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Self-reports of safe driving behaviors in relationship to sex, age, education and income in the US adult driving population

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Abstract

This study analyzed the data of a health and safety survey conducted on a representative sample of the adult driving population. The analysis focused on the relationships between self-reported safe driving behaviors (including belt use, observing speed limits, and abstaining from drinking and driving), and demographic characteristics (including sex, age, education and income). The results showed that the three behaviors are quite independent of each other, and, contrary to some stereotypes, there is no single high-risk group that is most likely to violate all three safe driving behaviors. The only consistent effect was that of sex: women reported higher observance rates of all three behaviors. Reported use of safety belts increases with age and education for both men and women. However while for women the reported use increases with income, for males the reported use does not change with income. Complete avoidance of drinking and driving was reported by most drivers in all groups, and the high rates hardly varied across the different age, education, and income groups. The number of people who reported that they observe the speed limit all the time increased with age, but decreased with increasing education and income. The results have implications for identifying violation-specific high-risk groups, and stressing different factors for each.

Keywords: Driving behavior; Drinking and driving; Safety belts; Speed

1. Introduction

Perceptions, attitudes and reported behaviors concerning health and safety of the American adult public were captured in annual surveys sponsored by Prevention Magazine between 1983 and 1995. The first 11 surveys were conducted by the Louis Harris and Associates organization, and the last two were conducted by Princeton Research Associates, Inc. The annual surveys were conducted by phone on a random sample of 1250 adults living in the US. The health-related questions dealt with habits such as smoking, exercising, drinking, dieting, weight control, stress control, dental and medical examinations, sleep, vitamin use, etc. The safety-related questions dealt with behaviors related to avoidance of home accidents, as well as driving safety questions related to speeding, drinking and driving, and use of occupant protection. This unique data source provides an opportunity to investigate national trends in driver health-related and safety-related reported behaviors and attitudes over a decade of increasing awareness of the importance of lifestyle to quality of life, and safe driving habits to traffic injury prevention. Two studies based on these data have already been published elsewhere. The first study analyzed the 11-years trends (from 1985 to 1995) in drinking and driving, use of seat belts, and speeding, and compared them to the trends in health-maintenance behaviors such as smoking, drinking, avoiding cholesterol, exercising, etc. (Shinar et al., 1999). That study demonstrated significant positive trends in avoiding drinking and driving and in the use of seatbelts, but not in most health maintenance behaviors and in observing the speed limit. The second study analyzed the relationship between drinking habits (frequency and amount), and avoiding drinking and driving, using seatbelts, and observing the speed limits (Schechtman et al., 1999). The analysis showed that while drinking amount and frequency are

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related to the likelihood of drinking and driving, they are not related to risk taking behaviors such as non-use of seatbelts and speeding.

Those survey results, based on self reports, appear to fly in the face of a common perception that all three unsafe driving behaviors are characteristic of a core group of high risk drivers, such as young males (Boyle et al., 1998), and low income and low education drivers (Shinar, 1993). Some support for the common perception comes from studies that have shown that speeding drivers are less likely to wear seatbelts (Preusser et al., 1988), though an earlier observational study failed to obtain such a relationship (Wasielewski, 1984). In a survey of 1800 Southern California drivers conducted by the Los Angeles Times in 1989 it was found that running red lights, drinking and driving (DWI), and speeding are not necessarily associated with the same sex–age–education–income characteristics. While speeding, DWI, and running red lights were more characteristic of young males, speeding (but not running red lights and DWI) was highly associated with higher education (higher than high-school) and higher income (more than $60 000) (Hemenway and Solnick, 1993). Although Hemenway and Solnick's study was not representative of the general US population, its findings cast a doubt on the robustness of the stereotypical high-risk driver population.

The purpose of this study was to determine the relationship between three safe-driving habits — the use of seatbelts, drinking and driving, and speeding-on the one hand, and the biographic variables of sex, age, education, and income. This is important to assess in a representative sample, since much of the highway safety literature focuses on 'high-risk' drivers, and these are often typified as young, male, low income and low education drivers. However, these assessments are typically not derived from analysis of unsafe driving behaviors of a representative sample of the driving population.

If safe driving behaviors are rational and mature habits that are shaped in response to exposure to relevant information and norms, then we should expect safe driving habits to be affected by sex, age, education, and income. This is because, generally speaking, from a very early age men take more risks and are involved in more accidents than women (Evans, 1991), and as people age they appear to be more safety conscious (Boyle et al., 1998). Education should provide a strong cognitive component of safety attitudes; and income as a measure of socio-economic status, should also be related to the prevailing norms among more educated people. Thus it can be expected that the three variables would have a synergistic effect on each of the three driving behaviors evaluated here.

2. Survey method and analytical approach

2.1. The sample

The study consisted of two samples of 1250 adults representative of the US adult population, who responded to the survey questions. The two independent samples were obtained in phone interviews that were conducted in November 1994 and November 1995, and each one constitutes a representative sample of the adult US population. The surveys were performed by Princeton Research Associates for Prevention Magazine. For purpose of this study, the combined sample included only the 93.3% of respondents who reported that they currently drive (evenly divided between males and females: 49% males in 1994 and 51% males in 1995).

2.2. Sampling strategy and accuracy

The annual surveys were based on a national sample of the adult (18 years or older) civilian US population independently living in the 48 contiguous states and the District of Columbia. The samples, stratified by the variables of geographic region and metropolitan versus non-metropolitan residence, provide an accuracy of 1% on each of these variables. Within each stratum, a primary sampling unit (PSU) is defined based on a process of multistage, unclustered sampling. One interview — based on random-digit-dialing method — is conducted for each PSU. Within each household a fixed respondent selection procedure is employed to determine the person to be interviewed. The procedure provides a 'good distribution of respondents by age and sex' (Louis Harris and Assoc., 1993 — Appendix A, p. 95). For the total annual sample size of 1250 the sampling error is estimated at 2–3%. However, the error increases substantially as the sample shrinks, so that for small subsamples of 100 respondents the error may already reach 10%. For the present analysis, combining two annual samples should reduce the sampling error to less than two percent for any main effect that is tested.

2.3. The study variables

The complete survey contained over 50 different questions focusing on demographics, on health-related and safety-related habits, on attitudes, and on beliefs. For the purpose of this analysis, we focused on four demographic variables — age, sex, education, and income — and three highway traffic safety questions that were asked in both surveys. Comprehensive descriptions of other variables and relationships among these variables, have been published elsewhere (Schechtman et al., 1999; Shinar et al., 1999).

For the analysis of driving safety, we analyzed the answers to the three questions concerned with highway traffic safety that were included in the survey:

1. How often do you wear a seatbelt when you are in the front seat of a car — all the time, sometimes, or never?
2. How often do you drive at or below the speed limit — all the time, sometimes, or never?
3. If you ever drink alcoholic beverages, how often do you drive after drinking — all the time, sometimes, or never? (Thus, drivers who 'never drank' were treated as those who reported they never drink and drive).

2.4. Analytical approach

To examine the association between age, sex, education, and income on the one hand and each of the three safe driving behaviors, on the other hand, we conducted four-way ANOVAs with interactions. In order to retain low sampling error rates, it was necessary to pool categories in the three predictor variables. This is because the original age, education, and income levels yielded a matrix of 924 cells ($2 \times 11 \times 7 \times 6$); obviously too many for a sample of 2320 drivers. To reduce the number of cells and increase the number of respondents in each cell, we redefined the levels of each of these variables as follows:

1. Age (11 categories pooled into three): 18–25, 26–50, and 51+ years
2. Education (seven categories pooled into three): elementary; less than high-school; and high-school and above. However, since there were only 44 respondents with elementary education or less, this category was not included in the analyses and figures below.
3. Total household income (six categories pooled into three): $\leq$ \$15 000; \$15 001–35 000; and $>$ \$35 000.

The safe driving measures were the percentages of drivers who complied with each of the three behaviors. However, to apply the data to ANOVA, it had to be transformed to arc-sin $\sqrt{p}$, where p is the proportion of drivers who complied with the desired safe behavior 'all the time'. The frequencies of respondents reporting 'never' was close to zero, and therefore the proportion of drivers who observed each behavior 'sometimes' is the complement of proportion of people observing a safe driving behavior 'all the time'.

3. Results

An initial analysis of the Spearman-ρ correlations among the three demographic variables of age (11 categories), income (six categories), and education (seven categories), yielded several statistically significant correlations, but only one of them — between education and income ($\rho = 0.39$, $P = 0.001$) — was of marginal practical value, accounting for approximately 15% of the variance. The correlations among the other demographic variables were all much lower (though due to the sample size some were statistically significant) ranging from 0.01 to 0.16. This pattern did not change when the sample was analyzed separately for males and females.

The distributions of age, education, and income differed significantly between men and women. The percentage of male drivers was higher among those under 25 years old, and lower among the oldest drivers (65+ years old) ($\chi^2 = 40.6$, $P < 0.001$). There were more women respondents with household income under \$15 000, and more men with household income over \$35 000 ($\chi^2 = 37.70$, $P < 0.001$). There were slightly more women in the lower education levels of eight grades or less, and slightly more men with higher education levels ($\chi^2 = 17.40$, $P = 0.008$).

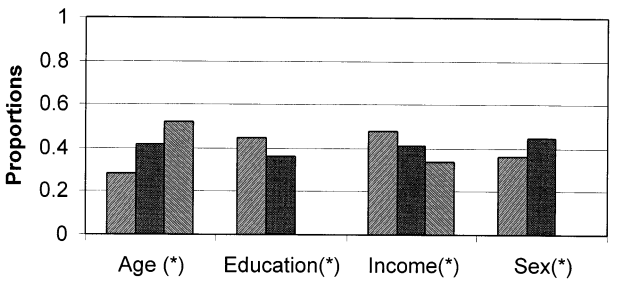
The three safe driving behaviors were very weakly associated with each other. Spearman's ρ coefficients ranged from 0.02 to 0.14. Only the association between frequency of drinking and driving and frequency of observing the speed limit was significant ($\rho = 0.14$, $P = 0.0001$). Use of seat belts appears to be unrelated to either drinking and driving or exceeding the speed limit (with $\rho \leq 0.10$). When analyzed separately for males and females, the pattern remained the same.

3.1. Individual differences observing the speed limits

The ANOVA on the effects of sex, age, education and income (including all two-way interactions) on the probability of observing the speed limits all the time revealed significant main effects of sex, age, education and income, but no significant interactions. The percentage of drivers observing the speed limits all the time was higher for females than for males [with average percentages of 45 vs. 36%, $F(1,16) = 23.71$, $P = 0.0002$]; for older drivers than for younger drivers [with average percentages of 52, 42 and 28%, $F(2,16) = 51.3$, $P = 0.0001$]; for lower-educated than higher-educated drivers [with average percentages of 45 vs. 36%, $F(1,16) = 22.74$, $P = 0.0002$], and for lower-income than higher-income drivers [with average percentages of 48, 41 and 34%, $F(2,16) = 18.08$, $P = 0.0001$]. The absence of any interactions indicates that the effects of the four variables are additive and not synergistic. Removal of all the non-significant interactions from the model did not affect the results: all main effects remained significant. The effects of the four variables can be appreciated from Fig. 1.

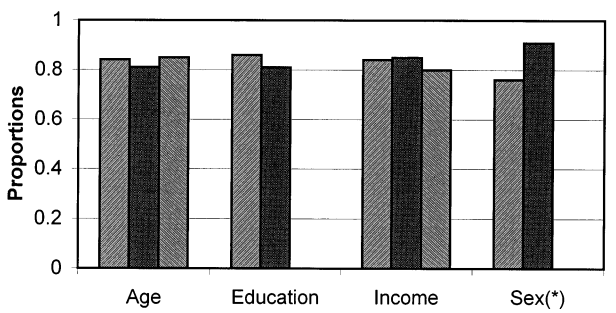
3.2. Individual differences in refraining from drinking and driving

The ANOVA on the effects of sex, age, education and income (including all two-way interactions) on the probability of abstaining from drinking and driving revealed only one significant main effect — sex. No other main effects or interactions were significant. More women than men reported that they abstained from drinking and driving [with average percentages of 91 vs. 76%, $F(1,16) = 27.67$, $P = 0.0001$]. Removing the two-way interactions did not affect the results. The effects of the four variables can be appreciated from Fig. 2.



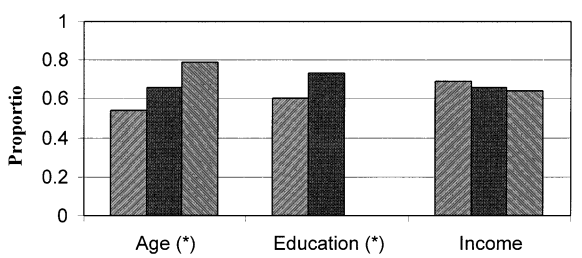
* All groups are significantly different (α=0.05)

Fig. 1. Proportion of drivers observing speed limits all the time by age, income, education and sex.



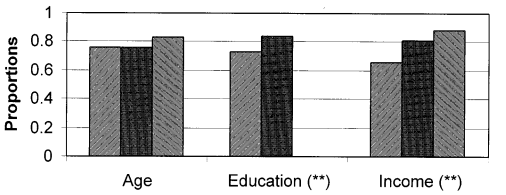
* All groups are significantly different (α=0.05)

Fig. 2. Proportion of drivers who never drink and drive by age, education, income and sex.



* All groups are significantly different (α=0.05)

Fig. 3. Proportion of male drivers using seat belts all the time by age, education and income.



** All groups are significantly different (α=0.05), after removing all non-significant interactions

Fig. 4. Proportion of female drivers using seat belts all the time by age, education and income.

3.3. Individual differences in use of safety belts

The ANOVA on the effects of sex, age, education and income (including all two-way interactions) on the probability of using safety belts all the time revealed significant main effects of sex, age, and education, and a significant interaction of sex with income. Sixty seven percent of the males reported using seatbelts all the time, compared to 78% of the females [$F(1,16) = 10.87$, $P = 0.0046$]. The interaction between sex and age was marginally significant ($P = 0.08$). Since sex interacted with two of the other main effects, the results for males and females were analyzed separately. For males, only the main effects of age and education were significant. More old drivers than young reported that they use seat belts all the time [79, 66 and 54% for old, middle-aged and young, respectively, $F(2,4) = 11.5$, $P = 0.022$]; More higher-educated males reported using seat belts all the time than lower-educated males [73 vs. 60%, $F(1,4) = 10.86$, $P = 0.03$]. An analysis that excluded the non-significant interactions did not change the results. For female drivers, none of the main effects or interactions was found significant, but after removing the interactions from the model, income and education were found significant. Among females, income was directly related to reported use of seatbelts, with highest rates obtained for the highest income females and lowest for the lowest income females [average percentages 88, 81 and 66%, $F(2,12) = 8.91$, $P = 0.004$]; and more higher-educated females than lower-educated females reported using seatbelts all the time [84 vs. 73%, $F(1,12) = 10.86$, $P = 0.03$]. The effects of the three variables on males and females can be appreciated from Figs. 3 and 4.

3.4. The likelihood of safe behavior as a function of age, sex, education and income

The previous analyses focused on the effects of the demographic variables on the three behaviors, *given* that the drivers reported that they observed the specific safe behavior 'all the time'. Thus, they provided information on the percentages of the different levels of age,

sex, education and income for these drivers. In addition, the same data set can be used to study the likelihood of observing each behavior 'all the time' *given* driver age, sex, education, and income. To find the best explanatory variables for estimating the probability that a driver will obey the law 'all the time', a stepwise logistic regression was used for each behavior. The dependent variable was binary: 1 if the safe behavior was 'always' observed; and 0 otherwise. The independent variables were age (11 levels), sex, income (six levels), education (seven levels), and all of their two-way interactions. Results showed that for speeding, the most predictive model included age, sex and the interaction of income with education. For drinking and driving, the most predictive variables were sex, interaction of income with education, and the interaction of sex with age. For using seat belts, the most predictive variables were age, income, education, and the interaction of sex with income. However, none of the logistic models had a satisfactory predictive power, with sensitivities approaching 0 for a 0.5 decision criterion, and concordance levels ranging from 66 to 68%, for all three measures.

4. Discussion

The associations obtained here between demographic characteristics and safe driving behaviors are consistent with some pre-existing notions and previous findings, but also contradict a few. The validity of this data base stems from the fact that it is a large representative sample of the US adult driving population, but its shortcoming stems from the fact that it is based on self-reports. Social desirability — the need to reply in a manner consistent with positive social norms — can have a large effect on people's responses. To the extent that using seatbelts, observing the speed limits, and avoiding DWI are all socially desirable behaviors, there may be a bias in the reported percentages of those who comply with these behaviors. Thus the absolute values may be suspect. On the other hand, this data base is very telling in the differences among the three behaviors and in the association between each of them and the individual characteristics measured here.

The different patterns observed for the three behaviors indicate that drivers do not view all three in the same way. Across all groups, use of seatbelts is the most practiced, while observing the speed limit is the least practiced. Still, the percentages of people practicing each of these behaviors, varied widely across age, sex, education, and income levels, but not in a uniform manner. This pattern of results suggests that efforts to increase seatbelt use, reduce DWI, and reduce speeding should be directed differentially at different target groups. The idea that the high risk drivers are the same people who tend to commit all unsafe behaviors is not supported by these results. In contrast, our findings are consistent with those of Hemenway and Solnick (1993), who reported that drivers with higher income and higher education were more likely to report that they speed than drivers with lower income and lower education.

Specifically, with respect to speeding, it appears that the target groups that are assumed to be most reachable by public information campaigns (high education/high income), are the least sensitive to it. One possibility is that as the level of education increases, people become more familiar with conflicting arguments and data about the relationship between speed and crashes. Also, in the absence of belief about the impact of speeding on safety, the reliance on enforcement that is typically restricted to fines, is not very effective, since as the level of income increases, the deterring effect of the fine decreases. This is not the case with respect to the role of seatbelts and DWI. The primary reason people give for using seatbelts is to avoid injury (rather than habit, 'it's the law', or avoiding a ticket) (Boyle and Sharp, 1997). Thus it seems that there is now wide agreement about their perceived effectiveness in injury reductions, so people are more likely to wear seatbelts for their perceived safety value. For DWI — a behavior that is difficult to eradicate in the case of addiction — both the tolerance of the police is low and the penalties meted out by the courts are much more severe than just fines.

Since the findings of this study are based on self-reports, it is necessary to alley concerns of bias that are typically associated with such data: sampling bias, and response bias. Sampling bias was minimized in the present study by using random-digit phone dialing techniques. Up to three attempts were made to reach a respondent (including an additional call to try and 'convert' any designated respondent who has refused or terminated an interview), and replacing missed respondents by others from the same primary sampling unit (same geographic area and with similar demographic characteristics).

Response bias is more elusive and more difficult to eliminate. Most health-related and safety-related questions have a definite 'socially desirable' answer; and all other things being equal, people are generally biased to respond in socially desirable fashion (e.g. 'I always use safety belts'), than a socially undesirable fashion (e.g. 'I never use safety belts'). Consequently, in evaluating the data from such questions, one should assume that the true levels of compliance with any behavior are probably lower than the levels reported in this survey. The implication of this bias is that trends and relationships obtained in this study are much more valid than the absolute levels reported. The actual absolute levels of reported compliance with any behavior can be used as

valid indicators only when the relationship between the true behavior and the self-reported one has been previously established. For example, in the case of safety belts, Streff and Waggenaar (1989) estimate that the reported safety belt use rate is 1.3 times higher than the actual use rate. However, even then there may be other moderating variables that make such a simplification tenuous. In the specific case of safety belts, the adjustment that is needed appears to vary among different age groups (Shinar, 1993).

5. Conclusions and recommendations

The three safe driving behaviors-using seatbelts, observing the speed limit, and refraining from drinking and driving-cannot be treated as individual manifestations of a general 'safety habit'. Furthermore, their violation does not seem to be limited to a unique high-risk group that can be defined in terms of age, sex, education, and income. Instead, drivers consider each recommended behavior independently, and consequently they may seem inconsistent in their approach to driving safety. Still, across all groups, the highest rate of compliance was with not drinking and driving, and the lowest rate of compliance was with observing the speed limit.

In a manner consistent with crash involvement (Evans, 1991), women, with few exceptions, report higher rates of compliance on all three behaviors. However, in most cases, their behavior fluctuates as a function of age, education, and income in a manner similar to that of men. Also consistent with previous studies, use of safety belts increased with age, and education (but not with income). Since enforcement of safety belt use is rather lax, this result suggests that the cognitive appeals for use of safety belts are sufficiently effective to counteract any feelings of inconvenience associated with wearing them.

Adherence to speed limits and avoidance of DWI are not treated in the same way as using seatbelts. The tendency to speed decreases with age, but actually increases with education and income. Thus, it appears that the more educated and affluent, believe they can judge for themselves the merits and risks of speeding. To achieve higher compliance levels, more definitive information about the positive relationship between speed and crashes must be provided to these groups.

DWI was the least associated with age, education, and income. Although the pattern was somewhat similar to that of speeding (with a suggestive increase of DWI with increasing education and income), the overall levels of reported abstention from drinking and driving were quite high so as to minimize these differential effects.

In summary, the major recommendation that stems from these conclusions is that different focused programs must be directed at each unique segment of the population for the different safe driving behaviors. Programs addressing more than a single issue, must first determine to what extent the multiple issues are relevant to the specific target groups. NHTSA has in the past identified target populations for different programs, the results of this survey provide further insights into their segmentation by age, education, and income.

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