A STRUCTURAL MODEL OF DRINKING AND DRIVING: ALCOHOL CONSUMPTION, SOCIAL NORMS, AND MORAL COMMITMENTS*

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A structural model based upon data from a random sample of 1,000 U.S. drivers accounted for 56% of the variation in alcohol-impaired driving, with total monthly alcohol consumption as the strongest predictor. Significant contributions of age, sex, peer group values, and preference for beer suggested the operation of socialization to group norms. There was a substantial contribution of personal moral commitment against drinking and driving. However, there was no significant inhibitory influence of legal knowledge and perceived arrest risk. These findings are consistent with Andenaes's view that general deterrence should be more broadly construed to include the moral component as well as the fear component of the law.

Studies of drinking and driving in the United States have revealed a rather consistent demographic profile of offenders as displayed in mortality rates, arrest statistics, random roadside breath tests, and self-report surveys. Compared to the general driving population, disproportionate numbers of alcohol-impaired drivers have been found to be unmarried males in their 20s and 30s (Davis, 1982; Jones, 1977; Jones and Joscelyn, 1978). As one might expect, drinking-driving violators report higher levels of monthly alcohol consumption than do other drivers. A more surprising finding is a consistently higher rate of violations among beer drinkers than among drivers who prefer other alcoholic beverages (Berger and Snortum, 1985; Jones and Joscelyn, 1978; Perrine, 1970, 1974; Zylman, 1974).

Far more is known about the demographics than the dynamics of drunk driving. What motivates drunk driving and, conversely, what deters the offense? From his comprehensive review of the international literature, Ross (1982) found little evidence that increased legal threat through tougher laws

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and enforcement programs yields lasting deterrent effects as reflected in crash statistics. However, Andenaes (1952, 1977) maintains that legal threat is only one of the determinants of deterrence. Along with Andenaes (1978), Votey (1984) and Snortum (1984a, 1984b) have noted the limitations of interrupted time-series analysis for assessing the broader network of influences behind alcohol-impaired driving. Although most investigations of the effects of legal threat in deterring drunk driving have been based on aggregate data, such as arrest rates and accident statistics, survey methods are necessary in order to access the way that individuals perceive and evaluate laws, risks, and violations (Bishop, 1984; Waldo and Chiricos, 1972).

Structural modeling or path analysis is a useful statistical technique for testing posited models of causal relationships within a set of variables. The procedure produces estimates of effects of one variable upon another, both direct effects (independent of other variables) and indirect effects (mediated by intervening variables). In the present research, structural modeling was used to help clarify the relative influence of two major facets of compliance with the law described by Andenaes (1952, 1977): the "fear component" produced by the direct threat of legal sanctions versus the "moral component" which brings compliance through the development of personal values in support of the law. "From the legislator's perspective, creating moral inhibitions is of greater value than mere deterrence, because the former works even when a person need not fear detection and punishment" (Andenaes, 1977: 51).

Norström (1978) developed a simple causal model that accounted for 24% of the variation in drunk driving in a sample of 1,541 Swedish drivers. His model used three background demographic variables (age, sex, marital status), two "opportunity" variables (mileage, alcohol consumption), and two subjective measures (perceived risk of an accident after drinking and moral attachment to the law) to predict the self-reported frequency of drunk driving in the past year. He also examined knowledge of the law and perceived risk of arrest, but neither of these variables had a causal influence in the model. Norström found no significant direct effects of the demographic variables on drunk driving but showed, rather, that these variables acted through the intervening variables. Of the two opportunity variables, mileage had a negligible effect upon drunk driving, while total monthly alcohol consumption was a strong predictor, both in terms of the simple Pearson correlation ($r = .35$) and the direct contribution (independent of other variables) as reflected in the path coefficient (.22). Interestingly, moral attachment to the law was the best predictor of alcohol-impaired driving, with $r = -.38$ and a path coefficient of $-.29$. Finally, perceived risk of an accident was a weak predictor, with a path coefficient of $-.12$.

In a later study, Norström (1981) essentially replicated these findings with a larger Swedish sample ($n = 3,359$), but this time he applied the LISREL computer program which allowed the use of multiple indicators to measure

drunk driving and moral attachment to the law as latent variables. His final model posited a causal path from drunk driving to perceived risk of an accident, opposite to the direction of the path in his 1978 model. Despite these differences in method, very similar findings were obtained for the paths to drunk driving, with path coefficients of .55 for total alcohol consumption and .41 for moral attachment.

The present research was designed to address two principal goals. First was the desire to replicate Norström's findings with a sample of American drivers. On the surface, there would be little reason to expect similar dynamics in models developed in Sweden and the U.S., given national differences in per capita alcohol consumption, temperance traditions, and cultural homogeneity (Snortum, 1984b). Furthermore, compared to the U.S., Sweden has stricter blood alcohol limits, more severe sanctions, and lower rates of alcohol-impaired driving.

Second was the wish to extend Norström's model by examining the effects of "subcultural" influence upon violation rates. Andenaes (1977: 51) has suggested that "a successful inculcation of moral standards may result in social pressure toward acceptable behavior even for persons who have not personally been influenced by the moral message of the law." Conversely, peers may exert a negative influence. There is a vast literature which demonstrates the strong effects of peer groups in adolescent drug and alcohol use (Burkett and Carrithers, 1980; Kandel, 1980). It remains to be seen whether the drinking-driving values ascribed to friends will be a significant influence with the general population of adults, and whether these ascribed values will exert effects which are independent of the driver's own values. In addition to the general influence of peers, there may be a "beer subculture" with its own values and standards regarding the acceptability of drinking and driving (Berger and Snortum, 1985).

METHODS

THE SURVEY

Fifty questions were employed in a 15-minute telephone interview to collect information on demographics, behaviors, and attitudes concerning alcohol use and drinking-driving violations. While many of the items were adapted from earlier drinking-driving surveys employed in the U.S. (Gallup, cited in U.S. Department of Justice, 1983; Selzer, Vinokur, and Wilson, 1977), most of the items were drawn from previous research in Scandinavia in order to produce an instrument with sufficient generality for eventual application to cross-cultural comparisons (Hauge, 1978; Klette, 1978; Norström, 1978).

The data were collected by an established national polling service in April 1983, with calls placed during evenings and weekends. Random digit dialing

with stratification by state and a 50-50 split by sex yielded 1,000 completed surveys from a national probability sample of licensed drivers, aged 16 and above, in the contiguous 48 states. For details on the administration and limitations of the survey, see Berger and Snortum (1985).

THE VARIABLES

Demographic. The initial analysis included the following demographic variables: education, income, marital status (1 = married; 0 = other), sex (male = 0; female = 1), and age.

Opportunity. Opportunities for drunk driving were measured by the total amount of driving and total amount of alcohol consumption. Total annual driving mileage was obtained as a direct estimate by each respondent. Total alcohol consumption per month was calculated from the reported quantity and frequency of drinking beer, wine, and distilled spirits.

Social support. Alcoholic beverage preferences and friends' attitudes toward driving after drinking were used as indicators of social support for drinking and driving. The preferred beverage was defined as the alcoholic beverage for which total consumption was the greatest. Ties between preferred beverages were broken by random assignment to one of the beverages in the tie, and the item was dummy coded to contrast beer drinkers (1) with all other drivers (0). Attitude of friends was indicated by responses to the question, "Do you think that your friends would disapprove if they knew you were driving on the highway after drinking four cans of beer?" Answers ranged from "They definitely would not disapprove" (1) to "They definitely would disapprove" (5).

Psychological preconditions for deterrence. Four variables were included in this category: perceived risk of an accident, risk of arrest, knowledge of applicable law, and moral attitude toward driving after drinking. Accident risk was assessed by asking for an estimate of the chances that a man would get in an accident if he had drunk six shots of whiskey and had a long way to drive home. Responses ranged from "only one chance in 1,000" (1) to "1 chance in 2" (4). Risk of arrest was measured on the same scale for the same hypothetical man. Knowledge of the law was indicated by the number of correct responses to four questions: maximum penalties for the first offender, legal blood alcohol content limits, legal proof of intoxication, and number of drinks needed to reach illegal limits. To assess their own attitudes toward driving after drinking, respondents were asked: "Speaking for yourself, do you feel that it is or is not morally acceptable for you to drive your car after having consumed four cans of beer or four drinks of any kind?" Answers

included acceptance of drinking and driving (1), uncertain or undecided (2), and rejection of drinking and driving (3).

Alcohol-impaired driving. The dependent measure was an estimate of the maximum blood alcohol level attained prior to driving in the past year. The basis of this calculation was the respondent's estimate of "the largest number of drinks that you, personally, have been able to handle and still manage to drive your car back home." In order to accommodate differences in body weight, the individual's weight and total number of drinks were entered into a conversion table provided by the U.S. Department of Transportation (1982) to derive a crude estimate of blood alcohol level. This conversion table is based on the assumption that all consumption occurred in one hour and that the three basic types of beverages each contain approximately one-half ounce of alcohol per serving (for example, one ounce of 100-proof distilled spirits, 12 ounces of beer containing 4% alcohol, or 4 ounces of wine containing 12% alcohol).

RESULTS

Variables Dropped From the Model

As a first step in the analysis, the variables were screened for their contribution in predicting the criterion variable (estimated maximum blood alcohol attained prior to driving in the past year). Cases with data missing on any of the 14 variables were excluded, leaving 758 cases with complete data for this analysis. A recursive structural model was formulated, with causal flow between clusters of variables posited to be in the following order: demographic, opportunity, social support, and psychological preconditions to the criterion variable. Hierarchical regression analysis was used to test the contribution of each variable to the structural model. Because of the large sample size and the large number of variables tested, a conservative criterion for inclusion was adopted. Seven variables failed to produce path coefficients that were larger than .10 in absolute value and statistically significant at the $p < .001$ level and, consequently, they were dropped from the model.

Income and education level were not significantly correlated with the criterion variable ($r = -.01$ and $r = .05$, respectively), nor were they significantly correlated with any variable that was predictive of the criterion. Total mileage and marital status were both correlated with the criterion ($r = .18$ and $r = .21$, respectively, both $p < .001$), but no individual structural paths from either variables met the criterion for inclusion.

Knowledge of the law was not significantly correlated with any other variable in the analysis, and none of the individual measures in the composite was significantly related to the criterion variable. Responses were near chance on

all four of the questions, indicating very poor general knowledge of specific state laws regulating drinking-driving violations.

Surprisingly, the perceived risk of arrest was unrelated to the criterion ($r = .01$). Higher estimates of accident risk were associated with lower blood alcohol levels before driving ($r = -.17$, $p < .001$), but the direct path coefficient to the criterion variable did not attain significance.

CORRELATIONS AMONG THE PREDICTOR VARIABLES

Pearson correlations among the remaining six predictor variables and the criterion variable are presented in Table 1. Cases with data missing on any of the seven variables were excluded from this analysis, leaving 939 cases with complete data. As shown in the first column of Table 1, higher levels of alcohol-impaired driving were most closely associated with higher levels of total alcohol consumption, a preference for beer, and the attitude that driving after drinking is not morally wrong. Moderate, but highly significant, correlations of the other variables with the criterion indicated that the more highly impaired drivers tended to be younger males who felt that their friends would not object to their driving while intoxicated.

Table 1. Correlations Between Variables in the Structural Model

		Y1	X1	X2	X3	X4	X5
Y1	MBAE When Driving	1.00					
X1	Female	−.22*	1.00				
X2	Age	−.34*	.04	1.00			
X3	Alcohol Consumption	.63*	−.28*	−.16*	1.00		
X4	Prefer Beer	.49*	−.29*	−.22*	.42*	1.00	
X5	Friends' Attitude	−.38*	.20*	.22*	−.27*	−.25*	1.00
X6	Moral Attitude	−.52*	.22*	.16*	−.45*	−.34*	.37*

*$p < .001$ (two-tailed) N=939

Although the correlations in the first column of Table 1 reflect the strength of the linear relationship of individual variables to the criterion, it is risky to ignore the simultaneous effects of other variables. A high correlation may be spurious if both variables are influenced by the same prior variables. Path analysis techniques were used to disentangle direct, indirect, and spurious relationships.

CAUSAL ANALYSIS

Causal effects were estimated for a hierarchical model that used all of the

variables in Table 1. The two demographic measures (sex and age) were used as prior variables. The posited causal order for the remaining four predictor variables is from top to bottom in Figure 1. Each of the remaining variables,

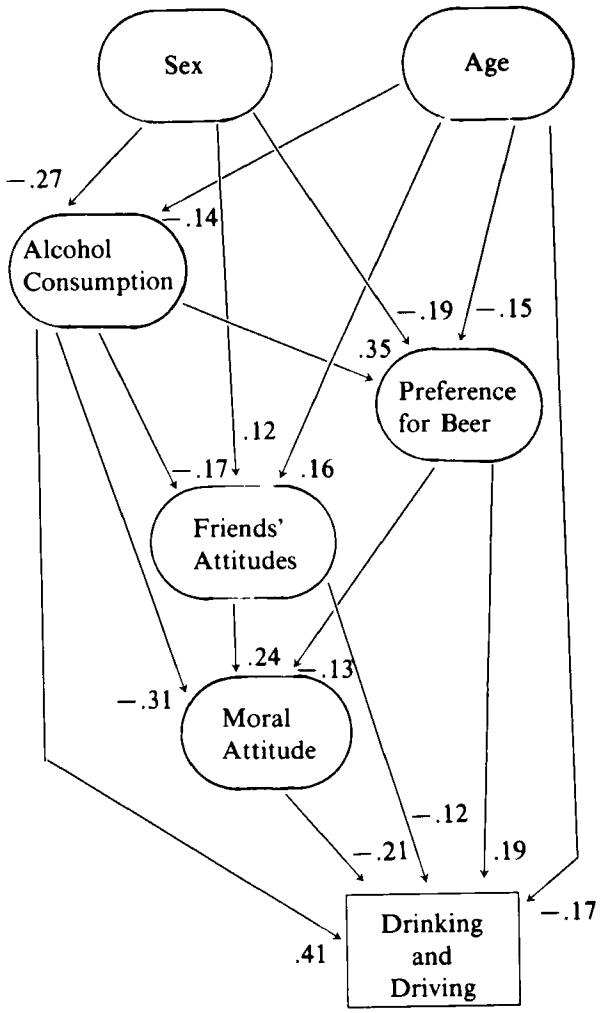

Figure 1. Structural Model of Driving after Drinking

starting with total alcohol consumption, was considered to be a potential cause of only those variables that followed it in the model. Thus, all six

independent variables were used as predictors of the criterion variable, maximum degree of intoxication before driving in the past year.

The simplified causal model shown in Figure 1 includes only variables and paths with substantial effects (path coefficients with an absolute value of at least .10, and statistical significance beyond the .001 level). This model has the advantage of conceptual simplicity while it retains the predictive power and essential theoretical structure of much more complex models that were considered earlier. The five variables with direct paths to the criterion together accounted for 56% of the variance.

In addition to identifying direct effects, the analysis also produced estimates of indirect effects upon the criterion (mediated by intervening variables) as well as an estimate of that part of the relationship which is spurious (for example, due to a third variable that has a causal influence on both the original variable and the criterion) (Cohen and Cohen, 1983: 353-371).

Table 2. Summary of Direct, Indirect, and Spurious Effects on Drunken Driving

Predictor		Correlation	Direct	Indirect	Spurious
X1	Female	−.22*	.02	−.24	—
X2	Age	−.34*	−.17*	−.17	—
X3	Alcohol consumption	.63*	.41*	.17	.05
X4	Prefer beer	.49*	.19*	.04	.26
X5	Friends' attitudes	−.38*	−.12*	−.05	−.21
X6	Moral attitude	−.52*	−.21*	—	−.31

Tests of significance are for correlations and direct effects only.

*$p < .001$ $n = 939$ Cumulative $R^2 = .56$ Adjusted $R^2 = .55$

Table 2 and Figure 1 together show that the correlation of sex with drunk driving is expressed largely through sex differences in alcohol consumption, friends' attitudes, and preference for beer. Age also acts through these intervening variables, but there remains a direct link indicating that, independent of the intervening variables, older persons are less likely to drink to high levels before driving.

The large correlation of total alcohol consumption with drinking and driving ($r = .63$) is explained only in small part by the intervening variables (indirect effects = .17). The direct effects (.41) are much more important, leaving only a small portion (.05) to be explained by spurious effects, such as the contribution of age to both alcohol consumption and drunk driving.

Preference for beer is strongly related to drinking and driving ($r = .49$). Although much of this relationship is spurious (.26) in that it can be attributed to "third variables," especially higher total alcohol consumption, the

direct contribution beyond all of the other variables in the model (.19) is highly significant.

The attitudes of friends toward driving after drinking and the respondents' own moral attitudes retained highly significant direct links to the criterion, although a large portion of the zero-order correlations could be explained by the effects of prior variables.

DISCUSSION

LIMITATIONS

There are some methodological limitations of structural modeling which should be borne in mind in the attempt to interpret this model and compare it to Norström's (1978, 1981) models based on Swedish drivers. One limitation of structural modeling, especially in the social sciences, is that the causal order among subjective variables is often ambiguous and the selection of a model must rely on a theory which may be wrong (James, Mulaik, and Brett, 1982). There are techniques, such as two-stage least-squares and maximum likelihood procedures, for estimating reciprocal causality of two variables measured at the same time; however, Reichardt and Gollob (1984) have discussed some of the logical limitations of these procedures. Another approach is to collect and analyze longitudinal data (Paternoster, Saltzman, Waldo, and Chiricos, 1983). For example, if the same persons were surveyed with a time lag of a year or so, it would be possible to estimate the path coefficients from each variable at Time 1 to each variable at Time 2. While there are logical and methodological advantages to longitudinal designs, there is no guarantee that the order of causality is the same as the order of measurement (Rozelle and Campbell, 1969).

A second reason for caution when interpreting path analyses is that models tend to oversimplify complex relationships. Only a limited number of variables and paths can be included in any one model. Nevertheless, a path analysis can be viewed as descriptive of the fit of a particular model to the data. Poor models can be discarded, although one must recognize that a model that fits the data well may not be the best possible model. Alternate models might account for the data equally well or even better. However, it is important to note that the direct path coefficients to the criterion variable in a hierarchical model will be the same, regardless of the order of earlier variables. Thus, the proportion of criterion variance explained by the present model (56%) is not dependent on the choice of the direction of causal flow between the predictor variables.

Finally, in comparing this model to Norström's models for Swedish drivers, it should be remembered that while this study has drawn heavily on his work, there are often differences in the content and number of items used to measure key theoretical constructs. Furthermore, compared to this study,

Norstöm's predictor variables were handicapped by having to hit a relatively smaller "target," for the range of scores on the criterion variable was far more compressed in Sweden than in the U.S. For example, only 8% of Swedish drivers (Norström, 1981) versus 25% of American drivers admitted to driving within the past year after drinking as much as three beers. Converting the data for the most drinks consumed before driving (assuming a one-hour drinking period), 31% of U.S. drivers would have exceeded the Swedish blood alcohol limit of .05% blood alcohol content and 16% would have exceeded the most common U.S. limit of .10% blood alcohol content.

COMPARISONS WITH THE SWEDISH MODELS

The present structural model of factors predicting alcohol-impaired driving in the U.S. has essential features consistent with Norström's (1978, 1981) models for Swedish drivers. In both countries younger males tended to have greater total alcohol consumption, which in turn was predictive of alcohol-impaired driving, and persons who viewed drinking and driving as morally wrong were less likely to report having committed the offense.

Accident Risk. While there was an inverse relationship between perceived accident risk and drinking-driving reports in both countries, the zero-order correlations were somewhat weaker in the U.S. (−.17) than in the two Swedish studies (about −.30 using several measures of accident risk). Moreover, when assessed in the context of other variables, perceived accident risk did not qualify for inclusion in the American model, but yielded direct paths to drunk driving in both of Norström's models. Despite the consistency of these Swedish findings on accident risk, the interpretation of this variable is somewhat problematic. When Norström (1981) tested a nonrecursive (two-way) model of the data from his second sample, estimates of accident risk appeared to function more clearly as an *effect* of drinking-driving behavior than as a cause.

Driving Opportunities. The variables that failed to contribute to either the current model or to Norström's models also deserve special attention. First, the "opportunity" variable of total mileage had only a modest correlation with the criterion ($r = .18$) in the U.S. sample, and direct paths failed to reach significance when other variables were considered. Similarly, Norström (1978) found a correlation of $r = .20$ between mileage and drunk driving in a sample of Swedish drivers, but he did not find a significant direct path to the criterion. The lack of a strong relationship may not be surprising for Sweden, since driving is so clearly separated from drinking. On the other hand, if Americans exercise little control over driving after drinking, one would expect Americans who drive the most to also be most likely to drive while intoxicated. The data do not offer much support for this notion. In fact,

there is even some scattered evidence (Jones and Joscelyn, 1978) that disproportionate numbers of drinking drivers are low-mileage drivers.

Knowledge of the Law. A striking finding was that U.S. drivers did not respond above chance levels to questions of knowledge about drunk driving laws. While 52% of Swedish drivers knew the penalties for drunken driving, accuracy on other questions was much lower (Norström, 1981). It is commonly assumed that knowledge of the law is a prerequisite of effective deterrence; yet knowledge of the law failed to make a significant contribution to the current model or to either of Norström's models (1978, 1981). Norström (1981) cautioned that specific knowledge of the law may not be necessary for the law to have a deterrent effect. It may be that knowledge of the law at a primitive level of "right or wrong" is enough to activate a deterrent effect, whether or not technical details of the law are known.

Risk of Arrest. What does it mean that "perceived risk of arrest" failed to contribute to the structural models in either country? These findings seem to challenge the importance of the "fear component" of the law as a major source of drinking-driving deterrence. Moreover, these results are also consistent with the rather unimpressive effects of "get tough" laws and enforcement programs reviewed by Ross (1982). However, there are a number of reasons for caution about generalizing too broadly from these findings. First, several other studies have found inverse relationships between perceived risk and various self-reported offenses, such as marijuana use, shoplifting, and vandalism (Bishop, 1984; Paternoster et al., 1983; Silberman, 1976). Second, a literature review by Paternoster et al. (1983) revealed that perceived risk may be vulnerable to a variety of methodological influences—for example, significant effects were more often found in studies which were based upon arrest risks estimated for oneself rather than for generalized "others." Perhaps the subjects of the present study had difficulty identifying with the hypothetical man who had just drunk six shots of whiskey. Thus, while the findings fail to support the influence of a "fear component" of the law, this failure might eventually be traced to weaknesses in method rather than theory.

Peer Influences. The current analysis uncovered strong evidence that peers may influence drinking-driving behavior, a factor which Norström did not consider in his models. The perception that friends would not object to one's driving after drinking and a preference for beer both can be interpreted as indices of subgroup norms. It is important to note that the significance of the direct paths to the criterion for these two variables indicates an influence of friends beyond the respondent's age, sex, and total alcohol consumption. One might suspect that the perceived attitudes of one's friends would be little

more than a projection of one's own attitudes. However, when personal moral attitudes were included, the direct influence of friends' attitudes on violations remained significant.

Moral Attachment to the Law. Personal moral attitude toward driving after drinking was an especially strong predictor of violations ($r = -.52$, $p < .001$). Although much of this relationship could be explained by total alcohol consumption, preference for beer, and friends' attitudes, the direct path was still quite large ($-.21$). A reasonable argument could be made that there may be a causal influence in the opposite direction as well, since people may develop moral attitudes in part to accommodate their behavior. While this possibility cannot be excluded, the interpretation of moral attitudes as a convenient rationalization would be more persuasive if moral attitudes proved to be a completely spurious reflection of total monthly alcohol consumption, but this is clearly not the case. Of course, the only conclusive evidence for the independent operation of such a construct would be to observe a stable pattern of moral commitment against drunk driving well before the person's first drinking-driving opportunity. Some recent work in this direction lends credence to the role of moral attitude as a causal influence upon behavior. In a five-year, four-wave longitudinal study of adolescents, Huba and Bentler (1983: 212) identified a stable personality tendency of *law abidance* which "seemed to precede causally either the adoption of drug-taking behaviors or the development of peer and adult intimate support systems espousing mildly deviant behaviors."

Further indirect evidence of a causal influence for moral commitment is provided by the finding of strong national differences in moral commitment against drunk driving which parallel the differences in violation rates for Sweden and the U.S. Ninety-seven percent of the Swedish drivers claimed to be opposed to driving after drinking as many as three cans of strong beer or four glasses of wine, compared to 79% of American drivers who were personally opposed to driving after drinking as many as four beers. Because of the high proportion of abstainers in the American sample (38%), there was concern that extreme moral attitudes of this group might be unduly influencing the structural model. However, when abstainers were removed from the sample and the model was retested, the effect of moral values was still strong ($r = -.48$, path coefficient $= -.21$, both $p < .001$) and the total variance accommodated by the model was still high (48%).

SUMMARY

In conclusion, these data are encouraging in that they demonstrate the utility of considering values and attitudes in addition to demographics and

"opportunity" variables in predicting drinking-driving violations. Moral attitude was especially influential, along with group norms as indexed by a preference for beer and perceived attitudes of friends. On the other hand, perceived risk of arrest and knowledge of the law had no apparent effect on inhibiting drinking-driving violations. In support of Andenaes (1952, 1977), these findings suggest that theories of general deterrence of laws should include moral attitudes toward the law in addition to fear of legal consequences.

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