RISK PERCEPTION ISSUES IN THE USE OF MOTORIZED SHOULDER BELT/MANUAL LAP BELT SYSTEMS

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Two experiments employed surveys to address seat belt experience and use as well as perceptions of risk associated with various seat belt configurations. In Experiment 1, a questionnaire was administered to two samples: 104 students at the University of Houston and 162 volunteers at a shopping mall in Raleigh, North Carolina. Of primary interest was the use of manual lap belts in motorized shoulder belt systems and reasons for their use or non use. Results showed that compared to manual three point belts, usage rates for manual lap belts in the motorized system were lower. Forgetting and traveling a short distance were frequently cited as reasons for not fastening belts. Estimates of fatalities in a head-on collision scenario indicated lap belts and shoulder belts were perceived to provide equal protection. In Experiment 2, 147 students at the University of Houston completed a follow-up questionnaire. Usage patterns were virtually the same as in Experiment 1. Estimates of likelihood to use lap belts after viewing six different warnings about seat belt use showed warnings containing more explicit hazard information were likely to lead to higher use rates.

INTRODUCTION

Seat belts have now been required in passenger vehicles in the United States for nearly three decades; in 1966 lap belts were required and in 1968 both lap and shoulder belts were included in the requirements. Through the 1970s and early 1980s seat belt requirements underwent various revisions. In 1984 the Federal Motor Vehicle Safety Standard (FMVSS) 208 was amended to require the use of automatic (passive) systems in motor vehicles. A phase-in period for the passive systems was set up as follows: 10% of all 1987 model year cars were required to have automatic protection; 25% of 1988 cars; 40% of 1989 cars; and by 1990 it was required for all cars.

The passive system requirements could be met in two ways, air bags or automatic seat belts. The use of the latter is the focus of the present research. Automatic seat belt systems come in a variety of configurations; they come motorized or non motorized; they come equipped with or without a lap belt; some of the systems are detachable and some are not; and, some come equipped with a knee bolster, which is designed to prevent occupants from sliding forward in the event of a crash when the lap belt is either absent or not worn. The passive belt system with a motorized shoulder belt and manual lap belt has been adopted by a number of vehicle manufacturers.

In order for the automatic belt system to be fully effective, it is necessary that the manual lap belt be fastened. Without the lap belt the occupant is more likely to be subject to certain kinds of movement that can increase the likelihood of serious injury or death. For example, submarining or catching the neck with the shoulder belt may occur, which can result in spinal cord injuries, quadriplegia or paraplegia. Also, ejection from the vehicle, particularly in rollovers, is more likely without the lap belt, greatly increasing the probability of fatal injury. The low usage rates of the lap belts in these designs and the resulting injuries that would have been prevented or lessened with the use of lap belts has generated concern about why the lap belts are not being used and how increased usage may be brought about.

Since the introduction of laws requiring the installation of safety belts, researchers have been surveying usage rates. Such studies have included analyses of various belt system designs as well as some of the factors that influence usage patterns. In recent years several studies have examined the use of automatic shoulder and manual lap belts (Reinfurt, St. Cyr, and Hunter, 1990; Williams, Wells, Lund and Teed, 1989; Streff and Molnar, 1991; Rosenfeldt, 1988). Looking at these studies, comparisons can be made between usage rates for the manual three point belt and the manual lap belt in the motorized shoulder belt system. Generally, the results have shown substantial differences in the rates at which these two belts are being used. For example, Reinfurt et al. (1990) reported 74% usage for the manual three point belt but only 29% for the lap belt in the motorized system. Similar results were reported by one of the automobile manufacturers (Rosenfeldt, 1988). An exception to this pattern of results was reported by Streff and Molnar (1991) who found usage rates for both the manual lap belt in the motorized system and the three point manual system to be in the 71% to 79% range. All of the studies reported high rates of usage for the motorized shoulder belts, generally above 90%. One idea that has been put forth regarding the low lap belt usage in the motorized shoulder belt system is that the motorized belt moving into place gives drivers or passengers the feeling of being buckled up (Reinfurt et al., 1990).

Partly in response to an early awareness of the low use of manual lap belts, manufacturers of the motorized shoulder belt systems have employed warnings to alert the driver and passenger

to fasten the lap belt. Generally, these warnings have appeared in the vehicle owner's manual and on the sun visors.

The work reported in this paper represents an effort to explore some of the circumstances associated with the use or lack of use of manual lap belts in the motorized shoulder belt design. Two experiments were carried out: the first explored usage rates and possible reasons for use and non use; the second further explored usage rates as well as possible effects different warnings might have on rates of use.

EXPERIMENT 1

Method

Subjects. The study consisted of a survey questionnaire that was administered to two groups of subjects. The first group was a sample of 104 students enrolled in psychology courses at the University of Houston. The second group was 162 volunteers whose participation was solicited at a shopping mall in Raleigh, North Carolina.

Questionnaire. The questionnaire consisted of several pages of questions. There were some differences in the questionnaires administered to the two groups. More specifically, a few questions were omitted from the shopping mall group questionnaire in order to shorten the time required. However, questions pertaining to the issues of primary interest were included for both samples. In all, there were 32 and 24 questions administered to the University of Houston group and the shopping mall group respectively. Several types of questions were included:

1. *Demographic:* Age and sex.

2. *Driving experience:* Questions about how long the person has been driving, types of vehicles driven, settings (rural or urban), types of highways, etc.

3. *Seat belt experience and usage:* Questions about types of seat belt systems in their cars and cars they are familiar with, information about any warnings in their vehicles regarding seat belt usage, estimates of percentages of times they use belts, reasons for using belts when they do, and reasons for not using belts when they do not.

4. *Judgments and/or estimates about safety:* Likelihood they will personally have an accident in various future time segments, probabilities of fatalities for head on collisions at 40 mph (64.4 km/h) mph for a driver and a right front passenger given various seat belt configurations in use.

Procedure. The procedures for administering the questionnaires were straightforward. Students in the university sample signed up for the study, came to a room at a designated time, and completed the questionnaire in groups. Subjects in the shopping mall sample were simply administered the questionnaire at the time they volunteered.

Results

The subjects in both samples were split approximately equally between males and females. The mean age for the university sample was 21 years and for the shopping mall sample 33 years. Not surprisingly, years of driving experience were highly correlated with age, so generally the university subjects had 2 to 5 years experience while the shopping mall subjects had a broad range of experience.

Subjects with three point belt systems in their vehicles totaled 73 (70%) in the university group and 108 (67%) in the mall sample. Subjects with motorized shoulder belt, manual lap belt systems totaled 21 (20%) and 30 (19%) in the two samples respectively.

Collapsing across the two samples, three point belt users reported using their seat belts about 90% of the time. For subjects with a motorized shoulder belt/manual lap belt system, shoulder belts were used 98% of the time while manual lap belts were used 67% of the time. Reported use in each of these categories was virtually identical in the two samples.

Reasons for use and non use were tabulated. Most frequently cited reasons for use in both samples were safety, habit, and the law. Reasons most often mentioned for not using belts in both samples were forgetting and traveling a short distance.

As noted in the Method section above, subjects were asked to estimate the number of drivers and right front passengers who would be killed in a head-on collision at 40 mph (64.4 km/h) for various configurations of seat belt use. These results are shown in Table 1. A four way ANOVA was conducted to test the effects of four factors on the number of estimated fatalities. The factors were: seat belt system in vehicle owned/driven by subject (motorized shoulder belt/manual lap belt vs. three point belts), presence/absence of lap belt in the accident, presence/absence of shoulder belt in the accident, and occupant position (driver/passenger). For the mall sample the between subjects factor of seat belt system owned/driven by subject was not significant at the usually accepted $p < .05$ level, although it was reasonably close, $F(1, 125) = 2.89$, $p = .09$. The trend indicated three point belt owners/users estimated a greater number of fatalities than the motorized shoulder belt owners/users did. The remaining factors were all highly significant; presence of lap belt, $F(1, 125) = 212.50$, $p < .001$, presence of shoulder belt, $F(1, 125) = 182.28$, $p < .001$ and occupant position, $F(1, 125) = 18.51$, $p < .001$. Higher rates of fatality were estimated when the shoulder belt was absent, when the lap belt was absent, and for passengers as opposed to drivers. No interactions between the factors were significant. The results for the university sample were similar and are as follows: the between subjects factor of seat belt system used by the subject was not significant, $F(1, 91) < 1.0$. The remaining factors were all highly significant; presence of lap belt, $F(1, 91) = 269.59$, $p < .001$, presence of shoulder belt, $F(1, 91) = 326.15$, $p < .001$ and occupant position, $F(1, 91) = 7.49$, $p < .01$. Again, no interactions were significant. As also seen in the mall data, higher rates of fatality were estimated when the shoulder belt was

Table1. Estimates of Percent Drivers and Right Front Passengers Killed

	Three Point Belt Users				Motorized Shoulder Belt/Manual Lap Belt Users			
	Driver		Passenger		Driver		Passenger	
Seat Belt Configuration	students	mall	students	mall	students	mall	students	mall
No Seat Belts Worn	74	69	76	75	72	59	76	65
Shoulder Belt Only Worn	48	44	51	48	50	37	55	41
Lap Belt Only Worn	50	44	54	48	51	36	56	41
Shoulder and Lap Belt Worn	23	25	24	28	25	19	22	21

absent, when the lap belt was absent, and for passengers as opposed to drivers.

Discussion

These results show usage patterns similar to earlier studies (Reinfurt et al., 1990; Rosenfeldt, 1988). The motorized shoulder belt use rates were very high, while the usage rate of the manual lap belt in the automatic system was lower than the usage rate of three point belts. The absolute values of these reported usage rates for manual belts were higher than in previous studies. This finding is not surprising, however, given that these rates are self-reports, while the other studies employed observational techniques. Streff and Wagenaar (1989) have shown reported usage rates typically exceed observed rates.

The subjects in both samples obviously recognized the value of both belts being fastened as indicated by the significance of these variables in the estimated fatalities results. The fact that neither shoulder belt presence/absence nor lap belt presence/absence interacted with the type of belt system in the vehicle that they own or drive further indicates no differences in these groups' perceptions of the safety value of each of the belts. Similarly, the two groups having different belt systems did not differ in the most frequent reasons reported for using and not using belts. There was, however, a suggestion that overall the three point belt owners/drivers regarded belt use as providing greater protection.

EXPERIMENT 2

This experiment represented an effort to replicate some of the results in Experiment 1 and to extend the findings by examining possible effects of warnings on belt usage rates. This study specifically focused on the automatic shoulder belt/ manual lap belt system.

Method

Subjects. A survey questionnaire was administered to a sample of 147students enrolled in psychology courses at the University of Houston.

Questionnaire. The questionnaire consisted of several pages of questions. The different categories of questions included:

1. *Demographic.* Age and sex.

2. *Seat belt experience and usage.* Questions about types of seat belt systems in their cars and cars they are familiar with and estimates of percentages of times they use belts.

3. *Perceived warning effectiveness.* Six different warnings designed to increase lap belt usage in automatic shoulder belt/ manual lap belt systems were tested. These included 4 warnings derived from warnings presently in vehicles equipped with the automatic shoulder belt/manual lap belt system and 2 warnings designed by the authors. Subjects read through three accident scenarios then were instructed to read a warning. Each subject viewed only one warning. Subjects answered the following two questions about the warning:

Question 1. Do you think the warning you read would influence people to fasten the manual lap belt if they read it?

YES___ NO___

Question 2. If 30% of drivers and passengers fasten the lap belt without reading this warning, what total % would fasten it after reading this warning?

___%

The 30% figure used in the last question was based on data from previous studies on manual lap belt use in the genreal population. It was included as a standard (baseline) percentage for subjects to evaluate any increases (or possible decreases) in judged lap belt use after viewing the warnings.

Warnings. The six warnings used in the experiment are shown below: Warnings 1 and 2 were designed by the authors while warnings 3-6 were derived from actual warnings in vehicles.

Procedure. Students signed up for the study, came to a room at a designated time, and completed the questionnaire in groups.

Results

The average age of this sample was 22. There was a larger percentage of females (n=110 or 75%) in the sample than males (n=37 or 25%). Subjects with three point systems in their vehi-

Figure 1. The Six Warnings used in Experiment 2.

Warning 1

⚠ WARNING!!!

- **ALWAYS fasten the LAP BELT in addition to using the automatic shoulder belt.**
  - Wearing only the shoulder belt WILL NOT provide adequate protection in a collision.
  - The LAP BELT provides the most effective protection in the event of an accident.
- **Not wearing the LAP BELT will increase the chances of:**
  - "submarining" in a collision - sliding under the shoulder belt and into the dashboard. This type of movement can result in severe or fatal injuries of the legs, hips, spine, neck, and head.
  - being thrown violently from the car in the event of a side-impact or roll-over type of accident.

Warning 2

⚠ WARNING

If you do not fasten the lap belt, in an accident your lower body may move forward, catching your neck on the shoulder belt causing a broken neck and paralysis.

Also, without the lap belt you could be thrown out of the car making it 40 times more likely you will be killed.

Fasten the lap belt

Warning 3

WARNING!

Relying on the automatic shoulder belt alone to restrain you is dangerous and could lead to more severe injuries in an accident. Wear your manual lap belt even though you have an automatic shoulder belt.

Warning 4

⚠ WARNING ALWAYS WEAR BOTH THE LAP AND SHOULDER BELTS. AND BUCKLE KIDS!

- **Not wearing your lap belt increases the chance of severe or fatal injury in an accident. The shoulder belt alone may not restrain you in all accidents.**

Warning 5

IMPORTANT FOR YOUR SAFETY

Following these instructions will greatly improve your chances of avoiding severe injury in case of an accident:

Always wear your lap belt when the car is moving.

If a lap belt cannot be worn, you should move the seat forward so your knees are as close to the instrument panel as possible

Warning 6

CAUTION

- **READ THE SEAT BELT INSTRUCTIONS BELOW. Failure to follow these instructions could increase the chance and or the severity of injury in an accident.**
- **For full restraint the manual lap belt and the automatic shoulder belt must be securely fastened.**

cles totaled 110 (75%) while motorized shoulder belt/manual lap belts totaled 36 (24%).

Reported use rates were quite similar to those obtained in Experiment 1. Three point belt users reported using their belts 89% of the time; subjects with motorized shoulder belt/manual lap belt systems reported using their shoulder belts 94% of the time while lap belt use was estimated at 63%.

Responses to the two questions regarding warning effectiveness are summarized in Table 2. For Question 1 regarding estimates of whether the warning would influence lap belt use, analysis showed that significantly more people believed that Warning 2 would increase the fastening of manual lap belts compared to Warnings 4 and 5 ($p < .05$). For Question 2 regarding the estimated % of lap belt use, analysis showed greater estimates of fastening lap belts after seeing Warning 1 than Warnings 5 and 6 and after seeing Warning 2 than Warning 6.

Table 2. Estimated Warning Effectiveness

Warning #	% of subjects responding yes to Question 1	Mean % estimates to Question 2
1	75	60
2	87	56
3	68	49
4	57	48
5	58	47
6	65	43

Discussion

The results of Experiment 2 showed reported patterns of belt use similar to Experiment 1 and to earlier studies.

The estimated influence of the different warnings on manual lap belt use in the automatic shoulder belt system indicates that there is room for improvement in the warnings currently employed. All of the significant effects indicated the warnings designed for this experiment (Warnings 1 and 2) were viewed as more likely to be effective.

GENERAL DISCUSSION

The pattern of reported seat belt use found in both experiments indicates that the manual lap belt in the motorized shoulder belt system is fastened less frequently than the manual three point belt. This outcome is consistent with several earlier studies (Reinfurt et al., 1990; Rosenfeldt, 1988), although not all (Streff and Molnar, 1991). A possible explanation for this difference as noted by Reinfurt et al. (1990) is that the automatic shoulder belt provides a sense of being belted or a sense of security. The absolute values of reported usage rates here are higher than those found in the earlier work, most likely because the present experiments used self-report techniques while the earlier studies used direct observation methods.

The most frequently reported reasons for not fastening the belts, forgetting and traveling short distances, neither supported nor contradicted the sense of security notion. Since the concept of already feeling secure was not a response that could be chosen in the questionnaire, these results do not directly address that explanation.

The results of estimated deaths in a 40 mph head on collision (see Table 1) shows clearly that subjects believed fewer deaths would occur with both belts fastened and more deaths with no belts worn. An interesting aspect of these data is that there are virtually no differences in death estimates for the lap belt only and shoulder belt only conditions. It appears that with regard to this type of accident and the estimated fatality measure, subjects regard the presence of a lap belt or the presence of a shoulder belt as providing equivalent protection. Putting it differently, the safety costs (again, by this measure) of not wearing a lap belt or not wearing a shoulder belt are judged to be about the same.

The warnings employed in Experiment 2 represent an effort to explore possible improvements in warning design with regard to increasing manual lap belt use. The primary difference between the two warnings designed for the experiment (supposedly improvements) and the four derived from current on-vehicle warnings was the explicitness of the hazards and consequences information provided. More specifically, these warnings emphasize the submarining and ejection hazards associated with not wearing the lap belt. The results generally supported the notion that more explicit warnings lead to increased cautious intent. This outcome is consistent with results reported by Laughery et. al (1993) which explored warning explicitness effects for a variety of consumer products.

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REFERENCES

Laughery, K.R., Vaubel, K.P., Young, S.L., Brelsford, J.W. and Rowe, A.L. (1993). Explicitness of consequence information in warnings. *Safety Science, 16,* 597-613.

Reinfurt, D.W., St. Cyr, L.L. and Hunter, W.W. (1990). Usage patterns and misuse rates of automatic seat belts by system type. In *34th Annual Proceedings of the Association for the Advancement of Automotive Medicine,* Scottsdale, 163-179.

Rosenfeldt, R. (1988). Passive and active seat belt field survey. Ford Automotive Safety Office.

Streff, F.M. and Molnar, L.J. (1991). Use of automatic safety belts in Michigan. *Journal of Safety Research, 22,* 141-146.

Streff, F.M. and Wagenaar, A.C. (1989). Are there really shortcuts? Estimating seat belt use with self-report measures. *Accident Analysis and Prevention, 21,* 509-516.

Williams, A.F., Wells, J.K., Lund, A.K. and Teed, N. (1989). Observed use of automatic safety belts in 1987 cars. *Accident Analysis and Prevention, 21,* 427-433.