

COMMUNITY-BASED FEEDBACK TO PROMOTE ROAD SAFETY

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(ABSTRACT)

The theory of risk compensation predicts that when individuals increase the practice of a safe behavior, they will also increase the practice of an unsafe behavior in order to maintain the same level of overall risk. In contrast, response generalization predicts that an increase in safe behavior will increase other safe behaviors in the same response class. The present study examined the effects of community-based feedback on the safety belt use of drivers in a small community in Southwest Virginia, while drivers on an intersecting highway served as a control group. An AB design was used to test the effects of the feedback on belt use. Turn signal use and right and left-hand turn behaviors were also measured to study risk compensation vs. response generalization. Baseline measures were taken for 13 weeks at which point two feedback signs were erected in the community for the remaining 17 weeks of the study. The words "SAFETY BELT USE IN NEWPORT LAST WEEK" with the percentages of male and female driver safety belt use the previous week appeared on the signs. Feedback

increased the safety belt use average in the community by 15.5 percentage points for males, and 9.7 percentage points for females over a 17 week period. Evidence for response generalization was shown by a 14.9 percentage point increase in turn signal use over the 17 weeks of the feedback intervention.

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Community-Based Feedback to Promote Road Safety

Safety belt use is an easy way for an individual to reduce the possibility of serious injury or death in a vehicle accident. In the United States there were 39,235 deaths from motor vehicle crashes in 1992 (Insurance Institute for Highway Safety, 1993). It has been estimated that safety belts are 43 (± 3)% effective in preventing vehicle accident fatalities; that is, if currently unbelted drivers and right-front passengers buckled up, fatalities would decrease 43 (± 3)% for this group (Evans, 1986). Because of the effectiveness of safety belts, 43 states in the U. S., Washington, D. C., and Puerto Rico have passed belt use laws (BULs) requiring safety belt use in the front seat of vehicles (National Highway Traffic Safety Administration, 1991).

Although BULs have been effective in increasing safety belt use during their first month in effect, these initial gains have typically declined over the next several months (National Highway Traffic Safety Administration, 1992; Williams, Wells, & Lund, 1987). The average safety belt use rate in states with a BUL is typically between 50 and 60 percent (Evans, Wasielewski, & von Buseck, 1982; Williams et al., 1987). In addition, it is likely that those most at risk of having an automobile accident are those least likely to increase their safety belt use in response to a BUL

(Ludwig & Geller, 1991; Preusser, Lund, Williams, & Blomberg, 1988). Thus, large-scale behavior change interventions are needed to motivate safety belt use by individuals unaffected by BULs (Ludwig & Geller, 1991).

Geller (1992) suggested that whenever an intervention study is conducted to increase safety belt use, other driving practices should also be measured if possible in order to examine concomitant changes in other driving behaviors. A similar argument was put forth earlier by Willems (1977), who advocated that applied behavior analysis take an ecological perspective. The ecological perspective emphasizes the need to evaluate behavior change interventions in terms of their "unintended" effects on participants' behaviors (Willems, 1977). In order to accomplish this, a researcher must be cognizant of the systemic nature of behavior and the influence of the environment in which the behavior takes place. Behaviors (such as driving safety behaviors) interact with each other in a dynamic fashion so that a change in one behavior will result in changes in other, related behaviors in the system. Thus, several behaviors related to a target behavior should also be measured in order to detect a change concomitant to a change in the target behavior (Willems, 1977).

Two of these unintended effects are risk compensation and response generalization (Geller, 1992). The theory of

risk compensation predicts that when drivers of motor vehicles increase their perception of safety, they will compensate for this by adopting other risky behaviors in order maintain a fixed level of perceived risk (Wilde, 1982). This theory was formulated in response to findings that real-world interventions to increase traffic safety were usually less effective than predicted from laboratory tests (Haight, 1986). For example, the increased use of safety belts in response to a state BUL has often not decreased injuries and deaths from auto accidents as much as expected (Wilde, 1982).

Some experimental support for risk compensation theory was provided by Streff and Geller (1988). Participants in their study drove a go-kart while using or not using a safety belt in two phases of 15 trials each, and their driving speed was recorded. Subjects who did not use a safety belt in the first phase but then switched to using a safety belt in the second phase increased their speed significantly more in the second phase than did a group who belted up in both phases. Streff and Geller (1988) only showed risk compensation when subjects switched to using a safety belt in a within-subject manipulation, not in a between-subject paradigm that compared safety belt users and nonusers. Nevertheless, any intervention which increases safety belt use could possibly result in the driver

compensating for the reduced risk of injury by performing other unsafe driving behaviors.

In contrast to risk compensation theory, response generalization predicts that an intervention that increases safety belt use would result in other safe behaviors being performed by the driver (Geller, 1992). Actually, it is possible some interventions may be more disposed to produce risk compensation, whereas other interventions may be more likely to produce response generalization. Thus, an ecological approach is needed to determine which (if either) of these effects occur (Geller, 1992). In a study of safety belt use by pizza delivery drivers, for example, Ludwig and Geller (1991) found that drivers increased their use of turn signals during an intervention phase that only targeted safety belt use.

The increase in turn signal use found by Ludwig and Geller (1991) was theorized to be the result of response generalization. That is, the non-target behavior (turn signal use) was in the same response class (safe driving) as the target behavior (safety belt use); and therefore when an intervention increased safety belt use, a behavior in the same class (i.e., turn signal use) also increased. Clearly, these results (and explanation) are opposite to that predicted by risk compensation theory. The present study was designed to probe for evidence of either one of these

phenomena during a community-based feedback intervention to increase safety belt use.

Many field studies have shown different applications of the three-term behavior analysis contingency (antecedent-behavior-consequence) to be effective in increasing safety belt use (Geller, 1992). Several studies have examined the effects of reminders (i.e., antecedent strategies) on community-wide safety belt use. Geller, Bruff, and Nimmer (1985), for example, evaluated a "Flash for Life" technique whereby an 11 x 14 inch flash card reading: "Please Buckle-up--I Care" was displayed to drivers not using their safety belt, and the message "Thank You for Buckling Up" (on the reverse side) was flashed to drivers who complied with the request. This technique increased belt use when used by the front-seat passenger of a car (Geller et al., 1985), by a person standing at a parking lot exit, and when the sign was posted at a parking lot exit (Berry, Geller, Calef, & Calef, 1992). Williams, Thyer, Bailey, and Harrison (1989) found that a sign reading: "Fasten Safety Belt" was effective in increasing safety belt use on a college campus when it was held by an individual (i.e., a prompter). However, the sign had no effect when it was posted at a parking lot exit.

Public posting of feedback along roadways has the potential to reach a large number of individuals. Several studies by Van Houten, Nau, and colleagues (Van Houten &

Nau, 1983; Van Houten, Nau, & Marini, 1980; Van Houten et al., 1985), and also a study by Ragnarsson and Björgvinsson (1991) showed that posting feedback on the percentage of drivers not speeding on a roadway reduced speeding on that road. In these studies, feedback was posted on a road sign bearing the message: "DRIVERS NOT SPEEDING YESTERDAY __%" with the percentage of non-speeders posted, and "BEST RECORD __%" written underneath with the highest daily percentage of non-speeders posted (Van Houten et al., 1980). Data on speeding were collected at a point down the road from the sign for a set period of time on weekdays. This public feedback intervention was quite effective in reducing speeding on four-lane undivided highways (Van Houten et al., 1980), and on two-lane residential roads (Van Houten & Nau, 1983). Also, weekly posting of feedback was found to be equally effective as daily posting (Van Houten et al., 1980). This feedback intervention worked in different countries, i.e., Iceland (Ragnarsson & Björgvinsson, 1991), Canada and Israel (Van Houten et al., 1985), and it has also been accompanied by a reduction in vehicle crashes on the targeted road (Van Houten et al., 1985).

Studies on the effectiveness of feedback to increase safety belt use have been mixed. Nau and Van Houten (1981-82) found that a feedback sign displaying weekly safety belt use was not effective in increasing belt use along two urban

highways in Nova Scotia. However, Grant (1990) found the posting of daily feedback on safety belt use to be effective in increasing belt use at a government training center. A portable sign with the message "DRIVERS WEARING SEAT BELTS ___%" was placed at the entrance to the training center and the percentage of drivers using their safety belts was updated daily. The sign was kept in place for six weeks and resulted in an increase in safety belt use from 65% during baseline to a peak of 82% during the intervention phase. Grant (1990) also incorporated an educational program at the training center, but the feedback component was effective independent of the educational program.

There are several possible reasons for the differential effects of feedback signs on safety belt use. One is that the feedback sign served as a discriminative stimulus for increased police enforcement of traffic laws (Van Houten et al., 1980; Nau & Van Houten, 1981-82). There was no legislation requiring safety belt use at the time of the Nau and Van Houten (1981-82) study, but there was a safety belt law at the time of the Grant (1990) study. Other possible reasons for inconsistent findings were the different settings of the two studies, and the relative size of the populations involved. The Nau and Van Houten (1981-82) study took place in large urban areas (Halifax, pop. 113,577 and Dartmouth, pop. 65,243; Nova Scotia), whereas the Grant

(1990) study occurred in a smaller industrial city (Cornwall, Ontario, pop. 46,425) at a local government training center. Hence, the Grant (1990) study had a specific group targeted for intervention (i.e., the workers at the training center), and the data collection and feedback intervention were conducted at the entrance to the parking lot of the training center where only workers at the center could be observed (Grant, 1990). However, in the Nau and Van Houten (1981-82) study, the target population was anyone traveling the roads where the feedback signs were located. Therefore, the feedback may have been considered more personal by the participants in the Grant (1990) study than in the Nau and Van Houten (1981-82) study.

The inconsistent effects of public feedback on safety belt use may also have been partially due to differential repeated exposure to the sign across studies. In the Nau and Van Houten (1981-82) study, only those drivers traveling on the targeted road came into contact with the feedback sign, and it is possible the number of drivers who repeatedly contacted the sign was small in proportion to the total number of drivers observed. This was also the case in the Van Houten et al. (1980) study of speeding, but rate of speed is a behavior which can be altered immediately in response to the feedback stimulus. In contrast, fastening a safety belt is not easy to do while driving, and buckling up

"on the run" may also be dangerous (Nau & Van Houten, 1981-82). In the Grant (1990) study, the feedback sign was frequently encountered by the participants, since the sign was posted at the only entrance to the parking lot of the government training center where the participants worked. Thus, frequent contact with a feedback sign may be necessary for this intervention to result in observed increases in safety belt use.

The present study used an ecological approach to evaluating the effects of a community-based feedback intervention on safety belt use. In addition to drivers' safety belt use, turn signal use and turning behaviors were recorded and analyzed for indications of risk compensation and/or response generalization. It was predicted that the public posting of feedback would increase the safety belt use of community members over baseline levels. Because of the small size of the participating community, the feedback was expected to be personalized for community members and they would encounter the feedback on several occasions. In these ways, the situation paralleled those in the Grant (1990) study where safety belt feedback was effective.

In the present study, a within-subject comparison was used to evaluate the effects of feedback on the non-target behaviors of turn signal use and risky turns. Drivers in a small, rural community were the focus of the within-subject

comparisons, and, when possible, vehicle license plate numbers were recorded in order to compare the behaviors of specific individuals across phases. In order to make the feedback more personal, feedback was given separately for males and females. It was predicted that response generalization would occur with the feedback intervention. In other words, if safety belt use by residents increased during the intervention phases, turn signal use would also increase, as would safe turns.

Participants were also divided into groups based on gender and vehicle size and type. It was predicted that males who drove pick-up trucks would be less likely to buckle-up during baseline, and would change their behavior less than other groups in response to the feedback. This prediction was posited because of a presumed "macho" attitude of many male pick-up drivers. It was also predicted that drivers of large vehicles would buckle-up less and be more likely to take unsafe turns than drivers of small vehicles due to risk compensation notions (i.e., drivers of larger vehicles feel safer than drivers of smaller vehicles, and thus take more risks).

Method

Participants

Participants were the drivers and front-seat passengers of vehicles leaving and entering a small community in

Southwest Virginia (Newport, VA) and of vehicles traveling on an intersecting highway. Observations were taken at an intersection between a four-lane, 55 MPH highway (Route 460) and a road leading into Newport (Route 42). See Figure 1 for a diagram of this intersection. 64% of drivers observed were male (n=6075) and 36% of drivers observed were female (n=3477). Occupants of vehicles which did not turn onto Route 42 from 460 served as a control group, while travelers on Route 42 were the focus of the intervention. Since Route 42 is the main access road to Newport, most of the participants traveling regularly on this road were Newport residents. However, since there is a store at this intersection, when vehicles entering 42 stopped at this store it was noted on the data sheet. If one of these vehicles was seen leaving the store and turning back onto 460, the driver was not considered to be a Newport resident. Even if the drivers seen leaving and entering Newport were not residents of the Newport community, the positions of the feedback signs made it probable for these drivers to see at least one of the feedback signs.

Insert Figure 1 about here

The location of the study was selected because the limited access to Newport afforded an opportunity to

differentiate residents from non-residents. Also, the intersection implicates risks for those (e.g., residents of Newport) turning onto a 55 MPH highway from a complete stop without the assistance of a traffic light (West & Dunn, 1971).

Data Collection

Participants were observed unobtrusively by trained research assistants and the author for one hour on weekdays. Observations were made from a vehicle parked in a parking lot overlooking the intersection (as depicted in Figure 1). Data was not collected on vehicles without visible shoulder belts or with automatic shoulder belts. Inter-observer reliability was assessed by having two observers independently collect the field data on approximately 43% of the observation sessions. The research assistants were trained to collect shoulder belt and turn signal use data and also to discriminate between different vehicle types and different types of left and right-hand turns.

The different vehicle categories were: 1) small automobiles, 2) large automobiles, and 3) trucks. The small automobile category included sub-compact, compact, and mid-size automobiles. Large luxury cars, station wagons, and vans were considered large automobiles. The truck category included all sizes of pick-up trucks and 4X4's (e.g., Jeeps, Broncos, etc.). These measures were taken to study whether

the increased safety of larger vehicles (Partyka, 1990) may promote risk compensation and decrease safety belt use (Geller, 1992). Indeed, Preusser et al. (1988) observed that drivers of larger cars used their safety belts less than drivers of smaller cars. Thus, vehicle type may be an important environmental factor affecting safety belt use and risks taken when turning on to a four-lane highway.

Different types of left and right-hand turns by vehicles turning onto the four-lane highway (see Figure 1) were recorded. The safest left-hand turn was defined as a direct turn when no traffic was near. An unsafe left-hand turn was driving halfway across the intersection to the median, stopping, and then turning onto the road. Another type of turn considered to be unsafe was when a vehicle turned into the left lane while traffic was in the right lane. These turns could have been executed by the same driver. For example, a vehicle could have advanced halfway across the intersection, stopped, and then either turned directly onto the road when no traffic was coming or turned into the left lane while traffic was in the right lane. Therefore, four left-hand turn behaviors were possible: 1) The safest behavior was a direct turn onto the road when no traffic was coming; 2) A moderately unsafe behavior was driving halfway across the intersection, stopping, then turning into the road when no traffic was coming; 3) A more

unsafe behavior was turning into the left hand lane while traffic was in the right hand lane; 4) The most unsafe behavior was driving halfway across the intersection, stopping, then turning into the left lane while traffic was in the right lane. There were only two categories of right-hand turns. The safest right-hand turn was a direct turn when no traffic was coming, and the most unsafe right-hand turn was turning into the right hand lane while traffic was in the left lane.

Because of different traffic conditions, every vehicle turning onto 460 did not have the same opportunity to make risky turns. If there was no traffic on 460 when a vehicle reached the intersection, the driver was able to make a direct turn onto 460 without having had the opportunity to engage in any risky behavior. Therefore, whether or not the vehicle had to wait for traffic to clear before turning was recorded and used as an indication of the opportunity to be unsafe.

Stopping halfway across the intersection is dangerous at this intersection because the median is very narrow and it is difficult to judge the position of one's car relative to the traffic lanes. In addition, drivers of large cars and pick-up trucks put themselves more at risk by stopping in the median than drivers of small cars, due to the increased length of their vehicles.

Observers were trained to discriminate reliably between different vehicle categories by explaining the characteristics of vehicles in each of the categories at a group meeting. The different types of turns were explained by the author using a map of the intersection on an overhead projector. In addition, the author or a trained assistant accompanied each pair of data collectors at least once in order to provide on-site training.

Procedure

An AB design with a control group was used to assess the effects of feedback on safety belt use. Baseline safety belt use was recorded for thirteen weeks, and then the feedback intervention was implemented. During baseline, breaks in the data collection occurred between weeks six and seven because spring break and a snowstorm made data collection difficult. Another break occurred between weeks 10 and 11 because of the unavailability of data collectors. On Monday of Week 14, feedback on community members' safety belt use was posted on a 4-foot tall by 8-foot wide portable sign placed 7 feet from the road (Route 42) approximately 100 yards from the intersection of route 42 and 460. The words "SAFETY BELT USE IN NEWPORT LAST WEEK" with the percentages of male and female driver safety belt use the previous week appeared on both sides of the sign. The letters were black and the numbers were red. Both letters

and numbers were 8 inches tall. See Figure 2 for a photograph of the feedback sign. During the feedback intervention, weekly percentages of safety belt use by males and females were updated at the end of each week of data collection.

Insert Figure 2 about here

A second feedback sign with the same message on one side was posted on a smaller sign in front of the Newport community recreation center. See Figure 3 for a map of Newport with the locations of the feedback signs. This second sign was 3-foot tall by 6-foot wide with 5-inch high black letters and numbers, and it stood 19 feet from the road (Route 42). The feedback message on this sign was posted so that drivers traveling toward Route 460 would see it. See Figure 4 for a photograph of this sign. The recreation center sign was accidentally removed on Week 16, but was reinstated on Week 19.

Insert Figure 3 about here

The main feedback sign remained in place for 17 consecutive weeks while 460 drivers received no intervention. Placement of the signs along Route 42 ensured

that each driver leaving Newport passed by at least one of the signs if not both, and care was taken to ensure that drivers and passengers of vehicles on Route 42 would have been able to read the signs while passing by.

Insert Figure 4 about here

Results

Interobserver Reliability

Of 9,540 total vehicle observations, 43% were recorded independently by two observers. Interobserver reliability percentages were defined separately for each column on the data sheet (i.e., safety belt use, safety belt nonuse, etc.), and were calculated by dividing the total number of observations agreed upon for a particular data category by the total number of agreements and disagreements and multiplying the result by 100. Interobserver agreement for safety belt use was 91.0%, 92.3% for belt non-use, 96.2% for males, 93.2% for females, 93.9% for turn signal use, 83.7% for signal non-use, 90.7% for small cars, 86.3% for large cars, 96.9% for trucks, 96.0% for direct turns, 81.2% for halfway turns, 69.4% for left lane turns, and 85.0% for combination halfway and left lane turns. For those observations where turns were recorded, interobserver agreement was 87.6% for the presence of traffic and 72.1%

for no traffic. Interobserver agreement for front-seat passenger belt use was 93.1%, 92.21 for belt non-use, 92.0% for males and 94.0% for females.

Baseline Analyses

During baseline, safety belt use was found to be related to several driver characteristics. See Table 1 for baseline safety belt use averages and number of observations. Gender and safety belt use were found to be

Insert Table 1 about here

significantly related for Newport drivers, Chi Square = 76.61(1), $p \leq .0001$, with females buckling up significantly more often than males (62.1% vs. 40.7%, respectively). This relationship was also shown when 460 drivers were considered, Chi Square = 13.12(1), $p \leq .001$ (73.0% for females vs. 59.5% for males). Vehicle type was related to safety belt use for Newport drivers, Chi Square = 92.93(2), $p \leq .0001$, with drivers of trucks buckling up less often than drivers of small and large cars (means of 33.2%, 55.3%, and 58.6%, respectively). This relationship for 460 drivers was also significant, Chi Square = 11.47(2), $p \leq .003$, with truck drivers being less likely to use their safety belts than drivers of small and large cars, and large car drivers buckling up more than truck and small car drivers (means of

56.3% for trucks vs. 64.8% for small cars, and 73.1% for large cars).

In order to separate the relationship of gender and vehicle type to safety belt use, separate Chi Square tests were performed between driver safety belt use and vehicle type for males and females. See Table 2 for baseline and intervention percentages for male and female Newport and 460 drivers of different vehicle types. Safety belt use was related to vehicle type for Newport males, Chi Square = 49.20(2), $p \leq .0001$, with means of 51.3% for small car drivers, 48.6% for large car drivers, and 30.5% for truck drivers. Vehicle type was also related to safety belt use for Newport female drivers, Chi Square = 9.11, $p \leq .01$, with belt use averaging 59.2% for small car drivers, 70.8% for large car drivers, and 54.7% for truck drivers. Belt use

Insert Table 2 about here

was also related to vehicle type for 460 males, Chi Square = 10.45, $p \leq .005$ (with means of 59.9%, 72.0%, and 52.2% for small, large, and truck drivers, respectively), but not for 460 females (means of 70.2%, 73.5%, and 82.1% for small, large, and truck drivers, respectively).

Interestingly, safety belt use was related to turn signal use by Newport drivers, Chi Square = 116.71(1),

$p \leq .0001$, with belt users displaying higher turn signal use than belt nonusers (78.2% [n=861] signal use vs. 53.5% [n=882] signal use, respectively). In addition, females used their turn signal more than males (70.7% [n=610] vs. 62.7% [n=1126], respectively), Chi Square = 10.73(1), $p \leq .001$. Within each gender, belt users were more likely to use turn signals than belt nonusers. Male belt users signalled their turns more than male belt nonusers (78.2% [n=463] signal use vs, 51.8% [n=645] signal use, respectively), Chi square = 79.31(1), $p \leq .0001$, and female belt users signaled more than female belt nonusers (78.3% [n=382] vs. 57.5% [n=221], respectively), Chi Square = 28.23(1), $p \leq .0001$. Turn signal use was only marginally related to type of vehicle, with truck drivers signaling less (62.1%, n=610) than drivers of small (66.1%, n=726) and large cars (69.3%, n=387), Chi Square = 5.58(2), $p \leq .06$.

Risk of turn was not related to belt use, turn signal use, gender, or vehicle type during baseline observations. Out of 315 observations of left hand turns with traffic (i.e., an opportunity to make an unsafe turn), 215 were direct turns (68.3%), 61 were halfway turns (19.4%), 27 were left lane turns (8.6%), and 12 were combination halfway and left lane turns (3.8%). Thus, an overwhelming majority of drivers emitted safe left-hand turn behaviors.

Intervention Effectiveness

Table 1 shows the percentage safety belt use during baseline and intervention phases by the different groups measured. Figure 5 depicts the weekly mean safety belt use by all Newport and 460 drivers during baseline and intervention phases. The level of safety belt use by Newport drivers was dependent on the phase of the study with drivers buckling up more during the intervention phase than the baseline phase, Chi Square = 97.98(1), $p \leq .0001$. As seen in Figure 5, safety belt use by Newport drivers increased from a baseline average of 48.2% to an average of 62.0% during the intervention phase, an increase of 13.8 percentage points. Mean safety belt use by Route 460 drivers increased 5.1 percentage points from baseline to intervention periods, and the level of 460 belt use was dependent on the phase of the study, Chi Square = 6.70(1), $p \leq .01$, with drivers buckling up an average of 64.3% of the time during baseline and 69.4% during the intervention phase (see Figure 5).

Insert Figure 5 about here

It can be seen from the visual inspection of Figure 5 that, after the first three weeks of feedback, there was no overlap in the weekly means of the baseline and intervention

periods for Newport drivers until Week 28, while there was considerable overlap in the baseline and intervention means for 460 drivers. In addition, weekly safety belt use by 460 drivers was not consistently above baseline levels until Week 25.

Safety belt use by males and females during baseline and intervention phases was also analyzed. Figure 6 depicts the weekly mean safety belt use by male and female Newport drivers. Safety belt use by Newport males increased 15.5 percentage points from a baseline average of 40.7% to an average of 56.2% during the intervention phase, Chi Square = 78.44(1), $p \leq .0001$. Newport female drivers' belt use averaged 62.2% during baseline and 71.9% during the intervention period, an increase of 9.7 percentage points, Chi Square = 19.26(1), $p \leq .0001$.

Insert Figure 6 about here

It can be seen in Figure 6 that after the first three weeks of the feedback intervention, Newport males' safety belt use began to increase and there was little overlap of baseline and intervention weekly means until Week 28. However, weekly belt use by Newport females was more variable during baseline and the first few weeks of the intervention phase than that of Newport males. Thus, there

was much more overlap in baseline and intervention weekly means for Newport females than for Newport males.

Insert Figure 7 about here

As shown in Figure 7, average safety belt use by male drivers on Route 460 increased 5.7 percentage points from a baseline average of 59.5% to an average of 65.2% during the intervention phase, Chi Square = 4.98(1), $p \leq .03$. However, an inspection of Figure 7 seems to show no clear trend of increasing belt use by 460 males following the installation of the feedback signs, and there was much overlap between the baseline and intervention weekly averages. Belt use by female drivers on Route 460 increased 3.8 percentage points from a baseline average of 72.7% to an average of 76.5% during the intervention phase. However, 460 females' level of safety belt use was not dependent on the phase of the study. An inspection of Figure 7 shows that there was considerable overlap in the weekly means during baseline and intervention phases for 460 females.

In order to study the relationship between vehicle type and intervention effectiveness, Newport and 460 drivers were divided into groups based upon the type of vehicle driven. Figure 8 shows the mean weekly safety belt use by Newport drivers of the different vehicle types. Newport small car

drivers increased their average safety belt use 8.3 percentage points from baseline to the intervention phase, Chi Square = 13.49(1), $p \leq .001$, buckling up an average of

Insert Figure 8 about here

55.3% of the time during baseline and 63.6% of the time during the intervention phase. Newport large car drivers were observed to use their safety belts an average of 58.8% during baseline and 67.0% during the intervention phase, an increase of 8.2 percentage points, Chi Square = 8.90(1), $p \leq .002$. Newport truck drivers showed the most pronounced increase in belt use of all three vehicle types. Belt use by these drivers increased 22.8 percentage points from a baseline average of 33.2% to an intervention average of 56.0%, Chi Square = 93.24(1), $p < .0001$.

Although there was some overlap in weekly means between baseline and intervention phases for Newport small car drivers, there was a definite trend of increased safety belt use during the intervention phase by drivers of small cars (see Figure 8). There was considerable overlap in baseline and intervention weekly means for Newport large car drivers. However, there did seem to be a slight upward trend in safety belt use during the intervention phase by this group. For Newport truck drivers, there was a clear increase in

safety belt use after Week 16 and little overlap between baseline and intervention weekly means until Week 27.

Safety belt use by 460 drivers of large cars and trucks was not dependent on the phase of the study, with increases in average belt use of 2.5 and 4.4 percentage points, respectively. However, belt use by 460 drivers of small cars was dependent on the phase of the intervention, Chi Square = 3.83(1), $p \leq .05$, with a slight increase of 5.7 percentage points from a baseline average of 64.8% belt use to 70.5% belt use during the intervention period. Weekly belt use by 460 drivers of different vehicle types was not graphed because low observation numbers during some weeks prevented a clear analysis of weekly belt use trends by these groups.

Table 2 shows the baseline and intervention averages for male and female drivers of different vehicle types in Newport. As can be seen, Newport males used their safety belts less than Newport females across vehicle types and phases. Indeed, it seems that the difference in belt use between truck drivers and drivers of small and large cars during baseline and intervention phases can be accounted for by the low belt use rate of male truck drivers. Male truck drivers used their safety belts 30.5% of the time during baseline while the average for female truck drivers was 54.7%, Chi Square = 16.44(1), $p \leq .0001$. During the

intervention period, male truck drivers' belt use averaged 52.4% while female truck drivers' averaged 74.1% belt use, Chi Square = 37.24(1), $p \leq .0001$. However, the group with the largest increase in belt use from baseline to intervention phases was male truck drivers who increased their belt use rate 21.9 percentage points from a baseline average of 30.5% to an average of 52.4% during the intervention phase. In addition, no sub-group of 460 drivers showed as large an increase in safety belt use from baseline to intervention phases as Newport male truck drivers.

Safety belt use by the front-seat passengers of vehicles entering and leaving Newport increased 14.6 percentage points from a baseline average of 42.1% (n=560) to an average of 56.7% (n=714) during the intervention period, Chi Square = 26.11(1), $p \leq .0001$. Belt use by the front seat passengers of vehicles traveling on Route 460 averaged 65.3% (n=202) during baseline and 72.1% (n=458) during the intervention phase. This increase was not significant.

During baseline and intervention phases, license plate numbers were recorded for 13.4% of vehicles observed leaving and entering Newport. There were 28 vehicles with recorded license plate numbers who were observed at least once during both baseline and intervention periods. Driver gender and

vehicle type also matched for these vehicles. These 28 drivers (20 males and 8 females), had an average safety belt use of 28.6% (n=28) during baseline. This average rose to 57.1% (n=28) during the intervention period, an increase of 28.5 percentage points. Twenty of the 28 drivers were observed not using a safety belt during baseline, and of these 20 drivers, only 9 were observed to be unbuckled during the intervention phase. In other words, average belt use during the intervention phase for these drivers was 55%.

Intervention Chi Square Analysis

See Table 1 for average belt use percentages by the different groups during the intervention period. Safety belt use continued to be related to driver gender during the intervention period for Newport drivers, with females buckling up more than males (71.9% vs. 56.2% respectively), and large cars also continued to buckle up more than Newport truck drivers (63.6% and 67.0% vs. 56.0% respectively), Chi Square = 37.33(2), $p \leq .0001$. In addition, even though turn signal use increased from 65.7% during baseline to 80.3% during the intervention period, turn signal use by Newport drivers was still significantly related to belt use during the intervention, with belt users exhibiting turn signal use 83.9% (n=2273) of the time and belt nonusers signaling 74.3% (n=1377) of their turns, Chi Square = 49.37(1),

$p \leq .0001$. Newport females also continued to use their turn signals more than Newport males (82.2% [n=1346] vs. 79.1% [n=2299] respectively), Chi Square = 5.17(1), $p \leq .02$. However, Newport male belt users continued to use their turn signals more than Newport male belt nonusers (83.1% [n=1299] vs. 73.8% [n=1000], respectively), Chi Square = 28.71(1), $p \leq .0001$, and Newport female belt users used their turn signals more than Newport female belt nonusers (85.0% [n=972] vs. 75.3% [n=373], respectively), Chi Square = 16.56(1), $p \leq .0001$.

Risk of turn was unrelated to safety belt use, turn signal use, gender, and vehicle type during the intervention period. Out of a total of 730 observations of turns, 554 (75.9%) were direct turns, 101 (13.8%) were halfway turns, 19 (7.7%) were left lane turns, and 19 (2.6%) were combination half and left lane turns. Just as in the baseline condition, most drivers made safe turns at the intersection during the intervention phase.

Risk Compensation Versus Response Generalization

Average weekly turn signal use by Newport drivers is graphed in Figure 9. As can be seen, even though turn signal use was not a target behavior for the feedback intervention, signal use by Newport drivers showed a significant 14.9 percentage point increase, from a baseline average of 65.4% (n=1743) to an average of 80.3% (n=3651)

during the intervention phase, Chi Square = 139.62(1), $p \leq .0001$. In addition, after Week 16 there was no overlap in baseline and intervention weekly means until Week 27.

Insert Figure 9 about here

Turn signal use by Newport drivers was significantly related to safety belt use during baseline, Chi Square = 116.71(1), $p \leq .0001$, with belt users signaling more than belt nonusers (78.2% signal use vs. 53.2% signal use, respectively). This relationship was also significant during the intervention phase, Chi Square = 49.37(1), $p \leq .02$, with belt users displaying higher turn signal use than belt nonusers (83.9% signal use vs. 74.3% signal use, respectively).

The percentage of safe versus risky turns by Newport drivers also increased during the intervention phase. Drivers exhibited safe (i.e., direct) versus risky (i.e., any other type of turn) turns after waiting for traffic to clear 68.3% (n=315) of the time during baseline and 75.9% (n=730) of the time during the intervention phase, an increase of 7.6 percentage points Chi Square = 6.22(1), $p \leq .01$. However, there was no relationship between safety belt use and risk of turn during the baseline or intervention phases. Also, there was no relationship between turn signal use and risk of turn during the baseline

or intervention phases.

For the 28 vehicle drivers whose license plate numbers were matched for the baseline and intervention periods, 10 of 20 (50%) were recorded using their turn signal during baseline, and 19 of 25 (76%) used their signal during the intervention phase, an increase of 26 percentage points.

Discussion

It appears the feedback intervention succeeded in increasing the safety belt use by drivers on Route 42. Mean weekly safety belt use by this group increased 13.8 percentage points, from a baseline mean of 48.2% to an intervention mean of 62.0%. While belt use by the control group (460 drivers) did increase somewhat during the intervention phase, the increase was not as great nor as consistent as it was for Newport drivers (5.1 vs. 13.8 percentage point increases), and weekly mean safety belt use by 460 drivers did not show a consistent increase over baseline levels until Week 25, long after the feedback signs had been in place (see Figure 5). Therefore, it doesn't seem the feedback intervention caused the increase in 460 drivers belt use during the intervention phase.

The intervention did not have an immediate effect on safety belt use for Newport drivers, however. As can be seen in Figure 5, belt use by Newport drivers did not begin to increase until the feedback signs had been in place for

three weeks. This may be because the feedback signs were updated on a weekly basis, and it took a few weeks for the Newport drivers to realize their safety belt use was being monitored and the sign updated every week.

Across phases and groups it was found that females buckled up more than males. This may have been because males typically take more risks when driving than females but think they are less likely to be involved in an accident (DeJoy, 1992). This was also evidenced by the observation that Newport males were less likely to use their turn signals than were Newport females. However, males were not more likely than females to take risky turns.

Figure 6 shows that Newport males increased their safety belt use more during the intervention phase (15.5 percentage point increase) than did Newport females (9.7 percentage point increase), whereas females maintained a higher use rate during the intervention (71.9% vs. 56.2%). With less overlap in weekly means for intervention and baseline phases, the increase in belt use for males is more convincing than the increase for females. This may be because females' averages posted on the signs were consistently high (and higher than males' averages) so that the perceived need to increase belt use was not as strong for females and for males.

It may be that most of the female drivers who would

have been affected by the feedback intervention were already consistently using their safety belts due to the Virginia BUL that was in effect at the time of the study. Indeed, Hunter, Stutts, Stewart, & Rodgman (1990) found that females were more likely than males to increase their belt use because of a BUL. In addition, Tipton, Camp, and Hsu (1990) found that while both males and females in their study reported that they increased their safety belt use immediately following the instigation of a BUL. After the BUL had been in effect for 16 months, only females reported safety belt use above their pre-law reports. Thus, the Newport males who increased their belt use during the feedback intervention may have also increased their belt use after the Virginia BUL was passed but did not maintain their increased usage at the time of the present study.

Newport males' safety belt use showed a marked decrease for Weeks 25 and 28, whereas Newport females' belt use maintained a high level for these weeks. This decrease in belt use by males caused the overall average for Newport drivers to decrease for these two weeks. Thus, even though Newport males showed a larger increase in belt use during the intervention period than did Newport females, the males did not maintain increased belt use for as long as females did.

Since belt use by 460 males and females also increased

during the intervention phase, it may be that some outside factor affected belt use across both groups. This seems unlikely, however, because safety belt use by 460 females did not show a consistent increase over baseline levels until Week 25 (see Figure 7), whereas Newport females' belt use began to increase at Week 17 (see Figure 6). In addition, Newport males showed a distinct increase in safety belt use at the beginning of the intervention period, whereas 460 males belt use was more variable during the intervention, and no clear trend of increased belt use is evident.

When vehicle type was used as the unit of analysis, it was found that drivers of small and large cars buckled up more than drivers of pick-up trucks and four wheel drive vehicles. However, Newport truck drivers showed the largest increase from the baseline to the intervention phase. Mean belt use for Newport male and female drivers of each vehicle type increased from baseline to the intervention phase, and male truck drivers showed the largest increase (22.8 percentage points). It had been predicted that male truck drivers would not increase their belt use as much as car drivers because of a presumed "macho" attitude of many male truck drivers. While it is true that this group had the lowest belt use rate during baseline (30.5%), any "macho" attitude that these drivers may have had did not preclude

the effectiveness of the feedback intervention.

A consistent finding in the data was that 460 drivers' belt use rates were higher than that of Newport drivers across phases, gender, and vehicle types. A possible explanation for this finding is that drivers on Route 460 were traveling for longer distances than Newport drivers, and so they used their safety belts more than Newport drivers traveling locally. Several studies have shown that drivers tend to use their safety belts more when they are planning on driving for long distances at high speeds rather than short distances at slower speeds (Fockler & Cooper, 1990; Howell, Owen, & Nocks, 1990). Route 460 is a rural highway with a 55 mph speed limit (which many drivers seem to exceed) which is located in a somewhat sparsely populated area of southwest Virginia where the data collection site was located. This road seems to be used by many drivers as a commuter route from rural sections of southwest Virginia and southern West Virginia to more populated areas of southwest Virginia. The data collection point was ten miles away from Blacksburg, Virginia (pop. 34,590) to the southeast and fifteen miles away from Pearisburg, Virginia (pop. 2,064) to the Northwest, the nearest population centers. It was also approximately 22 miles from the West Virginia border, and the data collectors noted that many vehicles on Route 460 had West Virginia license plates.

Thus, it seems reasonable to assume that the average length of trip for many 460 drivers was at least ten to 25 miles and that they were planning on driving at high speeds. Route 42 in Newport is a rural two-lane road with a 35 mph speed limit in Newport. It may be that Newport drivers were planning more local trips or, at least, were not commuting as far as many of the 460 drivers, and were less likely to use their safety belts than 460 drivers as a result.

As can be seen from the baseline Chi Square analysis, there were many individual differences in safety belt use among Newport and 460 drivers, and these differences tended to persist during the intervention phase (i.e., females buckled up more than males, car drivers buckled up more than truck drivers). The fact that drivers who were observed to be using their safety belt also tended to use their turn signal more often than belt nonusers seems to indicate that these two safe driving behaviors are related. Indeed, Ludwig & Geller (1991) also found that safety belt use and turn signal use were related for the participants of their study, and turn signal use increased during the intervention phase also. Thus, the finding of response generalization from safety belt use to turn signal use during the intervention phase of the present study is not surprising.

Drivers of large cars did not buckle up less, signal

less, or take more risky turns than small car drivers as was predicted. Therefore, no evidence was found for risk compensation by large car drivers relative to small car drivers. It may be that large car drivers are not constantly aware of the increased safety of their vehicle, and therefore it does not affect their behavior. Also, no measured variable showed a strong relationship with risk of turn. It seems that belted drivers were no more likely to take risky or safe turns than unbelted drivers. Some other variable which was not measured may have been responsible for the riskiness of turn attempted. For example, the willingness to take a risky left-hand turn at this intersection may partly be a function of the amount of time a driver has to wait to make a turn. The longer the driver has to wait, the more willing he or she may be to make a risky turn. The driver's motivation to make the turn quickly (e.g., being late for work) would also play a role. It is comforting, however, to note that most drivers at this intersection were observed to make safe turns rather than risky turns.

The data on turn signal use by Newport drivers provides evidence for the theory of response generalization and against risk compensation. It seems that the feedback intervention for safety belt use generalized to turn signal use for Newport drivers during the intervention phase as

evidenced by a 14.9 percentage point increase in turn signal use over baseline levels. These results were similar to those of Ludwig & Geller (1991) who also found that subjects' turn signal use increased during an intervention phase that targeted only safety belt use. The percentage of safe turns during traffic conditions also increased during the intervention phase. However, there was no relationship between safety belt use and risk of turn during either the baseline or intervention phases. So, it is not clear if the increase in safe turns was a result of response generalization or some other factor.

A qualification is needed for these findings of response generalization. Since drivers in the control group were traveling on Route 460, they had no opportunity to use their turn signals or make a risky turn, so there was no control group with which to compare turn signal use or risky turning by Newport drivers. Therefore, some factor other than the feedback intervention may have caused the increases in signal use and safe turns. In addition, the possibility that risk compensation by Newport drivers might have occurred is not ruled out by these findings. Newport drivers may have increased their rate of speed, made more rolling stops at stop signs, and/or followed the driver in front of them too closely after increasing their safety belt use during the intervention phase. These safe driving

behaviors (and many others) were not measured during this study, so evidence as to concomitant changes in these behaviors as a result of the intervention is not available. However, while it is possible that response generalization could occur for some behaviors while risk compensation occurred for other behaviors, this was not found in the current study. All safe driving behaviors measured in the current study increased during the intervention phase. While this is not definitive support that response generalization rather than risk compensation occurred, the data point toward that conclusion.

Although the current study demonstrated the effectiveness of community-based feedback in increasing safety belt use in a rural community, further studies need to examine the limits of this intervention. For example, would the feedback have been as effective in a larger city along a busier road, and how long would the effect last? The Nau and Van Houten (1981-82) study would suggest not, but the present study suggests possible ways to make a community-based feedback intervention more effective in an urban setting. First, a BUL should be effective at the time, since the feedback may serve as a discriminative stimulus for increased police enforcement of traffic laws. Second, a specific population should be selected for the intervention and the feedback sign should be directed

specifically toward this group (i.e., the residents of a housing development, members of a church, etc.). Third, the sign should be in a position where it could be seen by the target group on a regular basis. Finally, data collection should occur at a point after which the participants have had a chance to fasten their safety belts in response to the feedback sign.

It would also be useful to study whether or not feedback signs are more effective than written prompts in increasing safety belt use. Both are similar in that they require some sort of written display to convey their information. Theoretically, group based feedback interventions such as the one used in the current study should be more effective than simple prompts because they involve more extrinsic control over behavior (Geller, 1992). The effectiveness of feedback in combination with other interventions to increase safety belt use (i.e., public commitment, prompts) also needs to be explored. Feedback in this situation would provide information to participants as to their level of compliance with another intervention and may add to the intervention's effectiveness as a result.

Further study is needed to specify the conditions under which risk compensation and response generalization occur. The feedback intervention used in the present study seemed to produce response generalization, but it is possible

another intervention would have produced risk compensation. An ecological framework of behavioral interventions and their possible side effects needs to be developed in order to make risk compensation and response generalization more predictable and controllable. In order to do this, more applied behavioral studies need to incorporate an ecological perspective and measure behaviors other than the target behavior in order to document possible side effects of interventions. Further study would determine which non-target behaviors need to be measured and which do not. This ecological framework could then be used to help control for the occurrence of risk compensation during interventions and possibly lessen its effect, and would also help predict when response generalization is likely to occur.

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Table 1

Mean Safety Belt Use, Number of Observations, and Percentage Point Change from Baseline to Intervention Periods for Newport and Route 460 Drivers.

Group	Baseline		Intervention		Change
	Mean	N	Mean	N	
Newport	48.2%	1856	62.0%	4057	+13.8
Route 460	64.3%	728	69.4%	2921	+5.1
Newport Males	40.7%	1211	56.2%	2560	+15.5
Newport Females	62.2%	643	71.9%	1491	+9.7
460 Males	59.5%	467	65.2%	1837	+5.7
460 Females	72.7%	260	76.5%	1083	+3.8
Newport Small	55.3%	769	63.6%	1279	+8.3
Newport Large	58.8%	405	67.0%	1295	+8.2
Newport Truck	33.2%	662	56.0%	1460	+22.8
460 Small	64.8%	349	70.5%	1171	+5.7
460 Large	72.6%	168	75.1%	957	+2.5
460 Truck	56.3%	208	60.7%	784	+4.4

Table 2

Mean Safety Belt Use by Male and Female Newport and Route 460 Drivers of Different Vehicle Types, Number of Observations, and Percentage Point Change from Baseline to Intervention Phases.

Newport Drivers				
Gender	Vehicle	Baseline	Intervention	Change
Males	Small	51.3%, n=390	58.6%, n=662	+7.3
	Large	48.6%, n=220	60.6%, n=667	+12.0
	Truck	30.5%, n=587	52.4%, n=1220	+21.9
Females	Small	59.2%, n=377	68.8%, n=616	+9.6
	Large	70.8%, n=185	74.2%, n=624	+3.4
	Truck	54.7%, n=73	74.1%, n=239	+19.4
Route 460 Drivers				
Gender	Vehicle	Baseline	Intervention	Change
Males	Small	59.9%, n=187	66.3%, n=632	+6.4
	Large	72.0%, n=100	72.5%, n=523	+ .5
	Truck	52.2%, n=180	58.7%, n=676	+6.5
Females	Small	70.2%, n=161	73.3%, n=539	+3.1
	Large	73.5%, n=50	78.3%, n=434	+4.8
	Truck	82.1%, n=28	73.8%, n=107	-8.3

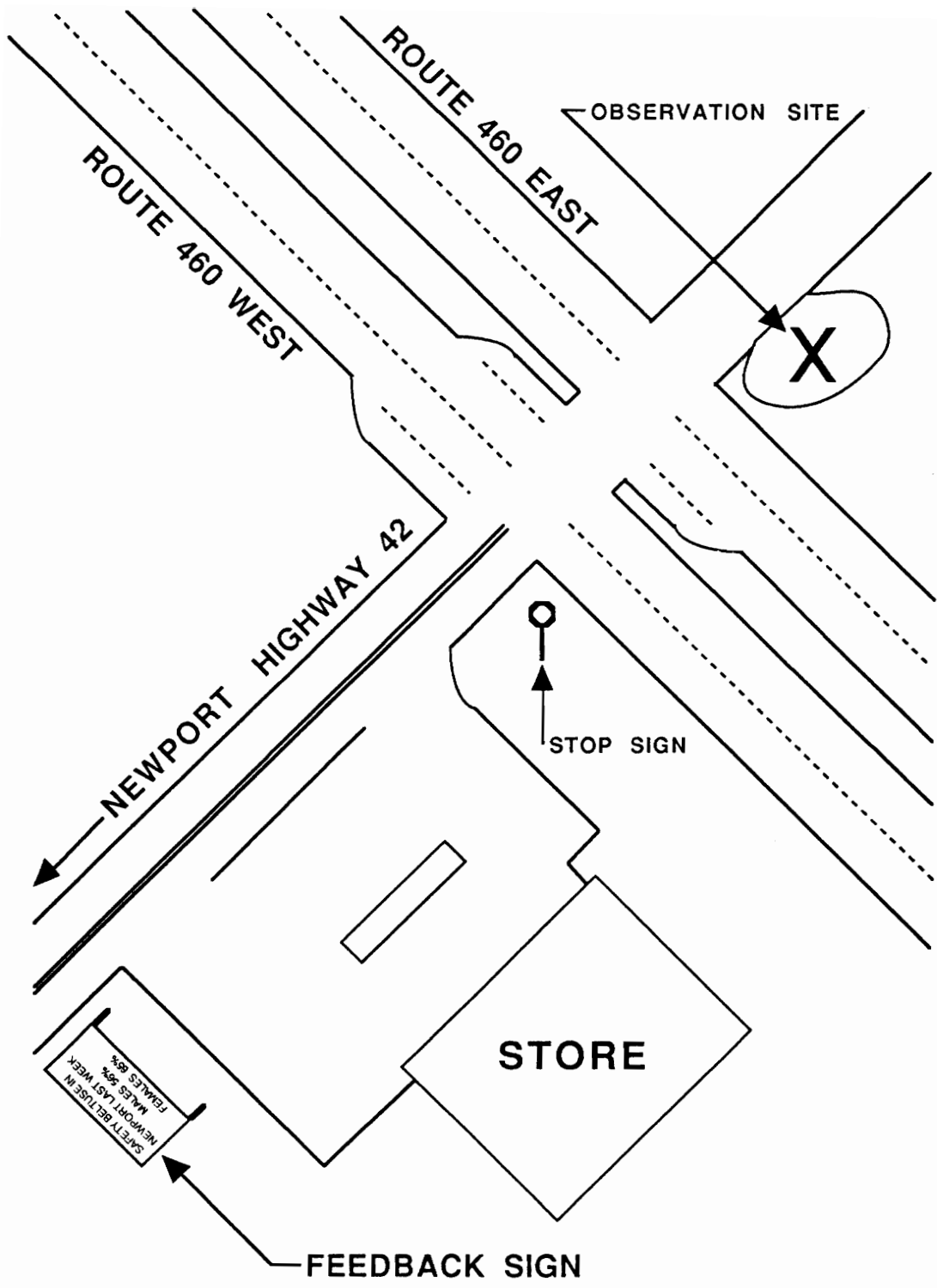


Figure 1: Data collection site and feedback sign location



Figure 2. Photograph of the feedback sign near the intersection of Route 42 and Route 460.

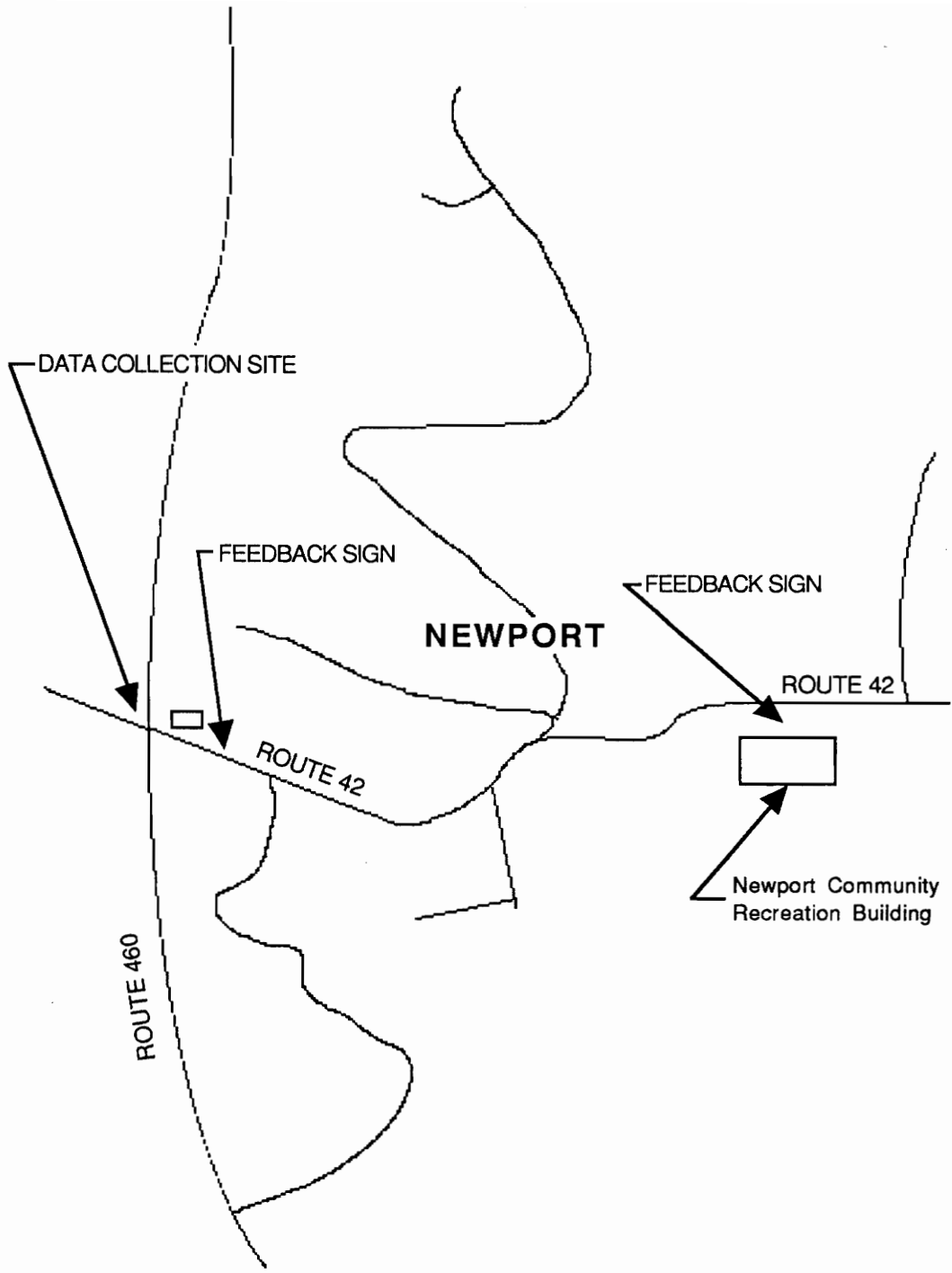


Figure 3: Map of Newport with feedback sign locations.



Figure 4. Photograph of the feedback sign in front of the Newport Recreation Center.

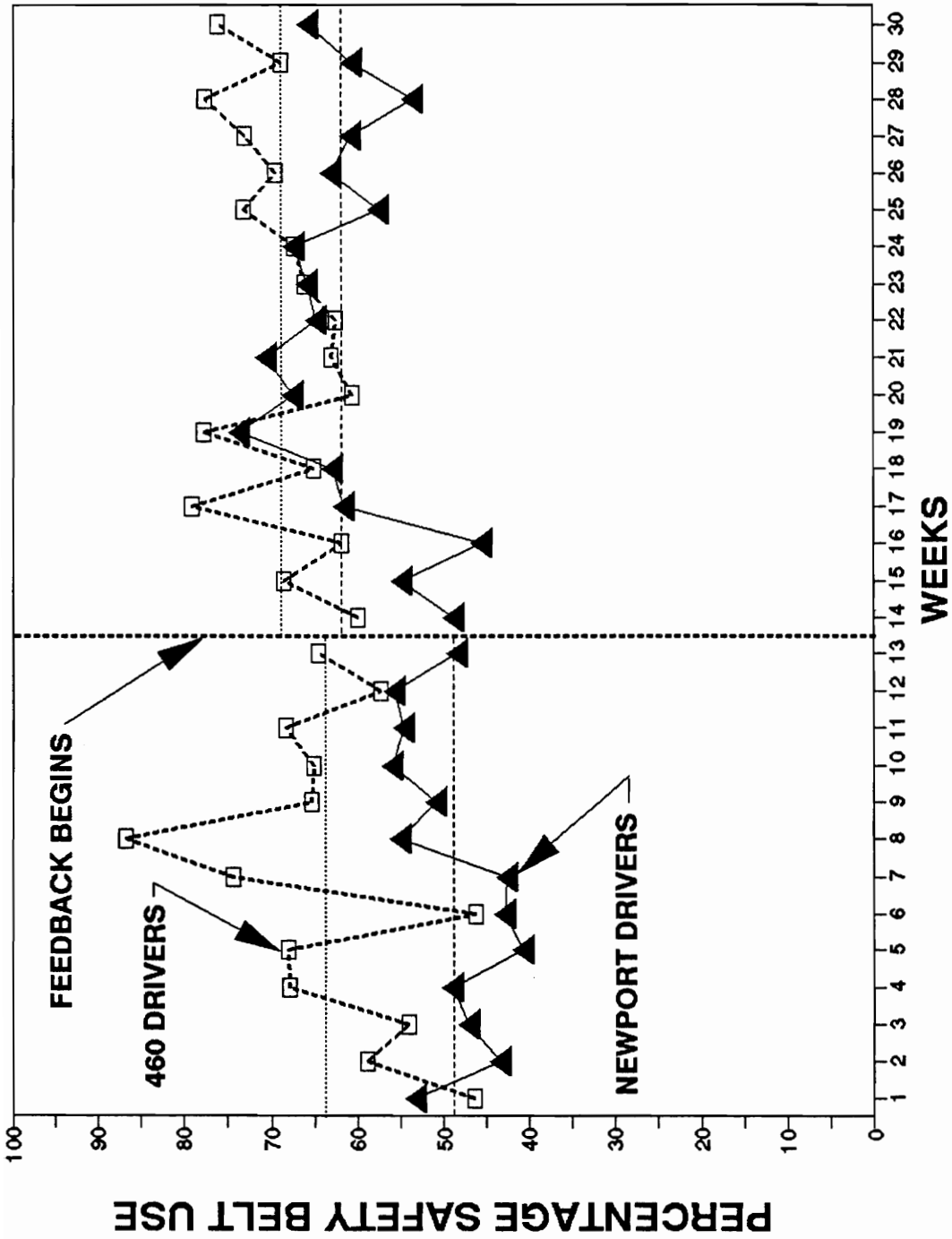


Figure 5: Safety belt use by Newport and 460 Drivers.

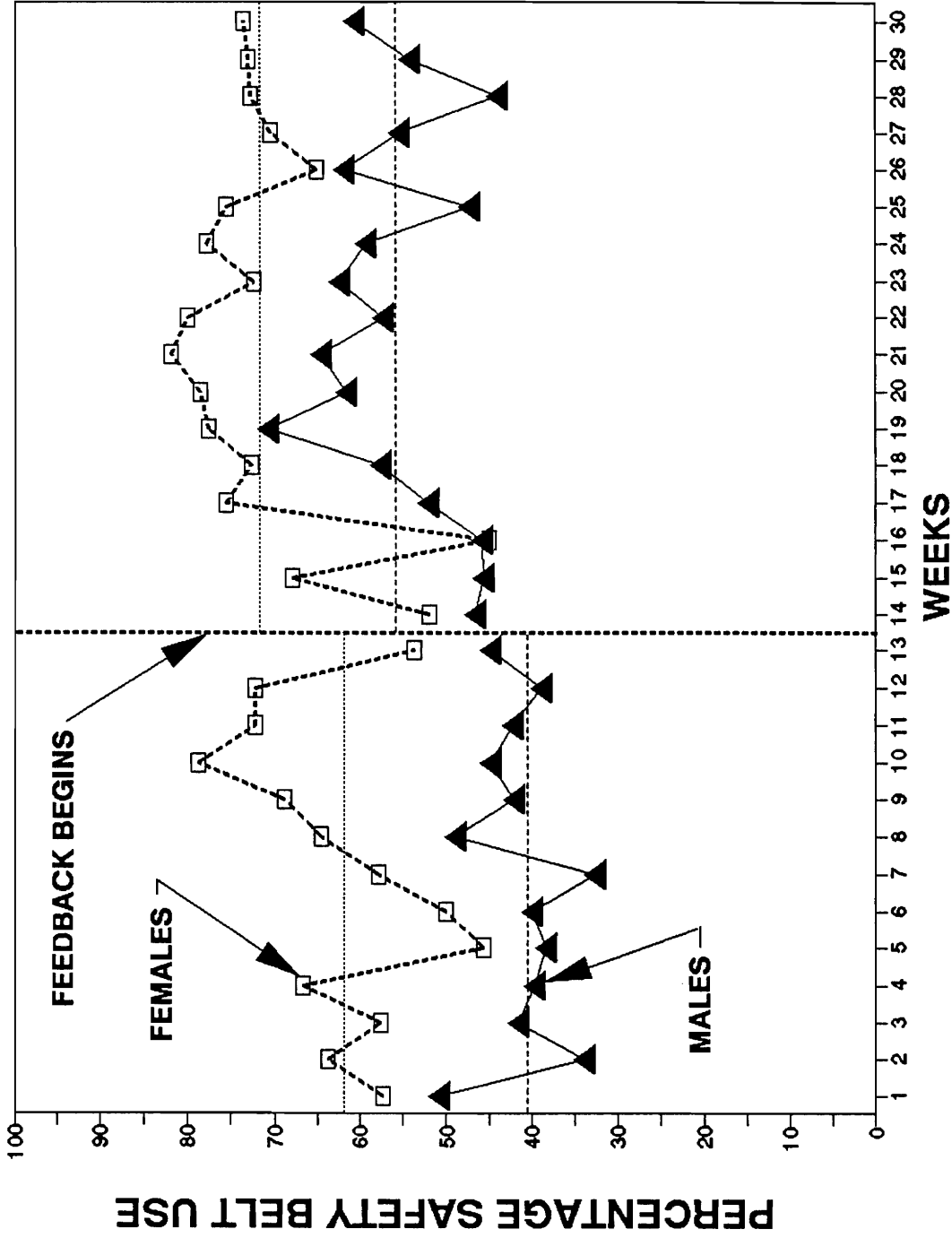


Figure 6: Safety belt use by male and female Newport drivers.

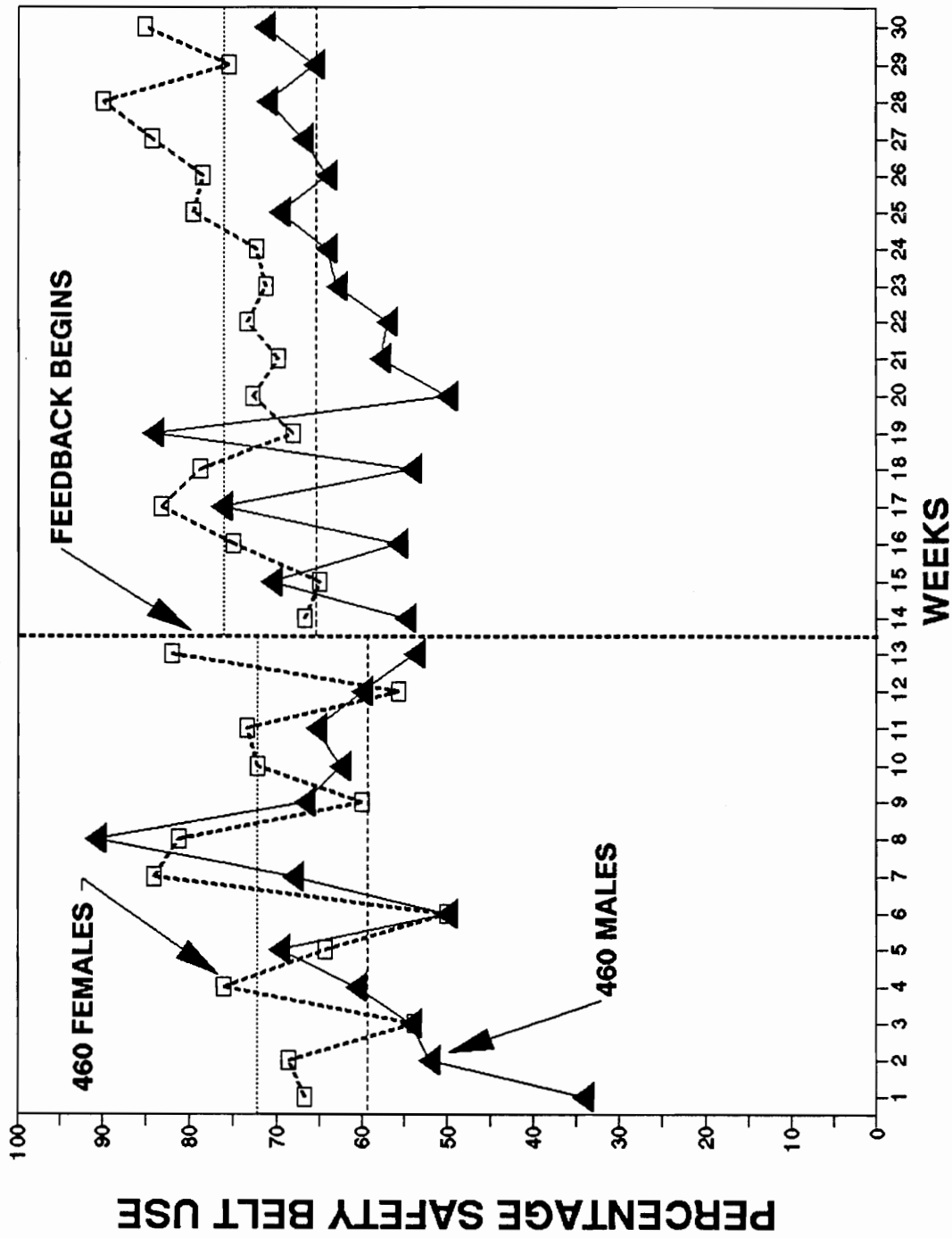


Figure 7: Safety belt use by male and female 460 drivers.

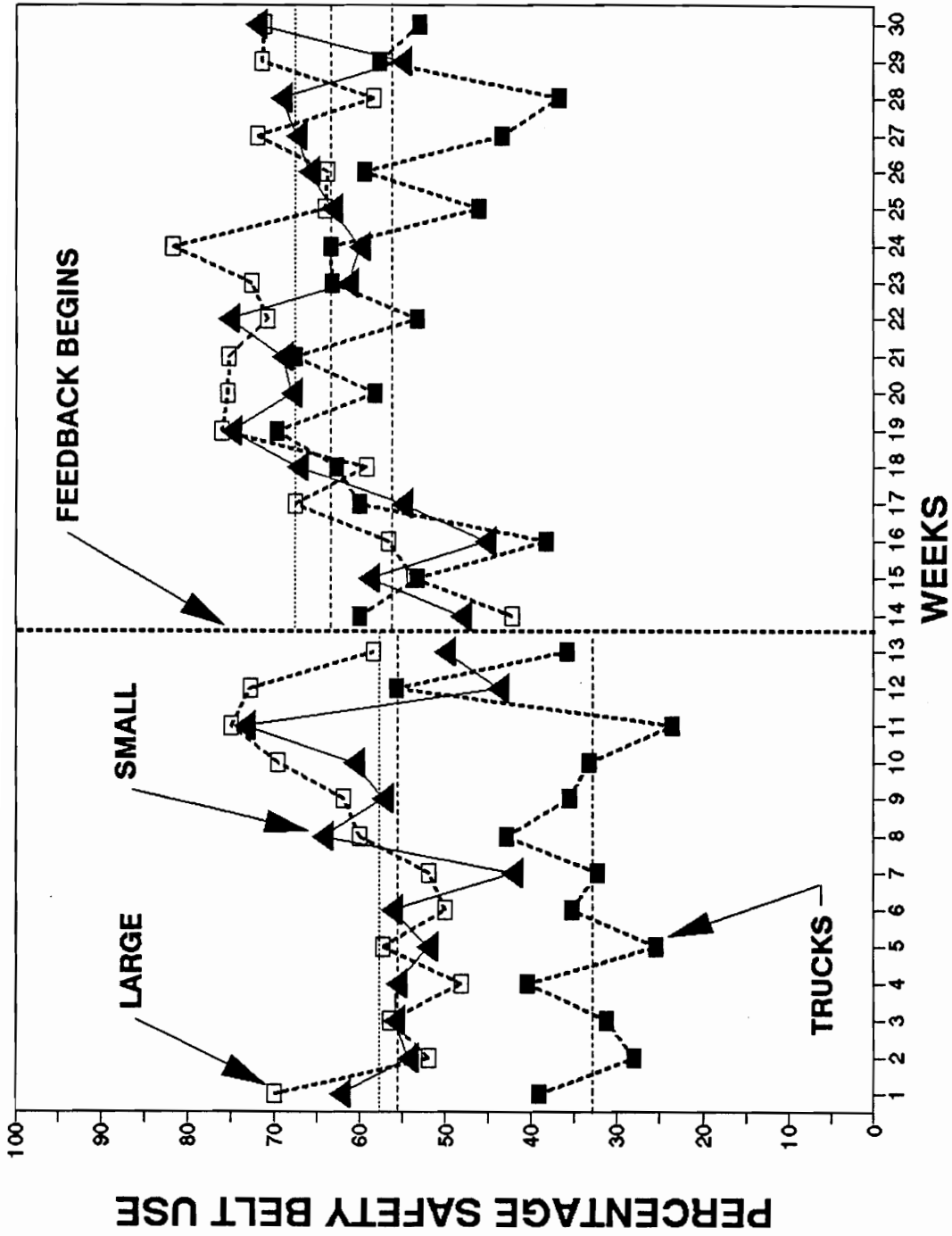


Figure 8: Safety belt use by Newport drivers of different vehicle types.

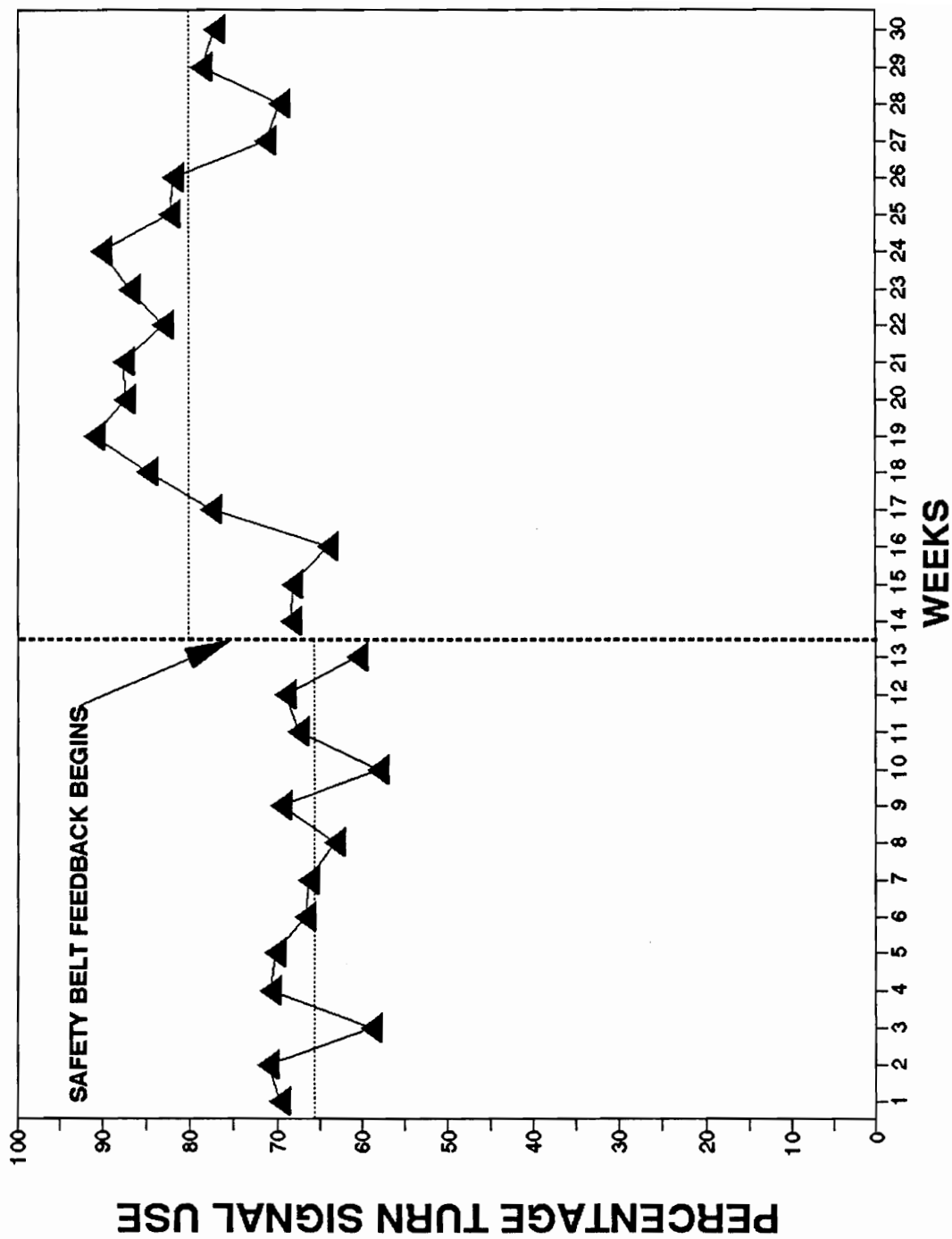


Figure 9: Turn signal use by Newport drivers.

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