Traffic Injury Prevention

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/gcpi20

Predicting DUI Decisions in Different Legal Environments: Investigating Deterrence With a Conjoint Experiment

Jie Yao
Mark B. Johnson & Kenneth H. Beck

Pacific Institute for Research and Evaluation, Calverton, Maryland
University of Maryland College Park, School of Public Health, College Park, Maryland

Accepted author version posted online: 09 Jul 2013. Published online: 27 Dec 2013.

To cite this article: Jie Yao, Mark B. Johnson & Kenneth H. Beck (2014) Predicting DUI Decisions in Different Legal Environments: Investigating Deterrence With a Conjoint Experiment, Traffic Injury Prevention, 15:3, 213-221, DOI: 10.1080/15389588.2013.808338

To link to this article: http://dx.doi.org/10.1080/15389588.2013.808338

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the “Content”) contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at http://www.tandfonline.com/page/terms-and-conditions
Predicting DUI Decisions in Different Legal Environments: Investigating Deterrence With a Conjoint Experiment

JIE YAO¹, MARK B. JOHNSON¹, and KENNETH H. BECK²

¹Pacific Institute for Research and Evaluation, Calverton, Maryland
²University of Maryland College Park, School of Public Health, College Park, Maryland

Received 22 April 2013, Accepted 21 May 2013

Objective: Driving under the influence (DUI) enforcement practices and sanctions contribute differentially to the certainty, swiftness, and severity of punishment, which are the key components of general deterrence theory. This study used a conjoint experiment to understand the decision-making process of potential DUI offenders and tested how variation in enforcement and legal punishment affects drinking and driving decisions. It sought to verify and quantify the unique deterrent effects of certainty, severity, and swiftness and to predict the rates of drinking and driving in different legal environments.

Methods: One hundred twenty-one college seniors and graduate students at the University of Maryland participated in the Web-based conjoint experiment. They were randomly assigned to 4 blocks, each of which included 9 hypothetical scenarios composed of different levels of DUI enforcement and penalties. Respondents were asked to state their likelihood of drinking and driving under each scenario, as well as their estimated chance of being caught by the police for DUI.

Results: Intensified enforcement, harsh jail penalty, and immediate long license suspension were found to be the strongest deterrents to drinking and driving. Alternative ways to get home were also important in reducing people’s willingness to drive. These factors accounted for most of the attribute effect on the DUI decision, whereas delayed punishment due to judicial processing, fine penalty, and legal blood alcohol concentration (BAC) limit had negligible effects. For the personal characteristics, college seniors and those who had previously driven after drinking were more likely to choose to drink and drive, whereas those who expect a jail penalty for a DUI offense were less likely to drive.

Conclusions: Our research confirmed and quantified certainty of punishment as the greatest deterrent to DUI, but it also indicated the equally important effect of a severe jail penalty. It provides evidence on the feasibility of using a conjoint experiment in future studies to understand the general driver population and, with the help of a simulation tool, to predict DUI decisions in different legal environments. Such predictions can be used to better inform policy decisions on developing targeted general deterrence programs in different communities.

Keywords: DUI, general deterrence, legal risks, decision making, conjoint experiment

Introduction

Alcohol-involved driving is a significant problem in the United States. According to the 2008 National Survey of Drinking and Driving Attitudes and Behaviors (Drew et al. 2010), 20 percent of the public aged 16 and older reported having driven a motor vehicle within 2 h of drinking alcohol in the past year. The 2007 National Roadside Survey found that 12 percent of weekend nighttime drivers on U.S. roads had been drinking, and 2 percent were higher than the illegal limit of 0.08 blood alcohol concentration (BAC; Lacey et al. 2009). Additionally, alcohol-impaired driving contributed to 10,228 fatalities in the United States in 2010, which accounted for 31 percent of the total motor vehicle fatalities for the year (National Center for Statistics and Analysis 2012).

As tragic as these figures are, the problem used to be worse. The passage of major drunk-driving prevention policies in the 1980s and 1990s (e.g., 0.08 g/dL per se law, raising the minimum legal drinking age to 21, zero tolerance for underage drinking drivers) has proven effective and contributed to a 43 percent reduction in the proportion of legally intoxicated drivers in fatal crashes between 1982 and 1997 (e.g., Dang 2008; Fell, Fisher, et al. 2008; Shults et al. 2001; Tippetts et al. 2005; Voas et al. 2000, 2003; Wagenaar and Toomey 2002). Since 1997, however, there has been relatively little progress, and research on further improving the effectiveness of the laws is needed.

The effect of impaired-driving laws on behavior is often explained through the theory of deterrence (e.g., Ross 1984). This theory posits that legal sanctions will prevent criminal conduct to the extent that the punishment is perceived to be certain, severe, and swiftly applied. Accordingly, if the
consequences of breaking a law seem unlikely or mild, the presence of that law itself will not prevent crime. The theory articulates that there are 2 types of deterrence: specific deterrence, which emphasizes arresting offenders and deterring them from future violations, and general deterrence, which targets potential drinking drivers in the public who have never experienced sanctions. The focus of this article is on general deterrence, which aims to make the public aware of the elevated legal risks associated with drinking and driving and to dissuade them from that behavior.

Despite nationwide passage of laws related to drunk driving, there is considerable variability in its level of enforcement (e.g., Fell, Tippetts, and Levy 2008). The driving under the influence (DUI) penalties also vary across cities, counties, and states and are implemented in different ways. These factors can largely shape the perceived legal risks of drinking and driving by the public, which in turn will moderate the general deterrent effect of the laws. Research on drinking and driving policies has shown that strategies aimed at increasing the certainty and swiftness of punishment (such as random breath testing and administrative license suspension programs) are more effective than laws that increase the severity of punishment alone (Homel 1988; Ross 1992; Ross and Voas 1990b; Wagenaar, Maldonado-Molina, Erickson, et al. 2007; Wagenaar, Maldonado-Molina, Ma, et al. 2007). Although a meta-analytic review of enforcement programs revealed a 22 percent median reduction in alcohol-related crashes (Elder et al. 2002), the variability in effectiveness was considerable, ranging from 1 to 36 percent among sites. Such variability could be due, in part, to the different legal environments where the consequences of drinking and driving vary.

Unfortunately, evaluations of enforcement programs rarely include examinations of the underlying legal structure, sanctions, and adjudication practices in the community where the enforcement is taking place (e.g., Benson et al. 2000; Dula et al. 2007). These factors contribute differentially to the certainty, swiftness, and severity of punishment, which jointly affect the decision-making process of drivers. When drivers are weighing the costs and benefits of driving after consuming alcohol, they essentially ask themselves 2 central questions: Should I drive? If so, what will be the consequences and, if not, what is the alternative to driving? Potential drinking drivers make these decisions in environments where different intensities of enforcement, sanctions, etc., generate unique combinations of certainty, swiftness, and severity. Due largely to the quasi-experimental design of program evaluation research, however, the field has yet to examine the relative contributions of each component in the context of one another. Our lack of knowledge in this area may practically constrain how effective deterrence-based policies can be.

Conceptually, one could expand an evaluation of enforcement programs to include information on sanctions and adjudication. However, the small number of extant programs for which there are data (e.g., Elder et al. 2002) would severely limit the ability of researchers to draw inferences about any specific legal practice, much less about the effect of a specific single legal practice in the context of other existing policies. An alternative approach would be to expose potential DUI offenders to different “DUI legal environments” (i.e., combinations of enforcement practices and sanctions) and examine the participants’ perceptions of DUI risk imposed by the justice system. The research described herein used a conjoint experiment to test the effects of such hypothetical situations. It sought to verify and quantify the unique deterrent effects of certainty, severity, and swiftness and predict the rates of drinking and driving in different legal environments. To our knowledge, this study is the first to examine the combination of DUI enforcement practices and policies that allows the identification of the unique contributions of each.

Methods

Conjoint Experiment

In this research, we identified a number of attributes (e.g., intensity of enforcement, jail penalty, fines) hypothesized to contribute to the general deterrence of impaired driving and conducted a conjoint experiment to estimate the effects of these individual attributes when evaluated in the context of one another. Conjoint experiments are widely conducted in marketing research to identify how various features influence the attractiveness of a product (Orme 2010). They are also increasingly popular in transportation and health policy research where policy makers wish to gauge responses to existing or newly proposed policy elements (e.g., Higgins et al. 2011; Rizzi and Ortiz 2003). Conjoint studies are different from standard surveys that ask respondents to rate each feature of interest separately (e.g., When buying a car, how important is a Global Positioning System?). Instead, conjoint studies involve participants evaluating (for example) the attractiveness of a product whose features have been systematically varied. By forcing participants to process information on multiple attributes simultaneously, weigh trade-offs against each other, and form judgments accordingly, conjoint studies are thought to more closely replicate how people really form decisions (Orme 2010). As a result, the importance of each individual feature derived from conjoint analysis can be better differentiated and more realistic (Louviere et al. 2000).

In the context of drinking and driving, a conjoint experiment is useful for simulating the decision-making process of potential DUI offenders. It allows for the examination of drivers’ perceptions of policies that mediate the 3 deterrence components (i.e., certainty, swiftness, and severity) in a synergistic way. The estimates obtained from analysis of conjoint responses will enable us to quantify the unique contributions of each component to people’s likelihood to drink and drive.

For this study, a conjoint experiment was developed with 7 attributes. Each attribute had 2 or 3 levels (see Table 1), and these levels were combined systematically to create various hypothetical deterrent scenarios. For the most part, the attribute levels were chosen based on current impaired-driving laws and policies in Maryland. However, some attribute levels were purely hypothetical (e.g., an illegal BAC limit of 0.05) but were included because we wished to model the theoretical significance of each deterrence component in a realistic and straightforward way.
Table 1. Conjoint experiment design

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Deterrence</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legal BAC limit</td>
<td>N/A</td>
<td>0.05/0.08</td>
</tr>
<tr>
<td>Enforcement level</td>
<td>Certainty</td>
<td>Low: Regular</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medium: DUI patrols and a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>possible sobriety checkpoint</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High: Targeted DUI patrols and a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sobriety checkpoint</td>
</tr>
<tr>
<td>Jail penalty</td>
<td>Severity</td>
<td>No penalty/a weekend</td>
</tr>
<tr>
<td></td>
<td></td>
<td>stay/7 days or more</td>
</tr>
<tr>
<td>Fine penalty</td>
<td>Severity</td>
<td>No penalty/$300/$2000</td>
</tr>
<tr>
<td>License suspension penalty</td>
<td>Severity</td>
<td>No penalty/for 30 days/for 6 months</td>
</tr>
<tr>
<td>When penalty will be applied</td>
<td>Swiftness</td>
<td>Immediately/1 month later/6 months</td>
</tr>
<tr>
<td>Alternative transportation</td>
<td>N/A</td>
<td>Taxi/free shuttle/friend driving</td>
</tr>
</tbody>
</table>

Five of the attributes incorporated the components of certainty, swiftness, and severity of punishment. Notably, license suspension was designed to be an immediate penalty, which can be imposed administratively at the point of arrest. In comparison, the incurrence of jail and fine penalties is always delayed (to varying extents) due to the judicial process, and this restriction was built into the design as well. In addition, every scenario included at least one of the 3 penalties (i.e., there was no scenario where “no penalty” was the option for all jail, fine, and license attributes; see Table 1). The current legal BAC limit and presence of alternative transportation were also included as attributes because they have potentially important policy implications, even though they do not directly map onto certainty, swiftness, or severity.

Based on these attributes, a full-factorial design would produce 1458 possible scenarios (if all possible levels of the 7 attributes were crossed without any restriction). However, it would have been unreasonable to ask participants to review and respond to each of them. Therefore, we used a blocked fractional factorial design (Dean and Voss 1999) to create a reduced, yet balanced, subset of the 1458 scenarios. The aforementioned method ensures that (a) each attribute level will occur equally often (or at least nearly equally often) for each attribute across all scenarios and (b) each attribute will be independent of every other attribute (or at least nearly independent).

Using SAS software (SAS Institute, Cary, NC) and its marketing research macros, we created 36 representative scenarios based on an efficient design (D-efficiency = 90.6) and divided them into 4 blocks of 9 different scenarios each. Each participant was randomly assigned to one of the 4 blocks, and scenarios were presented in a randomized order within each block. The design ensured that people were exposed to different attribute levels in a varied and balanced way across the scenarios presented, and their decisions on whether to drink and drive were not biased by the subset of scenarios presented to them. Figure 1 displays a sample of one such scenario.

Sample and Data Collection

A recruitment letter was sent to an e-mail list provided by the Registrar of University of Maryland, College Park, which included all 6774 seniors and graduate students enrolled in a particular semester. The letter invited them to take part in an online study and offered an incentive of $10 for their participation. More than 600 students responded with interest. However, due to budget constraints and the exploratory nature of the study, only a random sample of 160 students was selected from that pool and e-mailed a link to the study. The online study included a screener, the conjoint experiment, and several additional questions on demographics and past behaviors. The screener determined that a total of 121 students were eligible for the experiment (i.e., were at least 21 years old, had a driver’s license and access to a car, and did not abstain from alcohol). We intentionally recruited from older students and limited eligibility to persons aged 21 and older because different drinking and driving laws (i.e., zero tolerance) apply to those younger than 21. The study (screener, experiment, and questions) was programmed with the SurveyMonkey software (Palo Alto, CA), and it took about 10 to 15 min to complete. The study received institutional review board approval from the University of Maryland, College Park, and the Pacific Institute for Research and Evaluation.

For the conjoint experiment, participants (N = 121) were told to imagine that they had driven to a bar with a friend and felt tipsy after having some alcoholic drinks. They were
then exposed to one of the 9 scenarios (presented in a random order) for the block to which they were randomly assigned. Given the specific enforcement/policy scenario presented to them, participants were asked to indicate (on a 1 to 5 scale) the likelihood of their driving home in that situation, as well as their perceived chance of being caught by police if they did drive home. Before and after the conjoint experiment, respondents were also asked a few questions on demographics, current perceptions of DUI penalties, and past drinking and driving behaviors.

**Analysis**

**Data Processing**

The first step was to identify and exclude data from cases that did not appear to be responsive to the actual material presented. We retained only data from respondents who completed the survey in 8 min or longer and displayed no straightlining behavior in the conjoint experiment (i.e., not always choosing the same answer across all 9 scenarios). Because this study concerns general deterrence of the driving public (versus specific deterrence of offenders), we excluded data from one subject for whom there was a previous DUI penalty. After this screening process, the final sample size was reduced to 102 participants and 918 responses (102 participants × 9 scenarios each) were retained for analysis. Previous work in the field of marketing research suggests that conjoint data from at least 100 respondents should help ensure the robustness of estimates obtained from a well-designed experiment (Orme 2010). The reported likelihood of driving home for each scenario was recoded into a binary choice in order to make useful predictions of future behaviors. The likelihoods of 1 and 2 (i.e., most unlikely and unlikely) were classified as “will not drive home,” and the likelihoods of 3, 4, and 5 were classified as “will drive home.” The likelihood of 3 implies a neutral attitude, suggesting that the deterrent effect of a given legal scenario is not strong enough, so it was also classified as “will drive home.”

**Analytic Approach**

The data from the conjoint experiment were analyzed in serial using 2 broad approaches with distinct purposes. First, the data were analyzed to estimate the unique contributions of the different levels of the deterrence factors (see Table 2) on drinking and driving decisions. Second, these estimates were applied to a sensitivity analysis that allowed researchers to vary the features of the deterrent environment (e.g., a 0.08 illegal BAC limit with high-level enforcement, no jail penalty but a stiff fine) and determine the expected DUI rate for each environment of interest.

The initial estimation step itself involved 2 separate estimation methods. First, the conjoint responses were analyzed with a conventional 2-level mixed logit model (So and Kuhfeld 1995), which accounts for both sources of impact (i.e., individual characteristics such as demographics and past behaviors and the attribute levels presented) on the outcome of interest. The mixed logit model produces estimates that are called part-worths because if the estimates of each attribute level presented in a given scenario are summed, the utility of that scenario can be calculated and the likelihood of an outcome (i.e., drinking and driving in this study) under those circumstances can be predicted. Such part-worth estimates have been produced by conventional statistical methods at the aggregate level in many past studies, which regard the parameters as fixed. This approach produces parameter estimates and significance values regarding attribute levels and participant-level covariates.

The second estimation approach we used was hierarchical Bayes (HB), which treats the parameters as random variables that vary across individuals and provides individual-level estimates (Allenby and Rossi 2006). In other words, each respondent’s attribute preference, instead of the averaged preference across all respondents, can be statistically determined. HB estimation can greatly improve the estimation of part-worths and, more important, the accuracy of prediction, because “by modeling individuals rather than the ‘average,’ HB can separate signal (heterogeneity) from noise, which leads to more stable, accurate models whether viewed in terms of individual- or aggregate-level performance” (Orme 2010, p. 3). The personal characteristics of the participants are also included as

**Table 2. Part-worth estimates from the conjoint models**

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Part-worth from aggregate model</th>
<th>Part-worth from the HB model (averaged)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-2.13</td>
<td>-3.61</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Attributes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BAC 0.05</td>
<td>0.13</td>
<td></td>
<td>0.24</td>
</tr>
<tr>
<td>Reference: BAC 0.08</td>
<td>-0.13</td>
<td></td>
<td>-0.24</td>
</tr>
<tr>
<td>Enforcement: middle level</td>
<td>-0.14</td>
<td></td>
<td>-0.48</td>
</tr>
<tr>
<td>Enforcement: high level^</td>
<td>-0.60</td>
<td></td>
<td>-0.99</td>
</tr>
<tr>
<td>Reference: low level</td>
<td>0.74</td>
<td></td>
<td>1.47</td>
</tr>
<tr>
<td>Jail penalty: middle level</td>
<td>0.14</td>
<td></td>
<td>0.18</td>
</tr>
<tr>
<td>Jail penalty: high level^</td>
<td>-0.76</td>
<td></td>
<td>-1.22</td>
</tr>
<tr>
<td>Reference: low level</td>
<td>0.62</td>
<td></td>
<td>1.04</td>
</tr>
<tr>
<td>Fines penalty: middle level</td>
<td>0.08</td>
<td></td>
<td>0.31</td>
</tr>
<tr>
<td>Fines penalty: high level</td>
<td>-0.22</td>
<td></td>
<td>-0.12</td>
</tr>
<tr>
<td>Reference: low level</td>
<td>0.14</td>
<td></td>
<td>-0.19</td>
</tr>
<tr>
<td>License suspension: middle level</td>
<td>-0.17</td>
<td></td>
<td>-0.49</td>
</tr>
<tr>
<td>License suspension: high level^</td>
<td>-0.28</td>
<td></td>
<td>-0.51</td>
</tr>
<tr>
<td>Reference: low level</td>
<td>0.45</td>
<td></td>
<td>1.00</td>
</tr>
<tr>
<td>Immediate penalty</td>
<td>0.04</td>
<td></td>
<td>0.85</td>
</tr>
<tr>
<td>Penalty 1 month later</td>
<td>0.02</td>
<td></td>
<td>-0.46</td>
</tr>
<tr>
<td>Reference: Penalty 6 months later</td>
<td>-0.06</td>
<td></td>
<td>-0.39</td>
</tr>
<tr>
<td>Free shuttle^</td>
<td>-0.39</td>
<td></td>
<td>-0.64</td>
</tr>
<tr>
<td>Let friend drive</td>
<td>-0.09</td>
<td></td>
<td>-0.11</td>
</tr>
<tr>
<td>Reference: Taxi</td>
<td>0.48</td>
<td></td>
<td>0.75</td>
</tr>
<tr>
<td>Personal characteristics^</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior (versus graduate students)^</td>
<td>0.50</td>
<td></td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Male</td>
<td>0.13</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>Heavy drinker</td>
<td>0.06</td>
<td></td>
<td>.56</td>
</tr>
<tr>
<td>Expected to go to jail for DUI offense^</td>
<td>-0.21</td>
<td></td>
<td>.03</td>
</tr>
<tr>
<td>Have driven within 2 h of drinking before^</td>
<td>0.71</td>
<td></td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Have driven after having too much to drink before^</td>
<td>0.43</td>
<td></td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Have been stopped for DUI suspicion</td>
<td>0.14</td>
<td></td>
<td>.37</td>
</tr>
</tbody>
</table>

^Personal characteristics were included as covariates in the HB model, but their parameter estimates were not provided.

*P < .05.*
covariates in the HB model whose confounding influences are adjusted for in the estimation of attribute-level parameters.

Both the conventional mixed logit aggregate model and an HB model were developed to compare the estimates of all attribute levels in the current study, with the help of SAS software and the specialized Sawtooth Software (Orem, UT) for HB estimation. However, for the sensitivity analysis, we only used the individual-level HB estimates because HB estimation has been found to be more stable and accurate and, more important, can capture complex cross-effects by means of a simulation tool (Orme 2000). The HB part-worth estimates were used to calculate the expected DUI rate for each combination of attribute levels. Such calculations were built into a simulator in Excel that allowed us to vary the attribute levels, view instant changes in the DUI rate, and determine which attribute would have the biggest impact on the decision to drink and drive. The process of the sensitivity analysis will be discussed in more detail in the Results section.

Results

Respondent Characteristics

The majority (58%) of the sample had senior class standing, and a slight majority was female (52%). Most participants were self-identified white (72%), followed by Asian (16%). These sample characteristics approximate the population characteristics of the University of Maryland student body. For past drinking behavior, one-time binge drinking was prevalent among college students aged 21 or older; 73 percent admitted having had 5 (4 for women) or more alcoholic drinks within a 2-h period in the past year (see Table 3). Based on the frequency of binge drinking and frequency of drinking in general, 32 percent of the respondents were classified as heavy drinkers (those had one or more binge-drinking episodes in the past month and generally drank alcohol 2 times or more per week). Past drinking and driving behaviors were also pervasive: 80 percent admitted having driven within 2 h after drinking alcohol and 28 percent admitted having ever driven after drinking too much. These results are generally consistent with findings from other national surveys on alcohol use of college students (Hingson et al. 2010; Substance Abuse and Mental Health Services Administration 2000, 2002, 2006). On the other hand, only 11 percent of the respondents in this study had ever been stopped by the police for DUI suspicion, either at a sobriety checkpoint or on the road.

Respondents’ current perceptions of DUI penalties are also presented in Table 3. Participants were much less likely to expect a jail penalty, compared to a fine or license penalty. Only half of the respondents expected to go to jail because of a DUI conviction, and the majority expected a 1- to 3-day jail sentence. In comparison, fine and license penalties were expected by most. This is probably related to the fact that a conviction leading to jail time is relatively rare among DUI offenders, particularly first-time offenders, whereas fine and license penalties are much more common. Although the current law in Maryland allows a jail sentence of up to 2 months, it is rarely implemented in practice.

Estimation of Parameters With Conjoint Models

The characteristics of drivers presented herein could have affected responses to the conjoint experiment and were therefore controlled for their influences in the following conjoint models. Altogether, of the 102 participants’ responses to the 918 scenarios, 18 percent \((N = 164)\) indicated that they would drive after drinking in the given scenario (i.e., with reported likelihoods of 3, 4, or 5 on a 5-point scale). A 2-part mixed logit model at the aggregate level was then developed, which provided an adequate fit to the data based on the pseudo \(R^2\)’s (Nagelkerke \(= 0.62\), Estrella \(= 0.56\)). Table 2 presents the estimates and \(P\) values of the independent variables. Note that the dependent variable is to drive after drinking or not, so a negative estimate of a variable indicates that it reduces the likelihood of DUI.

Overall, high-level enforcement, a harsh jail penalty, and long license suspension would significantly reduce the respondents’ likelihood of drinking and driving. Providing a free shuttle to get home also had a significant effect. For personal characteristics, college seniors (compared to graduate students) and those who had previously driven after drinking were more likely to choose to drink and drive, whereas those who expected a jail penalty for a DUI offense were less likely to drive.

An HB model was also developed and produced part-worth estimates for each of the 102 respondents. Their average part-worths are presented in Table 2 for comparison with the aggregate model. Not surprisingly, most of them are directionally consistent with the aggregate model estimates but should be more accurate and can improve the accuracy of prediction (Orme 2000). The hypothesis testing used in conventional statistics is not done in Bayesian statistics, so no \(P\) values are reported for the HB estimates.
Sensitivity Analysis

Although Table 2 suggests what attribute levels within each attribute are mostly impactful, the conjoint part-worths do not permit direct cross-attribute comparison. The reason is that they are scaled to an arbitrary additive constant within each attribute and the scaling is unique to each attribute (Cohen 2003). Therefore, the relative importance of each attribute is usually determined through sensitivity analysis in a simulator. Sensitivity analysis done in marketing research shows “how much we can improve (or make worse) a product’s overall preference by changing its attribute levels one at a time, while holding all other attributes constant at base case levels” (Orme 2010, p. 81). For this study, our approach determined which attributes would have the biggest impact (either positive or negative) on the decision to drink and drive.

To conduct the sensitivity analysis, we first used the part-worths to calculate the utilities of various scenarios and predict the rate of drinking and driving under each one. The underlying statistical model for calculating the utility of a given scenario is as follows:

$$\text{Utility}(i) = \exp[x_i^\prime \beta],$$

where $i$ indexes the given scenario, $x$ is a vector of attribute levels that describe the scenario, and $\beta$ is a vector of regression coefficients that indicate the part-worths of the attribute levels.

The respondent’s choice of not drinking and driving is equivalent to choosing a scenario without any of the attribute levels shown (i.e., a scenario with utility $e^0 = 1$). Therefore, respondent “preference” for a given scenario, or the probability of drinking and driving under that scenario, can be estimated as:

$$\text{Pr}(i) = \frac{\text{Utility}(i)}{(1 + \text{Utility}(i))}$$

Figure 2 displays a screenshot of a simulator developed for this study, which is also the base case scenario: the illegal BAC limit being 0.08, low-level enforcement, no jail penalty, no fines, license immediately suspended for 30 days, and a $25 taxi ride being available. This scenario is presumably the closest match to the current legal environment of DUI. As mentioned, we used the individual-level HB estimates in the simulator and averaged the individual likelihoods of drinking and driving under a given scenario to calculate the overall predicted DUI rate. As shown in the figure, the DUI rate for the base case scenario is predicted to be 40 percent. Then, we changed attributes one level at a time (holding all other attributes constant at these base case levels) and recorded the incremental effect of each attribute level upon the predicted DUI rate. After we tested all levels within a given attribute, that attribute was returned to its base case level before testing another attribute. An example of such repeated simulations is when we changed the level of enforcement from low to medium, the DUI rate dropped from the baseline 40 to 16 percent, so the absolute difference, 24 percent, was recorded. Attributes that caused such notable changes are displayed in Figure 3.

Overall, the relative importance of each attribute was determined by the maximum change caused by their levels (in absolute numbers). For example, enforcement caused the highest rate change, with high-level enforcement leading to a 28 percent reduction in the DUI rate, followed by jail penalty (a 27% drop caused by the longest jail sentence) and license suspension (a 24% increase if not imposed). These rate changes were rescaled to sum up to 100 percent and ranked in Figure 4. Altogether, enforcement, jail, and license penalties accounted for more than 60 percent of attribute impact on the decision to drink and drive, whereas fine penalty and BAC limit had almost no effect.

As mentioned, the simulator also allows for testing cross-effects among the attributes. One issue that we were particularly interested in and tested in this study is the potential interaction effect between perceived risk of being caught and severity of penalty, as suggested by the current literature. The DUI rates at different jail penalty levels given each
Fig. 4. Attribute importance.

enforcement level are compiled in Table 4. Clearly, there were big drops in DUI rates from no jail to a high-level jail penalty across all 3 enforcement levels, but the changes seemed to be accelerated by increasing the enforcement intensity. In other words, the higher the perceived risk of being caught is, the more deterrent severe jail penalty might be. This phenomenon supports the existing literature, and future studies are needed to explore this interesting interaction further.

In addition, the subjective assessment of risk of being caught by the police was found to be strongly correlated with the level of enforcement. The average estimated chances of being caught for each enforcement level were 24, 48, and 69 percent, respectively. In particular, high-level enforcement was found to significantly increase the perceived risk of being caught (P < .05). It should be noted that the respondents tended to overestimate their risk of being caught for DUI, because the chances of arrest on any drunk-driving trip is less than 1 in 50 (Hedlund and McCartt 2002). Such a tendency has also been found in other studies (e.g., Ross and Voas 1990a).

Discussion

Research on drinking and driving policies has shown that strategies aimed at increasing the certainty of punishment are effective (e.g., Elder et al. 2002; Homel 1988; Ross and Voas 1990b). Consistent with such findings, this study confirms that intensified enforcement is one of the strongest deterrents to drinking and driving and further quantifies its impact relative to other factors. Enforcement intensity was also found to be strongly correlated with people’s subjective assessment of risk of being caught, which supports the use of level of enforcement as a measure of certainty of punishment.

A new finding is that a severe jail penalty, which is currently almost nonexistent in the United States, was also strongly associated with lower likelihood of drinking and driving. One possible explanation is that losing freedom by being in jail for more than a weekend might lead to more life inconveniences and even serious problems later on. For the respondents in this study, it would mean missing many classes, being affected negatively in their social life, etc. A harsh jail sentence could amplify the social stigma associated with DUI convictions. One respondent commented: “I consider the most severe penalties of drunk driving to be the social factors … not passing a background check for employment and the way people see me as a result of a DUI.”

The third component of deterrence, swiftness of penalty, was not found to have a strong deterrent effect. This seems to counter the findings from evaluation of administrative license suspension programs, which attributed significant decreases in alcohol-related crashes to the swiftness of such programs (e.g., Wagenaar and Maldonado-Molina 2007). However, this discrepancy might be due to the restricted design of the conjoint experiment, in which license suspension was designed to occur immediately, whereas jail and fine penalties were designed to be delayed for some time because of the reality of the judicial process. Consequently, the estimated effect of immediate punishment was confounded by that of the license suspension penalty, the latter of which was found to be a deterrent indeed. It remains unclear how much of the effect of license penalty is due to the immediacy or the severity of the penalty. This issue should be addressed in future studies.

In addition to the 3 theoretical components of general deterrence, another important factor in affecting people’s likelihood of drinking and driving is the alternative way to get home if they do not drive, as illustrated in the comment from one respondent: “The deciding factor was not necessarily the punishment (though at either extreme, either too light or too severe it might change it), but the type of alternative.” It was found that both a free shuttle and letting a friend drive were preferred to a taxi, but a free shuttle seemed to be the best option. Another respondent noted that she would not be comfortable with her friend driving her car, who was hypothesized to have also drunk some alcohol in the conjoint experiment, although much less. This speaks to the need to further study the use of designated drivers in reducing DUI, who are often found to consume alcohol as well (The Task Force on Community Preventive Services 2012).

There are also some counterintuitive findings from this study. The current illegal BAC limit was found to have no impact and caused confusion. This may be because many people do not have a clear understanding of BAC and might not know their BAC equivalents to feeling drunk. It has also been found that college students tend to underestimate their actual BACs when returning from bars (Thombs et al. 2003). Because no actual BAC was provided in the conjoint experiment, the respondents might have been confused about the illegal BAC limit and simply chose to ignore it when making their driving decisions. It might be helpful in future studies to provide more details to participants about BACs before they take the conjoint experiment. The fine penalty was also found to have a negligible effect. It would be helpful to design this attribute as a linear variable in future studies, which might allow for modeling elasticity of the DUI decision to different amounts.
of fine and generating a threshold amount at which a deterrent effect starts to occur.

Overall, this study sought to quantify the unique effects of certainty, swiftness, and severity, through the examination of different types of policies that operationalize the 3 concepts. It should be noted that the study sample came from a large suburban university on the East Coast, so the results may not be generalizable to other students or nonstudent populations. In addition, the findings were based on responses from presumably sober drivers that might change if people have elevated BACs at the time of the experiment. Nevertheless, this study provides evidence on the feasibility of using a conjoint experiment to examine DUI decisions of the general driver population in future studies. Conjoint experiments have been proven advantageous over the traditional rating scale questions in the fields of marketing and transportation research (e.g., Louviere et al. 2000; Orme 2010). A well-designed experiment has the capability of yielding more accurate responses because it mimics the process of making trade-offs in real life. The conjoint experiment in this study was deemed interesting and engaging by the respondents, many of whom commented that they liked the survey. Furthermore, the responses from a conjoint experiment can be integrated into a useful simulation tool, which can be used to make predictions of future decision making in complex legal environments with policy variants. Therefore, conjoint experiments hold great promise in helping inform policy decisions on developing and optimizing general deterrence programs in different communities.

Limitations

Conjoint experiments for estimating the deterrent effects of DUI policies and practices are both novel and promising, but they are not without limitations. As an unfamiliar exercise to most drivers, conjoint experiments must be designed simply and straightforwardly; they cannot include too many attributes and levels, because doing so might greatly increase the complexity of design and confuse respondents. Consequently, our study only focused on a limited number of legal aspects of general deterrence, whereas the real-world deterrence process is more complicated and involves nonlegal factors, such as personal and vicarious experiences (Nagin and Pogarsky 2001; Paternoster and Piquero 1995; Piquero and Paternoster 1998; Piquero et al. 2011). Although this study did include covariates in the analysis (such as past drinking and driving behavior and current perceptions), future studies will need to capture the complexity of the deterrence process, by incorporating important nonlegal factors into a more sophisticated design and data analysis.

Another limitation is that the conjoint experiment provided respondents upfront with full knowledge of the legal environment, whereas in reality many people may be unaware of the enforcement activities and penalties associated with DUI. It is noteworthy that DUI enforcement that is well publicized and highly visible is more likely to be successful than enforcement that is not well publicized (e.g., Fell, Tippets, and Levy 2008; Williams and Lund 1984). Thus, the practical effect of general deterrence efforts on reducing impaired driving is not merely based on the specific enforcement practices and sanctions but also on the public’s awareness of these. In addition, because of its exploratory nature and the relatively small sample size, we could only generate predictions based on HB estimates from all respondents. If there had been enough respondents within specific segments of interest, we could have examined segment-level sensitivities to changes in deterrence-based policies. For example, heavy drinkers or those who expect to have low DUI penalties might display lower sensitivities to the severity of a penalty. Some nonstudent populations might be less worried about a jail penalty than college students. Such segment-level analyses will generate more insights into subpopulations of interest for researchers and policy makers and allow for development of tailored DUI programs for such drivers.

Acknowledgments

We thank the Pacific Institute for Research and Evaluation for sponsoring this project.

References


Predicting DUI Decisions


