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EFFECTS OF PUBLIC POSTING ON DRIVING SPEED IN ICELANDIC TRAFFIC

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We replicated a study by Van Houten, Nau, and Marini (1980) that had revealed reductions in vehicle speeding following the posting of percentages of drivers not speeding on a sign at roadside. Our subjects were drivers entering a residential area where the speed limit changed from 90 km/hr (55.9 mph) to 60 km/hr (37.3 mph). A total of 4,409 vehicle speeds were taken from two observation sessions per day for 20 consecutive weekdays. The intervention consisted of a single posting condition, in which a hypothetical daily percentage of drivers not speeding was posted on a feedback sign, followed by a double posting condition, in which a sign posting a best result was erected beyond the feedback sign. Results revealed a significant speed reduction from an average of 69.0 km/hr (42.9 mph) during baseline to 63.4 km/hr (39.4 mph) during single posting. Average speed during double posting was 62.9 km/hr (39.1 mph). The percentage of drivers exceeding 70 km/hr (43.5 mph) dropped from 41.0 during baseline to 20.5 during single posting. The significant speed reductions add to the generality of findings of similar studies in Canada and Israel and offer possible explanations for the failure of feedback posting to reduce speed in the U.S.

DESCRIPTORS: speeding, public posting, feedback, community psychology

Several studies have documented a direct relationship between driving speed and traffic accident rate (Cirillo, 1968; Gadallah, 1976; "Higher Speeds," 1978; Sommers, 1985; West & Dunn, 1971). Furthermore, according to Johnson, Klein, Levy, and Maxwell (1980), a positive relationship exists between the speed of a car at the collision point and the severity of an accident. To prevent accidents in which high speed is a factor, police spend considerable time and money enforcing speed limits with radar surveillance (Reykjavik Police Department, 1989; "55 mph," 1985). In 1984, 8,026,920 drivers were charged with speeding in the U.S. ("55 mph," 1985). A low-cost speed control technique comparable in effectiveness to police radar surveillance would reduce law enforcement costs and enable the police to work in other areas of accident and crime prevention.

Several studies have shown public posting of driving speed in Canada and Israel to reduce vehicle speeds significantly (Sherer, Friedman, Rolider, & Van Houten, 1984; Van Houten & Nau, 1981, 1983; Van Houten, Nau, & Marini, 1980; Van Houten et al., 1985) and to be more cost effective than standard police radar surveillance (Van Houten & Nau, 1981). These studies used a road sign to display the percentage of drivers not speeding on a particular stretch of road during the day or the week before, as well as the highest percentage recorded to date. Van Houten et al. (1980) presumed that the feedback sign was a discriminative stimulus for increased police surveillance, with drivers responding as if the sign were a stationary police vehicle. Van Houten et al. (1980) also suggested that drivers might compare their own driving speeds to others and slow down, both to conform with

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the majority and to reduce the danger of being detected. Interestingly, Roqué and Roberts (1989) report that attempts to replicate the Van Houten et al. studies in the U.S. have not resulted in significant speed reductions.

The purpose of the present study was to replicate the basic procedures of Van Houten et al. (1980), with an additional examination of the effects of feedback signs on average vehicle speed. The dependent measure reported in all previous speed prompting studies has been limited to percentage of drivers exceeding certain speeds above the legal speed limit, with no mention of reductions in average speed. We also tried to make the radar measurement devices less detectable to drivers, especially those equipped with radar detectors, by directing the radar antenna at the rear of the vehicles after they had passed the radar. This procedure significantly reduces the time and distance a vehicle travels within the radar beam before its speed is recorded. In the Van Houten et al. studies the radar was directed at oncoming traffic. We believe this measurement procedure might have given drivers with radar detectors ample time to react to the radar beam rather than to the sign information.

METHOD

Subjects and Setting

The subjects were drivers entering the residential town of Mosfellsbær, Iceland (population 4,200) on a two-lane highway from 9:30 a.m. to 12:00 p.m. and from 1:00 to 3:00 p.m. on weekdays. The Vesturlandsvegur highway was selected because, according to police authorities, drivers frequently did not obey the 60 km/hr (37.3 mph) speed limit in effect for traffic through Mosfellsbær. This could cause danger to speeding drivers and to pedestrians and drivers crossing or entering the Vesturlandsvegur highway within the town limits. The experimental setting was the first 430 m of that highway, which posted a 60 km/hr speed limit to drivers entering the town from the same highway with a 90 km/hr (55.9 mph) speed limit. Speeds were obtained 430 m after the first speed limit sign that announced the 60 km/hr speed limit.

Apparatus

Vehicle speeds were measured using a Kustom KR-10 radar device manufactured by Kustoms Electronics Inc. Prior to beginning each session, the calibration of the radar antenna unit was checked by switching on the unit and holding two vibrating tuning forks separately in front of the antenna. The metering unit read 45 and 80 km/hr if the radar antenna unit was properly calibrated. Before each session, the radar metering unit was tested by pushing a button that automatically started a testing process and read 32 km/hr if it was properly calibrated. The antenna and metering units functioned normally on all occasions.

The radar antenna was concealed in a gravel-colored barrel (36 cm high and 32 cm wide), half-submerged in gravel, 3.2 m from the edge of the road. The antenna was fastened to an embedded pole surrounded by the barrel. This guaranteed a constant 5° measurement angle with the highway centerline. No corrections of recorded speeds were needed at such a small angle. The antenna was directed at the rear of vehicles observed through an opening (13 cm by 18 cm) in the side of the barrel. Thus, approaching drivers could see neither the opening nor the antenna.

The radar metering unit was placed inside an automobile parked in the same direction as the traffic observed, 19 m from the edge of the road. The automobile was parked behind a fence, partially hidden from the view of passing drivers.

Two blue aluminum feedback signs were used, each 1.15 m high and 2.50 m wide. Letters were white and 18 cm high, and the numbers were yellow and 22 cm high. The numbers could be easily peeled off and replaced. The signs were written in Icelandic. Sign 1 read "YESTERDAY __% DROVE THROUGH HERE AT THE RIGHT SPEED" and was placed 4.7 m from the edge of the roadside and 3.7 m in front of and beside a 60 km/hr speed limit sign facing the oncoming traffic. Sign 2 read "BEST RECORD SO FAR __%" and was placed 3.2 m from the edge of the roadside, 68 m beyond Sign 1. The percentage numbers on each sign were chosen randomly from numbers between 85 and 95 and were not based on actual speed data.

Procedure

Observation and recording. The speeds of at least 200 vehicles were sampled in two sessions on 20 consecutive weekdays. Each weekday, 100 to 150 vehicles were observed between 9:30 a.m. and 12:00 p.m., and 100 to 150 vehicles were observed between 1:00 and 3:00 p.m. Prior to beginning the first session of each day during the intervention phase, the observers changed the percentage posted on Sign 1 and on one occasion changed the best record on Sign 2 from 93% to 94%. The speed of each vehicle was hand recorded from a digital screen on the metering unit immediately after the vehicle had crossed a certain section of the road in a direct visual line between a lamp post and a fence post on each side of the road, as seen by the observer. To minimize confounding effects, recording was interrupted when (a) more than one vehicle was on the 60-m road stretch between the radar and the point of measurement, because it could be argued that the speed of the following driver(s) was influenced by the leading driver, (b) an exceptionally slow vehicle (e.g., a tractor) was traveling in the direction of the recorded traffic between the signs and the point of measurement, or (c) the radar displayed speeds of vehicles coming from the opposite direction.

Interobserver agreement. Measures of interobserver agreement were obtained once during each experimental phase. That is, two observers sat side by side in the front seat and recorded the vehicle speeds independently, according to the procedure described by Van Houten and Nau (1981). The positions of their data sheets prevented each observer from seeing the other's records. The two observers were considered in agreement on the speed of each vehicle if no more than 2 km/hr separated their written records. An officer from the Reykjavik Police Department acted as an observer during interobserver agreement measurement in Session 24. Interobserver agreement was 98.2% of 110 vehicle observations during Baseline 1, 98.2% of 114 observations during the single posting phase, 100% of 115 observations during the double posting phase, and 100% of 40 observations during Baseline 2.

Experimental Design

The study used an A-B-C-A reversal design, with the four phases being (a) Baseline 1, (b) single posting, (c) double posting, and (d) Baseline 2. However, because the single and double posting phases yielded very similar results, the resulting design is functionally the same as an A-B-A reversal design (Barlow & Hersen, 1984, p. 83). Therefore, the data were analyzed as in an A-B-A design by collapsing data across the single and double posting phases.

Baseline 1. Both signs were absent. This phase continued for 10 sessions (5 days).

Single posting. Sign 1 was erected and speed measured for eight sessions (4 days). The numbers on the sign were changed prior to the beginning of the former session on each weekday. Thus, the same number was posted for two sequential daily sessions (1 day). The sequence of numbers was 86, 91, 89, and 93.

Double posting. Sign 2 was erected along the roadside, 68 m beyond Sign 1, and speeds were measured for 12 sessions (6 days). The numbers on Sign 1 were changed as during the single posting phase. The sequence of numbers on Sign 1 was 88, 89, 94, 91, 88, and 92. The numbers on Sign 2 were 93 from Sessions 19 to 22 and 94 from Sessions 23 to 30.

Baseline 2. Both signs were absent and speeds were measured for 10 sessions (5 days).

RESULTS AND DISCUSSION

The main result of this field experiment was that there was no overlap in average speeds between the posting phases and the baseline phases, strongly suggesting functional control of the feedback signs on driving speeds. The results in Figure 1 show that overall average speed within each phase was 69.0 km/hr (42.9 mph) during Baseline 1, 63.4 km/hr (39.4 mph) during the single posting phase, 62.9 km/hr (39.1 mph) during the double posting

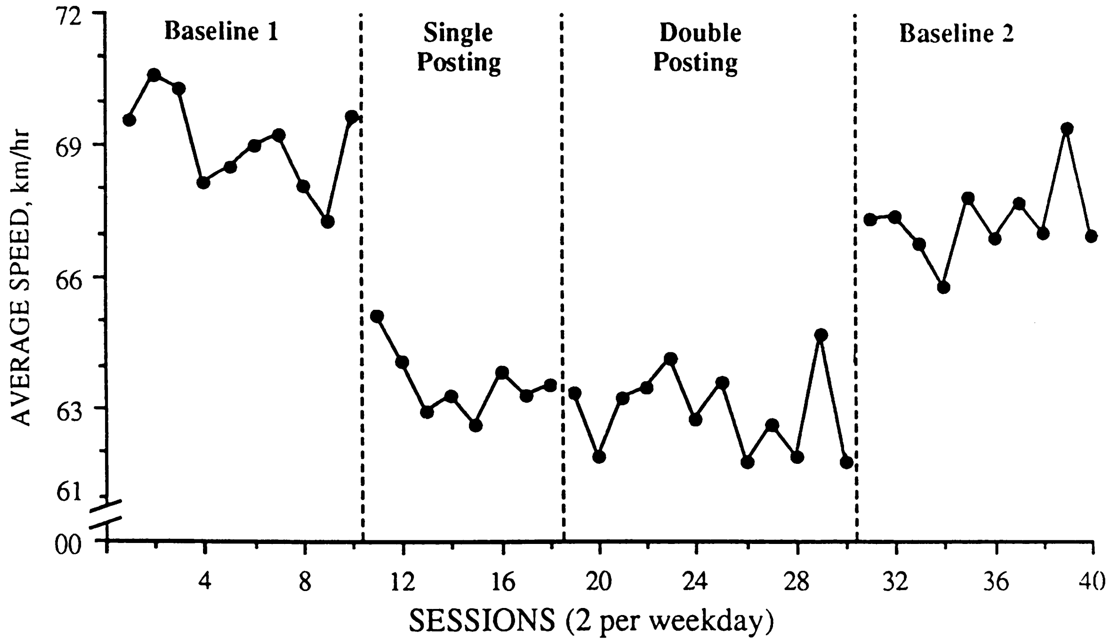

Figure 1. Average vehicle speeds per observation session within the four experimental phases.

phase, and 67.4 km/hr (41.9 mph) during Baseline 2. These results increase the generality of findings of the Van Houten studies, in which only the percentage of drivers exceeding particular speeds was reported and average speed reductions were not presented.

A one-way analysis of variance of the speeds indicated a significant difference between Baseline 1, Baseline 2, and the single posting and double posting phases combined, $F(2, 4406) = 166.8$, $p < .0001$. Furthermore, a Scheffé multiple group comparison test showed significant differences between the combined single and double posting phases and Baseline 1 (F-Scheffé = 1024.0; $p < .0001$), between the combined single and double posting phases and Baseline 2 (F-Scheffé = 731.7; $p < .0001$), and between Baseline 1 and Baseline 2 (F-Scheffé = 260.2; $p < .0001$).

A possible explanation for the significantly lower average speed during Baseline 2 compared to Baseline 1 is that the feedback signs' behavioral control was transferred to the 60 km/hr speed limit sign that stood parallel to Sign 1. It can be argued that drivers frequently traveling Vesturlandsvegur learned to react to the speed limit sign as well as to Sign 1, and as a result the speed limit sign was responsible for the significantly lower speeds during Baseline 2 compared to Baseline 1 when the speed limit sign had not been paired with the feedback signs.

Figure 2 illustrates the percentage of drivers traveling at speeds over 60, 70, and 80 km/hr respectively. The figure reveals stable and substantial percentage reductions in all three speed categories. Of interest is the percentage of drivers traveling over 70 km/hr, because, unofficially, they comprised the group being pulled over for speeding. During Baseline 1, 41.0% of the drivers (n = 1,089) traveled above 70 km/hr. The percentage of drivers in this category was reduced to 20.5% (n = 869) during single posting and was 17.8% (n = 1,351) during double posting. During Baseline 2 the percentage of drivers traveling above 70 km/hr increased to 34.0% (n = 1,100). One possible reason for the signs' strong effect might be that commercial and official signs of any kind are infrequent along Icelandic highways. As a consequence, the signs were probably quite noticeable and seemingly significant to the drivers.

The cost of sign construction and daily half-hour maintenance of numbers by one patrolman in Ice-

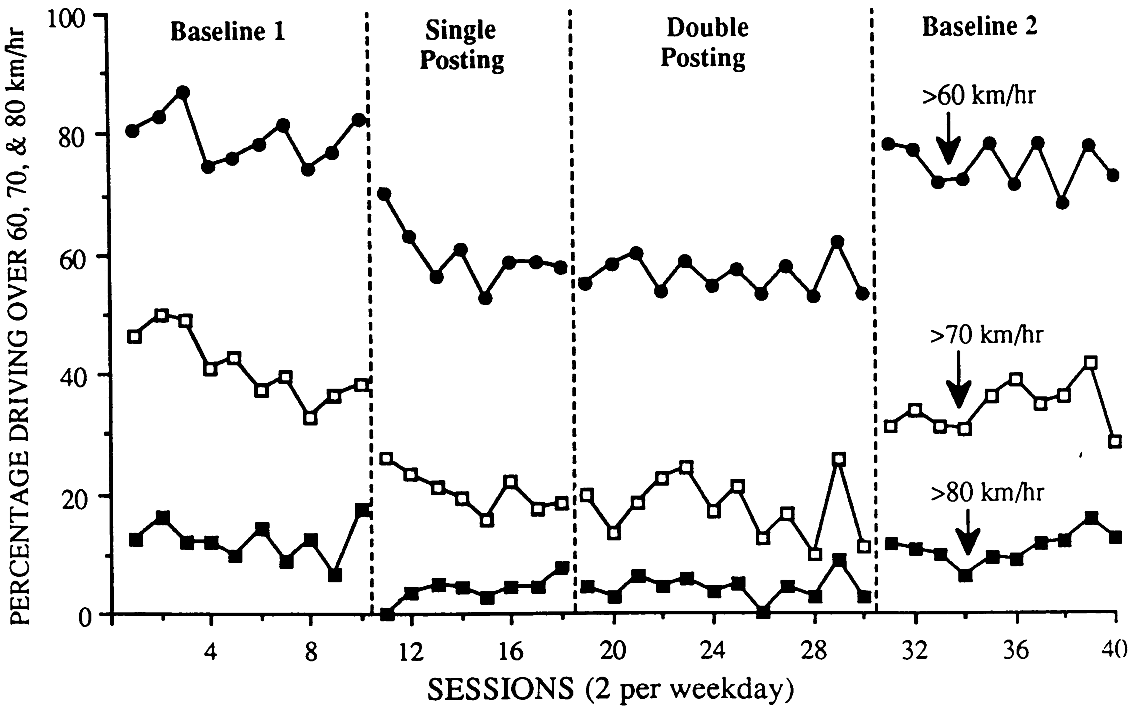

Figure 2. Percentage of drivers traveling at speeds over 60, 70, and 80 km/hr during consecutive observation sessions within experimental phases.

land would be approximately $3,875 a year. This cost could be reduced to $1,280 a year by using weekly posting of percentage of drivers not speeding, as found effective for 25 weeks by Van Houten et al. (1980). Traditional enforcement of driving speed with a mandatory two policemen per police vehicle, 7 days a week for 2 hours each day, costs $21,170 a year. It remains to be demonstrated, however, whether weekly posting of feedback numbers can maintain low driving speeds on a year-round basis.

Initially, we planned to compare effects of the two different signs. However, because the speed reductions during single and double posting were essentially alike, another single posting phase after the double posting phase would not have added to the analysis. Furthermore, when the experiment was conducted, the effects of similar feedback signs on driving speed had already been well documented in the Van Houten studies. For that reason, and also because the first two phases of the study revealed a significant change in average speed, a return to baseline following the single posting phase was not believed necessary. This design, however, prevented an analysis of the relative effects of each feedback sign. The resulting design probably made the signs' information appear logical to drivers frequently traveling Vesturlandsvegur, because it could be argued that posting best record information the 1st day after baseline measurement would reduce the signs' credibility.

A possible explanation for the failure of Roqué and Roberts' (1989) study to reduce speeding may be due to the location of their feedback sign and speed measurement equipment. In their study, the feedback sign stood 116.7 m beyond a permanent warning sign that read "Reduced speed ahead, 35 mph," and was positioned 206 m before a 35 mph (56.4 km/hr) speed limit sign indicating the beginning of a lower speed limit zone. Additionally, speeds were recorded as the vehicles drove by the speed limit sign, indicating the beginning of the lower speed limit zone. It can be argued that drivers in the Roqué and Roberts study failed to react to the feedback sign because it was placed outside the actual speed limit zone targeted for change. Another possible explanation is that the drivers actually reacted to the feedback sign when they had traveled a certain distance in the lower speed limit zone, but due to the position of the speed measurement equipment this behavior change was not detected.

In the present study, as in other studies conducted in transition zones where speed limits are lowered (Van Houten & Nau, 1981; Van Houten et al., 1980), the feedback sign was placed parallel to the first speed limit sign indicating the beginning of a lower speed limit zone, and the drivers' speeds were recorded when they had traveled the first 250 to 500 m in the lower speed limit zone. An experiment conducted in a transition zone, systematically varying the location of the feedback sign and measurement equipment, is needed to examine these possibilities. We further suggest that future public posting experiments in traffic should focus on revealing what minimum sign information is necessary to maintain acceptable driving speeds. Of particular interest is whether feedback numbers can be discarded from the signs without reducing sign effectiveness, because maintaining the numbers was a major cost factor in these studies.

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