not show any evidence of a general effect of the signs.

Site Characteristics

The overall effectiveness of the sign at each site was calculated by averaging the mean speed reductions in all three categories. Spearman rank correlation coefficients (r_s) were computed between sign effectiveness at each site and the number of intersections within 0.5 km past the sign site and the number of residences up to 0.5 km past the sign site. The correlations between sign effectiveness and

Figure 1. Mean percentage of drivers exceeding the speed limit by 10, 15, and 20 km/hr or more during each session of Experiment 1 at the paired and unpaired sign sites. Horizontal dashed lines represent the first baseline averages.

number of intersections and residences within 0.5 km past the sign were 0.79 and 0.83, respectively ($p < 0.05$, two tail). The correlation between sign effectiveness and traffic volume was -0.02 ($p > 0.05$, two tail).

Accident Analysis

The number of accidents on the seven treated streets that showed a reduction in speeding (excluding one street that failed to show a reduction) were tallied from police accident reports. Accident reports are filled out in Nova Scotia only if the

resulting damage totals \$500 or more. Data were not collected for 2 months because not all streets were in the same condition during this period. All minor accidents, which involved cars backing into other parked vehicles, or parking lot accidents were not considered. At all sites, only accidents that occurred within 1 km past the sign were counted.

The mean number of accidents on the seven treated streets averaged 29 per 5-month period over the four 5-month periods preceding the introduction of the signs. During the 5 months following the introduction of the second posting condi-

tion, there were only 19 accidents. This represents a 34% reduction in the number of accidents occurring on these streets. When the number of accidents during the second posting condition was compared with the number during the same months during the preceding year, the reduction was even larger (42%).

During the same period, the number of reported accidents in all other parts of the city of Dartmouth remained relatively constant. Comparing the number of accidents in the entire city during the second posting condition with the number during the same months during the preceding year revealed a reduction of 15% compared with the 42% reduction produced 1 km past the treated sites. An analysis of injury accidents was not possible because there were too few injury accidents in the vicinity of the sign sites to provide meaningful data.

EXPERIMENT 2

METHOD

Drivers and Setting

Drivers traveling on 14 streets in the city of Haifa, Israel, on Sunday through Friday (work-days) during daylight hours provided data. Data were collected on 100 vehicles per street on three randomly selected days each week between 9:00 a.m. and 4:00 p.m. Data were not collected on holidays. Streets were selected that were associated both with a high percentage of speeding and a high level of serious accidents. All speed readings were taken in residential areas.

Apparatus

Vehicle speeds were measured as in Experiment 1. The feedback signs were written in Hebrew, with 20-cm high letters bearing the message, % OF THE DRIVERS DROVE ACCORDING TO THE LAW LAST WEEK. BEST RECORD %." The sign also had the speed limit mounted in the upper right corner and contained the words "Israeli Police" with the police emblem and the words "Let's prevent accidents." All signs

were erected approximately 500 m ahead of the vehicle speed measurement points. The percentage of motorists traveling less than 15 km/hr over the speed limit on one randomly selected day per week was considered not speeding for the purpose of posting percentages on the signs.

General Procedure

Measures of interobserver agreement were obtained at least twice during each condition at all sites. Calculated in the same way as in Experiment 1, interobserver agreement averaged 97% and ranged from 89% to 100%. Accident data were obtained from the Haifa Police Department. Only accidents that caused an injury or a fatality had to be reported to Israeli police.

Experimental Design

A multiple baseline across streets design was used. After obtaining baseline data on all streets, the feedback signs plus a warning program were introduced sequentially on the 14 streets. During baseline the feedback sign was absent and the police used their usual methods of enforcement, which consisted of 4 hours of conventional ticketing, once per month. During the signs plus enforcement condition, the signs remained in effect and a warning program similar to that reported by Van Houten and Nau (1983) was introduced. On days when the warning program was in effect, the police applied this program for 1.5 hr, starting at a randomly selected time between 9:00 a.m. and 2:30 p.m. Motorists stopped for speeding were given an information flier and a warning ticket. The information flier differed from that used by Van Houten and Nau (1983) in that it also explained the feedback sign to motorists and asked them to strive to improve the percentage driving within the law. Another difference between the procedures was that, in Israel, a warning ticket automatically became a speeding charge if a computer showed that the person had been either warned or charged with the same offense during the preceding year. Whenever the program was introduced on a particular street, the police were present for 1.5 hr per day for the

Figure 2. Mean percentage of drivers traveling at or over 60 km/hr and 70 km/hr during each session of Experiment 2 on three typical streets. Horizontal dashed lines represent the initial baseline averages.

first 4 days and then their presence was gradually faded out over the next 8 weeks.

The radar operator was a regular member of the Haifa Police traffic division. Three university students, appointed as special police officers, received 2 weeks of training from the Haifa police, and were given official authority to issue traffic tickets and to wear regular police uniforms and badges.

Employing students was cost effective because they were paid less than regular police officers and worked only when needed.

On three of the streets a special enforcement program was also used, which involved the para-professional police stopping drivers who were not speeding (traveling between 48 km/hr and 42 km/hr) and thanking them for driving within the

speed limit. Police also gave motorists a certificate and a pen engraved with the message "Thank you for driving within the speed limit—Haifa Police." This program was also used without the regular warning program on two of the streets. This program was carried out for 1.5 hr per day and was faded out over a period of 8 weeks. Although motorists stopped during this condition had not violated the law, drivers passing by could not easily discriminate that police were not giving tickets; hence, for some drivers this program may have served as a discriminative stimulus for punishment. Although the police reported that the people they stopped seemed pleased to receive the pens and certificate, it is possible that the inconvenience associated with being stopped may have been aversive for some individuals.

Results and Discussion

The introduction of the sign and enforcement program together resulted in marked reductions in the percentage of motorists traveling within each speed category on all three streets. Figure 2 shows the percentages of motorists traveling 60 km/hr or more and 70 km/hr or more on three typical streets.

During the first 6 months following the erection of signs and the beginning of the enforcement program, there were 13 injury accidents on the side of the streets where the signs had been placed. These 13 injury accidents resulted in 14 minor injuries, 2 serious injuries, and no fatalities. During the same 6-month period of the preceding year there were 37 injury accidents on these streets resulting in 44 minor injuries, 6 serious injuries, and 1 fatality. During the 6 months prior to the start of the program there were 34 injury accidents, resulting in 42 injuries. Hence, the introduction of the sign and enforcement condition led to a 65% reduction in injury accidents compared with the same 6-month period during the prior year and a 62% reduction compared with the 6-month period just before the program was introduced.

During the first 6 months following the erection of the signs, there were 36 accidents on the side

of the street across from the signs, resulting in 32 minor injuries, 8 severe injuries, and 1 fatality. During the same period during the preceding year there were 25 accidents, resulting in 24 minor injuries, 6 severe injuries, and no fatalities on the same roadway.

Experiment 1 showed that the sign did not influence motorists traveling the opposite direction. Therefore, the failure to obtain a reduction in accidents on the side of the streets opposite the signs serves as a control for other factors that might have been responsible for the reduction in accidents on the side of the streets where the signs were erected.

These experiments demonstrated that the feedback sign alone and the feedback sign plus warning program reduced speeding at a large number of sites within two cities. The first experiment demonstrated that the signs did not influence speeding on nearby streets or the opposite side of the street where they were positioned. The direct discriminative effect of the sign was apparently needed to increase the probability that a motorist would slow down.

The first experiment also suggested that characteristics of the site where the sign was located may be an important factor in determining the extent of the sign's efficacy. Future research should be directed toward identifying these site characteristics, to ensure efficient placement of feedback signs. Experiment 2 indicated that the sign and enforcement program was effective in a setting very different from the one in which our original research had been carried out.

In both experiments it was often noted that vehicles traveled in platoons or groups. Thus, a factor that could have influenced the sign's effectiveness was the chain reaction established when one driver in a platoon of cars applied the brakes in response to the sign. Although this undoubtedly occurred, it should not be viewed as a problem but as a naturally occurring condition. Finally, the speed reductions produced in Canada and Israel were associated with reductions in accidents, thereby validating the importance of selecting reductions in speeding as a target for change.

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