Predicted Risk Perception and Risk-taking Behavior: The Case of Impaired Driving

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11 September 2007

[1] *This research was financed by the Société de l'assurance automobile du Québec, the Québec Department of Transport, and the Fonds pour la formation et l'aide à la recherche in the FCAR-MTQ-SAAQ program on road safety. Previous versions have been presented at the École Nationale des Arts et Métiers, Paris, at the Risk Attitude Conference, Montpellier, France, and at the FUR XII Conference, Roma. We thank Jean Boudreault, Andrée Brassard, and Lyne Vézina for their collaboration at various stages of this project. Stéphane Messier made an excellent contribution to the preparation and the management of the survey and Claire Boisvert improved significantly the presentation of the original manuscript. We thank Michèle Cohen, the editor, and an anonymous referee for very useful comments.*

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Abstract

Research suggests an association between risk perception and risk-taking behavior in a variety of contexts. There is empirical evidence that perceived risk is generally biased and that perception of risk influences behavior. Perception of risk can be endogenous. It is therefore more appropriate to instrument risk perception. This article studies the perception of the risks associated with impaired driving and the relation between predicted risk perception and driving behavior. We survey a sample of license-holders, half of whom are drivers with a past conviction for impaired driving, the other half or control group without such conviction. Predicted perceptual biases are shown to influence actual driving behavior.

Keywords: Risk perception, predicted risk perception, risk-taking behavior, impaired driving, traffic violation, road accident.

JEL Classification: D81, C11, C13, K42.

There is now a large academic literature on individuals' perception of risk and its relation to risky behavior. For example, the health risks associated with smoking and the decision to smoke is a particularly well studied case. Impaired driving shares some characteristics with smoking. Both have been subject to intensive media campaigns and are therefore well publicized risks. Indeed, surveys attest that driving under the influence (DUI) is among the most often cited perceived causes of traffic accidents (e.g., Vanlaar and Yannis (2006)). With respect to both smoking and DUI, there has also been a notable change in social attitudes in recent decades. Drinking and driving is now widely perceived as reprehensible behavior, thereby allowing social or peer pressure to complement specific policy measures. And whereas smoking is prohibited in the workplace and some public places, drunk driving is per se illegal and subject to severe sanctions. However, the detection of DUI is very imperfect. A recent estimate for the US puts the probability of detection at one arrest for every 27,000 miles driven by drunk drivers (Levitt and Porter (2001)). This connects with the issue of how small risks are perceived—a topic much discussed in the literature on risk perception.

There is empirical evidence that perceived risks are generally biased compared to objective risks. Whether biases tend upward or downward depends on several factors, including the spread of objective information and the individual's past experience. According to some studies, the extent of perceptual bias depends on the probability of the objective risk itself: people tend to overestimate low probabilities and to underestimate high probabilities. But the same studies show that biases can be corrected by an effective policy of spreading information about true probabilities, provided this information is accurate and credible. Some studies also document the fact that perceptions influence behavior. For example, Viscusi (1990) and others show that, in

comparison to non-smokers, smokers tend to have a lower perception of the risks of lung cancer, which in part explains why they smoke.

A direct transposition of these findings to road safety would imply that those who underestimate accident risks or the probability of arrest for DUI (or the harshness or prompt application of sanctions) are less cautious, are more likely to be arrested for a violation, and have more accidents. If this proved to be true, it would suggest that stepping up campaigns about objective probabilities would in itself be a dissuasive remedy. For instance, male drivers have been shown to have more optimistic judgments of their driving competency and accident risks than female drivers (DeJoy (1992)), which is perhaps a factor in the gender difference in accident frequencies. A corollary with respect to the deterrence effect of police surveillance would be that, if there were no perceptual biases, only a real increase in police patrols would have any effect on the frequency of accidents.

Impaired driving is a leading cause of death. Police patrols can reduce road accidents, provided surveillance creates real incentives for complying with safety rules. In this respect, it is standard to emphasize that deterrence rests on three factors: (1) probability of arrest or frequency of patrols, (2) harshness of sanctions or fines; and (3) prompt application of sanctions. Another crucial element, however, has to do with drivers' perception of the probability of being arrested if they drink and drive. Presumably, this requires frequent and well publicized patrols. Impaired driving is also deterred by the greater risks of accident that it entails. Information campaigns regularly seek to influence the perception of these risks, under the assumption that they tend to be underestimated by some drivers. Thus, in addition to the actual harshness of sanctions and the actual probability of sanctions or accidents, policies to reduce impaired driving must consider drivers' perceptions of the risks involved.

The present research provides estimates of how license-holders perceive the risk associated with impaired driving, depending on their drinking and driving habits, and of how these perceptions affect actual driving behavior. The first objective of the research is therefore to identify the determinants of the perception of risks, so as to explain their potential biases. In particular, we seek to determine whether drivers with a history of DUI or with self-reported DUI behavior have a lower perception of the risks involved. The second objective is to analyze the effects of the predicted risk perception on actual individual behavior, as captured by a driver's involvement in traffic accidents or road safety violations.

We survey a sample of 2,857 class-5 license-holders (for automobile and light truck) to evaluate their perception of the risk of impaired driving. Half of the respondents are drivers with a past conviction for impaired driving. The other half – or control group – is a similarly stratified sample of drivers with no such alcohol-related conviction. The sample is drawn from the data bases of the *Société d'Assurance Automobile du Québec* (SAAQ), the public insurer for bodily injury in Québec. Combining the survey results and the SAAQ files on license-holders, we are able to assess the determinants of the perception of risks. We can therefore evaluate whether the perceptions of drivers with a history of impaired driving differ from the general population of drivers. We can also quantify the direction and size of perceptual biases. Though this poses obvious difficulties of comparability, estimates of the objective probabilities are constructed by combining independent sources with the survey data and the files of license-holders.

The second step is to estimate the effect of predicted perceptions on driving behavior, controlling for the influence of other factors such as age, gender, income, region, etc. The working hypothesis is that drivers who underestimate the risks associated with impaired driving would tend to drive more imprudently. We use the license-holder's SAAQ file to capture this

effect. Individual records include the frequency of violations as well as the rate and severity of accidents. We present two series of estimates of the effects of a license-holder's perception of risks. In the first series, driving behavior is captured by the driver's past record of accidents and violations in the years preceding and the year following the survey. In the second series, it is captured only by the driver's record in the year following the survey. In order to account for any potential endogeneity problem, we used the conditional predicted perception of risk instead of the perception actually observed (obtained from the survey).

The paper develops as follows. Section 1 briefly reviews the literature on the link between perceptual biases and risk-taking behaviour and draws implications for the present study. A widely studied case is smoking, with the result that those with lower estimates of the risks are more likely to be smokers. There are no comparable studies on the relation between perceived risks and risk-taking by drivers, although many papers deal with the perception of traffic risks per se. One particular difficulty is the absence of solid data on the objective probability of apprehending impaired drivers. Different estimates are discussed and they become important references in the next sections of the article. Section 2 presents the data base, the sampling procedure, the explanatory variables chosen for the survey, and the statistical models. Section 3 sums up the principal findings on the determinants of perceptual biases. We consider the risk of arrest for impaired driving, the risk of having an accident while driving under the influence, and the risk of having an accident causing bodily injury or death. We show that several factors affect individuals' perception of risks such as age, family income, past violations and knowledge of safety rules with respect to drinking and driving. Section 4 analyzes the effect of predicted risk perceptions on driving behaviour. Overall, we find that predicted risk perception is significant in explaining behaviour and that the effect is generally as would be expected. For example,

individuals who underestimate the probability of being arrested for impaired driving commit more violations. Section 5 concludes. The details of the survey methodology and additional tables are in appendices.

1. Review of the literature

The policies introduced to reduce impaired driving in many countries over recent years rely on a number of educative, dissuasive, and punitive measures.[2] These policies have undeniably had a certain effect, at least as concerns the average driver. The proportion of accidents involving a driver under the influence (of alcohol in this paper) has declined almost everywhere. And spot checks of blood-alcohol levels give evidence of significant decreases in many countries. Obviously, these observations are subject to many reservations or nuances. For example, data from the U.S. National Road Survey do show appreciable decreases in the percentage of drivers with a positive blood-alcohol level on week-end evenings; this percentage dropped from 36.1% in 1973 to 25.9% in 1986 and to 16.9% in 1996. However, between 1986 and 1996, the improvement hinges solely on a drop in the proportion of drivers with low blood-alcohol levels (teetotalers) and not of those with high levels, whether such levels are defined at the 0.05 or 0.10 threshold. In either case, the survey shows that, between 1986 and 1996, there have been no significant changes (see Voas et al (1998)).

Pondering the effectiveness of the strategies aimed at fighting impaired driving raises questions about the channels chosen to deliver measures designed to influence driving habits. The classical repressive measures—harsher sanctions and increased police surveillance—use direct means to discourage undesirable behavior (Boyer and Dionne (1987), Shavell (2004),

[2] For an assessment, see Benson, Rasmussen, and Mast (1999), Young and Likens (2000), and Eisenberg (2003).

Bourgeon and Picard (2007), Dionne, Pinquet, Maurice, and Vanasse (2007)). Measures based on education or information do so indirectly by attempting to influence how the risks of alcohol-related accidents, detection, and sanctions are perceived. Educative measures also usually rely on persuasion in their attempt to modify attitudes and standards concerning socially acceptable behavior. When successful, these measures manage to shape individual behaviors by bringing to bear the reference group's influence. There are probably strong interactions between these different channels (see Homel (1989)). For example, drivers who most strongly disapprove of drinking and driving (and thus those who adhere most closely to the social norm conveyed by educational measures) are perhaps also those who most clearly perceive the risks of accidents or sanctions associated with impaired driving. They may also overestimate the risks!

Our study has to do with the determinants of the perception of the risk of arrest for impaired driving and with the relation between the perception of risks and behavior. By extension, it also examines the perception of the harshness of sanctions and of the risk of accident itself. The "perception" factor is fundamental, since it conditions the dissuasive impact of repressive measures. Obviously, the true goal of police surveillance and of sanctions for violations is not to "punish" offenders. They are rather means of applying a general policy of dissuasion to undesirable behaviors. These measures may on their own prevent high-risk individuals from doing harm (by withdrawing their licenses or confiscating their vehicles), but this aspect is often secondary to the general effect of dissuasion.

1.1. Subjective perception of risks

Over the past thirty years, many studies in psychology and economics have looked at the perception of risks, at learning processes (i.e. revision of perceptions based on new information),

and at their relation to decision-making.[3] For the purposes of this study, a few useful conclusions can be suggested.

1. Individuals would tend to overestimate the probability of relatively infrequent events and to underestimate that of more frequent events. Initially put forward by Lichtenstein et al (1978) this finding was at first explained solely as a characteristic of general psychology.

2. In the case of risks for which individuals have little direct information from their own personal experience, Combs and Slovic (1979) and Slovic et al (1982) have shown that over-evaluated risks also tend to be those which have been largely publicized. In other words, information received from various sources plays a big role in the perception of risks.

3. In the wake of the preceding works, several studies have examined the process by which new information modifies the perceptions of risk. Particular attention has been paid to specific actions (information campaigns, labeling, etc.). For example, Smith and Johnson (1988) have analyzed information campaigns on the dangers of exposure to radon and their effects on the perception of the risk of lung cancer caused by this gas (which, after tobacco, is the leading cause of lung cancer). The findings confirm the effectiveness of communication policies in modifying the perception of risks (see also Smith et al (1990), Magat et al (1987)).

4. However, these studies also reveal that, in order to influence the perception of risks, communication measures have to be credible (simple exhortations do not suffice) and compatible with the direct information that individuals could obtain from their own experience. The works of Viscusi and Connor (1984), Viscusi (1985) and Hakes and Viscusi (1997) thus suggest that

[3] See Arrow (1982) for a review of the first generation of studies and a discussion of the relation between learning processes and the rationality of behaviors.

learning processes are almost Bayesian; individuals assimilate in a relatively coherent manner most of the information that comes their way.

The rationality (or quasi rationality) with which individuals handle information can be reconciled with the existence of perceptual biases. Perceived risks would be identical to objective risks if the individuals were perfectly informed. In a situation where they would be poorly informed, their a priori perceptions would however be very diffuse as concerns the level of different risks. High risks are therefore greatly underestimated and low risks strongly overestimated. The acquisition of new knowledge corrects these perceptions. Thus revised, perceptions gain in objectivity, but only more or less so, depending on the quantity and quality of the new information acquired. The upshot is that low risks are still overestimated and high risks underestimated, but perceptual biases have nonetheless been partially corrected.

Many studies have examined the perception of traffic risks, although not necessarily those associated with drunk driving; see, among others, DeJoy (1989, 1992), Guerin (1994), Finn and Bragg (1986), Mannering and Grodsky (1995), Matthews and Moran (1986), and Rafaely et al (2006). These studies generally confirm the existence of age and gender differences in the perception of risks. Andersson and Lundborg (2006) find overassessment and underassessment among low- and high-risk groups, respectively, regarding road-traffic mortality risks. Phelps (1987) finds that young drivers grossly underestimate the relative risk of DUI compared with driving while sober. However, Phelps' own estimate of the relative objective risk is most probably inflated in view of the results obtained by Levitt and Porter (2001), thus exaggerating

the extent of underassessment of the relative risk.[4] In a study with particular relevance to the present paper, Job (1990) finds that confidence in the ability to drive after consuming alcohol increases steadily with age. Moreover, comparison of the survey data collected before and after the introduction of random breathalyzer tests and its associated media campaign does not support the prediction that confidence would thereby be reduced.

1.2. Risk perception and behavior

The study by Magat et al (1987) cited above is not only concerned with the processing of information but also with the behaviors it generates. Information on the risks in using potentially dangerous domestic products is shown to lead consumers to make what can be called rational adjustments. Information indicating a high risk induces precautions in the use and storage of these kinds of products.

The most widely studied case of the relation between perception of risks and behavior has to do with the decision to smoke. In Viscusi (1990, 1992), the link between cigarettes and the risk of developing lung cancer is considered. The question initially raised is whether smokers in the United States underestimate the risk of developing cancer. The study's conclusions are congruent with the hypothesis positing a relation between behavior and perception of risks as well as with the above-mentioned finding which shows that the risks of unlikely but highly publicized events tend to be overestimated. All the respondents overestimated the risk of developing lung cancer from cigarettes. However, there is a significant difference between the perceptions of smokers and non-smokers: Smokers' perception of this risk is, on average, relatively lower than that of

[4] In the Phelps study, the perceived relative risk of DUI versus driving while sober ranges from 1.47 to 7.43, depending on the number of drinks considered. In Levitt and Porter (see their Table 7 for drivers under 25 years old), the estimated relative risk for drivers in that age group is between 3.9 and 4.7.

non-smokers, which in part explains why they smoke. In other words, all the respondents show some perceptual bias, but this bias is higher (greater overestimation) among non-smokers.

Liu and Hsieh (1995) reproduce the main aspects of Viscusi's approach in their Taiwan study.[5] Their findings are also analogous: (i) the risk of lung cancer linked to cigarettes is generally overestimated; (ii) non-smokers tend to have a stronger perception of risks than do smokers; (iii) young people overestimate this risk more than the average for the population. But as concerns the thesis that highly publicized risks will tend to be overestimated, there are differences between the two studies. Though overestimation is observed in the Taiwan study, the perceptions of the risk of lung cancer from smoking are weaker in Taiwan than in the United States, and this could be due to differences between these two countries as regards the intensity of their public awareness campaigns highlighting the risks in question. In the case of Spain, Antoñanzas et al (2000a, 2000b) also find that non-smokers have stronger perceptions of the risks associated with cigarettes than do smokers. They show that young people overestimate these risks more than the average for the population as a whole and that more highly educated respondents overestimate risks less than the average individual. The latter finding may be explained by the fact that the risks perceived by the well educated are better documented, but it contradicts current opinion which holds that the decision to smoke is only a consequence of poor information.

There are no truly comparable studies on the relation between perceived risks and risk-taking by drivers. The few available studies rely on self-reported behavior (e.g., Brown and Cotton (2003), Ryb et al (2006)) or intentions regarding precautionary actions while driving (e.g., Parker et al (1992), Stasson and Fishbein (1990), and Svenson et al (1985)). Although these

[5] See also the recent study of Lundborg (2007).

studies attest to a negative relation between perceived risks and risk-taking, self-reported driving behavior (e.g., with respect to drinking and driving or to speeding) or intentions (e.g., the intention to commit violations or to wear a seatbelt) are probably themselves subject to some bias – to a much greater extent presumably than self-reported smoking. In the present paper, by contrast, actual behavior is inferred from objective data such as the individual's traffic violation record or his involvement in accidents.[6]

1.3. Detection of offenders and policies of dissuasion

Dissuasion refers to all actions aimed at influencing behavior through the threat of sanctions: measures individuals will perceive as increasing the cost of undesirable behavior. Dissuasion is built on the detection of violations and on the application of sanctions when a violation is detected. The dissuasive effect will be all the stronger when the probability of detection is high and the sanctions are harsh (the certainty of sanctions when caught and the speed of their application are also factors).[7]

The probability of detection plays a decisive role for a great many reasons (Zaal, 1999). Many studies show that, if the perceived probability of detection is weak, harsher sanctions will have only a negligible effect. The effect of dissuasions depends on the probability of detection as perceived by motorists. Educative measures (or the spread of information) can do their best to shape perceptions, but it is reasonable to think that the personal experiences of drivers and the

[6] We assume that individuals truthfully answer when evaluating different risks which does not necessarily eliminate endogenous problems and perception biases. Indeed, we do not see why there should be any personal advantage to lie when responding to questions about risk perception.

[7] Polinsky and Shavell (2000) present a general review of policies of dissuasion; Zaal (1999) gives a summary of the literature on measures encouraging compliance with the Safety Code. See also Paternoster (1987).

actual level of police surveillance will be the principal determinants. However, the relation between the perceived risk and the real risk is complex, as shown in the discussion below.

There are no solid data available on the probability of apprehending impaired drivers, but, in all likelihood, this probability would be very low. Kenkel (1993) suggests a probability similar to the estimations already advanced by Beitel et al (1975) and Borkenstein et al (1974, 1975): a probability averaging 0.003 per event of impaired driving. According to Borkenstein, probabilities ranging between 0.001 and 0.005 constitute a reasonable bracket. For their part, Beitel et al. (1975) have proposed 0.005 for a blood-alcohol level above the legal limit and 0.02 for drunkenness (blood-alcohol above 0.20). Levitt and Porter (2001), already referred to, suggest one arrest for every 27,000 miles driven. If the typical drunk driver makes a 10-mile trip, this would amount to a probability of approximately 0.0004 per trip. In any case, the objective probabilities of arrest per event would thus be very low, even when the most serious (and thus most easily detectable) cases are taken into account.

1.4. Implications for the current study

The foregoing observations suggest a certain number of predictions as to how the risk of arrest for impaired driving is perceived. First, it seems to be an established fact that the objective risks of arrest for impaired driving are, on average, very low. We would thus expect these risks to be overestimated by the average driver. Second, the average overestimation should be all the higher when the risks in question are highly publicized. Third, drivers with greater direct experience on the road should, in all likelihood, have a more accurate perception of the true risk of detection. Fourth, imprudent or delinquent drivers should also downplay the risk of arrest more than the average driver. Similar observations would apply to the perceived risks of accident. As to the perceived harshness of sanctions, the same predictions are perhaps not

warranted. As this information is more easily available, we can expect the perceptual bias in this case to be weaker than that for probabilities of detection or accident. Finally, bias in risk perception may also affect analysts' conclusions and policy makers' decisions. Our research does not cover this important aspect of risk regulation. Risk regulation should also be based on sound and objective statistical results.

2. Methodology

We proceeded in two steps. In the first, we estimated the individual's perceptual biases; in the second step, we looked to see whether the conditional estimated bias had a significant effect on driving behavior as measured by the frequencies of violations and accidents. In order to calculate perceptual biases, we used a survey asking drivers about their perceptions of different risks. The survey results were then compared with benchmark probabilities.[8]

2.1. Sample

We survey a sample of license-holders, half of whom are drivers with a past conviction for impaired driving and half of whom are a control group. From past experience (see SOM, 1997), we estimated we would be able to retrieve telephone numbers for about 60% of the drivers sanctioned (cases stratum) for an alcohol-related violation. We checked that there was no bias linked to obtaining more telephone numbers in one stratum rather than another. We anticipated a 50% response rate to our telephone survey. We also considered the fact that many drivers with a past conviction may not have a valid license during the survey period. So we decided to start with the whole population of cases over two years in Québec. In order to increase the survey's

[8] Detailed analysis of the survey procedure is presented in Appendix 1 on the web site.

accuracy, we stratified the sample targeted (control) according to age, gender, and administrative region, in the same proportions as the primary population extracted from the SAAQ files.

The initial cohort of cases represents all the license-holders having been sanctioned for an alcohol-related violation during the period running from 5 January 1998 to 29 December 1999. Alcohol-related violations include: 1) impaired driving; 2) refusing an alcohol test/blood sample; 3) driving with an alcohol blood level over 0.08; 4) impaired driving causing bodily injuries; 5) impaired driving causing death. This cohort of cases initially contained 28,982 drivers. Then we decided to draw from this number only those drivers with a regular or probationary class-5 license valid on 1 January 2001 and on 15 October 2001 and with no sanction exceeding 15 days in 2001. This step reduced the number of drivers to 12,223. Finally, after weeding out the cases of death, emigration, non-residency, identity theft, fraud and the like, we were left with 12,191 cases.

The second cohort, also numbering 12,191 drivers, is the comparison or control group. These were selected randomly according to the stratification observed for the cohort of cases, in terms of age, gender, and administrative region. Members of the control group were to have a license valid on 15 October 2001 and to have no record of any alcohol-related suspension, arrest or conviction since 1996 (convictions for other types of offences excluded), including administrative suspensions (automatic: 15 or 30 days) for a blood-alcohol level over 0.08. The telephone survey was conducted between 15 April and 10 May 2002. To reach our objective of completed interviews as dictated by budget constraint, we used 5,897 phone numbers which represent 42% of the 14,111 phone numbers found. We ended up with a random sample of 2,857 respondents (1,426 cases and 1,431 control subjects).[9]

[9] Details are given in Appendix 1 on the web site.

2.2. Individuals' perception of risks and perceptual bias

The three risks whose perception we analyze are 1) the risk of arrest by the police, 2) the risk of having an accident, and 3) the risk of a bodily-injury accident—all during impaired driving. To discover their perceptual biases, license-holders were asked questions allowing comparisons between their perceptions of risks and some benchmarks.

First, we needed to find out the probability of being arrested for impaired driving on a Friday. That day of the week was chosen for the three risks because it is the one associated with the highest number of accidents.[10] We did not know the percentage of holders of class-5 licenses who drive under the influence. To estimate this percentage, we first used the survey results. For this purpose, the relevant question on the questionnaire reads as follows: "Over the past 3 months, have you ever had five drinks or more in the two hours before driving?" We thus consider impaired driving to be cases where respondents say that they have driven after having 5 drinks or more. Taking the control cohort as a point of reference, we estimate that the percentage of license-holders who drive under the influence ranges between 1.41%, more than one, and 2.88%, one and more.[11] Given the number of class-5 license-holders in Québec, there would be between 56,953 and 116,754 class-5 license-holders who would engage in impaired driving. Based on SAAQ data, there are, on average, 69 tickets for violations of the Criminal Code issued on Fridays in Québec. We thus estimated that the risk of being arrested by the police on a Friday ranges between 0.0006 (69/116,754) and 0.0012 (69/56,953) which is between the 0.0004 per trip of Levitt and Porter (2001) and the bracket [0.001, 0.005] proposed by Borkenstein et al. (1974, 1975).

[10] For details, see Table 17 in Appendix 2 on the web site.

[11] For details, see Table 18 in Appendix 2 on the web site.

To find how the risk of being arrested by the police is perceived in such a case, we asked the following question: "Let's suppose that on a Friday evening there are about 20,000 drivers in Québec who engage in impaired driving. In your opinion, how many will be arrested by a police officer?" So, out of 20,000 motorists who engage in impaired driving on a Friday night, the number of those arrested by the police should range between 12 (0.6/1,000 × 20,000) and 24 (1.2/1,000 × 20,000).[12]

We define *the perception of the risk of being arrested for impaired driving by the police* as follows:

Y =	1	Overestimating the risk (above 24)	51.3%
	2	Underestimating the risk (under 12)	14.2%
	3	Accurate perception ([12, 24])	34.5%

The percentages on the right hand side are the answer rates. It is interesting to observe that 34.5% had an accurate perception of this risk while 51.3% overestimated it.

A similar approach was used for the perception of the two other types of risk, based on the following questions:

- How many of these 20,000 drivers will have an accident, regardless of their liability or the seriousness of the accident?
- Of these 20,000 drivers, how many will have an accident causing at least one injury or a death, regardless of their liability or the seriousness of the accident?

Here the objective probabilities are drawn from statistics recorded by the public insurer. Based on the SAAQ's statistical records, the average number of drivers involved in accidents

[12] We decided to have the same number of potential drivers for all questions. We choose 20,000 in order to have a feasible interval for bodily injury accidents, as discussed later.

involving at least one automobile or one light truck per year is shown below, according to the seriousness of the accident:

854 drivers involved in a fatal accident

5,933 drivers involved in an accident with serious injuries

44,322 drivers involved in an accident with minor injuries

180,087 drivers involved in an accident with material damage only (MDO)

The SAAQ data come from police reports; reports jointly agreed by motorists were not used. According to a study by Laberge-Nadeau et al (2001), jointly agreed reports are filled out for 3 out of 5 reported accidents with material damage only. Thus the number of drivers involved in accidents with MDO involving at least one automobile or one light truck is about 288,139 (180,087 × 1.60).

According to SAAQ records once again, the percentages of fatal, serious or minor accidents or those with MDO on a single Friday during the year are respectively 0.338%, 0.329%, 0.335%, and 0.342%. Moreover, according to the SAAQ, alcohol is a factor in 30% of fatal accidents, 18% of accidents causing serious injuries, and 5% of accidents causing minor injuries. Since we have no data on accidents with MDO and alcohol, we give this category the same percentage as for accidents causing minor injuries.

The average number of impaired drivers involved in accidents involving at least one automobile and one light truck can therefore be computed as follows, according to the seriousness of the accident:

0.9 drivers involved in a fatal accident

3.5 drivers involved in an accident with serious injuries

7.4 drivers involved in an accident with minor injuries

49.3 drivers involved in an accident with material damage only (MDO)

So on Friday in Québec, an average of 12 impaired drivers will be involved in a bodily accident involving at least one automobile or one light truck and 61 impaired drivers will be involved in an accident, independently of its seriousness. Now, out of 20,000 impaired drivers, the number of those involved in an accident will therefore range from 10 to 22 and the number of those involved in a bodily accident will range from 2 to 4.

We define the *perception of the risk of accident while driving with impaired faculties* as follows:

Y =	1	Overestimate risk (above 22)	38.3%
	2	Underestimate risk (below 10)	23.3%
	3	Accurate perception ([10,22])	38.4%

The accurate perception is also high for this risk and the non-accurate perceptions are better balanced than for the risk of being arrested.

We define *perception of the risk of bodily-injury accident while driving with impaired* faculties as follows:

Y =	1	Overestimate risk (above 4)	56.9%
	2	Underestimate risk (below 2)	10.2%
	3	Accurate perception ([2,4])	32.9%

Here the distribution of perceptions is more like that for the risk of being arrested. Only 10.2% underestimate this risk.

2.3. Generalized Logit Model

This model is used to determine the variables which explain perceptual biases. The explanatory variables originate either from the survey or the SAAQ files. They include gender,

age, cohort (i.e., *cases* or *control* group), number of violations, family income, stated behavior (relative to speeding, driving after drinking, preventive alcohol test), knowledge of the legal alcohol limit and of the number of drinks to reach that limit, knowledge of sanctions for impaired driving (fines, suspension), and attitude with respect to zero tolerance.

The three categories of the dependent variable (Y) are treated qualitatively (overestimate, underestimate, accurate perception) and a generalized logit model is adjusted by producing two parametric vectors. The model takes the form:

$$\ln\left(\frac{\Pr(Y=1\mid X)}{\Pr(Y=3\mid X)}\right)=\alpha+\beta' X, \qquad \ln\left(\frac{\Pr(Y=2\mid X)}{\Pr(Y=3\mid X)}\right)=\delta+\lambda' X, \tag{1}$$

where α and δ are the constants, β and λ are the parameters' vectors, X is the control variables' vector, and where 1 corresponds to overestimate, 2 to underestimate, and 3 stands for accurate perception. So a positive β_i means that the variable X_i has a positive effect on overestimation while a positive λ_j means that the variable X_j has a positive effect on underestimation. Note that the same individual cannot obtain both 1 and 2 and thus cannot be included in both regressions.

2.4. Predicted perceptions

We used conditional predicted perceptions to estimate the effect of risk perception on driving behavior. We had the choice between two methodologies: using the perceptions stated by individuals or using the conditional perceptions predicted by the models in (1) above. The conditional predicted perception makes it possible to control several factors from which biases may arise, factors such as past driving experience, presence or absence of past convictions, and exposure to risk. By computing the conditional perception, we also take care of the potential endogeneity problem associated with risk perception. Some individuals may convince themselves that their behavior is not dangerous in order to be comfortable with it. For example, smokers may

convince themselves that smoking is not dangerous for their health in order to smoke and drinkers may convince themselves that drinking and driving is not dangerous in order to continue drinking. We thus opted for this approach, even though the number of observations obtained from the survey is rather low (making it more difficult to construct a stable model). We also compare our results with those obtained with observed risk perception. Based on the model above, the predicted perception for license-holder *i* is as follows.

Probability of overestimating the risk:

$$P\left(Y_i = 1 \mid X_i\right) = \frac{\exp\left(\hat{\alpha} + \hat{\beta}' X_i\right)}{1 + \exp\left(\hat{\alpha} + \hat{\beta}' X_i\right) + \exp\left(\hat{\delta} + \hat{\lambda}' X_i\right)}. \quad (2)$$

Probability of underestimating the risk:

$$P\left(Y_i = 2 \mid X_i\right) = \frac{\exp\left(\hat{\delta} + \hat{\lambda}' X_i\right)}{1 + \exp\left(\hat{\alpha} + \hat{\beta}' X_i\right) + \exp\left(\hat{\delta} + \hat{\lambda}' X_i\right)}. \quad (3)$$

Probability of having an accurate perception of the risk:

$$P\left(Y_i = 3 \mid X_i\right) = \frac{1}{1 + \exp\left(\hat{\alpha} + \hat{\beta}' X_i\right) + \exp\left(\hat{\delta} + \hat{\lambda}' X_i\right)}. \quad (4)$$

The coefficients are the maximum likelihood estimators of the constant and the parameters of the overestimation and underestimation regressions respectively.

2.5. Perception of risks and behavior of drivers

We performed two types of analysis: 1) analysis of behavior in the year following the survey, and 2) analysis using all the data available before and after the survey. This second procedure using longitudinal data (repeated measurement over time) improves the statistical reliability of the results by providing more information, but the interpretation is perhaps not as straightforward. Driving behavior is captured by accidents in which the driver is involved,

violations leading to demerit points, and demerit points accumulated which take care of the severity of sanctions. We also did separate analyses for all accidents and for accidents causing injuries and deaths. We therefore performed four regressions, one for each of the possible dependent variables reflecting driving behavior.

The methodology for the impact on behavior is as follows. The unit of observation is one class-5 license-holder whose license is valid for at least one day during the year following the survey. "Demerit points" is the total number accumulated during the year following the survey. This is the weighted average of the number of violations. So the linear regression model was used in this case. Accidents during the year following the survey is a dichotomous (very few had more than one accident) variable equal to unity if there is one accident or more and equal to zero otherwise. We separate bodily injury accidents from all accidents. The Logit model was used for the estimations. For violations occasioning demerit points during the year following the survey, the negative-binomial regression model was estimated because the number of violations is a count ranging from 0 to any positive count. We did reject the Poisson regression model.

3. Results for perception of risks

Descriptive statistics are presented in Table 1. We must emphasize that they represent a stratified sample of drivers sanctioned for an alcohol-related violation, so they are not representative of the population of license-holders in Québec. Many variables were obtained from answers to questions during the survey. These questions are available from the authors. Observe that the total number of respondents retained is 2,694, while 2,857 individuals participated in the survey. The 163 observations dropped are distributed as follows: 17 had no regular driving permit although the administrative file indicated the contrary before the survey

and 146 did not answer many of the study's behavioral questions such as those related to drinking behavior and driving while drinking.

The survey questions were divided into five major groups: 1) driving behavior; 2) drinking behavior; 3) knowledge of regulation; 4) opinion on drinking and driving; and 5) personal data. Only 10.54% of drivers sanctioned for an alcohol-related violation are women while they represented 46.67% of license-holders in 2002. The age distribution is also different from that of the population of license-holders in Québec in 2002: 10% (under 24); 17% (25-34); 23% (35-44); and 48% (45 and over). Drivers in the age groups 25-34 and 35-44 are more highly represented in this study. Findings from the survey show that: 22% of respondents had at least one traffic violation during the 15 April 2001–14 April 2002 period; 71% admit they speed while driving; 16% did not drink over the three months preceding the survey and 41.87% did not drink in the hour before driving; 10% of respondents do not know the legal alcohol limit and many more do not know how many drinks are necessary to attain the limit (i.e. about two drinks). Of course, the true number varies from one individual to the next but we observe that 19% responded 4 and more drinks to attain the legal limit. Here it is difficult to separate knowledge from endogeneity. Finally, the knowledge of other regulatory rules is dispersed. It is also interesting to observe that 39.16% agree that the regulation should be zero tolerance of alcohol while driving. We now look to see how these differences affect risk perception about driving and having accidents.

(Insert Table 1 here)

Table 2 sums up the main econometric findings on the perception of risks. It presents estimations of the factors which affect the perception of risks among the individuals interviewed during the telephone survey. Three types of estimation were used to analyze three types of

perception: 1) perceived risk of arrest for impaired driving; 2) perceived risk of having an accident occasioning a police report while driving under the influence; 3) perceived risk of having an accident causing bodily injuries or death while driving under the influence. For each perception, an individual can either overestimate the risk, underestimate the risk or perceive it accurately.

An individual cannot have all three types of perception at the same time (i.e. overestimate, underestimate, and perceive a risk accurately in responding to the same question), but this individual may change stance from one question to the next and from one risk to the next. This is why the same factors do not always explain variations in perception from one question to the next. For example, the same individual may overestimate the risk of being arrested for impaired driving, but underestimate the risk of having an accident under the same conditions. For each risk in Table 2, column 1 represents overestimation of the risk and column 2 its underestimation. The distribution of individuals between the two columns depends on their answers to the questionnaire. The figures in the last line of the table (Total) indicate the number of persons who overestimate or underestimate in each column. Those with an accurate perception correspond to the difference (not indicated) between 2,694 and the sum of the two numbers indicated for each question at the bottom of columns 1 (overestimate) and 2 (underestimate).

The classes of explanatory variables selected are based on the fact that at least one factor is significant at least at the 10% level for one of the six possible perceptions or columns: overestimation or underestimation for at least one type of risk. In the following discussion, we shall highlight the factors which are significant at the 5% level.

We take as a benchmark the risk of being arrested for impaired driving (in the table, “being arrested”). Comparisons with the two other risks will be made whenever warranted by

interesting results. We see that one factor has a simultaneous effect on both overestimation and underestimation: the number of violations occasioning demerit points during the year preceding the survey. Those who did not accumulate violations have a more accurate perception of the risk of being arrested than those who accumulated violations other than alcohol-related ones (underestimating less and overestimating less). This perhaps explains why they do not accumulate violations. Moreover, those without accumulated violations also underestimate and overestimate (10%) less highly the risk of being involved in an accident, but do not have different risk perception from those who do accumulate violations as concerns accidents causing bodily injury.

Gender has no effect (significant at 5%) on biased perceptions of the different risks. Age does, in contrast, have a positive effect on the underestimation of the three risks, even though the level of significance is only 10% for bodily injuries. This means that those under 35 underestimate the risks of being arrested and of having an accident more than those who are 35 and over. This finding can be used to measure the effect of experience on the perception of risks. On the other hand, age does not really affect the probability of overestimating, although those under 35 overestimate less the risk of having an accident with bodily injury (10%).

The cohort variable measures the status of those selected for the analysis. The cases represent those who have been convicted for impaired driving, while the control group is composed of individuals selected randomly according to criteria chosen to make them comparable to subjects in the case cohort. The fact of being in one group rather than the other affects only perception of the risk of bodily injury. Individuals having accumulated one or more license suspensions (cases) underestimate and overestimate the risk of bodily injury more than those who had no alcohol-related suspensions during the period studied in this research. This

means that they have a less accurate perception of this risk. This finding is not surprising, and it will be important in explaining the number of accidents with bodily injury.

Individuals who say they never speed overestimate the risk of being arrested more, but their perception does not differ from those who say they have often, sometimes or rarely speeded when it comes to the other two risks. This finding shows once again that overestimating a risk can rein in the behavior of delinquents. Furthermore, it is not evident that individuals make a sharp distinction between the risk of being arrested for speeding and that of being arrested for other violations such as those related to alcohol. We now turn to the factors related to drinking habits.

Respondents declaring they have not had a drink in the three months preceding the telephone survey (did not drink) overestimate the risk of accident and of bodily injury accident while driving with impaired faculties more than those who say they have driven after having five drinks or more in the two hours preceding the use of their vehicle. In contrast, those who have fewer than five drinks before driving do not perceive risks differently from those who have five or more drinks two hours before getting behind the wheel. The sole exception is those who do not drink at all in the hour before driving; they also overestimate (10%) the risk of accident.

(Insert Table 2 here)

Knowing the 8% legal alcohol limit for driving a vehicle seems to be associated with a clearer perception of the three risks (less overestimation, but at only 10% for the probability of being arrested for impaired driving) than not knowing this information. This finding indicates that individuals who know more about the Highway Safety Code (at least as concerns drinking and driving) have a better perception of the different risks—at least they do not overestimate them.

However, knowing the number of drinks it takes to reach the 8% limit has a less significant effect on perception of the different risks. Indeed, among respondents, only two coefficients are significant at 10%, but they still indicate that individuals who mention fewer than five drinks have a better perception of risks, in the sense that they overestimate the risk of a bodily-injury accident less (3 or 4 drinks) and underestimate the risk of being arrested less (1 to 2 drinks).

Respondents who declared having already passed an alcohol test to prevent impaired driving overestimated the risk of being arrested and the risk of bodily injury (both at 10%) less than those stating they have never taken that preventative measure. It seems that those who said they passed an alcohol test as a preventative measure have a more accurate perception of both risks.

Those with less knowledge of the length of an immediate suspension underestimate the risk of accident less but overestimate the risk of a bodily-injury accident more. Similarly, those who do not know the court fine overestimate the risk of bodily injury more. In other terms, respondents with correct answers to these questions have a clearer perception of risks.

Subjects who agree with zero tolerance overestimate the three risks more than those who do not agree (at 10% for being arrested and having a bodily-injury accident) but underestimate the risk of a bodily-injury accident less. As a rule, they have a less accurate perception of these three risks than those who do not agree. Finally, those with family incomes below $40,000 overestimate the risk of being arrested and having an accident more (10%) than those with an income above $40,000.

To summarize, several factors affect individuals' perception of risks. The major factors are age; the fact of having accumulated violations in the year preceding the survey; being a non-

drinker over the last three months; knowledge of the legal alcohol limit for driving; opinion of zero tolerance; and family income. The second step is now to see how predicted perceptual biases affect individual driving habits.

4. Analysis of the effects of predicted risk perceptions on driving habits

In this section, we present analyses linking individuals' predicted perceptions of risk to their driving habits. We also discuss results associated with observed risk perceptions. Driving habits are captured by the actual occurrence of accidents and violations. For each violation and accident model, we use one of the predicted risk-perception variables as the explanatory variable, together with several control variables. We analyzed the effect of the predicted value on the occurrence of accidents with bodily injuries, on the occurrence of all types of accidents (all accidents), on violations, and on demerit points accumulated, but the effect of risk perception is significant for only the last two types of occurrences and only when cases and control groups are not separated. Accordingly, only the latter results are shown in a first step. We then separated predicted values for the two groups. The analysis is based on 2,689 observations, because we could not find information on the driving habits of five drivers in the SAAQ files. We start with the risk of being arrested for impaired driving.

4.1. Perception of the risk of being arrested for impaired driving

To compute the predicted perception, we reestimate the two first columns of Table 2, keeping only the categories that are significant in explaining the perception of the risk of being arrested for impaired driving.[13] For each of the 2,689 respondents, we calculate the predicted

[13] The reestimated equations are in Table A1 of Appendix 3.1 on the web site. We did also use all the variables in Table 2 and obtained the same results. They are available from the authors. Which methodology dominates is still an

probabilities (overestimate, underestimate, accurate perception). The estimates of the effects were obtained based on several control variables, but we present only the coefficients of the perception variables.[14]

The results in Table 3a indicate that individuals in the cases group who underestimate the probability of being arrested for impaired driving commit more violations of the Highway Safety Code and have more demerit points, no matter which model is used. The results are, however, significant for the two groups with regressions for the 1995-2003 period. We must also mention that individuals in the cases group who overestimate also have more demerit points. We shall come back to this type of result that is less intuitive.

(Insert Table 3 here)

4.2. Perception of the risk of accident while driving with impaired faculties

The procedure is the same as above. For each of the 2,689 respondents, we calculate the predicted probabilities of overestimating or underestimating the risk of accident while driving with impaired faculties.[15] The effects on the violations and demerit points accumulated are presented in Table 4.

(Insert Table 4 here)

It is interesting to note that, when we compare the coefficients, while underestimation of the risk is indeed associated with more violations, the same is true to some extent with overestimation of the risk, although the effect is less marked. Additional estimations (not

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open question in the literature. We did a paired t-test on the difference between the two predictions (with all variables or with only the significant ones). We did not reject the null hypothesis that the difference between the two predictions is 0. Details are available.

[14] Complete regressions are available in Appendix 3.2 on the web site.

presented) show that the probability of correctly perceiving the risk (i.e. using as an explanatory variable the probability that an individual has an accurate perception) is associated with fewer violations and fewer demerit points. These additional results related to overestimation are counter intuitive and may be explained by the fact that we only have access to a rather low number of observations, thus making it more difficult to obtain stable results. As we will discuss at the end of this section, these counter intuitive results are rather rare.

4.3. Perception of the risk of having an accident causing bodily injury while driving with impaired faculties

We now turn to perception of the risk of having an accident causing bodily injury while driving with impaired faculties.[16] The effects on driving habits are presented in Table 5. Again, risk perception does affect driving behavior and here the results are much more intuitive.

(Insert Table 5 here)

4.4. Dividing predicted values between cases and control group

Table 2 showed that risk perceptions differed between cases and the control group only with respect to the risk of accidents with bodily injuries. Accordingly, we also estimated different predicted values for this perception, depending on whether or not an individual has been convicted for an alcohol-related violation.[17] We should mention that the variables explaining the probabilities of overestimating or underestimating the risk of having an accident causing bodily injury differ in the two tables. In fact, the overestimation of this risk by the control group includes many significant variables drawn from the telephone survey. The modeling for the

[15] We used the estimations presented in Table A2 on the web site.

[16] The predicted perceptions come from Table A3 on the web site.

[17] The estimated perceptions are computed from regressions in Tables A4 and A5 on the web site.

perception of this risk thus differs depending on whether there has been a conviction linked to alcohol (cases) or not (control group).

We then used the predicted perceptions of each group to explain occurrences of accidents, violations or accumulated demerit points (Table 6). By contrast with the previous results, there are no results where risk perception is a significant explanatory variable for all four types of occurrences linked to driving habits. Another difference is that, generally speaking, the effect of overestimating the risk now has the predictable effect of being associated with less risky behavior for the cases group while we still have a counter intuitive result for the control group.

(Insert Table 6 here)

We must emphasize that using observed risk perception instead of predicted risk perception yields similar results only in a subset of the estimations. Table 7 summarizes the comparison results.

(Insert Table 7 here)

We observe that we obtain the same results in five situations while using the observed perception instead of the predicted perception. In all situations studied during this research, only one situation yields significant results with observed prediction and no significant results when predicted perception is used (not presented). To summarize, our results indicate that the predicted risk perception is significant in 32 situations, while the observed perception is significant in only 5 situations. Among the 32 situations only 5 have the wrong sign and all are for overestimation.

5. Discussion and conclusion

The first objective of this research was to analyze the perception of the risk associated with impaired driving. This includes the risks of being apprehended or of being involved in a

road accident, with or without bodily injury, while driving after drinking. A second objective consisted in assessing the extent to which individual perceptions affect driving habits.

Our main conclusions can be summed up as follows. As a rule, several factors affect the way individuals perceive risks. The most important are age; the accumulation of violations during the year preceding the survey; being a non-drinker over the last three months; knowing the legal alcohol limit for driving; agreeing with a possible amendment introducing zero tolerance for drinking-driving into the Highway Safety Code; and family income. Generally, no variable directly measuring drinking habits had much effect on perceptions, not even the fact of being a case (having been convicted) rather than a member of the control group (except for accidents with bodily injury).

These conclusions agree with some of our working hypotheses cited at the beginning of the study. We did in fact expect that biases would be stronger in young people and in the less well informed. We also expected that the accumulation of violations of the Highway Safety Code could be linked to perceptual biases. Our greatest surprise was to observe that belonging to the cases group or the control group did not have much impact on perceptual biases, except that cases do differ from the control group in their perception of the probability of being involved in an accident causing bodily injury. However, it was not easy to determine the net effect, as some individuals in the group of cases overestimate and others underestimate this probability. In most of our analyses, we were thus led to use the predicted perceptions of the two groups indiscriminately in order to explain driving habits, although we did separate the two groups' perceptions of the risk of having an accident causing bodily injury.

Analyses of the effects of perceptions on individuals' driving habits produce interesting results in terms of road safety. Perceptual biases do not as a rule affect the risks of all accidents,

or at least we did not capture such an effect. By contrast, the risks of accumulating violations or demerit points are affected by differences in perception. Since these two risks give similar results, we limit our discussion to the risk of accumulating violations to the Highway Safety Code. All violations are lumped together, no matter what their nature. For lack of an adequate number of observations, we were not able to analyze the risk of a suspended license.

The results indicate that individuals who underestimate the probability of being arrested for impaired driving commit more violations against the Highway Safety Code. Some results also indicate that those who overestimate also tend to commit more violations, although the effect is less pronounced and less frequent. One interpretation is that those with an accurate perception of risks commit fewer violations. Thus, as expected, underestimation of risk seems to lead to less prudent driving, but misperception (whether over- or underestimation) also seems to be associated with less prudent driving. However, in the cases where we were able to separate the predicted perceptions between cases and the control group, overestimation was associated with less risky behavior.

Another interpretation of the result that overestimation can be associated with more violations may be related to the fact that we only had access to a rather low number of observations, thus making it more difficult to obtain stable results. In fact, these counter intuitive results are rather rare (5 over 32).

There is, of course, a caveat, in that we have no precise knowledge of the objective risk of being arrested and have estimated it in a very indirect manner. There are no statistics on this subject. We do not truly know how many drivers are on the road at any given time or even at different times during the week. A fortiori, we are unable to tell how many motorists are driving under the influence in these different time slots. Do even the police have any precise knowledge

on this score? Based on traffic violation reports, several observers suppose that a great many people drink and drive on Friday and Saturday evenings. There are perhaps more police patrols on the road at these times. Moreover, statistics on traffic tickets indicate the day but not the hour. We choose Friday because it is the day of the week when more accidents occur in Québec. Finally, our general question about drinking and driving is not related to a Friday, but we believe that this conditional behavior should not be limited to a Friday. Our lower (higher) bound for the objective probability of being arrested under the influence is 0.0006 (0.0012) while the best estimate by Levitt and Porter (2001) is 0.0004 per trip under the same driving conditions and the estimates made by Borkenstein et al. (1974, 1975) are in the following bracket [0.001, 0.005].

Nevertheless, assuming our definition of what constitutes misperception is not too far off, the results suggest that, with an improved perception of this risk, drivers tend to be more cautious. Improving perception does not necessarily imply putting more patrols on the road. But giving due regard to the preceding discussion, it does imply calling attention to the different risks, provided that they are accurately portrayed. These risks must also seem credible: actual police actions must back up the risk portrayed. Analyzing the determinants of perceptual biases makes it possible to aim measures at categories of drivers who tend either to underestimate or overestimate risks. Several kinds of measures can be contemplated: education, public awareness campaigns, modification of the behavior of those who apply the regulations, harsher sanctions, better statistics, etc. Our statistical results show that those who underestimate tend to be more at risk. Measures designed to correct perceptual biases are thus to be considered.

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Table 1 Descriptive statistics

Explanatory variable	N	%
Gender		
Women	284	10.54
Men	2,410	89.46
Age on 15 April 2002		
24 and under	318	11.80
25 - 34	664	24.65
35 - 44	729	27.06
45 and over	983	36.49
Cohort		
Cases	1,373	50.97
Control group	1,321	49.03
Number of violations between 15 April 2001 and 14 April 2002		
None	2,096	77.80
1 or more	598	22.20
Speeding while driving		
Never	789	29.29
Often, sometimes, rarely	1,905	70.71
Number of drinks per week		
2 or less per week	918	34.08
3 to 5	677	25.13
Do not drink	439	16.30
6 and more	660	24.50

Driving after x drinks over the last three months		
None in hour before driving	1,128	41.87
1 in hour before driving	650	24.13
2 or more drinks in hour before driving	375	13.92
Did not drink	439	16.30
5 or more drinks 2 hours before driving	102	3.79
Knowledge of legal alcohol limit		
0.08	2,415	89.64
Other	279	10.36
Knowledge of number of drinks to reach 0.08		
1	250	9.28
2	1,052	39.05
3	757	28.10
4	362	13.44
Non-respondent	130	4.83
5 and more	143	5.31
Stopped drinking early before driving		
No	1,189	44.14
Yes	1,505	55.86
Passed an alcohol test before driving		
No	2,367	87.86
Yes	327	12.14
Knowledge of length of court ordered driving suspension		
Under one year	663	24.61
Over one year	199	7.39

One year	1,832	68.00
Knowledge of length of an immediate suspension for impaired driving		
One week or less	305	11.32
One month or more	1,617	60.02
Non-respondent	30	1.11
15 days	742	27.54
Knowledge of amount of court ordered fine		
Less than $500	1,137	42.20
$1,000 and more	429	15.92
Non-respondent	34	1.26
Between $500 and $999	1,094	40.61
Zero tolerance of alcohol while driving		
Agree	1,055	39.16
Disagree	1,639	60.84
Family income		
$40,000 and under	1,217	45.17
Non-respondent	106	3.93
Over $40,000	1,371	50.89
Total	2,694	100.00

Table 2 Estimations of the Probability of Overestimating or Underestimating the Risk of Impaired Driving (Generalized Logit Model) (Standard derivation in parentheses)

Explanatory variable	**Being arrested**		**Having an accident**		**Bodily injury accident**	
	Overestimate risk	Underestimate risk	Overestimate risk	Underestimate risk	Overestimate risk	Underestimate risk
Constant	**0.7463 (0.1520)	-0.2586 (0.2036)	0.2063 (0.1536)	**-0.3992 (0.1831)	**0.7561 0.1548	**-0.8129 0.2437
Gender						
Women	*0.1370 (0.0733)	0.0299 (0.1099)	-0.0269 (0.0722)	-0.1132 (0.0918)	-0.0176 (0.0721)	-0.1808 (0.1379)
Men		—		—		—
Age on 15 April 2002						
Under 35	-0.0554 (0.0467)	**0.1571 (0.0650)	0.0516 (0.0490)	**0.2106 (0.0545)	*-0.0885 (0.0464)	*0.1258 (0.0736)
35 +		—		—		—
Cohort						
Cases	0.0348 (0.0485)	0.0594 (0.0689)	-0.0117 (0.0501)	-0.0023 (0.0579)	**0.1225 (0.0489)	**0.1951 (0.0792)
Control group		—		—		—
Number of violations between 15 April 2001 and 14 April 2002						
None	**-0.1281 (0.0541)	**-0.1498 (0.0735)	*-0.0943 (0.0562)	**-0.1280 (0.0618)	0.0628 (0.0528)	0.0111 (0.0820)
1 or more		—		—		—
Speeding while driving						
Never	**0.1319 (0.0501)	0.0456 (0.0733)	0.0696 (0.0507)	-0.0245 (0.0614)	0.0749 (0.0505)	-0.0491 (0.0869
Often, sometimes, rarely		—		—		—

Explanatory variable	Being arrested		Having an accident		Bodily injury accident	
	Overestimate risk	Underestimate risk	Overestimate risk	Underestimate risk	Overestimate risk	Underestimate risk
Driving after x drinks over the last three months						
None in hour before driving	0.0136 (0.0801)	-0.1020 (0.1104)	*0.1575 (0.0858)	-0.0133 (0.0924)	0.0999 (0.0802)	-0.1846 (0.1254)
1 in hour before driving	0.0677 (0.0903)	-0.0613 (0.1247)	0.0610 (0.0968)	-0.0109 (0.1028)	0.0652 (0.0902)	0.0340 (0.1343)
2 or more drinks in hour before driving	0.1405 (0.1095)	0.1120 (0.1478)	0.0231 (0.1168)	-0.0032 (0.1225)	-0.0960 (0.1077)	0.0207 (0.1566)
Did not drink	-0.0829 (0.1078)	-0.0942 (0.1519)	**0.2350 (0.1124)	0.0138 (0.1312)	**0.3295 (0.1114)	-0.0634 (0.1871)
5 or more drinks 2 hours before driving		—		—		—
Knowledge of legal alcohol limit						
0.08	*-0.1364 (0.0770)	-0.1757 (0.1088)	**-0.2353 (0.0747)	0.0798 (0.1044)	**-0.2454 (0.0821)	*-0.2508 (0.1349)
Other		—		—		—
Knowledge of number of drinks to reach 0.08						
1or 2	-0.0679 (0.0780)	*-0.1899 (0.1078)	-0.0065 (0.0776)	-0.0048 (0.0957)	0.0088 (0.0796)	-0.1220 (0.1226)
3 or 4	0.0329 (0.0873)	-0.0470 (0.1199)	-0.0495 (0.0875)	-0.0325 (0.1050)	*-0.1593 (0.0874)	-0.2174 (0.1383)
Non-respondent	0.2568 (0.1664)	*0.4155 (0.2201)	0.1326 (0.1572)	-0.0837 (0.2084)	0.2298 (0.1713)	0.3777 (0.2651)
5 or more		—		—		—

Explanatory variable	Being arrested		Having an accident		Bodily injury accident	
	Overestimate risk	Underestimate risk	Overestimate risk	Underestimate risk	Overestimate risk	Underestimate risk
Passed an alcohol test before driving						
No	*-0.1245 (0.0685)	-0.1294 (0.0936)	-0.0716 (0.0696)	-0.0366 (0.0792)	*-0.1264 (0.0689)	-0.0674 (0.1078)
Yes		—		—		—
Knowledge of length of an immediate suspension for impaired driving						
Other	0.0723 (0.0532)	0.0612 (0.0750)	-0.0076 (0.0560)	**-0.1212 (0.0620)	**0.1095 (0.0535)	0.0310 (0.0832)
15 days		—		—		—
Knowledge of amount of court ordered fine						
Other	-0.0127 (0.0440)	-0.0784 (0.0620)	0.0413 (0.0458)	-0.0737 (0.0517)	**0.0931 (0.0439)	-0.0414 (0.0701)
Between $500 and $999		—		—		—
Zero tolerance of alcohol while driving						
Agree	*0.0824 (0.0482)	-0.0424 (0.0702)	**0.0976 (0.0496)	-0.0534 (0.0585)	*0.0936 (0.0482)	**-0.1804 (0.0844)
Disagree		—		—		—
Family income						
$40,000 and under	**0.2455 (0.0886)	-0.0577 (0.1157)	*0.1669 (0.0921)	-0.1494 (0.1025)	0.1446 (0.0914)	-0.1909 (0.1361)
Non-respondent	-0.2335 (0.1503)	0.1980 (0.1877)	-0.0769 (0.1576)	0.2205 (0.1701)	0.0456 (0.1561)	*0.4105 (0.2214)
Over $40,000		—		—		—
Total (2,694)	1,381	383	1,032	627	1,534	274

Level of significance: *10%; **5%; ***1%

Table 3: Analysis of the Effect of Perception of the Risk of Being Arrested for Impaired Driving on the Frequency of Violations and Accumulated Demerit Points (Standard deviation in parentheses)

3a Year after the Survey

Explanatory variable	**Violations**	**Demerit points**
	Negative Binomial	**Linear Regression**
Perception predicted		
▪ Control group		
Overestimate	-0.092 (0.948)	0.117 (0.644)
Underestimate	2.464 (1.480)	1.732 (1.124)
▪ Cases		
Overestimate	0.959 (0.182)	1.014 (0.603)
Underestimate	***4.319 (1.271)	***4.522 (1.053)

Level of significance: ***1%

3b Annually for the Period from 1 June 1995 to 31 May 2003

Explanatory variable	**Violations**	**Demerit points**
	Negative Binomial	**Linear Regression**
Perception predicted		
▪ Control group		
Overestimate	-0.116 (0.475)	0.171 (0.301)
Underestimate	***4.807 (0.755)	***3.012 (0.521)
▪ Cases		
Overestimate	0.505 (0.399)	**0.668 0.277
Underestimate	***3.837	***3.770

Explanatory variable	Violations	Demerit points
	Negative Binomial	Linear Regression
	0.671	0.484

Level of significance: **5%; ***1%

Table 4: Analysis of the Effect of Perception of the Risk of Having an Accident while Drinking-Driving on the Frequency of Violations and Accumulated Demerit Points (Standard deviation in parentheses)

4a Year after survey

Explanatory variable	**Violations**	**Demerit points**
	Negative Binomial	**Linear Regression**
Perception predicted		
▪ Control group		
Overestimate	0.268 (0.795)	0.529 (0.539)
Underestimate	**2.276 (1.058)	**1.632 (0.796)
▪ Cases		
Overestimate	0.427 (0.882)	0.777 (0.650)
Underestimate	***2.781 (1.029)	***2.444 (0.815)

Level of significance: **5%; ***1%

4b Annually for the Period from 1 June 1995 to 31 May 2003

Explanatory variable	**Violations**	**Demerit points**
	Negative Binomial	**Linear Regression**
Perception predicted		
▪ Control group		
Overestimate	0.687 (0.386)	**0.571 (0.247)
Underestimate	***4.263 (0.523)	***2.567 (0.358)

Explanatory variable	Violations	Demerit points
	Negative Binomial	**Linear Regression**
▪ Cases		
Overestimate	***1.389 (0.422)	***1.369 (0.296)
Underestimate	***3.928 (0.501)	***3.435 (0.361)

Level of significance: **5 %; ***1%

Table 5: Analysis of the Effect of Perception of the Risk of Having a Bodily Injury Accident while Drinking-Driving on the Frequency of Violations and Accumulated Demerit Points (Standard deviation in parentheses)

5a Year after the survey

Explanatory variable	**Violations**	**Demerit points**
	Negative Binomial	**Linear Regression**
Perception predicted		
▪ Control group		
Overestimate	-0.746 (0.745)	0.107 (0.513)
Underestimate	0.480 (2.050)	1.040 (1.502)
▪ Cases		
Overestimate	0.172 (0.767)	0.548 (0.582)
Underestimate	**3.895 (1.666)	***3.719 (1.358)

Level of significance: **5%; ***1%

5b Annually for the Period from 1 June 1995 to 31 May 2003

Explanatory variable	**Violations**	**Demerit points**
	Negative Binomial	**Linear Regression**
Perception predicted		
▪ Control group		
Overestimate	***-0.993 (0.368)	-0.173 (0.238)
Underestimate	1.933 (1.012)	**1.569 (0.380)
▪ Cases		
Overestimate	-0.416	0.012

Explanatory variable	Violations	Demerit points
	Negative Binomial	Linear Regression
	(0.381)	(0.265)
Underestimate	**1.865	***2.029
	(0.838)	(0.597)

Level of significance: **5%; ***1%

Table 6: Analysis of the Effect of Perception of the Risk of Having a Bodily Injury Accident while Drinking-Driving on All Accidents, Bodily Injury Accidents, Violations, and Demerit Points. (The predicted perceptions of the Control Group differ from those of the Cases.) (Standard deviation in parentheses)

6a Year after the Survey

Explanatory variable	**All accidents**	**Bodily injury**	**Violations**	**Demerit points**
	Logit	**Logit**	**Negative Binomial**	**Linear Regression**
Perception predicted				
▪ Control group				
Overestimate	1.393	-1.794	0.146	0.368
	(1.606)	(3.477)	(-1.419)	(0.562)
Underestimate	4.341	1.800	4.490	2.568
	(4.990)	(10.564)	(2.450)	(1.809)
▪ Cases				
Overestimate	-2.286	***-7,669	**-1.602	-0.854
	(1.349)	(2.804)	(0.680)	(0.501)
Underestimate	-1.856	-4.366	0.166	0.308
	(2.506)	(4.851)	(1.348)	(0.976)

Level of significance: *10%; **5%; ***1%

6b Annually for the Period from 1 June 1995 to 31 May 2003

Explanatory variable	**All accidents**	**Bodily injury**	**Violations**	**Demerit points**
	Logit	**Logit**	**Negative Binomial**	**Linear Regression**
Perception predicted				
▪ Control group				
Overestimate	**1.441	0.817	0.105	0.307
	(0.605)	(1.339)	(0.399)	(0.263)

Explanatory variable	All accidents	Bodily injury	Violations	Demerit points
	Logit	Logit	Negative Binomial	Linear Regression
Underestimate	***5,974	5,210	***5,592	***3.580
	(1.858)	(4.160)	(1.362)	(0.849)
▪ Cases				
Overestimate	0.431	-0.974	***-2.097	***-1.386
	(0.441)	(1.017)	(0.329)	(0.229)
Underestimate	0.087	-2.416	-0.809	-0.256
	(0.820)	(1.935)	(0.611)	(0.435)

Level of significance: **5%; ***1%

Table 7: Comparison of significant results between predicted and observed perceptions

	Predicted perception	**Observed perception**
Table 3a Cases		
Demerit point, underestimate	+	+
Table 3b Control group		
Violations, underestimate	+	+
Table 4b Control group		
Violations, underestimate	+	+
Demerit point, underestimate	+	+
Table 5b Control group		
Violations, overestimate	-	-

Appendices

Appendix 1: Survey Methodology

Population of sanctioned drivers in 1998 and 1999

The SAAQ first provided us with an initial estimation of the number of drivers sanctioned for alcohol in the province of Québec in 1998 and 1999, distributed according to age group, administrative region at the time of sanction, and gender. The distribution is presented in Table 8.

Table 8: Distribution of all drivers sanctioned for a violation involving alcohol in 1998 or in 1999 in Québec, according to age, administrative region at the time of sanction, and gender

Age group	Administrative region	Men		Women		Total	
		N	%	N	%	N	%
16-24	Mtl, Laval, Qué	905	3.49	99	3.24		
	Other regions	3,665	14.13	301	9.86		
	Sub-total	4,570	17.62	400	13.10	4,970	17.15
25-34	Mtl, Laval, Qué	1,941	7.49	202	6.62		
	Other regions	4,775	18.41	609	19.95		
	Sub-total	6,716	25.90	811	26.57	7,527	25.97
35-44	Mtl, Laval, Qué	1,978	7.63	294	9.63		
	Other regions	5,659	21.82	873	28.60		
	Sub-total	7,637	29.45	1,167	38.23	8,804	30.38
45 and +	Mtl, Laval, Qué	1,816	7.00	195	6.39		
	Other regions	5,191	20.02	479	15.69		
	Sub-total	7,007	27.02	674	22.08	7 681	26.50
	Total	25,930	100.00	3,052	100.00	28,982	
		89.47		10.53			100,00

Based on these data, we estimated that, annually, about 14,500 of the drivers present in the files of the SAAQ had been sanctioned for an alcohol-related violation. The alcohol-linked violations selected are: 1) impaired driving; 2) refusal to take a breathalyzer/blood sample; 3) driving with an alcohol blood level higher than 0.08; 4) impaired driving causing bodily injuries; 5) impaired driving causing a fatality.

Description of initial sample

Cohort of cases

We extracted from the cohort of cases in Table 8 only those holders of a regular or probationary class-5 license (valid on 1 January 2001 and on 15 October 2001) who, in 2001, had received no sanction lasting longer than 15 days. This step reduced the number of drivers to 12,223. After weeding out cases of deaths, emigration, non-residency, identity theft, fraud, etc., there remained 12,191 cases. Their distribution according to age, on 1 October 2001, sex, and administrative region is presented in Table 9. There are fewer drivers in the 16-24 group, since all the drivers in Table 9 are older than in Table 8.

Table 9: Distribution of the 12,191 holders of class-5 licenses having been sanctioned for a violation involving alcohol, according to age on 1 October 2001, gender, and administrative region

Age group	Adminstrative region	Men		Women		Total	
		N	%	N	%	N	%
16-24	Mtl, Laval, Qué	269	2.54	39	2.42		
	Other regions	1,041	9.84	86	5.33		
	Sub-total	1,310	12.38	125	7.75	1,435	11.77
25-34	Mtl, Laval, Qué	736	6.96	91	5.65		
	Other regions	1,906	18.02	250	15.51		
	Sub-total	2,642	24.98	341	21.16	2,983	24.47
35-44	Mtl, Laval, Qué	831	7.86	140	8.68		
	Other regions	2,185	20.65	467	28.97		
	Sub-total	3,016	28.51	607	37.65	3,623	29.72
45 and +	Mtl, Laval, Qué	983	9.29	154	9.55		
	Other regions	2,628	24.84	385	23.88		
	Sub-total	3,611	34.13	539	33.43	4,150	34.04
	Total	10,579	100.00	1,612	100.00	12,191	100.00

Cohort of control subjects

The second cohort, the control group, was selected randomly from the population of license-holders according to the same stratification as that observed in the cohort of cases population (Table 9)— in terms of age on 1 October 2001, gender, and administrative region. Its composition is given in Table 10. These control subjects must have a valid driving license on 15 October 2001 and their driving record must show no suspension, arrest or conviction for alcohol since 1996, including administrative suspensions (immediate: 15 or 30 days) for a blood alcohol level exceeding 0.08. Other types of convictions may have occurred but are not taken into account.

Table 10: Distribution of the 12,191 holders of class-5 licenses not having been sanctioned for a violation involving alcohol, according to age on 1 October 2001, gender, and administrative region

Age group	Adminstrative region	Men		Women		Total	
		N	%	N	%	N	%
16-24	Mtl, Laval, Qué	269	2.54	39	2.42		
	Other regions	1,041	9.84	86	5.33		
	Sub-total	1,310	12.38	125	7.75	1,435	11.77
25-34	Mtl, Laval, Qué	736	6.96	91	5.65		
	Other regions	1,906	18.02	250	15.51		
	Sub-total	2,642	24.98	341	21.16	2,983	24.47
35-44	Mtl, Laval, Qué	831	7.86	140	8.68		
	Other regions	2,185	20.65	467	28.97		
	Sub-total	3,016	28.51	607	37.65	3,623	29.72
45 and +	Mtl, Laval, Qué	983	9.29	154	9.55		
	Other regions	2,628	24.84	385	23.88		
	Sub-total	3,611	34.13	539	33.43	4,150	34.04
	Total	10,579	100.00	1,612	100.00	12,191	100.00

TELEPHONE SURVEY

Pre-test

We pre-tested our questionnaire with a group of 30 subjects during the first year of the project. Conducted by an independent firm (SOM), the pre-test was designed to validate the formulation of the questions asked. We were also able to take note of respondents' reactions to each of the questions asked, since it was only during this pre-test that respondents allowed the interviewer to record their answers. It was very important for us to make sure that the questions were clearly understood, especially those on the perception of risks. We were also able to evaluate the sequencing of questions (the way one question led to the next), since different sequencing scenarios had been prepared to help us find out how we could obtain the maximum information on perception, while still asking questions in a logical order which would be easily understood by the greatest number of respondents possible.

LOOKING UP TELEPHONE NUMBERS

Toronto Info_direct, owned by the Cornerstone Group of Companies Ltd., undertook to look up the phone numbers for the 24,382 class-5 license-holders (12,191 cases and 12,191 control subjects). This task came up with 14,111 telephone numbers, 57.9% of 24,382. In Table 11 we note that, for the group of holders without any conviction for an alcohol-related violation (cohort of control subjects), telephone numbers were obtained for 63.6% of the men and 41.3% of the women. For men and women with convictions (cohort of cases), we found telephone numbers for 56.2% and 48.3% respectively.

Table 11: Distribution of licensees, according to phone number found, gender, and either conviction for an alcohol-related violation (case) or not (control group)

Telephone number obtained	Men				Women			
	Cohort of cases		Cohort of control - group subjects		Cohort of cases		Cohort of control- group subjects	
	N	%	N	%	N	%	N	%
Yes	5,941	56.2	6,727	63.6	778	48.3	665	41.3
No	4,638	43.8	3,852	36.4	834	51.7	947	58.7
Total	10,579	100.0	10,579	100.0	1,612	100.0	1,612	100.0

Table 12: Distribution of licensees, according to telephone number found, gender, age on 1 October 2001, administrative region, and either conviction for an alcohol-related violation (case) or not (control group)

Age group	Administrative region	Tel.	Men				Women			
			Cohort of cases		Cohort of con.-group subjects		Cohort of cases		Cohort of con.-group subjects	
			N	%	N	%	N	%	N	%
16-24	Mtl, Laval, Québec	yes	155	57.6	169	62.8	22	56.4	18	46.2
		no	114	42.4	100	37.2	17	43.6	21	53.8
			269	100.0	269	100.0	39	100.0	39	100.0
	Others	yes	613	58.9	649	62.3	46	53.5	50	58.1
		no	428	41.1	392	37.7	40	46.5	36	41.9
			1,041	100.0	1,041	100.0	86	100.0	86	100.0
25-34	Mtl, Laval, Québec	yes	378	51.4	402	54.6	39	42.9	44	48.4
		no	358	48.6	334	45.4	52	57.1	47	51.6
			736	100.0	736	100.0	91	100.0	91	100.0
	Others	yes	991	52.0	1,063	55.8	109	43.6	100	40.0
		no	915	48.0	843	44.2	141	56.4	150	60.0
			1,906	100.0	1,906	100.0	250	100.0	250	100.0
35-44	Mtl, Laval, Québec	yes	413	49.7	488	58.7	72	51.4	77	55.0
		no	418	50.3	343	41.3	68	48.6	63	45.0
			831	100.0	831	100.0	140	100.0	140	100.0
	Others	yes	1,193	54.6	1,312	60.0	215	46.0	165	35.3
		no	992	45.4	873	40.0	252	54.0	302	64.7
			2,185	100.0	2,185	100.0	467	100.0	467	100.0
45 and +	Mtl, Laval, Québec	yes	615	62.6	704	71.6	94	61.0	61	39.6
		no	368	37.4	279	28.4	60	39.0	93	60.4
			983	100.0	983	100.0	154	100.0	154	100.0
	Others	yes	1,583	60.2	1,940	73.8	181	47.0	150	39.0
		no	1,045	39.8	688	26.2	204	53.0	235	61.0
			2,628	100.0	2,628	100.0	385	100.0	385	100.0

Dissociating by age group and administrative region, we note, in Table 12, that the percentage of telephone numbers obtained ranges among men between 54.6% (25-34, Montreal, Laval, Québec) and 73.8% (45 and over, Other regions). Among women, this percentage ranges between 39.0% (45 and over, Other regions) and 58.1% (16-24, Other regions).

RESPONSE RATE

The telephone survey also administered by SOM was conducted between 15 April and 10 May 2002. To reach our objective of 2,850 completed interviews (as dictated by budget constraint), SOM used 5, 897 telephone numbers: 42% of the 14,111 telephone numbers found.

Table 13 presents the administrative results of the data collection: 2,857 interviews were in fact completed and 1,292 licensees refused to respond (314 household refusals and 918 personal refusals).

Once the numbers not called were removed, 5,119 of the 5,897 numbers (86.8%) were valid for the survey. The valid numbers are those remaining from all the numbers obtained, after subtracting 778 numbers for the following reasons: telephone numbers out of service (405 including discontinued numbers (121), fax number (21), "unknown" numbers following a move (113), "no person by that name at this number" (146) as well as duplicates (4); non-residential numbers (76); trouble with line (2); ineligible numbers (290), and out-of-stratum numbers (5) (see Table 13). The numbers dropped represent respectively a total of 461 numbers for the group of holders with a conviction for an alcohol-related violation (cohort of cases) and 317 numbers for the group of holders with no conviction for an alcohol-related violation (cohort of control subjects).

Furthermore, 38.3% of the interviews were not completed, either because of refusal (23.3%), of absence (8.5%), of inability to answer (1.5%) or of failure to reach the number during the survey period (5%).

Table 13: Administrative results of data collection for the 5,897 telephone numbers used by SOM, according to either conviction for an alcohol-related violation (cases) or not (control-group subjects)

	Cohort of cases		**Cohort of control-group subjects**		**TOTAL**	
	N	**%**	**N**	**%**	**N**	**%**
Telephone numbers						
No service	250	8.2	155	5.4	405	6.9
Non residential	45	1.5	31	1.1	76	1.3
Trouble with line	0	0.0	2	0.1	2	0.0
Ineligible	165	5.4	125	4.4	290	4.9
Outside of stratum	1	0.0	4	0.1	5	0.1
Sub-total	461	15.1	317	11.1	778	13.2
Interviews						
Not completed						
Not reached during period of survey	138	4.5	157	5.5	295	5.0
Unable to answer / Foreign language	45	1.5	46	1.6	91	1.5
Absent	287	9.4	213	7.5	500	8.5
Refusal	692	22.7	684	24.0	1,376	23.3
Sub-total	1,162	38.1	1,100	38.6	2,262	38.3
Completed	1,426	46.8	1,431	50.3	2,857	48.5
Total sample	3,049	100.0	2,848	100.0	5,897	100.0

Table 14 gives the estimated response rate. To obtain this estimation, we proceeded as follows:

1) The telephone numbers not reached during the survey period total 295 plus the 2 lines with trouble, bringing the total to 297 numbers.

2) Dropping this total from the initial 5,897 numbers, we obtain 5,600 numbers reached, 572 of which were unusable (405 out of service, 76 non-residential, and 91 unable to answer/foreign language) and 5,028 of which were then usable (5,600-572).

3) The number of usable numbers reached comes to 89.8% (5,028/5,600 × 100)

4) We estimate the number of usable numbers not reached by the % of the usable numbers reached times the number of unusable numbers, which gives 297 × 89.8%, which equals 266.

5) The total number of usable numbers is estimated by adding the number of usable numbers reached and the estimated number of usable numbers not reached: 5,028 + 266 = 5,294.

6) The estimated response rate in percentage is defined as the relation between the number of interviews completed and the total number of usable numbers multiplied by 100: 2,857/5,294 × 100 = 59.4%.

It is interesting to note that the response rate is 59.1% among holders having been convicted of an alcohol-related violation (cohort of cases) and 59.8% among holders with no such conviction (cohort of control subjects), which is very similar (Table 14). The refusal rate is estimated at 26.0% (2,262/5,294 × 100). It is 26.3% among holders with no conviction (cohort of control subjects) and 25.7% among holders with a conviction (cohort of cases). These rates are also similar. We do see a slight difference in the non-response rate, which is defined as follows: the number of holders absent when called (500) + the estimated number of usable numbers not reached (266) for a total of 766 which is divided by the estimated number of usable numbers (5,294). This relation is multiplied by 100, which gives 14.5%. These rates are respectively 15.2% and 13.8%, depending on whether the respondent has a conviction (cases) or does not (control subjects).

Table 14: Response rate estimated according to either conviction for an alcohol-related violation (cases) or not (control group)

	Cohort of cases	**Cohort of control-group subjects**	**Total**
Total sample	3,049	2,848	5,897
Numbers not reached	138	159	297
Numbers reached	2,911	2,689	5,600
unusable	340	232	572
usable	2,571	2,457	5,028
% of usable numbers reached	88.3 %	91.4 %	89.8 %
Estimation of number of usable numbers not reached	121	145	266
Estimated total number of usable numbers	2,692	2,602	5,294
Estimated non-response (%)	15.2	13.8	14.5
Refusal (%)	25.7	26.3	26.0
Estimated rate of response (%)	59.1	59.8	59.4

Table 15 gives the rates for response, non-response, and refusal (in %), according to gender, age, administrative region, and whether the holder has been convicted (cases) or not (control subjects).

Table 15: Rate of non-response, refusal, and response (in %), according to gender, age, administrative region, and either conviction (cases) or not (control group)

Age group	Administrative region	Rate (%)	Men		Women	
			Cohort of cases	Cohort of control-group sub.	Cohort of cases	Cohort of control-group sub.
16-24	Mtl, Laval, Québec	Non-response	17.4	28.0	33.3	57.1
		Refusal	24.4	12.2	11.1	00.0
		Response	58.1	59.8	55.6	42.9
	Others	Non-response	21.7	24.1	32.0	12.5
		Refusal	13.2	11.0	04.0	25.0
		Response	65.1	64.9	64.0	62.5
25-34	Mtl, Laval, Québec	Non-response	21.7	12.7	35.3	26.9
		Refusal	19.4	28.0	5.9	26.9
		Response	58.9	59.3	58.8	46.2
	Others	Non-response	14.9	15.6	14.0	27.7
		Refusal	19.8	20.4	26.3	06.4
		Response	65.2	64.0	59.6	66.0
35-44	Mtl, Laval, Québec	Non-response	17.1	07.5	08.3	18.9
		Refusal	32.9	32.9	33.3	35.1
		Response	50.0	59.5	58.3	45.9
	Others	Non-response	13.4	10.9	06.1	15.2
		Refusal	23.0	28.2	37.8	18.2
		Response	63.7	60.9	56.1	66.7
45 and +	Mtl, Laval, Québec	Non-response	14.5	06.3	15.4	13.3
		Refusal	35.5	41.7	34.6	46.7
		Response	50.0	52.1	50.0	40.0
	Others	Non-response	08.8	07.8	09.5	16.2
		Refusal	34.3	34.1	33.3	21.6
		Response	57.0	58.2	57.1	62.2

COMPARATIVE ANALYSIS OF THE DRIVING RECORDS OF RESPONDENTS AND NON-RESPONDENTS

The initial sample contains 24,382 holders of a class-5 license (12,191 cases and 12,191 control subjects). For 81 of them, we had no access to information on the number of years of driving experience they had with a class-5 license; they were thus withdrawn from the cohort. We note,

in Table 16, that only 1 of the 24,301 license-holders did not have a license on 31 December 2001. The percentage of the 24,301 license-holders who did not have a valid driving license on 31 December varies between 0.07% for 2000 to 10.4% for 1995 because the license had been suspended for at least one of the following reasons: 1) unpaid fine, 2) driving under sanction, 3) violation of the criminal code, 4) accumulation of demerit points, or 5) apprehension by a police officer for driving while impaired.

Table 16: Number of holders of a class-5 license in the sample at 31 December of the current year

Year	**Holder of a valid class-5 license at 31 December of the current year**				**% of the 24, 301 licensees without a valid class-5 license**
	Yes	***Not obtained***	***Suspended***	**No**	
1995	21,773	2,510	15	2,528	10.4
1996	22,351	1,741	209	1,950	8.0
1997	23,071	994	236	1,230	5.1
1998	23,435	548	318	866	3.6
1999	23,330	178	793	971	4.0
2000	24,284	2	15	17	0.1
2001	24,300	0	1	1	0.0

In our study of driving records, we considered only drivers holding a class-5 license in the period under study. Furthermore, licensees do not necessarily keep their class-5 license for the whole year considered. To obtain the average number of accidents and of accidents causing bodily injury or of violations sanctioned by demerit points per year, we then made a weighted calculation based on the license's number of valid days in the year, taking into account the number of months of driving experience and the number of days the license was suspended in the year considered. Thus, for 1995, instead of having 21,773 license-holders, we obtain 21,017.65 holders/year.

We note that it is the group of license-holders with a conviction for an alcohol-related violation (cohort of cases) whose rates of accidents and of accidents with bodily injury exceed those of the Québec population at large. The group of license-holders without convictions (cohort of control subjects) has rates of accidents and accidents with bodily injury similar to those of the Québec population at large. Given the low number of fatal accidents, we did not split the sample based on whether or not there was a conviction for an alcohol-related violation.

When adjustments have been made for age, observation period, gender, having been convicted (cases) or not (control subjects) and having complete the questionnaire or not and taking into account any possible temporal correlation, the accident risks of license-holders who did not answer the questionnaire are not significantly different from those who did answer the questionnaire, leaving aside those whose telephone numbers we did not find. The latter are 7.7% more at risk for accidents than those who did complete the questionnaire.

On the other hand, compared to license-holders who did complete the questionnaire, the risk of having an accident causing bodily injury is 28.8% higher among license-holders who refused to answer the questionnaire, 24.7% higher among those who were not reached, 22.1% higher among

those whose telephone number we did not find, and 35.0% higher among those whose telephone number was invalid. It also appears that the risks of accidents and of accidents causing bodily injury decline with age.

Now we want to compare the frequency of total accidents and of annual accidents causing bodily injury of those who completed the questionnaire with that of those who did not, adding to the estimation model the interaction between having been convicted (cases) or not (control subjects) and between having completed the questionnaire or not. Adjusting for age, period of observation, and gender; for having a conviction or not; for having completed the questionnaire or not; and taking into account any possible temporal correlation, we find that the risk of accident for license- holders who did not complete the questionnaire is not significantly different than that for those who did, whether among those with convictions (cases) or among those without (control subjects).

As concerns accidents causing bodily injury, the percentages of convicted license-holders (cases) whose telephone numbers were invalid or whose telephone numbers were not found or who were not called are, respectively, 50.0%, 20.9%, and 24.1% more at risk than those who completed the questionnaire. On the other hand, among license-holders without convictions (control subjects), it is those whose telephone number we could not find who are 23.9% more at risk than those who completed the questionnaire.

Adjusting for age, observation period, and gender; for having been convicted (cases) or not (control subjects); for having completed the questionnaire or not; and taking into account any possible temporal correlation, we find that license-holders who were not reached by the polling firm or whose telephone number was not found are respectively 13.4% and 7.0% more likely to commit violations entailing demerit points than those who completed the questionnaire. We also find that the risk of committing violations entailing demerit points diminishes with age. We also note that men and license-holders with a conviction for an alcohol-related violation (cases) are respectively more likely to commit a violation than women and license-holders without such a conviction (control subjects).

The results of adding the interaction between having been convicted (cases) or not (control subjects) also show that among license-holders without a conviction (control subjects) those who were not reached are 14.1% more likely to commit a violation than those who completed the questionnaire, whereas among the group of license-holders with a conviction (cases) those whose telephone number we could not find or who were not reached are respectively 12.6% and 13.5% more likely to commit a violation that those who did complete the questionnaire.

To sum up, the rates of response and refusal are similar whether the licensee has been convicted for an alcohol-related violation (cases) or not (control subjects); these rates are respectively: 59.1%, 25.7% and 59.8%, 26.3%. Moreover, the licensees who answered the questionnaire are neither more nor less likely to have an accident than those who did not. Unfortunately, this is not the case as concerns accidents causing bodily injury and violations entailing demerit points, where there seems to be a volunteer bias**.** More specifically, we see that, among licensees with convictions (cases), those whose telephone numbers were invalid or not found are respectively 50.0% and 23.9% more at risk for bodily accidents compared to those who completed the

questionnaire. On the other hand, among licensees without convictions (control subjects), those whose telephone numbers were not obtained are 23.9% more likely to have accidents with bodily injury than those who did complete the questionnaire—at a 10% confidence level. For violations entailing demerit points, we find a bias towards licensees who were not reached—whether they had convictions (cases) or not (control subjects)—as compared to those who did complete the questionnaire: 13.5% and 14.1%. And among licensees with convictions (cases), the bias is also towards those whose telephone numbers were not obtained: 12.6% more at risk for violations than those who did complete the questionnaire.

These findings lead us to conclude that, in this study, the selection bias will have minimal effects on results, since the drivers who were not reached in the group with convictions for alcohol-related violations (cases) are more dangerous that those who were reached.

Appendix 2: Objective probability for driving with impaired faculties

We want to find the probability of being arrested by a police officer for driving with impaired faculties, on a Friday in Québec. We choose Friday because this is the day of the week that counts the highest number of accidents during the period of interest. Table 17 presents the distribution of accidents over the days of the week during the 1999-2002 period. We observe that Friday has the highest score for each year of the period.

Table 17*:* Distribution over days of the week of accidents involving a police report during the 1999-2002 period in Québec

Day	1999	2000	2001	2002	1999-2002
Monday	0.1360	0.1331	0.1350	0.1371	0.1353
Tuesday	0.1415	0.1407	0.1380	0.1406	0.1402
Wednesday	0.1440	0.1436	0.1415	0.1391	0.1421
Thursday	0.1531	0.1524	0.1629	0.1558	0.1559
Friday	**0.1803**	**0.1736**	**0.1792**	**0.1827**	**0.1789**
Saturday	0.1351	0.1349	0.1331	0.1328	0.1340
Sunday	0.1100	0.1219	0.1103	0.1118	0.1135

We didn't know the percentage of class-5 license-holders who drive with impaired faculties. To estimate this percentage, we first used the polling results. For this purpose, we relied on question 16 of the questionnaire, which is formulated as follows: "In the past 3 months, have you ever driven after having five drinks or more in the two hours before taking the wheel?" (Table 18) We thus consider as impaired drivers those who say that they have driven after having five drinks or more. Taking the cohort of control subjects as the reference point, we estimate that the percentage of license-holders who drive with impaired faculties ranges between 1.41% (20/1,423), more than once and 2.88% (41/1,423), once and more. Now if, in Québec, there are 4,052,216 class-5 license-holders, there would be somewhere between 56,953 and 116,754 class-5 license-holders who drive with impaired faculties.

Based on the SAAQ data, there are, on average, 69 violations of the criminal code issued on a Friday in Québec. We thus estimate that the risk of being arrested by a police officer on a Friday will range between 0.6/1,000 (69/116,754) and 1.2/1,000 (69/56,953). This bracket was used for the objective risk of being arrested.

To evaluate how drivers perceive the risk of being arrested by a police officer, we asked the following question: "Let's suppose that on a Friday evening there are about 20,000 impaired drivers on Québec roads. In your opinion, how many of them will be arrested by a police officer? (Question 24b)" So out of 20,000 drivers with impaired faculties on a Friday, the number of those arrested by a police officer will range between 12 (0.6/1,000 $\times$ 20,000) and 24 (1.2/1,000 $\times$ 20,000).

This estimate is not perfect. First of all, the first question does not refer to a Friday. Drivers may not behave in the same way each day of the week, although we suspect they may drink and drive more often during the weekend. But it is not clear that the conditional driving behavior should be

different from one day of the week to another. Second, the data used for violations covers the whole of Friday, whereas the perceived risk question refers only to Friday evening. Again, we suspect that drivers may drink and drive more often in the evening but there are more police patrols on the roads.

Table 18: Q_16: In the last three months… did you ever drive after having five or more drinks within two hours before driving?

Driving a vehicle after five drinks +	**Cohort of control subjects**	
	N	**%**
Once	21	1.48
Twice	7	0.41
3 to 5 times	10	0.70
More than 5 times	3	0.21
Never	1,380	96.98
Non-respondent	2	0.14
Total	1,423	100.00

Appendix 3: Supplementary tables

3.1 Tables used to compute the estimated probabilities in Section 4

Table A1: Estimations of the probability of overestimating or underestimating the risk of arrest for impaired driving, using the Generalized Logit Model

Explanatory variable	Coefficient	
	$\hat{\beta}$	$\hat{\lambda}$
	Overestimate	**Underestimate**
Constant	***0.6709	-0.2899
Age group		
Under 25	-0.1477	0.1521
25–34	0.0354	0.1620
35–44	**0.1434	-0.0412
45 +	Reference group	
Nunber of violations		
None	**-0.1101	*-0.1392
1 +	Reference group	
Speeding		
Never	***0.1525	0.0610
Often, sometimes, rarely	Reference group	
Number of drinks per week		
2 or less per week	*0.1248	-0.0422
3 to 5	*-0.1431	**-0.2359
Did not drink	-0.0493	-0.0516
6+	Reference group	
Legal alcohol limit		
0.08	**-0.1547	-0.1534
Other	Reference group	
Number of drinks to reach 0.08		
1	-0.0397	-0.2166
2	0.0109	-0.1494
3	0.0705	-0.0285
4	-0.1586	**-0.3670
Non-respondent	*0.3412	*0.4629
5 +	Reference group	
Passed an alcohol test		
Yes	*0.1216	0.1212
No	Reference group	
Knowledge of length of an immediate suspension for impaired driving		
One week or less	-0.0621	*-0.3629
One month or more	-0.0151	-0.0310
Non-respondent	0.2359	0.5704
15 days	Reference group	
Living with a partner		
Yes	**-0.1001	-0.0431
No	Reference group	
Family income		
$40,000 and under	***0.2430	-0.0619
Non-respondent	*-0.2488	0.1757
Over $ 40,000	Reference group	

Level of significance: *10%; **5%; ***1%

Table A2: Estimations of the probability of overestimating or underestimating the risk of having an accident while drinking-driving (Generalized Logit Model)

Explanatory variable	Coefficient $\hat{\beta}$ Overestimate	Coefficient $\hat{\lambda}$ Underestimate
Constant	**0.3686	*-0.4154
Age group on 15 April 2002		
Under 25	-0.0324	0.0861
25–34	0.0496	***0.2446
35–44	-0.0640	**-0.1949
45 +	Reference group	
Number of violations		
None	*-0.1014	**-0.1483
1 +	Reference group	
Weaving in and out of traffic		
Rarely, never	*0.0998	0.0159
Often, sometimes	Reference group	
Number of drinks on same occasion		
1	**0.3086	0.2149
2	-0.0525	-0.1279
3	-0.0260	-0.1917
4	0.0393	**0.3506
Non respondent	-0.4262	-0.3079
Did not drink	0.1753	0.0227
5 +	Reference group	
Legal alcohol limit		
0.08	***-0.2314	0.1138
Other	Reference group	
Knowledge of length of court ordered driving suspension		
Under one year	-0.0604	-0.1370
Over one year	0.1226	**0.3325
One year	Reference group	
Knowledge of length of immediate driving suspension for impaired driving		
One week or less	**-0.3191	-0.0567
One month or more	-0.1594	0.0677
Non-respondent	*0.5744	-0.3652
15 days	Reference group	
Knowledge of amount of court ordered fine		
Less than $500	-0.1649	-0.2252
$1,000+	***0.4160	0.1609
Non respondent	-0.1602	0.0093
Between $500 and $999	Reference group	
Zero tolerance		
Agree	**0.1041	-0.0867
Disagree	Reference group	
Family income		
$40,000 or less	**0.1816	-0.1554
Non-respondent	-0.0711	0.2033
More than $40,000	Reference group	

Level of significance: * 10%; ** 5%; *** 1%

Table A3: Estimations of the probability of overestimating or underestimating the risk of having a bodily injury accident while drinking-driving (Generalized Logit Model)

Explanatory variable	Coefficient	
	$\hat{\beta}$	$\hat{\lambda}$
	Overestimate	**Underestimate**
Constant	***1.0151	*-0.4707
Age group		
Under 25	*-0.1737	0.0910
25–34	-0.0882	0.1428
35–44	0.0024	***-0.3888
45 +	Reference group	
Cohort		
Cases	0.0815	*0.1527
Control group	Reference group	
Driving after … drinks		
No drinks within the hour	*0.1432	*-0.2247
1 drink or more within the hour	0.1053	0.0702
2 drinks or more within the hour	-0.0753	0.0903
Did not drink	**0.2889	-0.1171
5 +	Reference group	
Legal alcohol limit		
0.08	***-0.2301	-0.2082
Other	Reference group	
Number of drinks to reach 0.08		
1	0.2101	-0.0697
2	-0.0759	-0.1242
3	**-0.2024	-0.2053
4	-0.1430	-0.1232
Non-respondent	0.1434	0.2502
5 +	Reference group	
Stopped drinking early		
Yes	*0.0803	**0.1677
No	Reference group	
Passed an alcohol test		
Yes	*-0.1239	-0.1074
No	Reference group	
Knowledge of length of immediate suspension for impaired driving		
One week or less	-0.2607	0.1676
One month or more	-0.1033	-0.1724
Non-respondent	*0.6885	0.5131
15 days	Reference group	
Zero tolerance		
Agree	*0.0849	**-0.1917
Disagree	Reference group	
Level of education		
Primary or secondary	***0.1591	0.0114
Cegep or university	Reference group	
Family income		
$40,000 and under	0.1032	-0.2155
Non-respondent	0.0471	*0.4040
More than $40,000	Reference group	

Level of significance: *10%; **5%; ***1%

Table A4: Estimations of the probability of overestimating or underestimating the risk of having a bodily injury accident while drinking-driving (Generalized Logit Model) *in Control* group

Explanatory variable	Coefficient	
	Overestimate	**Underestimate**
Constant	***-0.5879	***-1.3231
Speeding		
Never	0.0882	*-0.2758
Often, sometimes, rarely	Reference group	
Driving after…drinks		
No drink within the hour	***0.3342	-0.2139
1 drink or more within hour	0.1406	0.1850
2 drinks or more within hour	*-0.3033	-0.0875
Did not drink	***0.5215	-0.2243
5 drinks or more within hour	Reference group	
Legal alcohol limit		
0.08	***-0.2845	-0.1546
Other	Reference group	
Knowledge of the amount of court ordered fine		
Less than $500	-0.0780	-0.0348
$1,000 or more	**0.2343	0.0093
Between $500 and $999	Reference group	
Level of education		
Primary or secondary	***0.2725	0.1650
Cegep or university	Reference group	

Level of significance: * 10%; ** 5%; *** 1%

Table A5: Estimations of the probability of overestimating or underestimating the risk of having a bodily injury accident while drinking-driving (Generalized Logit Model) *among* cases

Explanatory variable	Coefficient	
	Overestimate	**Underestimate**
Constant	***1.3087	-0.2641
Age group		
Under 25	-0.0972	0.1896
25–34	*-0.1794	0.1413
35–44	-0.0165	***-0.5346
45 +	Reference group	
Number of violations		
None	**0.1466	0.0663
1 or more	Reference group	
Reasons for drinking		
To be sociable	0.0614	-0.2326
To enjoy meal more	-0.1137	0.1329
To relax	-0.1564	-0.3425
For the taste	0.1126	-0.1020
Other reasons	0.0253	**0.6792
Did not drink	0.1711	0.0258
For pleasure	Reference group	
Legal alcohol limit		
0.08	*-0.2583	-0.3270
Other	Reference	
Number of drinks to reach 0.08		
1	0.2142	0.0477
2	**-0.3055	*-0.3597
3	**-0.3512	-0.1795
4	**-0.3749	-0.2354
Non-respondent	*0.7373	0.5093
5 +	Reference	
Passed an alcohol test		
Yes	**-0.1929	-0.0988
No	Reference group	
Legal limit at 0.04		
Agree	*0.1332	0.0095
Disagree	Reference	
Zero tolerance		
Agree	0.0330	**-0.3038
Disagree	Reference	
Family income		
$40, 000 and under	0.0709	*-0.3295
Non-respondent	0.0989	*0.6443
More than $40, 000	Reference group	

Level of significance: *10%; **5%; ***1%

3.2 Tables of Section 4 with all coefficients

Table 3: Analysis of the Effect of Perception of the Risk of Being Arrested for Impaired Driving on the Frequency of Violations and Accumulated Demerit Points

3a Year after the Survey

Explanatory variable	Violations		Demerit points	
	C	STD	C	STD
Constant	***-3.747	0.631	***-1.199	0.427
Cohort				
Case	-0.616	0.793	-0.727	0.564
Control group	Reference		Reference	
Gender				
Woman	Reference		Reference	
Man	***0.749	0.182	***0.382	0.100
Age bracket				
16 to 24	***0.687	0.141	***0.608	0.110
25 to 34	***0.381	0.124	**0.194	0.088
35 to 44	0.211	0.122	0.086	0.080
45 and +	Reference		Reference	
Administrative region				
Mtl, Laval, Quebec	Reference		Reference	
Others	0.009	0.094	0.036	0.069
Perception predicted				
Control group				
Overestimate	-0.092	0.948	0.117	0.644
Underestimate	2.464	1.480	1.732	1.124
Case				
Overestimate	0.959	0.182	1.014	0.603
Underestimate	***4.319	1.271	***4.522	1.053
Dispersal parameter	***0.603	0.144	***1.564	0.021
Number of observations	2,685		2,685	
Likelihood	-1,589.07		-5,011.27	

1: Coefficient; 2: Standard deviation; Level of significance: ** 5% ; *** 1%.

Table 3b: Annually for the Period from 1 June 1995 to 31 May 2003

Explanatory variable	Violations		Demerit points	
	C	STD	C	STD
Constant	-0.187	0.370	**-0.418	0.202
Observation period			-0.004	0.005
June 1995 - May 1996	0.088	0.056		
June 1996 - May 1997	0.063	0.056		
June 1997 - May 1998	0.058	0.055		
June 1998 - May 1999	***0.211	0.057		
June 1999 - May 2000	***-0.205	0.063		
June 2000 - May 2001	***-0.195	0.058		
June 2001 - May 2002	0.058	0.054		
June 2002 - May 2003	Reference			
Cohort				
Case	0.239	0.393	-0.172	0.262
Control group	Reference		Reference	
Gender				
Woman	Reference		Reference	
Man	***0.620	0.080	***0.306	0.047
Age bracket				

16 to 24	***0.732	0.066	***0.486	0.045
25 to 34	***0.438	0.062	***0.219	0.040
35 to 44	***0.250	0.061	**0.094	0.038
45 and +	Reference		Reference	
Administrative region				
Mtl, Laval, Quebec	Reference		Reference	
Others	-0.019	0.048	0.013	0.032
Perception predicted				
Control group				
Overestimate	-0.116	0.475	0.171	0.301
Underestimate	***4.807	0.755	***3.012	0.521
Case				
Overestimate	0.505	0.399	**0.668	0.277
Underestimate	***3.837	0.671	***3.770	0.484
Parameters				
a	***36.097	6.223	***0.609	0.057
b	***1.873	0.120	***-0.067	0.010
a*b			***0.013	0.002
Number of observations	20,695		20,695	
Number of license holdes	2,689		2,689	
Likelihood	-12,482.65		-39,645.43	

1: Coefficient; 2: Standard deviation; Level of significance: ** 5%; *** 1%.

Table 4: Analysis of the Effect of Perception of the Risk of Having an Accident while Drinking-Driving on the Frequency of Violations and Accumulated Demerit Points

4a Year after survey

Explanatory variable	Violations		Demerit points	
	C	STD	C	STD
Constant	**-4.038	0.533	***-1.481	0.366
Cohort				
Case	0.005	0.703	-0.154	0.511
Control group	Reference		Reference	
Gender				
Woman	Reference		Reference	
Man	***0.719	0.183	***0.372	0.100
Age bracket				
16- to 24	***0.696	0.135	***0.646	0.105
25 to 34	**0.303	0.132	0.173	0.093
35 to 44	**0.241	0.123	0.133	0.081
45 and +	Reference		Reference	
Administrative region				
Mtl, Laval, Quebec	Reference		Reference	
Others	0.020	0.094	0.048	0.070
Perception predicted				
Control group				
Overestimate	0.268	0.795	0.529	0.539
Underestimate	**2.276	1.058	**1.632	0.796
Case				
Overestimate	0.427	0.882	0.777	0.650
Underestimate	***2.781	1.029	***2.444	0.815
Dispersal parameter	***0.613	0.144	***1.566	0.021
Number of observations	2,685		2,685	
Likelihood	-1,588.74		-5,014.82	

1: Coefficient; 2: Standard deviation; Level of significance: ** 5%; *** 1%.

4b Annually for the Period from 1 June 1995 to 31 May 2003

Explanatory variable	Violations		Demerit points	
	C	STD	C	STD
Constant	**-0.779	0.320	***-0.673	0.168
Observation period			-0.005	0.005
June 1995 - May 1996	0.098	0.056		
June 1996 - May 1997	0.073	0.055		
June 1997 - May 1998	0.068	0.055		
June 1998 - May 1999	***0.218	0.057		
June 1999 - May 2000	***-0.198	0.063		
June 2000 - May 2001	***-0.190	0.058		
June 2001 - May 2002	0.062	0.054		
June 2002 - May 2003	Reference			
Cohort				
Case	0.217	0.346	-0.323	0.236
Control group	Reference		Reference	
Gender				
Woman	Reference		Reference	
Man	***0.575	0.079	***0.277	0.046
Age bracket				
16 to 24	***0.659	0.065	***0.449	0.044
25 to 34	***0.387	0.062	***0.192	0.040

35 to 44	***0.275	0.061	***0.124	0.038
45 and +	Reference		Reference	
Administrative region				
Mtl, Laval, Quebec	Reference		Reference	
Others	0.004	0.074	0.027	0.032
Perception predicted				
Control group				
Overestimate	0.687	0.386	**0.571	0.247
Underestimate	***4.263	0.523	***2.567	0.358
Case				
Overestimate	***1.389	0.422	***1.369	0.296
Underestimate	***3.928	0.501	***3.435	0.361
Parameters				
a	***37.373	6.379	***0.606	0.057
b	***1.969	0.129	***-0.068	0.100
a*b			***0.013	0.002
Number of observations	20,695		20,695	
Number of license-holders	2,689		2,689	
Likelihood	-12,454.62		-38,122.17	

1: Coefficient; 2: Standard deviation; Level of significance: ** 5%; *** 1%.

Table 5: Analysis of the Effect of Perception of the Risk of Having a Bodily Injury Accident while Drinking-Driving on the Frequency of Violations and Accumulated Demerit Points

5a Year after the survey

Explanatory variable	Violations		Demerit points	
	C	STD	C	STD
Constant	***-3.128	0.612	***-1.137	0.424
Cohort				
Case	-0.707	0.769	-0.439	0.563
Control group	Reference		Reference	
Gender				
Woman	Reference		Reference	
Man	***0.734	0.182	***0.379	0.100
Age bracket				
16 to 24	***0.792	0.136	***0.752	0.105
25 to 34	***0.438	0.126	***0.299	0.088
35 to 44	**0.320	0.137	**0.216	0.093
45 and +	Reference		Reference	
Administrative region				
Mtl, Laval, Quebec	Reference		Reference	
Others	0.008	0.094	0.039	0.070
Perception predicted				
Control group				
Overestimate	-0.746	0.745	0.107	0.513
Underestimate	0.480	2.050	1.040	1.502
Case				
Overestimate	0.172	0.767	0.548	0.582
Underestimate	**3.895	1.666	***3.719	1.358
Dispersal parameters	***0.613	0.145	***1.567	0.021
Number of observations	2,685		2,685	
Likelihood	-1,589.55		-5,015.98	

1: Coefficient; 2: Standard deviation; Level of significance: ** 5%; *** 1%.

Table 5b: Annually for the Period from 1 June 1995 to 31 May 2003

Explanatory variable	Violations		Demerit points	
	C	STD	C	STD
Constant	**0.758	0.347	-0.025	0.198
Observation period			-0.001	0.001
June 1995 - May 1996	0.065	0.056		
June 1996 - May 1997	0.046	0.055		
June 1997 - May 1998	0.044	0.055		
June 1998 - May 1999	***0.201	0.057		
June 1999 - May 2000	***-0.214	0.063		
June 2000 - May 2001	***-0.200	0.058		
June 2001 - May 2002	0.053	0.054		
June 2002 - May 2003	Reference			
Cohort				
Case	0.089	0.390	0.018	0.263
Control group	Reference		Reference	
Gender				
Woman	Reference		Reference	
Man	***0.607	0.080	***0.300	0.047
Age bracket				
16-24	***0.827	0.065	***0.591	0.045

25-34	***0.507	0.063	***0.301	0.042
35-44	0.292	0.064	***0.152	0.041
45 et +	***Reference		Reference	
Administrative region				
Mtl, Laval, Quebec	Reference		Reference	
Others	-0.017	0.048	0.014	0.033
Perception predicted				
Control group				
Overestimate	***-0.993	0.368	-0.173	0.238
Underestimate	1.933	1.012	**1.569	0.380
Case				
Overestimate	-0.416	0.381	0.012	0.265
Underestimate	**1.865	0.838	***2.029	0.597
Parameters				
a	***34.695	5.822	***0.587	0.056
b	***1.835	0.116	***-0.065	0.010
a*b			***0.013	0.002
Number of observations	20,695		20,695	
Number of license-holders	2,689		2,689	
Likelihood	-12,495.42		-38,170.99	

1: Coefficient; 2: Standard deviation; Level of significance ** 5%; *** 1%.

Table 6: Analysis of the Effect of Perception of the Risk of Having a Bodily Injury Accident while Drinking-Driving on All Accidents, Bodily Injury Accidents, Violations, and Demerit Points. (The predicted perceptions of the Control Group differ from those of the Cases.)

6a Year after the Survey

Explanatory variable	All accidents		Bodily accidents		Violations		Demerit points	
	C[1]	STD[2]	C	STD	C	STD	C	STD
Constant	**-5.407	1.343	-5.439	2.858	***-3.936	0.669	***-1.372	0.467
Cohort								
Case	2.934	1.618	4.440	3.322	**1.604	0.803	1.042	0.585
Control group	Reference		Reference		Reference		Reference	
Gender								
Woman	Reference		Reference		Reference		Reference	
Man	0.342	0.310	0.629	0.734	***0.736	0.182	***0.383	0.100
Age bracket								
16 to 24	***0.866	0.239	0.361	0.538	***0.747	0.130	***0.701	0.101
25 to 34	-0.021	0.249	-0.281	0.540	***0.383	0.124	***0.251	0.087
35 to 44	-0.146	0.255	0.233	0.515	0.202	0.129	0.109	0.086
45 and +	Reference		Reference		Reference		Reference	
Administrative region								
Mtl, Laval, Quebec	Reference		Reference		Reference		Reference	
Others	-0.294	0.202	0.152	0.365	0.007	0.094	0.040	0.070
Perception predicted								
Control group								
Overestimate	1.393	1.606	-1.794	3.477	0.146	-1.419	0.368	0.562
Underestimate	4.341	4.990	1.800	10.564	4.490	2.450	2.568	1.809
Case								
Overestimate	-2.286	1.349	***-7.669	2.804	**-1.602	0.680	-0.854	0.501
Underestimate	-1.856	2.506	-4.366	4.851	0.166	1.248	0.308	0.976
Dispersal parameters					**0.610	0.144		
Number of observations	2,685		2,685		2,685		2,685	
Likelihood	-627.059		-200.426		-1,587.531		-5,017.111	

1: Coefficient; 2: Standard deviation; Level of significance: ** 5%; *** 1%.

Table 6b: Annually for the Period from 1 June 1995 to 31 May 2003

Explanatory variable	All accidents		Bodily accidents		Violations		Demerit points	
	C[1]	STD[2]	C	STD	C	STD	C	STD
Constant	0.365	0.917	3.807	4.151	-0.184	0,377	*-0.424	0.221
Observation period							-0.002	0.005
June 1995 - May 1996	**0.255	0.104	0.361	0.216	0.064	0.056		
June 1996 - May 1997	**0.259	0.102	0.094	0.226	0.045	0.055		
June 1997 - May 1998	**0.215	0.103	0.332	0.214	0.043	0.055		
June 1998 - May 1999	0.036	0.116	-0.147	0.263	***0.202	0.057		
June 1999 - May 2000	0.032	0.116	0.144	0.238	***-0.215	0.064		
June 2000 - May 2001	**-0.239	0.115	-0.047	0.231	***-0.199	0.058		
June 2001 - May 2002	-0.307	0.117	-0.069	0.231	***-0.056	0.054		
June 2002 - May 2003	Reference		Reference		Reference			
Cohort								
Case	***1.626	0.582	2.330	1.303	***2.296	0.399	***1.478	0.271
Control group	Reference		Reference		Reference		Reference	
Gender								
Woman	Reference		Reference		Reference		Reference	
Man	0.088	0.098	-0.066	0.211	***0.608	0.079	***0.298	0.047
Age bracket								
16 to 24	***1.133	0.099	***1.077	0.218	***0.774	0.063	***0.541	0.043

25 to 34	***0.664	0.101	*0.400	0.224	***0.433	0.062	***0.240	0.040
35- to 44	***0.361	0.104	**0.435	0.220	***0.207	0.062	**0.085	0.039
45 and +	Reference		Reference		Reference		Reference	
Administrative region								
Mtl, Laval, Quebec	Reference		Reference		Reference		Reference	
Others	***-0.286	0.071	0.117	0.148	-0.018	0.048	0.017	0.033
Perception predicted								
Control group								
Overestimate	**1.441	0.605	0.817	1.339	0.105	0.399	0.307	0.263
Underestimate	***5.974	1.858	5.210	4.160	***5.592	1.262	***3.580	0.849
Case								
Overestimate	0.431	0.441	-0.974	1.017	***-2.097	0.329	***-1.286	0.229
Underestimate	0.087	0.820	-2.416	1.935	-0.809	0.611	-0.256	0.435
Parameters								
a	966.364	708.724	6 722.386	26 846.62	***34.391	5.546	***0.587	0.056
b	***4.724	1.354	***0.386	0.078	***1.916	0.124	***-0.065	0.010
a*b							***0.013	0.002
Number of observations	20,695		20,695		20,695		20,695	
Number of license-holders	2,689		2,689		2,689		2,689	
Likelihood	-4,958.033		-1,581.775		-12,472.843		-38,154.049	

1: Coefficient; 2: Standard deviation; Level of significance: ** 5%; *** 1%.