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THE EFFECTS OF PROMPTING AND FEEDBACK ON DRIVERS' STOPPING AT STOP SIGNS

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Complete stops at a high-traffic intersection on the campus of a public university were increased with a prompting and consequence intervention. Data were collected at two opposing stop signs (Stop A and Stop B); however, the intervention was implemented only at Stop A. During the intervention, a volunteer stood next to Stop A holding a poster that read, "Please Stop—I Care," with "Thank You For Stopping" on the reverse side. The poster was held by the volunteer so that drivers approaching Stop A could read the sign. Drivers approaching Stop B could see the volunteer but could not read the sign. When vehicles approaching Stop A made a complete stop, the volunteer flashed the "thank you" side of the poster to the driver. The strategy was evaluated using a multielement design. The intervention increased stops completed at Stop A from a baseline average of 13% to an intervention average of 52%. Stop B also showed improved stopping, from a baseline average of 6% to an intervention average of 28%. Data showed no relation between complete stops made and the drivers' use of turn signals and safety belts.

DESCRIPTORS: prompting, complete stopping, safety, antecedent

A National Highway Traffic Safety Administration (NHTSA) study (2002) found that an average of 117 people died each day in 2002 from motor vehicle crashes. The study also reported the leading cause of death for people ages 2 to 33 years old is motor vehicle crashes. It is estimated that 28% of occupants in motor vehicle crashes incur minor to moderate injury, and 6% incur severe to fatal injuries (NHTSA, 2002). In 2000 alone, the costs resulting from 41,821 deaths, 5.3 million injuries, and 27.6 million damaged vehicles were $230.6 billion (NHTSA, 2000).

In 2001, 20% of fatal crashes occurred at intersections (NHTSA, 2002). In addition, approximately 48% of all injury-causing crashes occur at intersections (Federal Highway Administration, 2002). More than 50% of the fatal crashes that occurred at intersections in 2002 in one midwestern state took place at stop signs (UMTRI Transportation Safety Analysis Division Transportation Data Center, 2002). When drivers fail to stop at stop signs, they risk a crash that could have been prevented if the driver had stopped completely. Unfortunately, not all drivers make complete stops as required by law.

Studies using applied behavior analysis have demonstrated that prompting effectively increases safety belt use (Austin, Alvero, & Olson, 1998; Engerman, Austin, & Bailey, 1997; Cope, Moy, & Grossnickle, 1988; Cox, Cox, & Cox, 2000; Geller, Bruff, & Nimmer, 1985; Thyer, Geller, Williams, & Purcell, 1987; Williams, Thyer, Bailey, & Harrison, 1989). Signs and volunteers were used in four of these prompting studies, with substantial increases in safety belt use resulting in each case. In addition, studies have demonstrated that consequences including feedback can increase driver safety behavior (Ludwig & Geller, 2000). It is feasible that these same behavioral strategies can also be applied to increase the percentage of drivers who make complete stops at stop signs. This study used a volunteer and a sign to influence the percentage of complete stops made at stop signs by drivers.

METHOD

Participants and Setting

The study was conducted on the campus of a midwestern public university with approxi-

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mately 30,000 students enrolled. A highly traveled three-way stop intersection was the site of data collection. The two targeted stops, Stop A and Stop B, were directly opposite each other at the intersection. Participants consisted of any driver who passed through one of the two stop signs at the time of data collection. Data were collected on weekdays between 8:00 a.m. and 9:00 a.m. because this was a period of high traffic on campus. The study occurred during September through December of one semester.

Data Collection

Data were recorded for complete stops made at the stop sign (all tires visible to observers stopped rotating), turn-signal use (turn signal was used for at least one blink), and safety belt use (recorded by observing if a shoulder belt was in use). Trained data collectors observed vehicles from inside a parked car in a parking lot adjacent to the stop signs. Data collectors first observed a car approaching Stop A and then immediately observed the next car that approached Stop B. During interobserver agreement sessions when traffic became congested, the observer called out the color and make of an approaching vehicle to be observed to ensure that both observers were observing the same vehicle. Observation sessions lasted until 20 observations had been conducted for each targeted stop sign. Sessions occurred four to five times per week on average.

Interobserver Agreement

Interobserver agreement was collected for 25% of the observation sessions. Agreement for safety belt use, turn-signal use, and complete stopping was 90%, 96%, and 93%, respectively, for Stop A and 87%, 92%, and 97%, respectively, for Stop B.

Design and Procedure

A multielement design was used to evaluate the impact of the intervention. Baseline data were collected for 16 observation sessions at each targeted stop sign. Then, the sign-flashing intervention was implemented and alternated with a baseline condition in randomized order. These intervention and baseline sessions were each conducted on different days.

Intervention. The intervention used a red poster (55 cm by 71 cm) that read in bold black letters, "Please Stop—I Care" and "Thank You for Stopping" on the reverse side. A female undergraduate student volunteer stood facing traffic approaching Stop A and held the poster with the "Please Stop—I Care" side facing the drivers approaching the stop sign. The volunteer held the poster at chest level, and remained motionless as vehicles approached. If the approaching vehicle made a complete stop, the volunteer flashed the reverse side of the poster ("Thank You for Stopping"). As that vehicle passed, the poster was again reversed to the prompting message so that the driver of the next oncoming vehicle could read it. If the approaching vehicle did not make a complete stop, the volunteer did not display the reverse side of the poster. Data collectors tracked the application of the intervention and found that it was correctly implemented in all cases.

During the intervention, data were collected for drivers passing through Stop A as well as those passing through Stop B. However, only drivers traveling toward Stop A could read the sign prompts. Because the stops were opposing each other, drivers approaching Stop B could see the presence of a person standing by the stop sign on the opposite side of the road.

RESULTS AND DISCUSSION

The upper panel of Figure 1 displays the percentage of complete stops made at Stop A. During the initial baseline phase, the mean percentage of complete stops was 13.6% (SD = 2.9; range, 0% to 27%). This continued during the baseline condition of the multielement phase when baseline averaged 7% (SD = 1.6; range, 3% to 10%) for Stop A. During the sign-

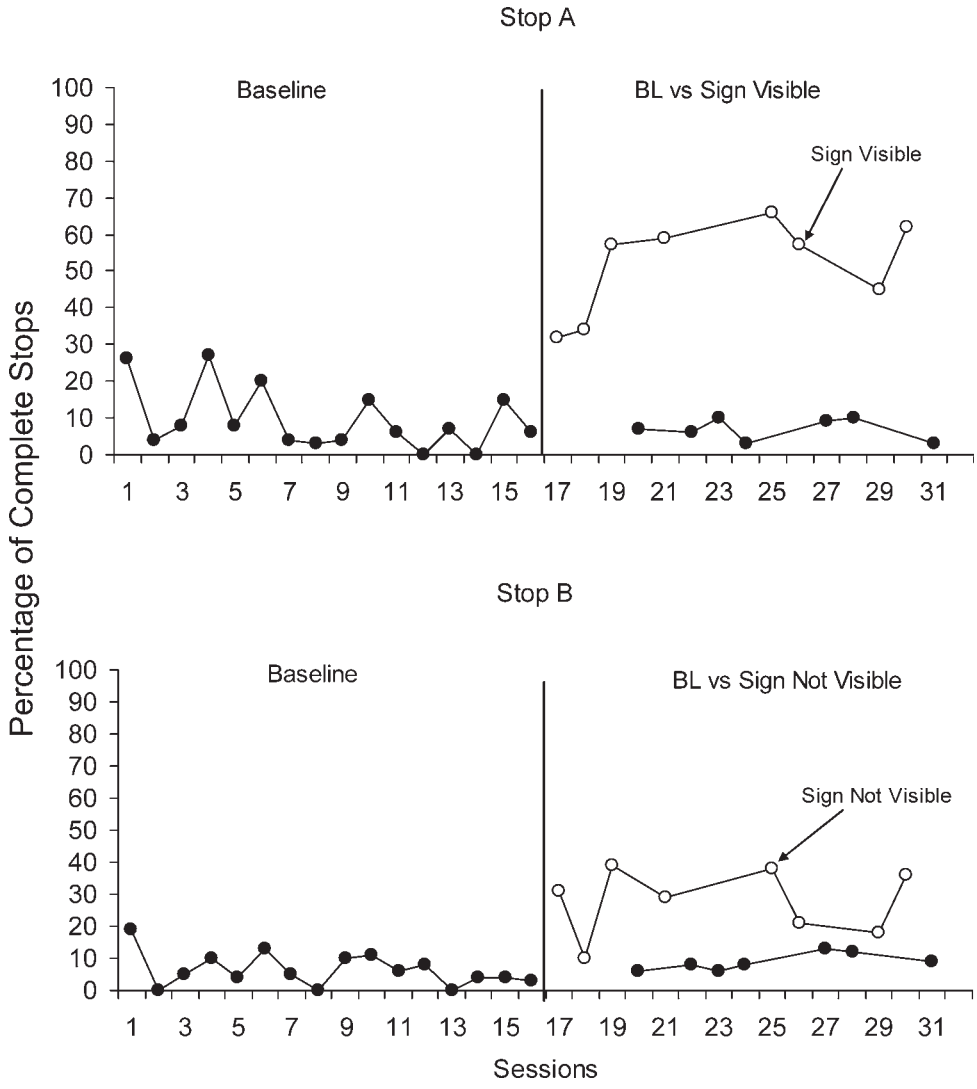

Figure 1. Percentage of complete stops made at Stop A (top) and Stop B (bottom).

flashing intervention, the mean percentage of complete stops increased to 52% (*SD* = 3.4; range, 32% to 66%).

The bottom panel of Figure 1 shows that the mean baseline percentage of complete stops made at Stop B was 6.4% (*SD* = 2.0; range, 0% to 19%) during the initial baseline phase and 9% (*SD* = 1.5; range, 6% to 13%) for the baseline condition of the multielement portion of the study. Stopping at Stop B increased to a mean of 28% (*SD* = 2.9; range, 10% to 39%) on days on which the sign-flashing intervention was in effect for Stop A.

Effect sizes were calculated to quantify the size of the intervention effect by comparing the original baseline to the intervention phase data. To calculate effect size, we used the *d* statistic as follows: intervention mean minus baseline mean divided by pooled standard deviation. The effect size (*d*) at Stop A was 1.23, and the effect size (*d*) at Stop B was 1.01. As interpretation guidelines, Cohen (1988) sug-

gested that a *d* value of 0.2 is small, 0.5 is medium, and 0.8 is large.

Turn-signal use and safety belt use were also recorded for each participant in the study. Turn-signal use for Stop A during baseline was 81% and increased to a mean of 87% during intervention. Despite some evidence in the literature that covariation (or response generalization) can be expected among targeted and untargeted driving behaviors (e.g., Ludwig & Geller, 1997), in this case the effect (6%) appears to be too small to argue that any covariance occurred. Similarly, safety belt use did not seem to be affected by the intervention. The baseline mean of safety belt use at Stop A was 79% and was 83% during intervention.

The results suggest that the intervention increased complete stops at both stop signs. The increase at Stop A was larger than that observed at Stop B. It is possible, but unlikely, that drivers at Stop B could see the "Please Stop—I Care" prompt. Our impression was that drivers could see only the backside of the volunteer standing at Stop A. Therefore, the increase in stopping at Stop B appears to have resulted from the presence of the volunteer, who was perhaps seen by oncoming traffic as a pedestrian about to cross the street. It is also possible some drivers at Stop B had previously driven through Stop A and contacted the intervention, effectively making the sign both a prompt and a consequence in some cases. Because vehicles were not identified individually, the effects of repeated exposures to the sign could not be evaluated. More specifically, the person holding the sign could have been an agent for social reinforcement as well as an agent for prompt delivery. The presence of the sign produced similar data paths for Stop A and Stop B for the first 2 days, but then the paths diverged and the effect at Stop A became more pronounced. If there were repeat drivers each day, this pattern of results would suggest that the sign functioned as a consequence for Stop A drivers and as a prompt for Stop B drivers. To determine the relative effects of prompts and consequences, future research should add a control condition in which the prompt is issued without a consequence for stopping or not stopping.

In addition, future research might investigate whether these effects were caused by the text of the prompt or merely by having a person holding a sign on the side of the road. This might be accomplished by having a volunteer hold a double-sided sign containing a neutral (unrelated to driving) message during baseline. The treatment could then replicate the treatment used in the current study. The results would allow researchers to identify the effects of the information on the sign versus the mere presence of the person holding the sign.

The intervention represents a starting point in the management of motorist stopping behavior. It should be noted that the intervention in its current form could not be adopted on a wide scale due to the cost of employing individual sign holders. One way to counter this limitation, at least at universities, would be to employ volunteers from student organizations. In the community, however, such a solution to the problem would not be so simple. This issue should be addressed by future research.

In conclusion, the current intervention appears to be an effective strategy to increase complete stops made at stop signs. The student volunteer anecdotally reported positive comments and positive gestures made by passing drivers, indicating that the intervention was well received.

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