



**NOVA SCOTIA ALCOHOL IGNITION
INTERLOCK PROGRAM:
OUTCOME EVALUATION
EXECUTIVE REPORT**



THE TRAFFIC INJURY RESEARCH FOUNDATION

The mission of the Traffic Injury Research Foundation (TIRF) is to reduce traffic-related deaths and injuries. TIRF is a national, independent, charitable road safety institute. Since its inception in 1964, TIRF has become internationally recognized for its accomplishments in a wide range of subject areas related to identifying the causes of road crashes and developing programs and policies to address them effectively.

Prepared by:

Ward Vanlaar, Marisela Mainegra Hing, Robyn Robertson
Traffic Injury Research Foundation
171 Nepean St. Suite 200
Ottawa, ON K2P 0B4

Ph: (613) 238-5235
Fax: (613) 238-5292
Email: tirf@tirf.ca
Website: www.tirf.ca

April 2015
Traffic Injury Research Foundation
Copyright © 2015
ISBN: 978-1-926857-61-9

**NOVA SCOTIA ALCOHOL IGNITION
INTERLOCK PROGRAM:
OUTCOME EVALUATION**

Executive Report

Introduction

In September 2008 Nova Scotia's Alcohol Ignition Interlock Program was implemented. The overall objective of the Program was to improve road safety and reduce the number of road traffic crashes and fatalities that may occur due to impaired driving. This report describes the outcome evaluation of Nova Scotia's interlock program. The Traffic Injury Research Foundation (TIRF) conducted this outcome evaluation as part of a large-scale evaluation of this safety measure. The main objective of the outcome evaluation was to examine the impact of Nova Scotia's interlock program on participants and to help identify areas for improvement. More precisely, the goals of the outcome evaluation were:

- > To determine the effectiveness of the program to reduce drink driving when combined with counselling and other Addiction Services components provided to the offender;
- > To identify potential improvements to the program or implementation of the program;
- > To determine the use of the program, e.g., participation rates and attrition.

Methodology

The outcome evaluation addressed the following questions:

1. How many participants re-offend, and how often, while enrolled in the program?
 - a. How many were caught and convicted of drink driving while in the program? How many were arrested but not convicted; how many were caught for other driving-related offences?
 - b. How many self-reported that they drove while drinking (or within an hour of drinking) while in the program?
2. How many failed attempts were logged on the interlock device?
 - a. What were the reasons for the failed attempts?
 - b. What was the BAC level of these failed attempts?
3. How many times did participants use the interlock device while in the program? What was the mileage driven during participation?
4. How many drove a non-interlock vehicle while in the program (based on self-reported data and conviction data)?
5. How many re-offend after they finished the program?
 - a. How many are caught and convicted of drinking and driving?
 - b. How many self-reported that they drove while drinking (or within an hour of drinking)?
6. What is the impact of the various aspects of the program, for example, voluntary versus mandatory participation?

7. Have participants' knowledge, attitudes and behaviors changed as a result of the program and in what ways?

The outcome evaluation also addressed interlock component-related research questions as discussed in the Process Evaluation Report (Robertson et al. 2010):

1. What is the distribution of participants in the program over time?
2. What is the attrition rate?
3. How do behavioral patterns among interlocked offenders change over time, more precisely with respect to blowing fails, violations and breath alcohol concentration (BAC) levels?
4. Is there a learning curve among participants on the device and does it change over time?
5. Is there a subpopulation that seems to be immune to the typical learning curve?
6. Is there a subpopulation that shows persistent and even deteriorating behavior over time?

Different types of data were used in this evaluation: conviction and crash records of individual participants, self-administered questionnaires to measure specific attitudes and behaviour, monthly counts of charges, convictions and crashes, and interlock logged events. For each type of experimental data (alcohol-related/interlock participants) except for the logged events, control data (no alcohol-related/no interlock participants) were also used to better support the findings. For the individual data analyses there were four different groups (see Table S-1): two experimental interlock groups (voluntary and mandatory interlock offenders) and two control non-interlock groups (offenders that had the option to participate in the interlock program and declined, and a retrospective control group consisting of offenders that would have been mandated into an interlock program had one existed).

Table S-1: Study groups	
Experimental Groups	Control Groups
Voluntary interlock offenders: > Had an interlock device installed on their vehicle voluntarily.	Voluntary no-interlock offenders: > Had the option to participate in the interlock program, however declined.
Mandatory interlock offenders: > Were required to have an alcohol ignition interlock device installed on their vehicle.	Mandatory control group offenders: > Were charged with an alcohol-related offence and would have been required to install a device had an interlock program existed at the time.

The data were analyzed using five different methods:

1. Several descriptive sub-analyses were conducted to investigate demographic characteristics and other features to determine whether and how much participants in the control groups differed from participants in the experimental groups with respect to a variety of dimensions. This provided

important contextual information to ensure groups were sufficiently similar as well as to properly interpret results from any of the data analyses.

2. To provide insight into the effectiveness of the program in terms of recidivism, the longitudinal data from the experimental and control groups that were tracked over time were analyzed using a variety of survival analysis techniques. These techniques allowed the comparison of time to recidivate or crash across participants in each of the groups.
3. To bolster the findings from the survival analyses and to make the conclusions more robust, time series analyses techniques were used to study monthly counts of crashes, convictions and charges. This made it possible to study any potential effect of the implementation of Nova Scotia's interlock program on these counts.
4. Changes in attitudes and opinions regarding the interlock program, drinking behaviour, and drink driving behaviour, as measured by surveys, were investigated separately using regression analysis.
5. Finally, the interlock data were also analyzed without comparing these data to a control group to study behavioural trends of interlocked offenders.

The descriptive analyses revealed that in general there were no significant differences between the respective experimental and control groups at the beginning of the study period, meaning that these groups were well-matched and highly similar. In terms of alcohol-related charges, the control-voluntary group exhibited a recidivism rate of 8.9% during the study period, while the interlock-voluntary and interlock-mandatory had recidivism rates of 0.9% and 3% respectively after the installation of the interlock device. The recidivism rates for the interlock groups increased to 1.9% (voluntary group) and 3.7% (mandatory group) after the devices were removed from the vehicle, but they were still smaller than the rate for the control-voluntary group. This means that interlock participants were less likely to recidivate, even once the device was removed. In terms of alcohol-related crashes the control-voluntary group exhibited a recidivism rate of 1.6% during the study period, while the interlock-voluntary and interlock-mandatory groups had a 0.6% and 0.8% rate respectively. These differences in terms of crashes were not statistically significant.

Survival analysis. The results from the survival analyses demonstrated that:

- > The interlock program was associated with a positive impact on reducing the risk for alcohol-related convictions of participants while driving.
- > There seemed to be no difference between mandatory and voluntary participants in terms of risk for alcohol-related convictions.
- > With respect to crashes, the analysis did not show a statistically significant difference between any of the studied groups.

Time series analysis. The results from the time series analyses suggested that:

- > There were no permanent effects on the number of alcohol-related charges and convictions in the province as a whole associated with the implementation of the program.
- > There were significant, albeit temporary effects in the first and seventh month after the program was

implemented. These effects included:

- » a 13.32% decrease in the number of alcohol-related charges in September 2008; and,
 - » a 9.93% decrease in the number of alcohol-related convictions in March 2009.
- > With respect to crashes, time series analyses suggested that:
- » At the 5% level of statistical significance, there were no significant effects associated with the implementation of the program on the number of alcohol-related crashes with fatal and serious injuries.
 - » There was a permanent effect at the 10% level of significance that represented a decrease of 0.0025 in the number of alcohol-related crashes every month since June 2009 (tenth month after the beginning of the program). Statistically speaking, this represented a small decrease (one fatal or serious alcohol-related crash in approximately 33 years). This was not unexpected as, to date most studies have not yet been able to definitively demonstrate a positive impact on crashes due to the small sample sizes and lack of sufficient data.

The small amount of data gathered from the questionnaires at exit and follow-up were insufficient to draw statistically significant conclusions and establish significant comparisons among groups with respect to changes in attitudes and opinions regarding the interlock program, drinking behaviour and drink driving behaviour. However, an interesting reported fact was that there was some evidence showing that a small proportion of interlock participants (in the mandatory group) drove a non-interlocked vehicle while in the program. This evidence should be considered in light of existing evidence about the alternative to interlocks, i.e., licence suspension, and which shows that many suspended drivers may drive anyway. While this finding may not be very surprising, it does speak to the importance of good monitoring of offenders while they are on the interlock, e.g., by tracking their mileage to help detect potential instances of driving non-interlocked vehicles.

The analysis of the interlock data suggested that there were learning curves which illustrated that offenders were more likely to violate at the beginning of program participation, but over time these violations decreased as offenders supposedly learned about, or experienced the consequences of program violations and the nuances associated with the functioning of, and compliance with, devices. In general, the curves were steepest at the beginning of program participation until approximately month 10, indicating that the learning effect may decrease or stop after a period of time. There were no large differences between male and female participants but there were clear differences between mandatory and voluntary participants. Although both groups revealed a learning effect, the effect was more pronounced for voluntary participants. In addition, clear differences were found between participants with condition 37 (condition on driver's license requiring a zero BAC) and participants without this condition. Although both groups revealed a learning effect, the effect was more pronounced for the participants without the condition.

Conclusion

In conclusion, with respect to specific deterrence (i.e., referring to preventing recidivism) there was strong evidence to suggest that participation in the interlock program reduced the risk of alcohol-related charges for the participants during the program. With respect to general deterrence (i.e., referring to a preventative effect on the entire population of drivers in Nova Scotia) there was a temporary decrease in the number of alcohol-related charges and convictions in the first and seventh month respectively following the implementation of the program. There was also some weaker evidence (i.e., at the 10% level of statistical significance) that there was a permanent decrease in the number of alcohol-related crashes with fatal and serious injuries every month since the tenth month after the beginning of the program.

When considering all the evidence combined, it can be argued that the implementation of the interlock program had a positive impact on road safety in Nova Scotia and that it reduced the level of drink driving recidivism in the province. There are also some promising indications to suggest a decrease in the number of alcohol-related road traffic crashes and fatalities due to the interlock program, although this finding should be confirmed with more data (crash data was available only until 2010). In sum, the evidence suggests the interlock program was better at preventing harm due to alcohol-impaired driving than the alternative of not using the interlock program.

Several recommendations were formulated based on the evidence from this study. These recommendations are:

- > Continue the use of the interlock program in Nova Scotia;
- > Consider the systematic use of a performance-based exit in the interlock program;
- > Consider further strengthening of monitoring in the interlock program;
- > Consider focusing on levels of risk in relation to non-compliance;
- > Consider the continued monitoring of crash data.

TABLE OF CONTENTS

Summary	i
1. Background.....	1
1.1 Alcohol ignition interlock programs	1
1.2 Drinking and driving pattern in Nova Scotia	2
1.3 Alcohol interlock program in Nova Scotia	2
2. Methodology.....	5
2.1 Research questions	5
2.2 Data	6
2.3 Study design	10
2.4 Data analysis	11
3. Descriptive analysis.....	15
3.1 Demographic characteristics of the sample	15
3.2 Individual data on convictions and crashes	16
3.3 Conclusions	16
4. Survival analysis during and after the program.....	19
4.1 Convictions	19
4.2 Crashes.....	20
4.3 Conclusions	21
5. Survival analysis after the program.....	23
5.1 Convictions	23
5.2 Crashes.....	24
5.3 Conclusions	25
6. Time series analysis.....	27
6.1 Charges	27
6.2 Convictions	27
6.3 Crashes.....	27
6.4 Conclusions	28
7. Questionnaire data analysis.....	29
7.1 Descriptive analysis	29
7.2 Regression analysis	30
7.3 Conclusions	31
8. Interlock data analysis	33
8.1 Descriptive analysis.....	33
8.2 Fails in monthly periods.....	34
8.3 Logistic regression analysis	41
8.4 Conclusions	43
9. Overall conclusions.....	45
10. Recommendations.....	49
10.1 Continue the use of the interlock program in Nova Scotia	49
10.2 Consider the systematic use of a performance-based exit in the interlock program	49
10.3 Consider further strengthening of monitoring in the interlock program	50
10.4 Consider focusing on levels of risk in relation to non-compliance.....	50
10.5 Consider the continued monitoring of crash data.....	50

References	51
Appendix A: Offence Codes	53
Appendix B: Questionnaires	55

1. BACKGROUND

1.1 Alcohol ignition interlock programs

Alcohol interlocks have been commercially available for more than 30 years. The first alcohol interlock devices were developed in the 1960s as a tool to prevent drunk driving. These first devices were performance-based interlock systems, which required drivers to perform a perceptual or motor task designed to detect impairment prior to driving. While these devices were sensitive to individual variations in performance and impairment, they were incapable of discriminating between drivers with low to moderate breath alcohol concentration (BAC) levels. In the 1970s, new devices that were based on breath alcohol measurement were developed and proved to be considerably more reliable than the earlier performance-based devices. These devices were designed to incapacitate drunk driving offenders by preventing them from starting a vehicle when their BAC was in excess of a pre-set limit.

Across jurisdictions and around the world, the implementation of alcohol interlock programs to supervise impaired driving offenders is diverse. No two applications are alike – alcohol interlocks are applied with different purposes to different populations of users; users must meet different eligibility requirements; multiple agencies may be involved in administering these programs; and, their respective reporting, monitoring, and sanctioning features vary substantially. Of interest, the many different agencies involved in program delivery often have somewhat different roles and authority, and represent different systems (e.g., driver licensing system, enforcement system, adjudication system, health care system). As such, alcohol interlock programs are frequently based on collaborative initiatives that engage multiple agencies as partners in program delivery.

Despite the existence of alcohol interlock programs for more than two decades, jurisdictions continue to be challenged by the implementation of these programs. This has occurred because the development of effective policies, practices and procedures to support regulations has been ad hoc in many jurisdictions. To date, research has been unable to provide clear guidance on effective features of alcohol interlock programs, and, of greater concern, agencies have received limited guidance and support in relation to practices and procedures. Collectively, this has meant that the implementation of alcohol interlock programs has evolved using more of a trial and error process, and jurisdictions continue to modify and enhance existing protocols based on lessons learned.

Research is ongoing to identify the effective features of programs (for a comprehensive reference list see <http://aic.tirf.ca/section2/references.php>). At the same time, collaborative initiatives involving researchers, practitioners and government agencies are beginning to identify much-needed guidelines for programs based on existing knowledge and new experiences. In this regard, the process and outcome evaluation of Nova Scotia's interlock program can contribute to knowledge development.

1.2 Drinking and driving pattern in Nova Scotia

Although rates of impaired driving have decreased over the years, drinking and driving is still a significant problem in Nova Scotia (Alcohol Indicators Report 2011). From 2003 to 2007, 23.1% to 26.2% of drivers involved in crashes that caused serious injury had consumed alcohol. The Canadian rates for the same period ranged from 18.0% to 19.5%. In a 2007 telephone survey of driving practices and alcohol knowledge among young Nova Scotian men aged 19–35 years (Changing the Culture of Alcohol Use in Nova Scotia 2007), 46% reported driving within two hours of consuming alcohol at least once in the past 12 months. Of those, 40% reported doing this 1–2 times; 24% said 3–5 times; and 36% said 6 or more times.

According to the Alcohol Indicators Report 2011, heavy-drinking rates in Nova Scotia are high. In 2007–2008, 38.9% of males and 17.5% of females engaged in heavy monthly drinking. During the same time frame, 17.9% of males and 7.0% of females engaged in heavy weekly drinking. Heavy-drinking rates are particularly high among young adults; the usual consumption pattern for 51.7% of Nova Scotia university undergraduate students in 2004 was five or more drinks on the days they drank, with 27.2% of all university students drinking heavily at least once a week.

According to a student's survey (Student Drug Use Survey 2012), rates of drinking and driving are decreasing. In 2012, 4% of students in grade 7, 9, 10 and 12 reported having driven a vehicle within an hour of consuming two or more alcoholic drinks. The drinking and driving rate among all students was 5.3% in 2007 and 6.6% in 2002. Among students in grades 10 and 12 with a driver's license, 10% drove within an hour of consuming two or more drinks in 2012 compared to 13.6% who reported doing so in 2007 and 14.8% in 2002. No gender or location differences were observed. In 2012, 5.4% of students in grades 7, 9, 10 and 12 were in a motor vehicle accident with them as a driver and less than 1% of students reporting drinking and driving prior to their accident. In 2012, 16.8% of students were a passenger in a vehicle with a driver who was impaired, compared to 19.2% in 2007, and 22.8% in 2002. No differences were observed for gender, grade level or school location.

Overall, per capita alcohol consumption among Nova Scotians increased 6.6% during a 20-year period, growing from 7.6 litres of pure alcohol in 1991 to 8.1 litres in 2010. The alcohol-related mortality rate increased by 27% between 2002 and 2008 (Alcohol Indicators Report 2011).

1.3 Alcohol interlock program in Nova Scotia

In September 2008 Nova Scotia's Alcohol Ignition Interlock Program was implemented. The overall objective of the Alcohol Ignition Interlock Program (AIIP) was to improve road safety and reduce the number of road traffic crashes and fatalities that may occur due to impaired driving.

Nova Scotia's program involves both voluntary and mandatory components. It is voluntary for first-time offenders deemed to be a 'low' or 'medium' risk (as determined by Addiction Services of Nova Scotia through the Alcohol Rehabilitation Program) and mandatory for those who are deemed to be a 'high' risk

and/or those convicted of drinking and driving (or the refusal of the breathalyzer) more than once in the past ten years. After entering the program, participants must have an alcohol interlock device installed on their vehicle(s). They will then receive an interlock licence, and must participate in ongoing rehabilitation counseling sessions throughout the interlock period. The licence allows them to drive an interlock-equipped vehicle during their revocation period as long as they are compliant with the terms of the program. Their licence is stamped with an 'R' indicating that they are restricted to driving an interlock-equipped vehicle. Furthermore, participants are only permitted to operate specific interlock-equipped vehicles (e.g., a participant is not allowed to operate another participant's interlock-equipped vehicle) and the Registry of Motor Vehicles (RMV) must be notified of all vehicles in which an interlock device is installed.

In April 2010 TIRF finalized a process evaluation as part of a large-scale evaluation of this safety measure (Robertson et al. 2010). The overall objective of the process evaluation was to obtain a common understanding about how Nova Scotia's interlock program was developed and how it was implemented in order to identify potential areas for improvement. Overall, the results revealed that the implementation of the alcohol interlock program in Nova Scotia proceeded according to the plan. "While some adjustments were required during program implementation to adapt to a changing environment, some instances of incompatible processes, and to address miscommunication, overall the implementation was highly consistent with the plan that was developed to guide this initiative" (Robertson et al. 2010, page 51). The second phase of the Alcohol Ignition Interlock Program evaluation is the outcome evaluation described in this report.

2. METHODOLOGY

This outcome evaluation was conducted by the TIRF as part of a large-scale evaluation of the alcohol ignition interlock program in Nova Scotia. The overall objective of the outcome evaluation was to examine the impact of the program on participants and to help identify areas for improvement. More precisely, the goals of the outcome evaluation were:

- > To determine the effectiveness of the program in reducing drink driving when combined with counselling and other Addiction Services components provided to the offender;
- > To identify potential improvements to the program or implementation of the program; and,
- > To determine the use of the program, e.g., participation rates and attrition.

To evaluate the impact of Nova Scotia's interlock program on participants and help identify areas of improvement, different types of analyses were used. In particular survival analysis and interrupted time series analysis were used to evaluate the impact of the program. In this section the methodology of the different analyses is described.

2.1 Research questions

The outcome evaluation addressed the following questions:

1. How many participants re-offend, and how often, while enrolled in the program?
 - a. How many were caught and convicted of drink driving while in the program? How many were arrested but not convicted; how many were caught for other offences?
 - b. How many self-reported that they drove while drinking (or within an hour of drinking) while in the program?
2. How many failed attempts were logged on the interlock device?
 - a. What were the reasons for the failed attempts?
 - b. What was the BAC level of these failed attempts?
3. How many times did participants use the interlock device while in the program? What was the mileage driven during participation?
4. How many drove a non-interlock vehicle while in the program (based on self-reported data and conviction data)?
5. How many re-offend after they finished the program?
 - a. How many are caught and convicted of drinking and driving?
 - b. How many self-reported that they drove while drinking (or within an hour of drinking)?
6. What is the impact of the various aspects of the program, for example, voluntary versus mandatory participants?

7. Have participants' knowledge, attitudes and behaviours changed as a result of the program and in what ways?

The following additional interlock related questions were answered in this outcome evaluation (these are interlock component related research questions 6 through 11 in the process evaluation framework):

1. What is the distribution of participants in the program over time?
2. What is the attrition rate?
3. How do behavioural patterns among interlocked offenders change over time, more precisely with respect to blowing fails, violations and breath alcohol concentration (BAC) levels?
4. Is there a learning curve among participants and does it change over time?
5. Is there a subpopulation (by gender, by mandatory/voluntary condition) that seems to be immune to the typical learning curve?
6. Is there a subpopulation that shows persistent and even deteriorating behaviour over time?

2.2 Data

Information from different existing data sources was used in this evaluation. This included driver licensing information, crash data and conviction data. These data were obtained from a variety of sources:

- > Registry of Motor Vehicles' data: Driver licensing information, individual crash and conviction;
- > TIRF Fatal and Serious Injured Crash data bases (Monthly crashes);
- > Justice Nova Scotia (monthly charges and convictions);
- > Interlock data (Alcohol Countermeasure System Corp.); and,
- > Questionnaire data (Addiction Services Nova Scotia, Opinion Search Inc.).

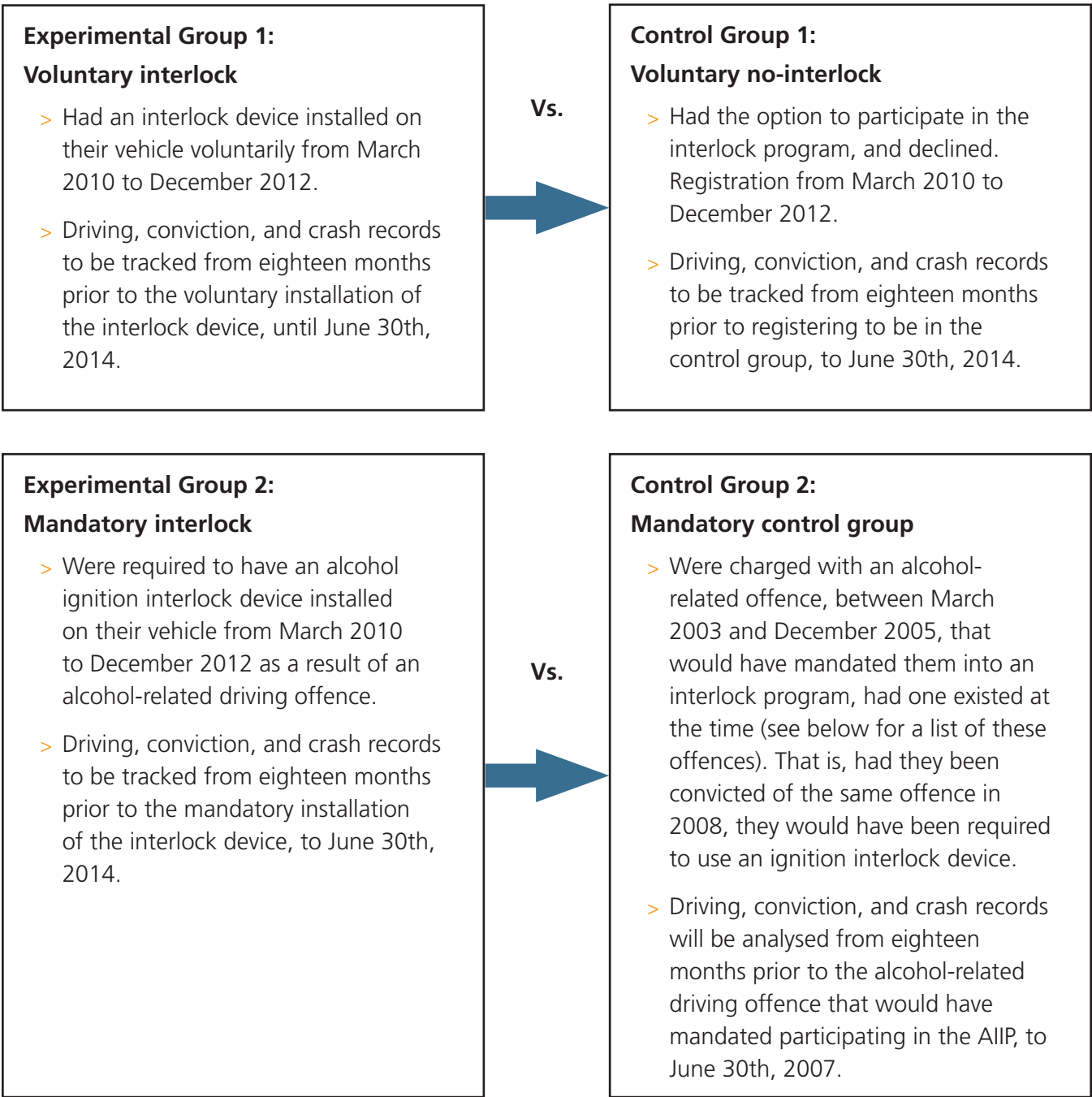
2.2.1 Individual driver data

In order to evaluate the effectiveness of Nova Scotia's Alcohol Ignition Interlock Program, data from two experimental groups (voluntary and mandatory interlock offenders) and two control groups (non-interlock offenders recruited during the current intake period and non-interlock offenders recruited retrospectively) were compared across several measures. For this study the classification of interlock participants as mandatory or voluntary was based on a proxy measure using the anticipated termination date of the program. If the time between the interlock device installation date and the anticipated termination date was less than a year, then the participant was considered voluntary, otherwise the participant was considered mandatory.

At the most basic level, comparisons were made between those who participated in the interlock program and those who did not with respect to driving history, crash records, and conviction records (see appendix A for a description of the offence codes considered). This was to determine whether drivers

who participated in the interlock program went on to have fewer alcohol-related crashes, convictions, and problems. A more detailed illustration of each group and the comparisons is presented below:

Figure 2-1: Study groups definition



Other detailed comparisons were made with respect to specific attitudes of participants including attitudes towards alcohol, drinking and driving and interlock logged events.

Questionnaire information among participants in the study. For each of the experimental groups, information was collected at three different points in time; during intake, exit and at a six month follow-up after exiting the program. For the control group (that was composed during the current intake window)

information was collected at two different points in time; intake and exit to the Driving While Impaired (DWI) program. The information was gathered using self-administered questionnaires on paper (see appendix B) and included:

- > demographics;
- > self-reported behaviour;
- > readiness to change;
- > Research Institute on Addictions Self Inventory (RIASI); and,
- > expectations about Interlocks.

The table below summarizes what information was collected at each point:

Table 2-1: Overview of data collection tools and data collection scheme			
	Intake interview	Exit interview	6-month follow-up
<i>Demographic information</i>	• Exp. — volunteers • Exp. — mandatory • Control — current	• Exp. — volunteers • Exp. — mandatory • Control — current	• Exp. — volunteers • Exp. — mandatory
<i>Readiness to change</i>	• Exp. — volunteers • Exp. — mandatory • Control — current	• Exp. — volunteers • Exp. — mandatory • Control — current	• Exp. — volunteers • Exp. — mandatory
<i>Attitudes about interlocks</i>	• Exp. — volunteers • Exp. — mandatory • Control — current	• Exp. — volunteers • Exp. — mandatory • Control — current	• Exp. — volunteers • Exp. — mandatory
<i>Research Institute on Addictions Self Inventory</i>	• Exp. — volunteers • Exp. — mandatory • Control — current	• Exp. — volunteers • Exp. — mandatory • Control — current	• Exp. — volunteers • Exp. — mandatory
<i>Self-reported behaviour</i>	• Exp. — volunteers • Exp. — mandatory • Control — current	• Exp. — volunteers • Exp. — mandatory • Control — current	• Exp. — volunteers • Exp. — mandatory

Demographics. This questionnaire contained standard demographic questions. The information gathered included gender, age, marital status, employment status, available cars, recidivism status and interlock knowledge.

Self-reported behaviour. This questionnaire was about drinking and driving behaviour. At intake the questionnaire had three questions about recent drinking and driving situations and the exit and follow-up questionnaires included other questions related to drinking and driving during participation in the program and about future expected behaviour.

Readiness to change. This questionnaire contained four subscales, each of which corresponded to one of Prochaska and DiClemente's (1986) stages of change: pre-contemplation, contemplation, action and maintenance based on their model of behaviour change. The subscale with the highest score represented the participant's current stage in this model of behaviour change. Pre-contemplation refers to a stage in which the individual is not considering a change in their behaviour. In the contemplation stage the individual thinks about changing their behaviour. In the action stage the individual is actively changing their behaviour and, finally, individuals who have reached the maintenance stage are working to prevent a relapse.

Research Institute on Addictions Self Inventory (RIASI). This is an empirically-derived instrument specifically designed for use with drink drivers (Nochajski et al. 1994). In addition to providing an indication of the extent of alcohol use, it has a subscale that assesses the likelihood of a repeat offence.

Expectations about interlocks. This questionnaire measures what clients expect from their participation in the ignition interlock program.

Interlock Information. Interlock data were provided by Alcohol Countermeasure System Corp. (the sole vendor in Nova Scotia). The data contained information for each participant in the interlock program, the date of installation of the interlock device, a list of events with the date/time of each interlock event and the type of the event during their participation in the program. The events were the results of the breath sample tests when trying to start the car (at start-up) or after having started the car (running retest). Results from these breath samples were classified according to the BAC level as "pass" (BAC level under 0.02%), "fail" (BAC level above 0.02%). The exact BAC level at each event was also provided.

2.2.2 Monthly counts data

Monthly counts of alcohol-related charges, convictions and crashes in Nova Scotia were compared with non-alcohol-related charges, convictions and crashes in Nova Scotia from 1998 to 2013 (see appendix A for a description of the offence codes considered).

The evaluation period included information from approximately ten years (from 1998 to 2008) before Nova Scotia implemented the interlock program and approximately five years (from 2008 to 2013) after implementation. Note however that crash data were only available up to 2010 (two years after AIIP implementation). Three different experimental time series were produced:

- > alcohol-related charges: monthly counts, 1998-2013;
- > alcohol-related convictions: monthly counts, 1998-2013; and,

- > alcohol-related fatal and serious crashes: monthly counts, 1998-2010.

For each of the alcohol-related time series, a corresponding non-alcohol-related control time series was included in the analyses to model the possible impact of AIIP after its implementation as well as to control for possible confounding variables that may have affected the experimental and control counts. The non-alcohol-related control time series were designed to be similar to the experimental series except for their relationship with alcohol, and as such, they should not have been influenced by the implementation of the alcohol ignition interlock program. (The purpose of the control time series was to eliminate alternate explanations of the possible results.) This made it possible to determine whether the implementation of the program was associated with any differences between the experimental and control data.

Other counts during the study period were also obtained and included in the analyses to control for their possible impact.

- > Population: Population estimates by quarters, aged 16 and over, 1998 to 2013 (Statistics Canada, 2014);
- > Unemployment rate: Monthly percentage of adults aged 15 and over in the labour force that are unemployed (Statistics Canada, 2014);
- > Heavy drinking: Annual population aged 12 and over who reported having 5 or more drinks on one occasion, at least once a month in the past 12 months, 1998 to 2012 (before 2008 available information was biannual) (Statistics Canada, 2013); and,
- > Alcohol sales: Average litres bought annually by adults aged 15 and older, 1998-2013 (Statistics Canada, 2014), Statistics Canada, CANSIM Table 183-0019 (per capita consumption estimates determined using population aged 15 years and over).

2.3 Study design

The study design utilized in this evaluation was a longitudinal study whereby data from two experimental groups (voluntary and mandatory interlock offenders) and two control groups (non-interlock offenders recruited during the current intake period and non-interlock offenders recruited retrospectively) were compared across several measures. The longitudinal data from the experimental and control groups that were tracked over time were analyzed using a variety of survival analysis techniques. This allowed for the comparison of the behaviour of interlocked offenders (voluntary or mandatory) with non-interlocked offenders in the control groups, in order to draw conclusions about the true impact of the program. Accounting for the potential influence of other possible factors was achieved by including as many control variables as possible based on the information gathered during pre-determined times (e.g., demographic information, information about readiness to change, etc.). Survival analysis made it possible to distinguish between short-term and long-term safety effects by using time until an event occurred as useful information in the analyses. Note that survival analysis is a very flexible technique that accounts for situations when the timing of the delivery of an intervention differs across individuals. This type of analysis provided answers to research questions 1, 4, 5 and 6.

Time series analyses were also used to bolster the findings from the survival analyses. It made it possible to obtain a better understanding of long-term trends by controlling for factors that may have influenced the results such as population, unemployment, heavy drinking and alcohol sales. These analyses were performed by looking at monthly rates of alcohol-related crashes, convictions and charges over a longer tracking period, including a period before and after the implementation of Nova Scotia's interlock program. These monthly counts were compared to similar counts of non-alcohol-related events. The evaluation period was approximately ten years (from 1998 to 2008) before Nova Scotia implemented the interlock program and approximately five years (from 2008 to 2013) after implementation.

The differences between the survival analyses and time series analyses may be explained by specific and general deterrent effects of the interlock program. In particular, the survival analyses made it possible to examine the impact of the program on specific, individual participants by looking at the behaviour of drink driving offenders enrolled in the interlock program in comparison with those who did not participate in the program. On the other hand, the time series analyses used data from the province as a whole, including drivers who were not enrolled in the interlock program. As such, the time series analyses enabled permitted the study of the general impact of the interlock program on the general population.

Changes in knowledge, attitudes and opinions regarding the interlock program, drinking behaviour, and drink driving behaviour were also investigated separately by comparing scores coming from the questionnaires that were administered at predetermined times. These analyses were used to answer research questions 1b, 4, 5b, and 6. Regression analysis was used to determine if the changes in the different behavioural scores were significant among the different groups taking into account possible factors such as demographics and initial behavioural scores. Useful findings from these analyses were integrated with findings from previous analyses to further elaborate on the conclusions. This generated information was useful to help answer research question 7.

Finally, the interlock data were analyzed without comparing them to behavioural indices from a control group. It warrants mentioning that the interlock device logs a huge amount of data (approximately 1.5 megabytes of information per offender per year on the interlock). Indexing techniques were used to gauge how many failed attempts were logged on the interlock device, the reasons for the failed attempts, and the number of tests delivered per offender. This analysis was used to answer research questions 2 and 3 and the additional interlock component-related research questions.

2.4 Data analysis

Data analyses were undertaken using five different methods.

1. Comparisons about demographic, convictions and crash data were performed using descriptive and bivariate analyses.
2. Survival analyses were conducted to evaluate the true impact of the program on convictions and crashes.

3. The survival function after inclusion in the study (interlock device installation date for interlock groups, consent date for the voluntary control and offence date for the mandatory control groups) was then estimated as the probability of not having convictions or crashes up to a certain time.
4. A graph of the survival function provided a summary of the time-related information. It was possible to compare data from different groups by visual inspection of their respective estimated survival time.
5. Different survival regression techniques were then used to consider additional factors (such as age and gender) in the survival models. This also helped determine the significance of the hazard ratios for the different factors.

Several time series models were investigated to determine the intervention effects of the AIIP. Three different structures were tested for an intervention effect as follows:

1. The sudden permanent model assumed the impact of the implementation of AIIP was immediate and permanent.
2. The gradual permanent model assumed there was a permanent change, but the change was gradual and not sudden (see Linden and Adams 2010).
3. The sudden temporary model assumed that there was an impact, but the impact did not last and can be represented by a spike in the data associated with the implementation or change.

Data from questionnaires were used to compare the groups at the beginning of the study and their change over time. Descriptive and bivariate statistics were used to describe the groups in terms of alcohol consumption and drinking-driving behaviours. Results were presented based on interviews at intake, exit and follow-up. Regression analyses were used to study the change in the RIASI total and recidivism scores and determined if there were significant differences between the groups. Possible confounding variables such as demographics and initial behavioural scores were also included in the regression models.

Interlock data analysis was conducted to determine the use of the program and understand behavioural patterns of offenders on an interlock. The analysis examined events logged (such as BAC levels and tests results) since the implementation of the program in 2008 until July 2014, for participants that had the interlock device installed until December 2012 (the intake period). Behavioural patterns were investigated in time blocks of three months (see technical report) and one month to reveal changes over time. Although the maximum time on the interlock in the sample was 68 months, approximately 75% of the participants were in the program for only 30 months. As such, the tracking period used was 30 months, individualized per participant since their device installation date. The data were analyzed in relation to several different types of events. These events included:

- > blowing a breath sample over 0.02;
- > blowing a breath sample over the provincial limit of 0.05;
- > blowing a breath sample over the criminal limit of 0.08; and
- > start-up violations and running retest violations.

The analyses were also broken down by gender as well as mandatory versus voluntary participants. Logistic regression analysis allowed comparisons of the odds of a failed test in the interlock device to the odds of a passed test while simultaneously controlling for several factors like months in the program, gender, mandatory/voluntary, start-up/running type of test, condition 37 (condition on driver's license requiring a zero BAC) and average mileage driven.

Finally, in order to protect identity of participants and in compliance with the Privacy Impact Assessment of this study, throughout the report only percentages were reported in descriptive tables where the cell counts were low.

3. DESCRIPTIVE ANALYSIS

3.1 Demographic characteristics of the sample

The sample contained 929 interlock experimental and 359 non-interlock control participants. The study groups (interlock-mandatory and interlock-voluntary versus control-mandatory and control-voluntary) correspond to the definition given in the methodology section (see Figure 2-1). The data from the interlock groups were obtained from Alcohol Countermeasure System Corp., and the data for the control groups were obtained from Addiction Services Nova Scotia and the Registry of Motor Vehicles.

A series of tests were conducted to analyze observed differences between the experimental and the control groups in terms of gender, age and condition 37. Condition 37 (condition on driver's license requiring a zero BAC) is a discretionary decision of the Registrar of motor vehicles, which means that it could be based on the risk rating of offenders or the opinion of medical practitioners. The usual period for the condition was three years.

With respect to gender, the only result that revealed significant differences was between both interlock groups, where the interlock-voluntary group had a larger percentage of females than the interlock-mandatory group. Overall, in all groups there was a higher percentage of males than females. However, even in the interlock groups where the gender and group were dependent, the differences in proportions of males and females were not too large.

With respect to age, the distribution of age categories was dependent on the group. The control groups had higher percentages (30.3% and 22.3%) of participants in the youngest age group 15-24. The interlock groups had only 4% and 7.1% of participants in the same young age group.

With respect to condition 37 the mandatory interlock group had the highest percentage (69.85%) of drivers with this condition.

Other comparisons were possible based on the demographic questionnaires for all contemporary groups (this excluded the control-mandatory due to the fact that this was a retrospective control group for which these data were not available). However, for these comparisons the sample size was smaller due to low response rates in the questionnaires. The sample contained 163 interlock and 318 non-interlock participants. The only significant results were with respect to the number of available vehicles (the control-voluntary has a larger percentage of participants with no vehicles than the interlock-voluntary) and with respect to being first-time offenders. Not surprisingly, the interlock-voluntary group had a larger percentage of first-time offenders than the interlock mandatory group.

In sum, the descriptive data revealed no relevant differences between the experimental (interlock) and their respective control group at the beginning of the study in terms of demographic characteristics, with the exception of age. This information was pertinent to the interpretation of any findings in the multivariate analyses, notably the survival analysis.

3.2 Individual data on convictions and crashes

Relevant information in terms of convictions and crashes for each participant in the study groups were obtained from the Registry of Motor Vehicles. Conviction data included all alcohol-related (see appendix A for the offence codes). From the data it was possible to identify 91.1% of all participants in the study.

The table below shows the percentage of participants in each group that had convictions after their inclusion in the study (interlock device installation date for the interlock groups, registration date in the group for the voluntary-control and offence date for the mandatory-control group) and after removal of the interlock device for the interlock groups. The table also shows the results of the significance tests that compared the results between groups.

Table 3-1: Percentage of participants with convictions and crashes after inclusion in the study for control groups and after install or removal for the interlock groups					
	Interlock-M	Interlock-V	Control-V	Control-M	Significant
alcohol-convictions	after-install: 3.02	after-install: 0.94	8.93	3.03	yes
	after-removal: 3.73	after-removal: 1.89			yes
alcohol-crashes	after-install: 0.83	after-install: 0.62	1.57	-	no
	after-removal: 1.86	after-removal: 0.63			no

The voluntary-interlock group had a smaller percentage (0.9% after installation and 1.9% after removal) of participants with alcohol-related convictions and the voluntary-control group had a larger percentage (8.9%) of participants with alcohol-related convictions.

The voluntary-interlock group had a smaller percentage (0.62% after installation and 0.63% after removal) of participants with alcohol-related crashes and the voluntary-control group had a larger percentage (1.57%) of participants with alcohol-related crashes. However, the p-values of the significance tests pertaining to the alcohol-related crashes were greater than 0.05, therefore these results were not statistically significant.

Since the data for the mandatory-control group were very limited this group was not included in further analyses in the next sections.

3.3 Conclusions

The descriptive statistics showed that with respect to gender there were no significant differences between the experimental and control groups. However, there were some differences with respect to the distribution of age and condition 37. The most important findings pertain to comparisons in terms of alcohol-related

convictions and crashes during the tracking period. The interlock-voluntary group demonstrated the smallest percentage of participants that had alcohol-related convictions and crashes during the tracking period. In contrast, the control-voluntary group demonstrated the largest percentage of participants that had alcohol-related convictions and crashes (although the results for crashes were not statistically significant). These same results held true after the interlock device was removed from the vehicle.

Although the percentage of participants in the voluntary-interlock with alcohol-related convictions and crashes increased, these percentages were still smaller than for those in the voluntary-control group. This means that participants in the interlock group had lower recidivism rates with respect to alcohol-related crashes and convictions, compared to non-participants. This finding was true both during installation and after the device was removed. These results may suggest a positive impact of the alcohol ignition interlock program in reducing the alcohol-related convictions that may last following the removal of the device and program exit. This is further examined in detail in the following sections.

4. SURVIVAL ANALYSIS DURING AND AFTER THE PROGRAM

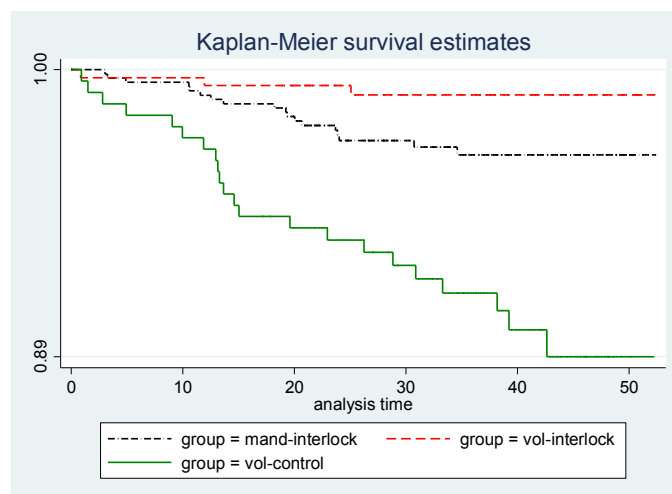
Survival analysis was used to compare the different study groups in terms of time to re-offend or crash during the tracking period based on their convictions and crash records related to alcohol (see appendix A for a description of the offence codes considered). The first subsection presents results with respect to convictions and the second with respect to crashes. Since the data for the mandatory-control group were very limited this group was not included in the analyses.

The analyses in this section considered time to re-offend and crash since inclusion in the study until the end of the study (June 2014). For the interlock groups, inclusion in the study was defined as the date the interlock device was installed. Therefore, these analyses examined the impact of the program from the time of device installation until the end of the study (i.e., including time after removal of the device until the end of the study). In the next section similar analyses are presented that examine the impact of the program after the interlock device was removed from the vehicle until the end of the study.

4.1 Convictions

Figure 4-1 shows that the survival pattern was very different for the voluntary-control group in comparison to the other two interlock groups. The analysis time on the horizontal axis is measured in units of months and represents the tracking period for each participant (since their inclusion date in the study until the end of June 2014). The vertical axis represents the probability of not being convicted up to a certain time.

Figure 4-1: Kaplan Meier survival estimates for convictions for all groups



The estimates showed that it took longer for the interlock groups to have an alcohol-related conviction than the voluntary-control group. The figure also shows that in the long term, the voluntary-interlock group has a more optimistic survival pattern (it takes longer before being convicted) than the mandatory-interlock.

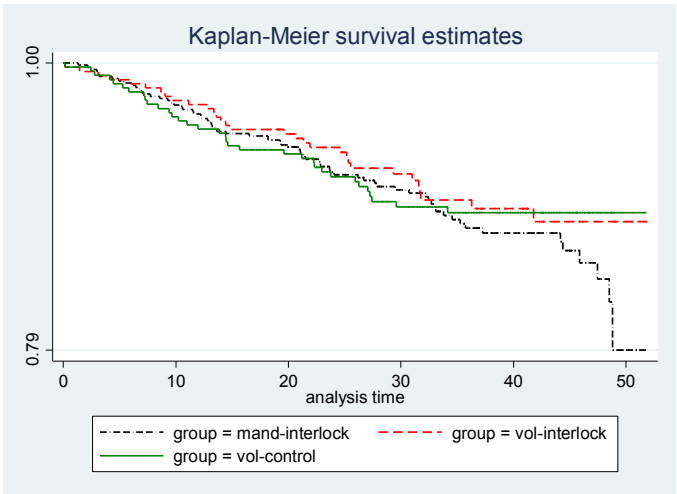
Based on a number of statistical tests (see the technical report for details), the data suggested the interlock program had a very strong effect on the behaviour of interlocked offenders. In particular, offenders in the voluntary control group were 10.5 times more likely to be convicted of an alcohol-related driving offence than offenders in the voluntary interlock group.

Table 4-1: Cox regression for convictions of the interlock-voluntary group with the control-voluntary group		
Factor	hazard ratio	significant
Groups		
interlock- voluntary	(baseline)	
control-voluntary	10.45	yes
age-category		
15-24	(baseline)	
25-34	1.64	no
35-44	1.12	no
45-64	1.05	no
65 and over	1.27	no
Gender		
female	(baseline)	
male	2.5	no
condition 37		
without condition	(baseline)	
with condition	1.45	no

4.2 Crashes

This subsection presents survival analyses similar to the previous section but with respect to crashes. The figure does not show evidence that the survival functions were different.

Figure 4-2: Kaplan Meier survival estimates for crashes for all groups



Statistical tests (see the technical report for details), suggested that the hazard ratios for crashes between the different groups were not statistically significant. The results also showed that age, gender and condition 37 were not relevant in determining the hazard rate of the participants.

Table 4-2: Cox regression for crashes of the interlock-voluntary group with the control-voluntary group		
Factor	hazard ratio	significant
Groups		
interlock- voluntary	(baseline)	
control-voluntary	1.37	no
age-category		
15-24	(baseline)	
25-34	1.36	no
35-44	0.63	no
45-64	0.69	no
65 and over	1.06	no
Gender		
female	(baseline)	
male	1.14	no
condition 37		
without condition	(baseline)	
with condition	0.87	no

4.3 Conclusions

The influence of the interlock program was examined in terms of convictions and crashes using survival analysis during the entire study period, i.e., both when the interlock was installed and after it was removed. With respect to convictions, the participants in the interlock program were less prone to have alcohol-related convictions; the survival analysis revealed it took longer for interlock participants to incur a conviction compared to the control participants. Although the voluntary-interlock group seems to be slightly less prone to have alcohol-related convictions in the long-term than the mandatory-interlock group, the differences were not statistically significant. In other words, the survival analyses support the notion that the interlock program is associated with a positive impact on reducing the risk for alcohol-related convictions, and there seems to be no difference with respect to mandatory and voluntary participants. This overall finding holds even when the voluntary-interlock group was compared to the voluntary-control group. Therefore, it can be concluded that the data suggest the interlock program had a very strong effect on the behaviour of all interlocked offenders. Of importance, the voluntary-control group with no interlock device were 10.5 times more likely to be convicted than offenders who voluntarily participated in the interlock program.

With respect to crashes there seems to be no statistically significant differences between the participants in the interlock and control groups.

It warrants mentioning that since the amount of data in the analyses was not very large, similar analyses were conducted using extra information for the interlock groups. The extra information consisted of including participants in the interlock program who enrolled before the intake period (from November 2008 to February 2010). While it can be argued that this unbalanced design would likely bias the results, overall, the findings were the same and this bolsters the validity of this finding.

5. SURVIVAL ANALYSIS AFTER THE PROGRAM

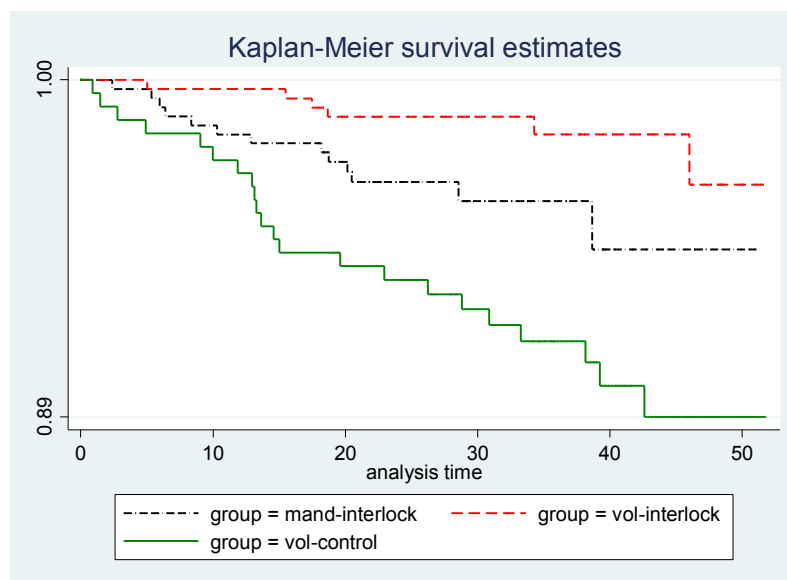
The survival analyses in the previous section examined the impact of the program since the installation of the device until the end of the study, whether the interlock device was still installed or not. In this section, survival analyses examine the impact of the program after the interlock device had been removed from the vehicle. For these analyses, only those who had the device removed in the period March 2010-December 2012 were considered in the interlock experimental groups. Since the data for the mandatory-control group were very limited this group was not included in the analyses.

As in the previous section, survival analysis was used to compare the different study groups in terms of time to re-offend or crash during the tracking period based on their convictions and crash records (see appendix A for a description of the offence codes considered). The first subsection presents results with respect to convictions and the second with respect to crashes.

5.1 Convictions

Figure 5-1 shows that the survival pattern is very different for the voluntary-control group in comparison to the two interlock groups, meaning that the interlock groups did not accumulate more convictions as quickly as those without an interlock. As before, the analysis time on the horizontal axis is measured in units of months and it represents the tracking period for each participant.

Figure 5-1: Kaplan Meier survival estimates for convictions for all groups



The figure shows that it took longer for the interlock groups to have an alcohol-related driving conviction than the voluntary-control group. The figure also shows that the voluntary-interlock group had a more optimistic survival pattern (it takes longer before being convicted) than the mandatory-interlock group.

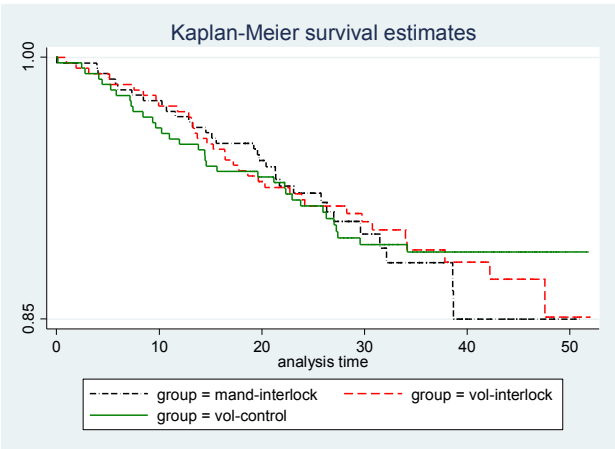
The least biased comparison between both voluntary groups, the voluntary-interlock and the voluntary-control, showed evidence that interlocked offenders had a significantly smaller chance of re-offending, even when only looking at the data after the interlock was removed. In this case offenders in the control-voluntary group were 5.4 times more likely to be convicted of an alcohol-related driving offence than offenders in the interlock-voluntary group after the device was removed.

Table 5-1: Cox regression for convictions of the interlock-voluntary group with the control-voluntary group		
Factor	hazard ratio	significant
Groups		
interlock- voluntary	(baseline)	
control-voluntary	5.41	yes
age-category		
15-24	(baseline)	
25-34	2.24	no
35-44	1.27	no
45-64	1.65	no
65 and over	1.53	no
Gender		
female	(baseline)	
male	2.88	no
condition 37		
without condition	(baseline)	
with condition	1.55	no

5.2 Crashes

Figure 5-2 shows that the survival pattern was not very different for the three groups. Several tests did not find evidence that the survival functions were different.

Figure 5-2: Kaplan Meier survival estimates for crashes for all groups



The Cox regression below comparing both voluntary groups, the voluntary-interlock and the voluntary-control, also showed no statistically significant results in terms of groups, gender and condition 37. However, the age groups 35-44 and 45-64 had significantly smaller hazard ratios than the younger baseline group aged 15-24 (hazard ratios 0.37 and 0.47 respectively).

Table 5-2: Cox regression for crashes of the interlock-voluntary group with the control-voluntary group		
Factor	hazard ratio	p-value
Groups		
interlock- voluntary	(baseline)	
control-voluntary	1.08	no
age-category		
15-24	(baseline)	
25-34	0.99	no
35-44	0.37	yes
45-64	0.47	yes
65 and over	0.56	no
Gender		
female	(baseline)	
male	0.96	no
condition 37		
without condition	(baseline)	
with condition	1.09	no

5.3 Conclusions

The results in this section (survival time since the interlock device was removed until the end of the study) were similar to the results in the previous section (survival time since the interlock device was installed until the end of the study). With respect to convictions, the risk of having an alcohol-related conviction was significantly larger for the voluntary-control group compared to the risk for both interlock groups combined, as well as compared to the risk of the voluntary-interlock group alone. With respect to crashes, in both cases there seemed to be no statistically significant differences between the interlock and the control groups.

Although the differences between interlock and control groups in terms of risk for convictions were less pronounced after the device was removed from the vehicle (hazard ratios in this section are less pronounced than in the previous section), the interlock program still had a significant and positive effect. This suggests a positive effect of the program in reducing the risk for alcohol-related convictions that is sustained, albeit less pronounced, after exiting the program. The less pronounced effect of the interlock on

the behaviour of interlocked offenders after device removal was a logical finding and it was consistent with the literature (see Alcohol Interlock curriculum for practitioners <http://aic.tirf.ca/section2/qa.php#q8>).

6. TIME SERIES ANALYSIS

In this section the results from the time series analyses are described. As explained in the methodology, these analyses used data from the province as a whole, including drivers who were not enrolled in the interlock program. As such, the time series analyses facilitated the study of the general impact of the interlock program on the general population.

A subsection is devoted to each time series (monthly counts of alcohol-related convictions, convictions and crashes) to explain the different steps involved in the building of the model as well as the results from each final model (see appendix A for a description of the offence codes considered).

6.1 Charges

After testing several time series models, i.e., sudden permanent, gradual permanent and sudden temporary models, it was determined that there was a sudden, albeit temporary effect associated with the first month after AIIP was implemented, i.e., September 2008. The effect suggests that, when controlling for trends in the population over age 16, unemployment rates, heavy drinking rates, alcohol sales and the non-alcohol-related charges, the implementation of the program in September 2008 had a non-lasting significant effect in the first month of the implementation. This effect was a 13.32% decrease in the number of alcohol-related charges in the first month of the program.

6.2 Convictions

For the time series of convictions there was a sudden temporary effect in the seventh month after implementation, i.e., March 2009. The effect suggests that, when controlling for trends in the population over age 16, unemployment rates, heavy drinking rates, alcohol sales and the non-alcohol-related convictions, the implementation of the program in September 2008 had a non-lasting significant effect in the seventh month of the implementation. This effect is a 9.93% decrease in the number of alcohol-related convictions.

It is interesting to note that while the effect found for the time series of charges was after the first month following the intervention, for the convictions the effect was found after the seventh month. It takes longer for convictions to appear compared to charges, thus it can be argued that it is normal to only see an effect several months later, in this case seven. The time between charges and convictions as apparent from these analyses seems to coincide with this time as reported in a lawyer's survey conducted in Canada, where it was found that it takes on average approximately six to seven months for a charge to proceed to a conviction (Robertson et al. 2009).

6.3 Crashes

Ten months after implementation there was a gradual and permanent effect on the number of crashes that was only significant at the 10% level but not at the more rigorous 5% level. The results suggested

that, when controlling for trends in the population over age 16, unemployment rates, heavy drinking rates, alcohol sales and the non-alcohol-related fatal and serious crashes, the implementation of the program in September 2008 did not have a significant effect at the 5% level. However, the effect at the 10% level of significance represented a decrease of 0.0025 in the number of alcohol-related crashes every month since June 2009. Note that, from a statistical point of view, this represents a small decrease corresponding to one fatal or serious alcohol-related crash in approximately 33 years.

6.4 Conclusions

The possible impact of the interlock program was examined in terms of charges, convictions and crashes using time series analysis. With respect to charges and convictions, the results presented in sections 6.1 and 6.2 suggest that there were no permanent effects in relation to the number of alcohol-related charges and convictions associated with the implementation of the program. There were significant, albeit temporary effects in the first and seventh month of implementation. These effects were a 13.32% decrease in the number of alcohol-related charges and a 9.93% decrease in the number of alcohol-related convictions in the first and seventh month of the implementation of the program.

With respect to crashes, according to the results presented in section 6.3, there were no significant effects associated with the implementation of the program in the number of alcohol-related crashes with fatal and serious injuries at the 5% level of statistical significance. However, there was a gradual permanent effect at the 10% level of significance that represents a small decrease – statistically speaking – of 0.0025 in the number of alcohol-related crashes every month since June 2009 (10th month of the program). Note that this was perhaps not unexpected as to date, most studies have not yet been able to definitively demonstrate a positive impact on crashes due to the small sample sizes and the lack of sufficient data.

7. QUESTIONNAIRE DATA ANALYSIS

Questionnaire data analysis was used to study attitudes and opinions regarding the interlock program, drinking behaviour and drink driving behaviour at different moments in time. Among the 481 participants who provided consent to participate and filled out questionnaires at intake, 32 completed exit questionnaires (exiting the DWI program and the interlock program) and only 20 completed the six month follow-up questionnaire. Furthermore, although there were 20 follow-up questionnaires at follow-up time for interlock participants, only one participant completed questionnaires at the three different times (intake, exit and follow-up).

Consequently, a description of the aggregated data at each relevant time is presented but analysis of the data to study behavioural changes was very limited. Regression models to describe the change in RIASI scores between intake and exit are presented for the 26 participants for whom data were available, but caution is warranted when interpreting these results due to the small sample sizes.

7.1 Descriptive analysis

The questionnaires completed by participants assessed a variety of characteristics. A series of statistical tests were conducted to compare the observed differences between the different groups at intake in order to determine the comparability of the groups.

To assess drink driving behaviour, all people who consented to participate in the study (i.e., the interlock-mandatory, interlock-voluntary and control-voluntary groups) were asked to complete the self-reported behaviour questionnaire. Among the approximately 8% of participants who reported the need to drive their car while impaired and decided not to drive it, the interlock-mandatory group had the largest mean, but the differences between the groups were not significant. With respect to the situation where they needed to drive their car while impaired and decided to drive it, only 2% of the respondents were in such a situation and the data were insufficient to compare groups.

The RIASI questionnaire contained several subscales, two of which were relevant to this evaluation – Total score and Risk of Recidivism. The RIASI Total scores were in the wide range of 8-41. A Total score of 9 or more is recommended as a cut-off point for an indication of potential problems. Of all participants, 99.8% had a Total score above 9 and the average Total score was 18.34 and this did not differ significantly between the groups.

The Risk of Recidivism subscale assesses the likelihood that the individual will be arrested on a subsequent occasion for a drink driving offence. A score of 3 or more for males and 4 or more for females on this scale is considered indicative of a high risk of recidivism. Overall, 98.32% of participants exhibited this level of risk. The average score was 6.72 and it did not differ significantly between the groups.

The Readiness to Change questionnaire allowed participants to be placed in one of four categories based on a model of stages of change. The stage indicates the individual's progress towards a change in their

problematic behaviour. Overall, approximately one-quarter (25.79%) of participants were in the pre-contemplation stage. Essentially, these individuals were not considering any change in their behaviour at the time the questionnaire was completed. Approximately 8% were considering a change in their behaviour but had done little if anything (contemplation to make a change). The stage with more participants (51.6%) was the action stage in which they were actively engaged in changing their behaviour. Finally, 14.6% were considered to be in the maintenance stage where they had changed their behaviour and were working to maintain the changes they had made. Both interlock groups differed in the assessed stage of change (statistically significant). The largest difference was in the pre-contemplation stage, where there was a larger proportion of interlock-voluntary (35.2%) compared to interlock-mandatory participants (13%). In addition, the total percentage of participants in the action and maintenance stages was larger (73.91%) in the interlock-mandatory than in the interlock-voluntary (56.33%). This means that the interlock-voluntary group was more likely to be in the pre-contemplation stage and the interlock-mandatory group was more likely to be taking action. However, the differences between both voluntary groups are not statistically significant.

Similar measures of both interlock groups and control group participants were collected at the exit of the interlock program or the DWI program. However, the data were too limited to draw robust conclusions. Regarding the measures of both interlock groups at follow-up, again, the data were too limited to draw any conclusions in this respect.

Regarding the question about driving a non-interlocked vehicle while in the program, a few members (2/16) of the mandatory-interlock group reported driving a non-interlocked vehicle (1 or 2 occasions). The respondents from the voluntary-interlock group reported zero occasions driving a non-interlocked vehicle. This is an important finding since it is typically assumed that this rarely happens and it is not common to find evidence of it; the evidence from this study supports the notion that this rarely happens indeed.

7.2 Regression analysis

As previously mentioned, analysis of the data to study behavioural changes was very limited. Data from the RIASI questionnaire at intake and exit was available for only 26 participants. Therefore caution is warranted when interpreting the results from the regression models.

A regression model for the change in RIASI Total score (defined as the RIASI total score at intake minus the RIASI total score at exit) indicates that both voluntary groups have larger changes (positive coefficients) in the RIASI Total score over time than the interlock mandatory group. The change is larger for the voluntary interlock group than for the control group. However, these results were not statistically significant so no meaningful conclusions can be drawn.

A regression model for the change in RIASI recidivism score (defined as the RIASI recidivism score at intake minus the RIASI recidivism score at exit) indicates that the voluntary interlock group has larger changes (positive coefficient) in the RIASI recidivism score over time than the interlock mandatory group. On the

other hand, the voluntary control group has smaller changes in the RIASI recidivism score over time than the interlock mandatory group. However, these results are not statistically significant, making it difficult to draw meaningful conclusions.

7.3 Conclusions

The amount of data from the questionnaires at exit and follow-up was too limited to draw meaningful conclusions about behavioural changes. This must be kept in mind when considering the results from these analyses.

The data from the RIASI questionnaire revealed that at the beginning of the study there were no significant differences between the groups with respect to the extent of alcohol use and recidivism. Basically all participants had potential problems with alcohol with no significant differences in the level of the problems. A large percentage of participants (98.3%) were assessed based on the RIASI to have a high risk of recidivism.

The Readiness to Change questionnaire at the beginning of the study showed differences in the attitudes among mandatory versus voluntary interlock participants. The majority of the mandatory participants (73.9%) were in the action or maintenance stages where they were reportedly changing their behaviour or were working to prevent a relapse. The percentage of voluntary-interlock participants in these stages was 56.33%. No significant differences were found in this respect between both voluntary groups.

The self-reported behaviour questionnaire revealed no significant differences between the groups. However, an interesting reported fact is that there was some evidence which showed that there were a few instances where interlock participants (in the mandatory group) drove a non-interlocked vehicle while in the program. In this regard, the evidence from this study supports the evidence in the literature that this rarely happens indeed.

8. INTERLOCK DATA ANALYSIS

8.1 Descriptive analysis

Table 8-1 compares mandatory- versus voluntary-interlock participants in terms of descriptive statistics for time in the program (in months), mileage driven (in kilometers; note that five outliers were identified with impossible values, which were not included when calculating the mean and median), total logged events per month and attrition rate for 1,323 participants for whom data were available during the study period.

The attrition rate in a period represents the percentage of participants who exited the program before their anticipated termination. The data showed that on average a mandatory participant drove 15.6% more in a month than a voluntary participant. With respect to the total logged events per month and attrition rates, there were not significant differences between both groups.

Table 8-1: Descriptive Characteristics of Interlock participants		
	Mandatory	Voluntary
Months in program		
mean (SD)	26.1 (10.3)	10.1 (5.3)
Average* mileage driven per month		
mean (SD)	2,946 (3,893)	2,546 (4,276)
median (IQR)	1,961 (1,782)	1,690 (1,332)
Total logged events per month		
mean (SD)	268.4 (115.3)	266 (122)
median (IQR)	259.7 (147.6)	244.1 (147)
Attrition in 12 months		
	3.3%	5.3%
*average mileage driven calculated after removing 5 outliers		

A total of 7,148,274 events were collected from the interlock devices used by the participants. The collected events were the results from the breath test when trying to start the car (start-up) or after having started the car (running retest). Results from these breath samples were classified by the device according to the BAC level as “pass” (BAC level under 0.02%) or “fail” (BAC level over 0.02%). Table 8-2 shows the distribution of event types in the data.

Table 8-2: Event types		
	N	%
All	7,148,274	100
fail at start-up	11,282	0.16
fail running retest	3,141	0.04
pass at start-up	3,760,015	52.60
pass running retest	3,373,836	47.20

The data were analyzed in relation to the type of events. The events were broken down in periods of time to help reveal changes in behaviour over time. This report presents the analyses of the data by month. Analyses based on periods of three months are available in the technical report. The analyses were also analyzed by gender, program status (mandatory or voluntary), condition 37 and device type.

8.2 Fails in monthly periods

Figure 8-1 shows the number of participants overall and according to different factors over time. Figure 8-2 shows fails and participants failing over time by the different BAC limits (0.02, 0.05 and 0.08). The curves show a decline in the number of fails over time, but the number of participants also decreased.

Figure 8-1: Number of participants overall and by factors over time

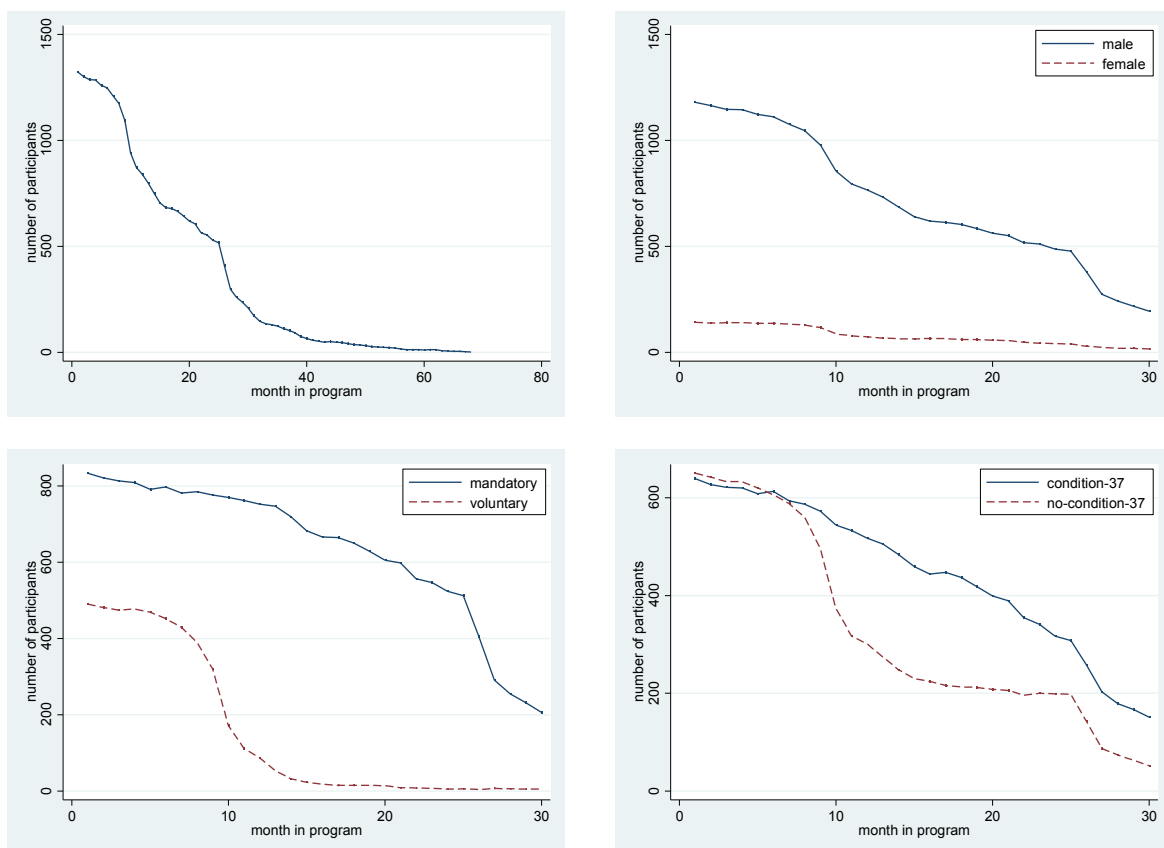


Figure 8-2: Number of fails and participants failing over time

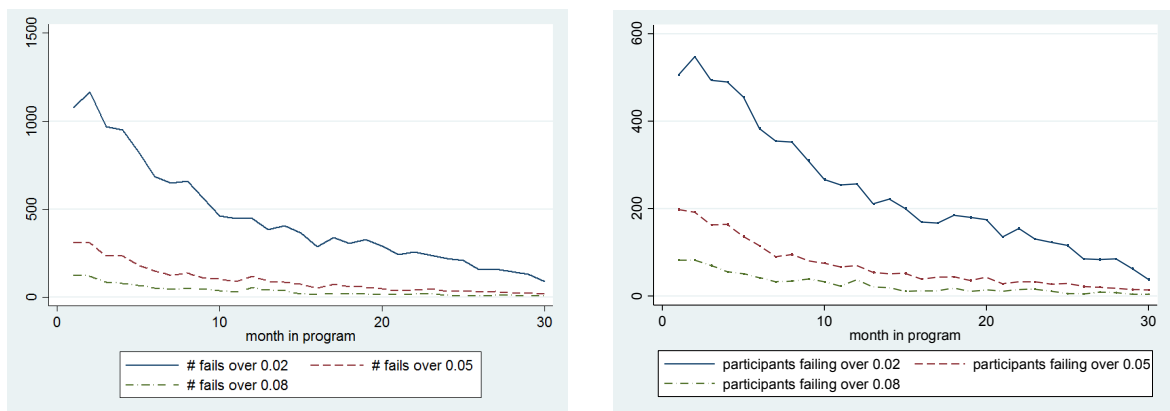
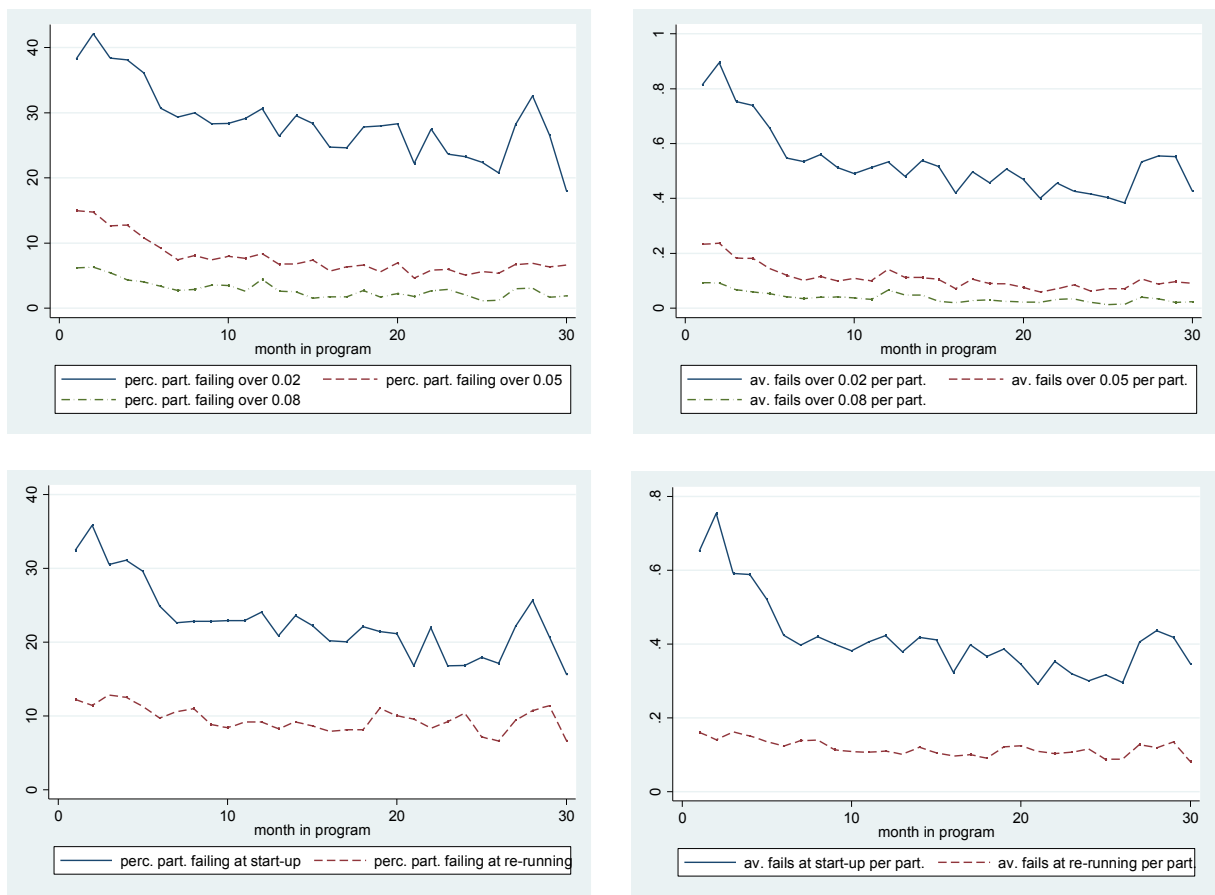


Figure 8-3 shows the percentage of participants failing and the average number of fails by participants over time for the different BAC limits (0.02, 0.05 and 0.08) as well as for start-up and running retests. The curves show that the percentage of participants failing and the average number of fails per participant decreased over time. The decrease was more pronounced in the first 10 months and then became less pronounced and was almost negligible in the subsequent months. Of particular interest was that after the 24-month period the curves showed some high peaks or increasing pattern; this result was more pronounced in the case of the less risky behaviour (BAC over 0.02). This may suggest that the less risky behaviour of driving at low BAC continues or may even return over a longer period of time.

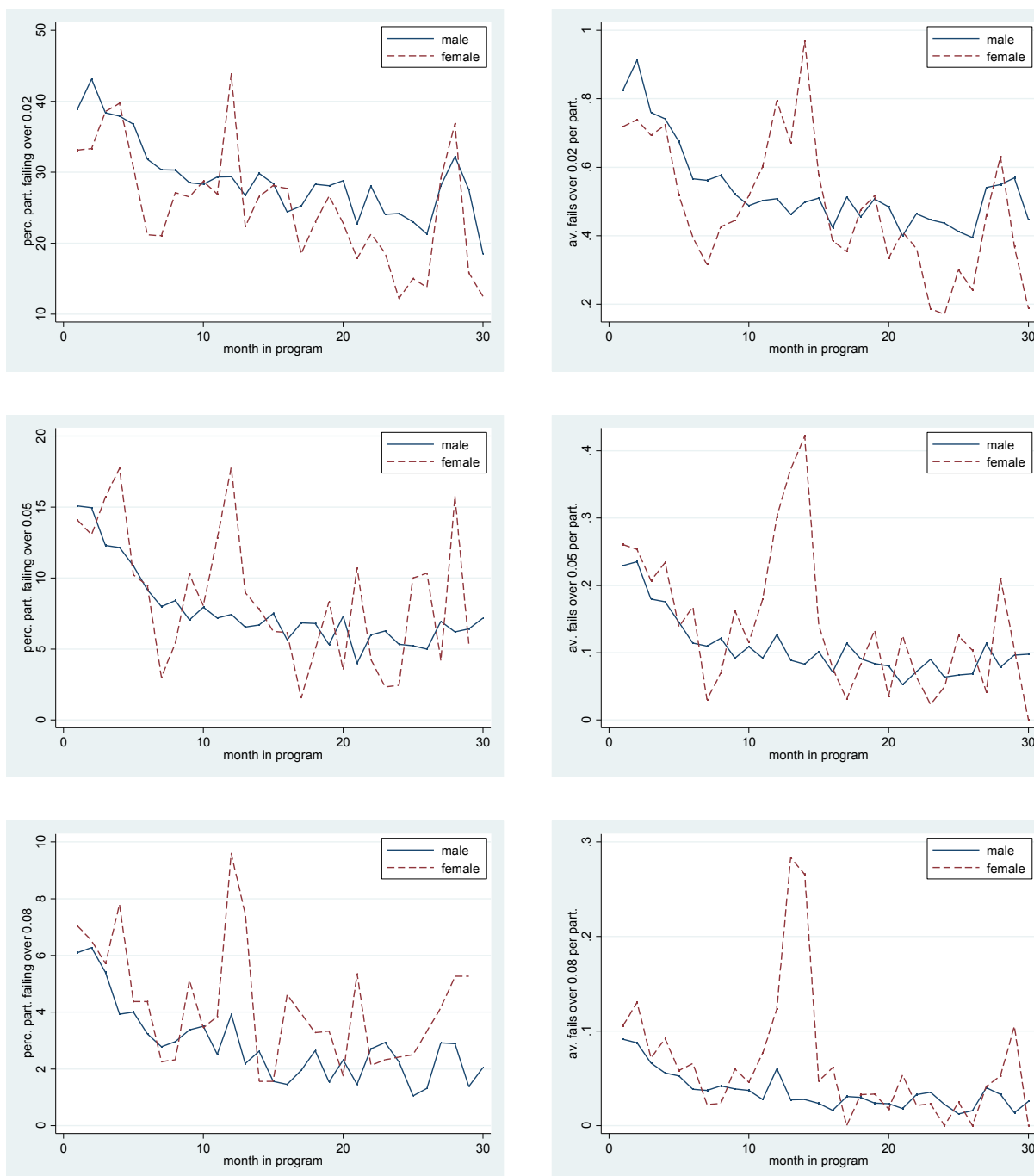
Figure 8-3: Percentage of participants failing and average number of fails by participants



8.2.1 Gender

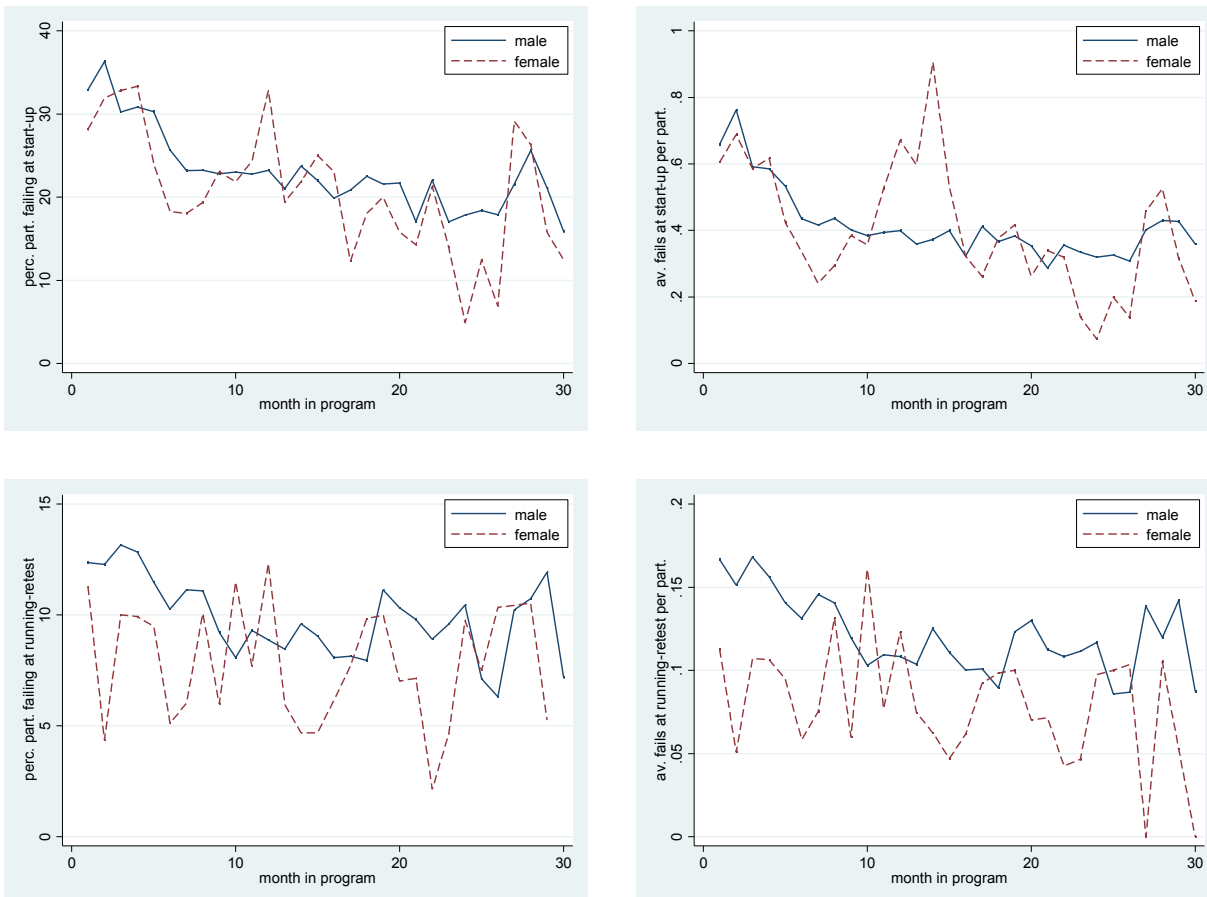
Figure 8-4 shows the percentage of participants failing and the average number of fails by participants over time for the different BAC limits (0.02, 0.05 and 0.08) according to gender. Figure 8-5 shows the percentage of participants failing and the average number of fails by participants over time at start-up and running retests by gender.

Figure 8-4: Percentage of participants failing and average number of fails by participants, according to gender



In general, the curves for males were similar to the overall curves in the previous section (males represented approximately 91% of total participants). They showed a general decreasing pattern for the percentage of participants failing and the average number of fails per participant. On the other hand, the curves for females showed irregular patterns, particularly after the tenth month in the program. In general, there seemed to be a decreasing pattern in the curves for females up to about month ten, except for running retests. This means that males and females become more compliant with the device over time.

Figure 8-5: Percentage of participants failing and average number of fails by participants, according to gender at start-up and running retests



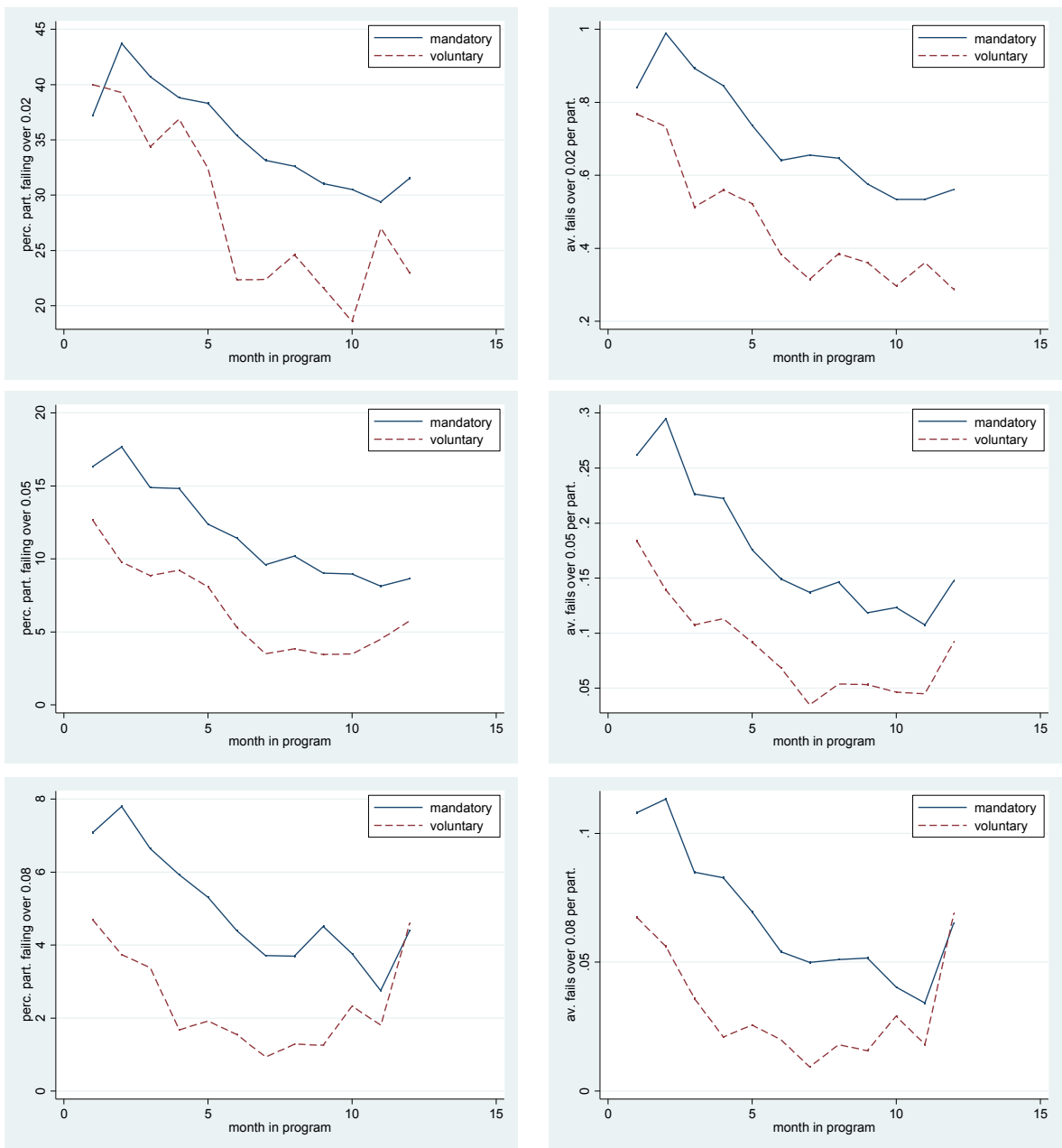
Comparing male versus female participants in general, there appeared to be no large differences, meaning that males and females in the program showed comparable behaviour. Upon closer examination, from installation up to month ten in the program, the percentages and averages for failed tests over 0.02 at start-up and at running retests appeared slightly smaller for females than for males. However, for failed tests over 0.05 and over 0.08, the curves for females are more volatile and this is because the number of female participants in the program is quite low.

8.2.2 Mandatory versus voluntary

Figure 8-1 shows the number of participants by program status over time. Although the voluntary participants were defined by those expected to be in the program for less than a year, some may have received an extension beyond a year. Since the number of voluntary participants beyond one year was very small, the next figures show data over a 12 month period only.

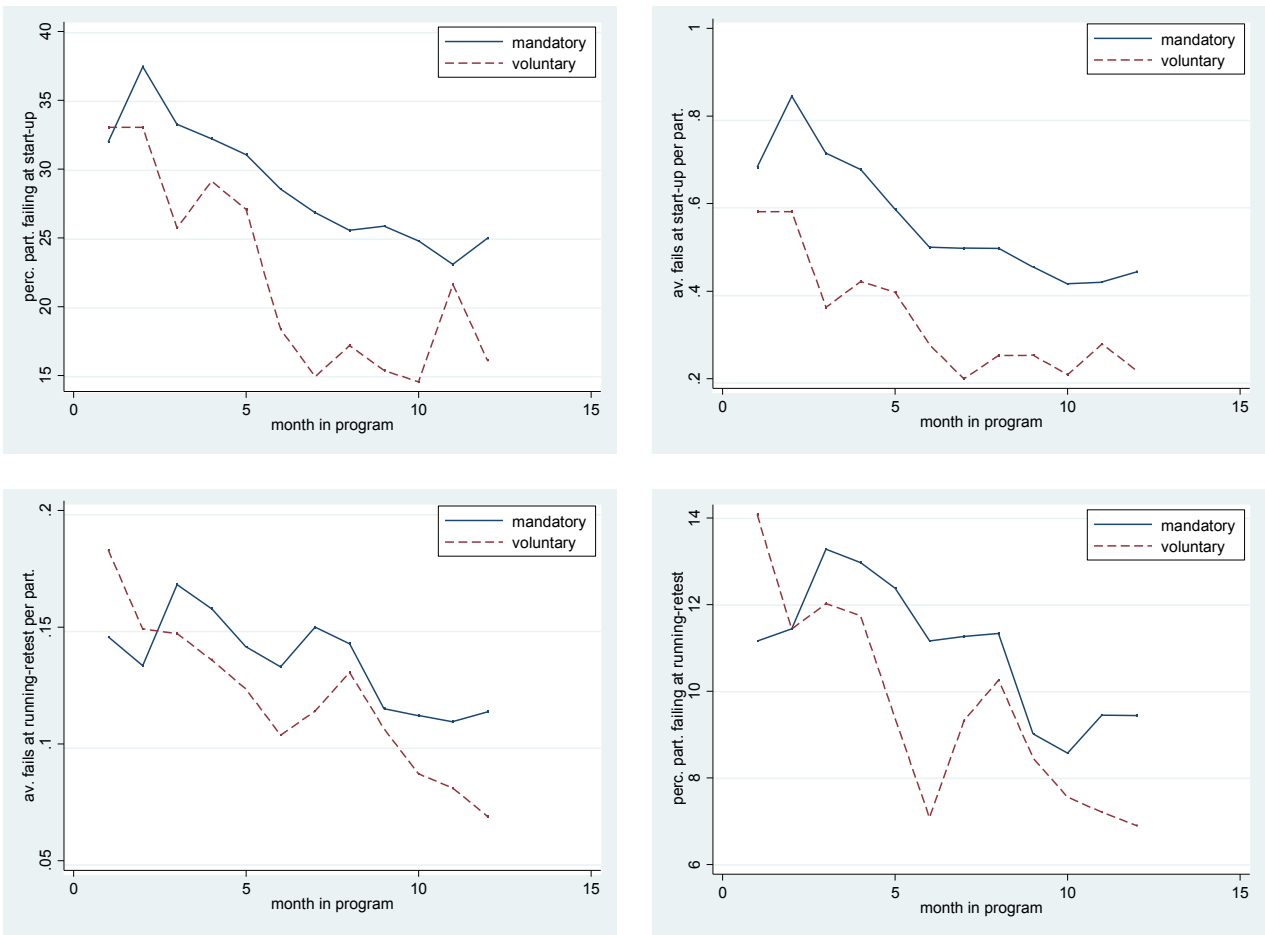
Figure 8-6 shows the percentage of participants failing and the average number of fails by participants over time for the different BAC limits (0.02, 0.05 and 0.08) by status. Figure 8-7 shows the percentage of participants failing and the average number of fails by participants over time at start-up and running retest according to voluntary versus mandatory status.

Figure 8-6: Percentage of participants failing and average number of fails by participants.
By status



In general, the percentages and averages were smaller for the voluntary participants than for the mandatory ones meaning that the voluntary participants became more compliant more quickly. However, both mandatory and voluntary participants revealed a decreasing pattern in the percentage of participants failing and in the average number of fails per participant over time.

Figure 8-7: Percentage of participants failing and average number of fails by participants. By status at start-up and running retests



8.2.3 By condition 37

Figure 8-8 shows the percentage of participants failing and the average number of fails by participants over time for the different BAC limits (0.02, 0.05 and 0.08) by condition 37. Figure 8-9 shows the percentage of participants failing and the average number of fails by participants over time at start-up and running retest by condition 37.

Figure 8-8: Percentage of participants failing and average number of fails by participants. By condition 37

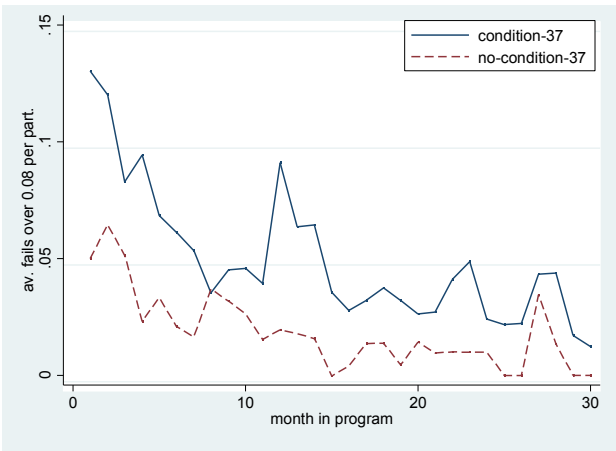
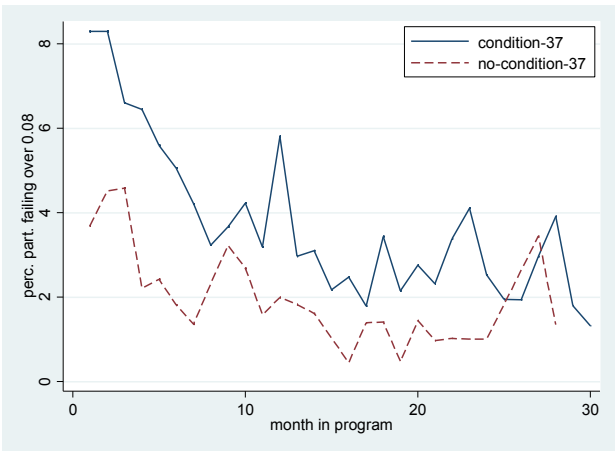
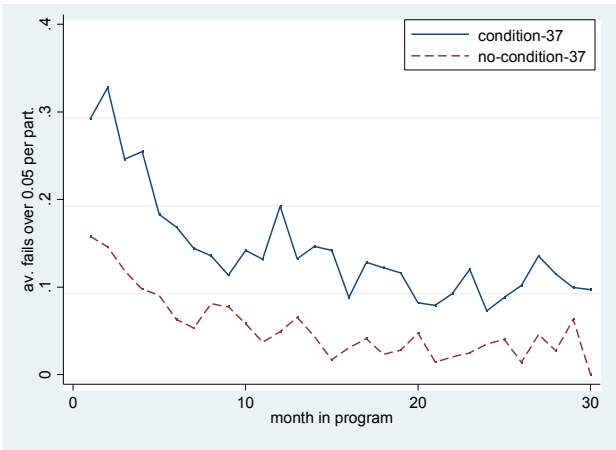
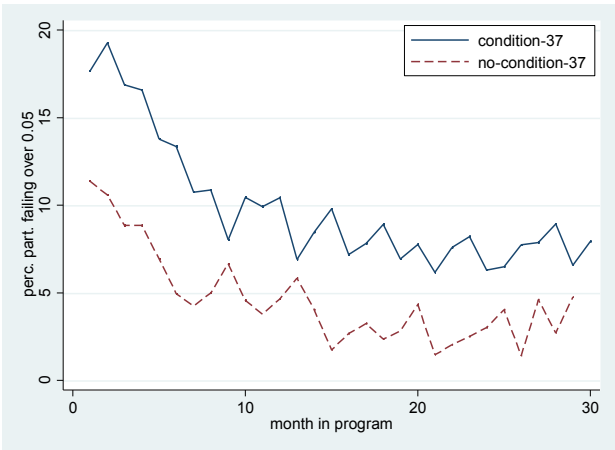
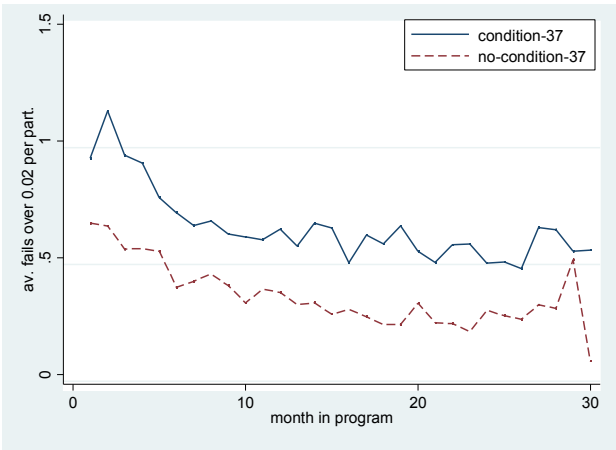
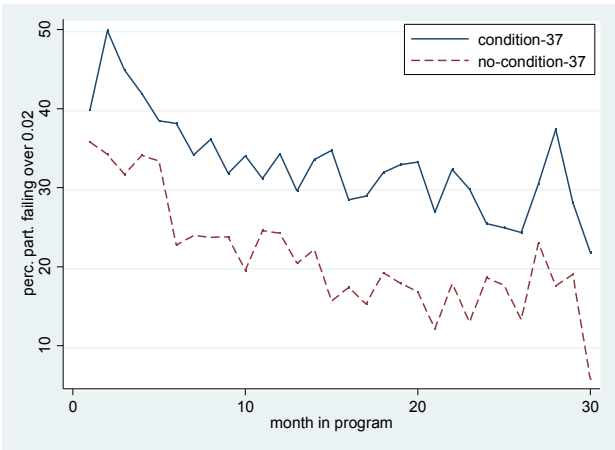
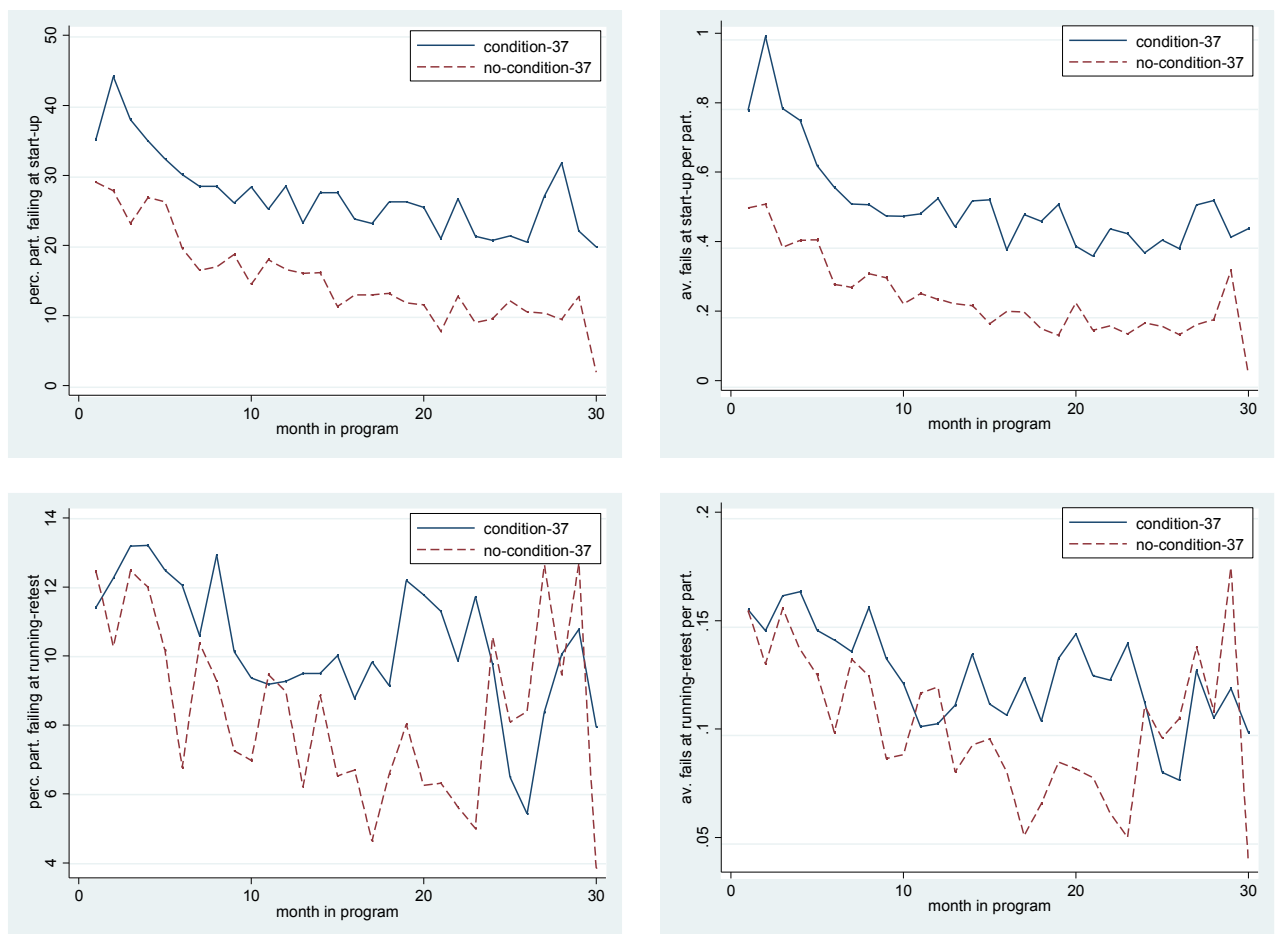


Figure 8-9: Percentage of participants failing and average number of fails by participants. By condition 37 at start-up and running



In general, the percentages and averages were smaller for the participants without the condition than for the participants with the condition, meaning that participants without the condition were more compliant with the program. However, both groups of participants reveal a decreasing pattern in the percentage of participants failing and in the average number of fails per participant over time.

8.3 Logistic regression analysis

Logistic regression analysis enabled a comparison of the odds of a failed test versus the odds of a passed test while simultaneously controlling for several factors like months in the program, gender, age, mandatory/voluntary status, start-up/running type of test, condition 37 and average mileage driven per month (per thousands of kilometers).

Table 8-3 shows the estimated logistic models for the fails over the 0.02, 0.05 and 0.08 limits in a 12 month tracking period. In the model for the fails over the 0.02 limit all estimated parameters are significant (p -values<0.05) except for gender and one age category, age 35-44 (p values= 0.056 and 0.3). The results show that the odds of failing over the 0.02 limit:

- > decreased over time (OR=0.94), 6% per month;

- > were larger (OR=1.3) for a mandatory participant than for a voluntary participant;
- > for a participant with condition 37 are larger (OR=1.5) than for a participant without the condition;
- > were larger (OR=3.4) at start-up than at running retests; and,
- > decreased with mileage driven (OR=0.97), 3% per 1000 kilometers.

The estimated models for fails over the 0.05 and 0.08 limits were similar in the sense that the same factors

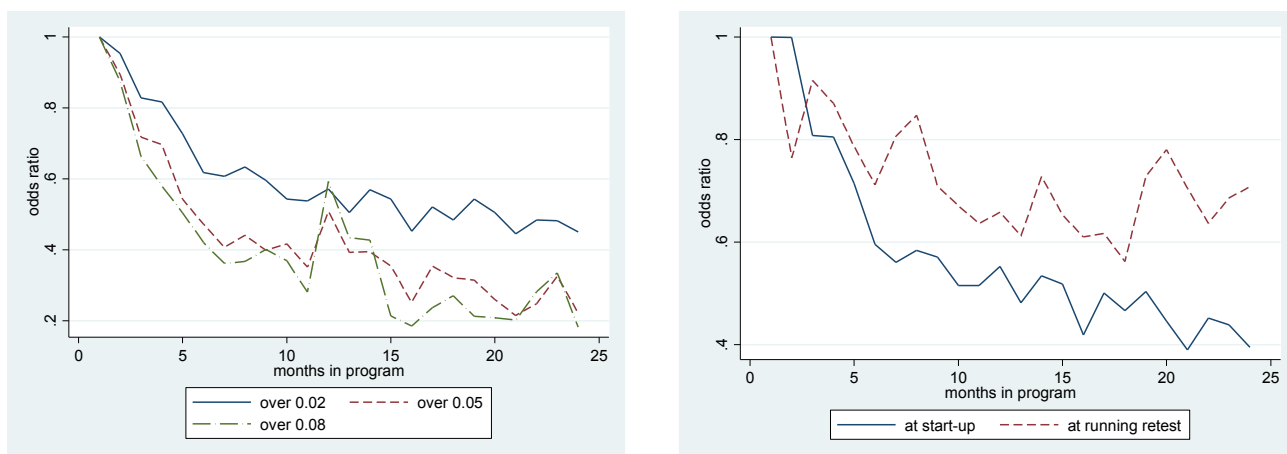
Table 8-3: Logistic regression models for fails over 0.02, 0.05 and 0.8						
	over 0.02		over 0.05		over 0.08	
	hazard ratio	p-value	hazard ratio	p-value	hazard ratio	p-value
months	0.94	<0.001	0.91	<0.001	0.91	<0.001
gender						
female	(baseline)		(baseline)		(baseline)	
male	0.93	0.06	0.69	<0.001	0.63	<0.001
age-category						
15-24	(baseline)		(baseline)		(baseline)	
25-34	0.73	<0.001	0.70	0.002	0.79	0.26
35-44	0.93	0.17	0.93	0.50	1.12	0.58
45-64	0.85	0.001	0.92	0.46	1.27	0.23
65 and over	0.79	0.001	0.48	<0.001	0.64	0.11
status						
voluntary	(baseline)		(baseline)		(baseline)	
mandatory	1.29	<0.001	1.70	<0.001	2.01	<0.001
condition 37						
without condition	(baseline)		(baseline)		(baseline)	
with condition	1.51	<0.001	1.89	<0.001	1.80	<0.001
event type						
at start-up	(baseline)		(baseline)		(baseline)	
running retest	3.42	<0.001	14.37	<0.001	18.4	<0.001
average mileage per month	0.97	<0.001	0.92	<0.001	0.86	<0.001

(months, status, condition 37, event type and mileage) were significant and the value of their odds ratios indicated that those same factors were more likely to be associated with fails in both models. However, the effect of the different factors seemed to be slightly more pronounced for the more risky behaviour since the values of the odds ratios were not as close to 1. One particular difference was with respect to gender. In the models for fails over 0.05 and 0.08 gender was significant (pvalues<0.001). It should be noted however, that the differences in gender were actually small (0.07% versus 0.05% of fails or 0.03% versus

0.02%). Due to the large sample size (3,942,047 observations) small effects were more easily found to be significant, even when the actual differences might not be meaningful.

With the logistic regression analysis it was possible to obtain the odds ratios for the specific values of categorical variables. This allowed, for example, obtaining the odds ratios for each value of the month with respect to the first month and seeing how the odds for failing changed over time from month to month. Figure 8-10 shows the change over time of the odds ratios for failed tests comparing the three limits (0.02, 0.05 and 0.08) and start-up fails versus running retest fails. The figure shows that the odds of failing decreased faster for the more risky behaviours (fail over 0.05 and 0.08) suggesting that participants learned faster to be compliant and to avoid these more risky behaviours. The comparison between failing at start-up and running retests suggested that participants learned to be compliant faster during start-up breath tests than during running retests.

Figure 8-10: Change over time of odds ratio for failed tests relative to month 1



8.4 Conclusions

Overall, results from the interlock data suggested that there were “learning curves”, illustrating that offenders were more likely to violate at the beginning of program participation (with larger percentage and average number of violations per participants and larger odds for failing tests), but over time these violations decreased as offenders learned about, or experienced the consequences of, program violations and the nuances associated with the functioning of, and compliance with, devices. In general, the curves were steepest at the beginning of program participation until approximately month 10, indicating that the “learning effect” may decrease or stop after a period of time. However, it warrants mentioning that the decreasing pattern of the events was not always a smooth one. Sometimes the curves revealed peaks, despite an overall decrease from the beginning until the end of the program, but it was not clear if those peaks were the result of a data artefact or true peaks. In this regard, it warrants mentioning that the data became more volatile toward the end of the tracking period because fewer participants were still in the program.

In general, between males and females there did not appear to be large differences in terms of percentage of participants that failed and average number of fails per participant. Although both groups had a learning effect up to at least month ten in the program (when the data for females were more reliable), the descriptive analyses indicated that, in general, the learning effect was more pronounced in male participants than female participants. The more volatile nature of the data for females was related to the smaller number of female participants in the program, especially longer than ten months. The logistic regression for the odds of failing tests versus passing tests supported these findings and even when the gender factor was significant, the differences were very small.

Clear differences were found between mandatory and voluntary participants. Although both groups revealed a learning effect, the effect was more pronounced for voluntary participants. In general, the mandatory participants exhibited odds of failing approximately 20% larger than the odds for the voluntary participants. Also, clear differences were found between participants with condition 37 and participants without this condition although both groups revealed a learning effect. The effect was more pronounced for the participants without the condition, who also had smaller odds of failing.

With respect to the comparisons between fails at start-up or fails at running retests, it seemed the learning effect was more pronounced at start-up with larger decreases in the percentage of participants failing, although it is acknowledged that the percentages of fails were larger at start-up than at running retests from the outset. In addition, the odds of failing tests were larger at start-up than running re-retests.

With respect to the three BAC limits (0.02, 0.05 and 0.08), the odds of failing decreased faster for the more risky behaviours (fails over 0.05 and 0.08) suggesting that participants learned faster to be compliant and avoid these more risky behaviours.

9. OVERALL CONCLUSIONS

The overall objective of the outcome evaluation was to examine the impact of Nova Scotia's interlock program on participants and to help identify areas for improvement. Different types of data were used in this evaluation, including conviction and crash records of individual participants, self-administered questionnaires to measure specific attitudes and behaviour, monthly counts of charges, convictions and crashes, and interlock logged events. Control data (not alcohol-related/non-interlocked participants) were also used to better support the findings for each type of experimental group (alcohol-related/interlock participants).

The data were analyzed in different ways. First, the descriptive analyses revealed that in general there were no significant differences between the respective experimental and control groups at the beginning of the study period with the exception of age-related differences. In terms of alcohol-related convictions, the control-voluntary group exhibited a recidivism rate of 8.9% during the study period, while the interlock-voluntary and interlock-mandatory groups had a 0.9% and 3% recidivism rate respectively after the installation of the interlock device. The recidivism rate for the interlock groups increased to 1.9% (voluntary group) and 3.7% (mandatory group) after the device was removed from the vehicle, but they were still smaller than the rate for the control-voluntary group. This means that interlock participants had lower recidivism rates during installation as well as post-removal compared to non-interlock participants.

At the beginning of the study the majority of the mandatory participants (73.9%) were reportedly changing their drinking behaviour or working to prevent a relapse (action and maintenance stage), compared to the remainder 26.1% that were considering a change but were doing little if anything about it (pre-contemplation and contemplation stages). The percentage of voluntary-interlock participants that were reportedly changing their drinking behaviour or working to prevent a relapse was 56.3%. These results showed that offenders in the Nova Scotia program appeared to display a greater positive attitude in the program relative to findings in other studies (Nochajski and Stasiewics 2006; Wieczorek and Nochajski 2005), demonstrating that the program may be more positive in general.

In terms of alcohol-related crashes the control-voluntary group had a crash rate of 1.2% during the study period, while the interlock-voluntary and interlock-mandatory groups had a 0.6% and 0.8% rate respectively (although the differences were not statistically significant). A variety of survival analysis techniques were used to provide more insight into the effectiveness of the program in terms of recidivism and crashes. The results supported the notion that the interlock program was associated with a positive impact on reducing the risk for alcohol-related convictions, and there appeared to be no difference in this respect between mandatory and voluntary participants. With respect to crashes, the survival analyses did not show any statistically significant difference between any of the studied groups.

To bolster the findings from the survival analyses, time series analysis techniques were also used to study monthly counts of charges, convictions and crashes including a before and after period (i.e., before and

after the implementation of Nova Scotia's interlock program). The results suggested that there were no permanent effects associated with the implementation of the program in terms of the number of alcohol-related charges and convictions. There were significant, albeit temporary effects in the first and seventh month following the implementation. These effects included a 13.32% decrease in the number of alcohol-related charges and a 9.93% decrease in the number of alcohol-related convictions in the first and seventh month respectively following the implementation of the program. With respect to crashes, there were no significant effects associated with the implementation of the program in relation to the number of alcohol-related crashes with fatal and serious injuries at the 5% level of statistical significance. However, there was a permanent effect at the 10% level of significance that represented a small decrease – from a statistical point of view – in the number of alcohol-related crashes every month since June 2009 (tenth month after the beginning of the program). Note that this corresponded to a decrease of one fatal or serious alcohol-related crash in approximately 33 years. This is perhaps not unexpected as to date most studies have not yet been able to definitively demonstrate a positive impact on crashes due to the small sample sizes and small programs resulting in lack of sufficient data.

The amount of data from the questionnaires at exit and follow-up was insufficient to draw meaningful conclusions with respect to changes in attitudes and opinions regarding the interlock program, drinking behaviour, and drink driving behaviour. However, an interesting reported fact was that there was evidence showing that some interlock participants in the mandatory group drove a non-interlocked vehicle while in the program. This evidence should be considered in light of existing evidence about the alternative to interlocks, i.e., licence suspension, and which shows that many suspended drivers continue to drive. As such, the evidence from this study supports the notion that interlocked offenders driving non-interlocked vehicles rarely happens indeed.

Finally, data were analyzed from the interlock devices, without comparing this to a control group. Overall the results suggested that there were learning curves illustrating that offenders were more likely to violate program rules at the beginning of program participation, but over time these violations decreased as offenders learned about, or experienced the consequences of program violations and the nuances associated with the functioning of, and compliance with, devices. In general, the curves were steepest at the beginning of program participation until approximately month 10, indicating that the learning effect may decrease or stop after a period of time. In general, males and females did not appear to have clear differences in terms of the percentage of participants failing and average number of fails per participant, although both groups had a learning effect. The learning effect was more pronounced in male participants than female participants. Clear differences were found between mandatory and voluntary participants. Although both groups revealed a learning effect, the effect was more pronounced among voluntary participants as well. In addition, clear differences were found between participants with condition 37 and participants without the condition although both groups revealed a learning effect. The effect was more pronounced for participants without the condition.

In sum, with respect to specific deterrence (i.e., referring to preventing recidivism) among individuals in the program there was strong evidence to suggest that participation in the interlock program reduced the risk of alcohol-related charges among participants. With respect to general deterrence (i.e., referring to a preventive effect on the entire population of drivers in Nova Scotia) there was a temporary decrease in the number of alcohol-related charges and convictions in the first and seventh month respectively with respect to the implementation of the program. There was also some weaker evidence (at the 10 % level of statistical significance) that there was a permanent decrease in the number of alcohol-related crashes with fatal and serious injuries every month since the tenth month after the beginning of the program.

When considering all of the evidence combined, it can be argued that the implementation of the interlock program had a positive impact on road safety in Nova Scotia and that it reduced the level of drink driving recidivism in the province. There were also some promising indications to suggest a decrease in the number of alcohol-related road traffic crashes and fatalities due to the interlock program, although this finding has to be confirmed with more data. In sum, the evidence suggested the interlock program was better at preventing harm due to alcohol-impaired driving than the alternative of not using the interlock program.

10. RECOMMENDATIONS

10.1 Continue the use of the interlock program in Nova Scotia

When collectively considering the evidence, one main recommendation was clearly substantiated, i.e., to continue the use of the interlock program in the province. While the evidence regarding the positive impact of the program on crashes may have been weaker and needs further bolstering, in particular with respect to the general deterrent effect of the program on the entire population of Nova Scotia as a whole, nonetheless, the evidence convincingly showed that the recidivism rate of interlocked offenders was lower than that of non-interlocked offenders. This was true, not only when the device was installed, but this positive effect extended beyond the time when the device was removed, both for voluntary and mandatory interlocked offenders. This finding was consistent with many other studies that have evaluated the impact of interlock programs.

A comparison of the results from this evaluation with other evaluation studies showed that the reduction in recidivism rates in Nova Scotia (79%-90% reduction) appeared to be at the high end of the spectrum. More than 10 evaluations of interlock applications have reported reductions in recidivism ranging from 35-90% (Elder et al. 2011; Marques et al. 2010; Voas and Marques 2003; Vezina 2002; Tippetts and Voas 1997; Coben and Larkin 1999; Raub et al. 2001). While it was not possible to test this hypothesis due to the lack of an appropriate control group where no treatment services were provided at all, the strong evidence regarding the impact of the interlock program during the time when the device was installed as well as after removal may be related to the fact that Nova Scotia's program included the provision of treatment services in combination with the use of the interlock program. Additionally, interlock offenders appeared more ready for change relative to general research findings, which may also be explained by the treatment component of the interlock program (note that all offenders included in this study, both interlocked ones and non-interlocked ones received some basic form of treatment). It is known from the literature that, generally speaking, better results are obtained when the interlock is used in combination with some form of treatment, rather than using the interlock by itself (Zador 2011).

10.2 Consider the systematic use of a performance-based exit in the interlock program

Despite the fact that the evidence in this study showed that the program had an effect that extended beyond the removal of the device, it is acknowledged that the evidence also showed that any benefits of the program seemed to diminish once the device was removed. For this reason, in combination with evidence from the literature regarding the usefulness of a performance-based exit whereby an offender's time on the device is extended until he/she can demonstrate compliance with program rules, another recommendation is to consider the systematic use of this feature in Nova Scotia's interlock program. While such a performance-based exit is already used on an ad-hoc basis in the program, it is recommended to formulate specific program rules that would enable the systematic use of this program feature. As such, an optimal balance can be achieved between rehabilitation and public safety.

10.3 Consider further strengthening of monitoring in the interlock program

The pronounced effects with respect to reduced recidivism rates and learning curves underscored the quality of the program in its current form. However, there was also some evidence suggesting that the program could further benefit from stronger monitoring still (Zador et al. 2011; Vanlaar et al. 2013, Casanova-Powell et al. 2014). For example, there was evidence to suggest that in rare occasions an interlocked offender drove a non-interlocked vehicle. While this evidence should be weighed in the context of the performance of alternative measures where non-compliance is typically not so exceptional (see for example the levels of disregard of license suspension that are traditionally high), these findings suggested the need for monitoring mileage levels of interlocked offenders to detect early any indications of non-compliance, face-to-face meetings with interlocked offenders at servicing during their time on the interlock to establish a rapport with them also to detect early instances of non-compliance, as well as sufficiently high levels of traffic enforcement in the province to establish a general deterrent effect that could help reduce the likelihood of such instances of interlocked offenders driving non-interlocked vehicles.

10.4 Consider focusing on levels of risk in relation to non-compliance

The evidence from the interlock data analysis suggested that learning curves were more pronounced in relation to riskier behaviours, i.e., failed tests at higher BAC limits (0.05 and 0.08). While it can be argued that this was a positive finding in itself, it also illustrated the need to provide clear feedback and education to offenders about the dangers and problems associated with drinking and driving at lower alcohol levels. Essentially, offenders on the interlock should not be drinking at all, and there are several reasons for this. Therefore, it is important they learn equally fast about compliance with regard to lower limits such as the 0.02 limit.

This was also true in relation to the high-risk offenders (mandatory ones and those with condition 37) who were less amenable to learning to be compliant.

10.5 Consider the continued monitoring of crash data

In light of the fact that the time series analysis found a permanent effect that was borderline-significant, i.e., only significant at the level of 10% but not at the more rigorous 5% level, it is paramount to continue to monitor these trends. In this regard, it warrants mentioning that only crash data through to 2010, inclusive were available for this time series analysis. It is possible that this permanent effect may turn out to be significant at the 5% level after all, should more years of data be available to strengthen analyses. Given that the ultimate goal of any road safety measure should be to decrease the number of crashes and victims, it goes without saying that it is important to update these analyses accordingly when data become available.

REFERENCES

- Alcohol Indicators Report 2011 Nova Scotia. Nova Scotia department of Health and Wellness, 2011.
- Asbridge, Mark and Donald Langille. (2013). Nova Scotia Student Drug Use Survey 2012, Technical report. Addiction Services, Nova Scotia department of Health and Wellness, and Dalhousie University.
- Baker, A. (1987). In Car Alcohol Breath Analyzer – A Pilot Study. Safety Education Centre, College Park, Maryland.
- Coben, J.H., and Larkin, G.L. (1999). Effectiveness of Ignition Interlock Devices in Reducing Drunk Driving Recidivism. *American Journal of Preventative Medicine* 16(15): 81-87.
- Changing the culture of alcohol use in Nova Scotia: an alcohol strategy to prevent and reduce the burden of alcohol-related harm in Nova Scotia. (2007) Department of Health Promotion and Protection, Addiction Services, Province of Nova Scotia.
- Elder, R.W., Voas, R., Beirness, D., Shults, R.A., Sleet, D.A., Nichols, J.L., & Compton, R. (2011). Effectiveness of ignition interlocks for preventing alcohol-impaired driving and alcohol-related crashes. *American Journal of Preventative Medicine*, 40(3), 362-376.
- Marques, P.R., Voas, R.B., Roth, R., & Tippetts, S.A. (2010). *Evaluation of the New Mexico Ignition Interlock Program*. Report No. DOT HS 811 410. Washington, D.C.: National Highway Traffic Safety Administration.
- Nochajski, T.H., & Stasiewicz, P.R. (2006). Relapse to driving under the influence (DUI): A review. *Clinical Psychology Review*, 26, 179-195.
- Robertson, R., Holmes E., & Vanlaar, W. (2009). Alcohol Interlocks in Canada - From Research to Practice.
- Robertson, R., Holmes E., & Vanlaar, W. (2010). Nova Scotia Alcohol Ignition Interlock Program: Process Evaluation.
- Roberston, R., Vanlaar, W, Simpson, H., & Boase, P. (2009). Results from a national survey of Crown prosecutors and defense counsel on impaired driving in Canada: A "System Improvements" perspective. *Journal of Safety Research*, 40, pp. 25-31.
- Tippetts, A.S. and Voas, R.B. (1997). The effectiveness of the West Virginia interlock program on second drunk-driving offenders. In: C. Mercier-Guyon (Ed.) *Alcohol, Drugs and Traffic Safety – T97*. Proceedings of the 14th International Conference on Alcohol, Drugs and Traffic Safety, Annecy, France, September 21-26, 1997. Annecy: CERMT, Vol.1, pp. 185–192.
- Vanlaar, W., McKiernan, A., Robertson, R. (2013). *Behavioral Patterns of Interlocked Offenders: Phase II*. Ottawa: Traffic Injury Research Foundation.
- Vezina, L. (2002). The Quebec Alcohol Interlock Program: Impact on Recidivism and Crashes. In: D.R. Mayhew & C. Dussault (Eds.) *Alcohol, Drugs and Traffic Safety 0 T2002*. Proceedings of the 16th International Conference on Alcohol, Drugs and Traffic Safety. Montreal, August 4-9, 2002. Quebec City: Societe de l'assurance automobile du Quebec, pp. 97-104.
- Voas, R.B. and Marques, P.R. (2003). Commentary: Barriers to Interlock Implementation. *Traffic Injury Prevention* 4(3): 183-187.

Wieczorek, W.F., & Nochajski, T. (2005). "Characteristics of Persistent Drinking Drivers: Comparisons of First, Second, and Multiple Offenders." In D. Hennessey and D. Wiesenthal (Eds.), *Contemporary Issues in Road User Behavior and Traffic Safety* (pp. 153-166). New York: Nova Science Publishers Inc.

Zador, P. L., Ahlin, E. M., Rauch, W. J., Howard, J. M., & Duncan, G. D. (2011). The Effects of Closer Monitoring on Driver Compliance with Interlock Restrictions. *Accid Anal Prev.* Nov 2011; 43(6): 1960–1967

APPENDIX A: OFFENCE CODES

Alcohol-related offence codes

Criminal Code of Canada (CCC) Offences	
Offence Description	Criminal Code Section
blood alcohol level over legal limit causing bodily harm	255(2.1)
blood alcohol level over legal limit causing death	255(3.1)
impaired causing bodily harm	255(2)
failure or refusal to provide sample causing bodily harm	255(2.2)
impaired causing death	255(3)
failure or refusal to provide sample causing death	255(3.2)
impaired operation	(253(1)(a) or 253(a)
blood alcohol over legal limit	253(1)(b) or 253(b)
failure or refusal to comply with demand	254(5)
Nova Scotia Motor Vehicle Act	
Offence Description	Code
newly licensed driver over zero BAC	100A
over legal limit or refusal	279A
low BAC	279C

Non-alcohol-related offence codes

Criminal Code of Canada (CCC) Offences	
Offence Description	Criminal Code Section
Dangerous operation of motor vehicle (no injury)	249(1)(a)
Dangerous operation of motor vehicle (causing injury)	249(3)
Dangerous operation of motor vehicle (causing death)	249(4)
Driving while disqualified	259(4)
Failure to stop at the scene of an accident	252(1)(a)(b)(c)
Nova Scotia Motor Vehicle Act	
Offence Description	Code
Unlicensed driving	64, 80
Unsafe lane change and offences related to lined traffic	111,
Unsafe following distance	117(1)
Driving to left of centre line "Duty to drive on right"	110
Using hand-held cell phone or texting while driving	100D(1)
Seat belt violation	175(2)(3)(4)(5)(6)
Careless and imprudent driving	100

Speeding or dangerous driving	101
Passing school bus or failure to obey crossing guard	103(3), 125A(4)
Improper overtaking and passing	114,
Driving on left of centre line	115
Speeding in excess of speed limit (30 km/hr. and under)	102, 106A(a)(b), 106B(1)(a)(b)
Failure to obey traffic signs or signals or yield right of way	83(2)
Failure to yield to pedestrian	125(1)(2)
Manslaughter resulting from the operation of a motor vehicle in violation of section 236 CCC	278(1)(a)

APPENDIX B: QUESTIONNAIRES

- > Demographics
- > Self-reported behaviour
- > Readiness to Change
- > Research Institute on Addictions Self Inventory (RIASI)
- > Expectations about Interlocks

Demographic Information

D1 Date of this interview

DD/MM/YYYY

D2 Driver licence number **(to be completed by clinician)**

D3 Case ID number **(to be completed by clinician)**

D4 First and Last name (please print)

D5 What is your date of birth?

DD/MM/YYYY

D6 What is your marital status?

- 1 ☐ Single
- 2 ☐ Married
- 3 ☐ Living together
- 4 ☐ Divorced / separated
- 5 ☐ Widowed
- 6 ☐ Other status (write in)

D7 Who else lives in your household? **Select all that apply.**

- 1 ☐ Wife / partner
- 2 ☐ Children
- 3 ☐ Brothers / sisters
- 4 ☐ Friends
- 5 ☐ Parents / step-parents / other relative
- 6 ☐ Other
- 7 ☐ Live alone, **Go To question D10**

D8 Does anyone else in your household have a driving licence? **Select all that apply.**

- 1 ☐ Husband / wife / partner
- 2 ☐ Children
- 3 ☐ Brother / sister
- 4 ☐ Friend
- 5 ☐ Parent / step-parent / other relative
- 6 ☐ Other (write in)
- 7 ☐ No one else

D9 Is anyone else in your household with a driver's license restricted to using the interlocked vehicle?

- 1 ☐ Yes
- 2 ☐ No

Demographic Information

D10 How many motor vehicles do you have readily available for your personal use?

of vehicles

D11 Which of the following best describes your current position? **Select only one category.**

- 1 ☐ Self-employed
- 2 ☐ Employed part-time
- 3 ☐ Employed full-time
- 4 ☐ Housewife / husband
- 5 ☐ Retired
- 6 ☐ Unemployed and seeking work
- 7 ☐ Unemployed but not seeking work
- A ☐ Student
- B ☐ Other (write in)

D12 To which of these groups do you consider you belong?

- 1 ☐ White
- 2 ☐ Black-Caribbean
- 3 ☐ Black-African
- 4 ☐ Black-other black groups
- 5 ☐ Indian
- 6 ☐ Pakistani
- 7 ☐ Chinese
- 0 ☐ None of these

D13 Was the offence that led to your recent disqualification your first drink driving conviction?

- 1 ☐ Yes
- 2 ☐ No

D14 Do you feel you were given enough information about the interlock program in order to decide whether you would want to participate?
(Please circle the number you most agree with)

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

D15 Please check the box that you most identify with

- 1 ☐ I am/will be in the interlock program
- 2 ☐ I am/will **not** be in the interlock program

Self-Reported Behaviour-Intake

- S1** On how many occasions in the last month have you needed to drive your car while you were drinking or within one hour of drinking but decided **not** to drive it?

1 Enter number of occasions

- S2** On how many occasions in the last month have you needed to drive your car while you were drinking or within one hour of drinking and decided to drive it?

1 Enter number of occasions,
If response is zero (0), **please move on to the next questionnaire**

- S3** The last time when you drove your car while you were drinking or within one hour of drinking, where were you doing most of your drinking?

1		Bar
2		Restaurant
3		Own home
4		Friend / relative's house
5		Party
6		Other (write in)

Self-Reported Behaviour – Exit, follow-up Interlock

- S1** On how many occasions in the last month have you needed to drive your car while you were drinking or within one hour of drinking but decided **not** to drive it?

1 Enter number of occasions

- S2** On how many occasions in the last month have you needed to drive your car while you were drinking or within one hour of drinking and decided to drive it?

1 Enter number of occasions,
If response is zero (0), **Go to question S4**

- S3** The last time when you drove your car while you were drinking or within one hour of drinking, where were you doing most of your drinking?

1 Bar
2 Restaurant
3 Own home
4 Friend/relative's house
5 Party
6 Other (write in)

- S4** On how many occasions during your participation in the interlock program have you driven a non-interlock vehicle?

1 Enter number of occasions

- S5** Do you think it is likely that you will drink and drive again in the future now that the interlock will no longer be installed in your car?

1 Yes
2 No

- S6** Do you think you will plan ahead in the future to arrange for alternative transportation next time when you are drinking?

1 Yes
2 No

Self-Reported Behaviour –Exit DWI

- S1** On how many occasions in the last month have you needed to drive your car while you were drinking or within one hour of drinking but decided **not** to drive it?

1 Enter number of occasions

- S2** On how many occasions in the last month have you needed to drive your car while you were drinking or within one hour of drinking and decided to drive it?

1 Enter number of occasions

If response is zero (0), **Go to question S4**

- S3** The last time when you drove your car while you were drinking or within one hour of drinking, where were you doing most of your drinking?

1 Bar
2 Restaurant
3 Own home
4 Friend / relative's house
5 Party
6 Other (write in)

- S4** Do you think it is likely that you will drink and drive again in the future now that your revocation is over?

1 Yes
2 No

- S5** Do you think you will plan ahead in the future to arrange for alternative transportation next time when you are drinking?

1 Yes
2 No

Readiness to Change

This questionnaire asks for your thoughts about your own drinking. Please check to show how strongly you AGREE or DISAGREE with each statement.

	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
RE1 I don't think I drink too much					
RE2 I am trying to drink less.					
RE3 I was drinking too much at one time but I have managed to change					
RE4 I enjoy drinking but I feel I drink too much					
RE5 I sometimes think I should cut down on drinking					
RE6 I have changed my drinking but I am looking for ways to keep from slipping back to the old pattern					
RE7 I feel that it is a waste of time talking about drinking					
RE8 I have recently changed my drinking					
RE9 I want to keep from going back to the drinking problem I had before					
RE10 I am actually doing something about my drinking					
RE11 I feel I should consider drinking less					
RE12 I feel that drinking is a problem sometimes					
RE13 I feel that there is no need for me to change my drinking					
RE14 I am changing my drinking habits					
RE15 I feel it would be pointless to drink less					
RE16 I see myself as an alcoholic					

RIASI

Please check the box to show if the statement is true or false

		True	False
RI1	I smoke or use tobacco products		
RI2	I have no problem telling a companion that he or she has done something to hurt my feelings		
RI3	I often feel so restless I can't sit still		
RI4	When I drank 7 or more drinks I become aggressive		
RI5	I like people who are sharp and witty even though they may sometimes hurt other peoples' feelings		
RI6	When the alcohol runs out, I leave a party		
RI7	When I make plans, I am almost certain to make them work		
RI8	I have relatives who have had problems with alcohol or drugs		
RI9	I have been arrested for crimes other than drinking and driving		
RI10	My hand often shakes when I try to do something		
RI11	I am irritated a great deal more than people are aware of		
RI12	Since the age of 18, I have been accidentally cut, or cut in a fight, or burned badly enough to leave a scar		
RI13	A family member was arrested for drinking and driving		
RI14	When I don't get my own way, I sulk or pout		
RI15	I slow down when a traffic light turns to amber		
RI16	I often feel like a powder keg ready to explode		
RI17	When I have a problem I try to make it go away by drinking		
RI18	I have no trouble sleeping or staying asleep		
RI19	I sometimes do dangerous or risky things just for fun		
RI20	I have experienced a major stressful life event in the past 12 months		
RI21	I feel that I have lived the right kind of life		
RI22	It is easy for me to turn down an unreasonable request from a friend		
RI23	I have feelings that something bad will happen to me		
RI24	I feel like I have lost energy I am fatigued and tired		
RI25	I often have feelings of nervousness		
RI26	I often feel sad or blue		
RI27	A drink or two gives me energy to get started		
RI28	I am probably not capable of slapping someone, even when I lose my temper		
RI29	When I get beyond a certain point, I don't stop drinking until all the booze is gone or I pass out		
RI30	I don't like to break rules, even if I think they are wrong		

		True	False
RI31	I hardly ever drink more than I plan to		
RI32	I am not interested in surprising or upsetting others by doing something that might shock them		
RI33	It depresses me that I did not do more for my parents		
RI34	I like to gamble for money		
RI35	After seven or more drinks, I feel happier		
RI36	I often acted without thinking as a child		
RI37	I was referred for a liver test, or a blood test for liver enzymes		
RI38	Since the age of 18, I have needed emergency treatment for an injury of some kind		
RI39	I skipped school as a child		
RI40	When I am drinking, I make sure I do not skip any meals		
RI41	I often feel hopeless about the future		

Please answer the following question by writing in your response in the box next to each question.

RI42	How many jobs have you had in the past five years?	
RI43	How many times have you ever been convicted for moving traffic offences such as speeding, running a red light or failing to stop at a STOP sign?	
RI44	How much money do you usually spend on alcohol in a week? (Include the cost of drinking at home, at friends' or relatives' houses and in pubs, bars and restaurants)	
RI45	If you go out drinking, how many places do you drink at in one evening? (Include friends' and relatives' houses as well as pubs, bars and restaurants)	
RI46	What is the largest number of drinks you have ever consumed in a 24 hour period? (One drink is a ½ pint beer/lager, a single measure of spirits, a glass of wine or one Alcopop.)	
RI47	How many days of the week do you usually drink?	
RI48	When you are drinking, how many drinks do you usually have?	
RI49	How many drinks does it take before you begin to feel the effects of alcohol?	

Listed below are a few statements about your relationships with others.

Please circle the number to indicate how much each statement is TRUE or FALSE for you.

		Definitely true	Mostly true	Don't know	Mostly false	Definitely false
RI50	I am always courteous even to people who are disagreeable	1	2	3	4	5
RI51	I sometimes feel resentful when I don't get my way	1	2	3	4	5
RI52	No matter who I'm talking to, I'm always a good listener	1	2	3	4	5

Expectations about Interlocks-Intake

This questionnaire asks about your expectations of the interlock. Please check to show how strongly you AGREE or DISAGREE with each statement.

	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
E1 I am sure that I will be able to use the Interlock OK					
E2 The Interlock will stop me from driving after drinking.					
E3 Using the Interlock will be embarrassing for me.					
E4 Having the Interlock fitted in the car will be embarrassing for me					
E5 I think using the Interlock will become a habit, just like putting your seat belt on					
E6 Having the Interlock will allow me to keep my job.					
E7 Having the Interlock will keep me from becoming dependent on others for transport.					
E8 Having the Interlock will help maintain family harmony.					
E9 Using the Interlock could become a hassle.					
E10 Having the Interlock will affect my drinking habits.					
E11 Having the Interlock will change my driving habits.					
E12 I expect to benefit from using the Interlock.					
E13 I think the advantages of using the Interlock are greater than the disadvantages.					
E14 I wouldn't bother to try and beat the Interlock – it's got too many security measures					

Expectations about Interlocks – Exit, follow-up

This questionnaire asks about your previous experiences with the interlock. Please check to show how strongly you AGREE or DISAGREE with each statement.

		Strongly agree	Agree	Not sure	Disagree	Strongly disagree
E1	I was able to use the Interlock OK					
E2	The Interlock stopped me from driving after drinking					
E3	Using the Interlock was embarrassing for me					
E4	Having the Interlock fitted in the car was embarrassing for me					
E5	I think using the Interlock became a habit, just like putting your seat belt on					
E6	Having the Interlock allowed me to keep my job					
E7	Having the Interlock kept me from becoming dependent on others for transport					
E8	Having the Interlock helped maintain family harmony					
E9	Using the Interlock became a hassle					
E10	Having the Interlock affected my drinking habits					
E11	Having the Interlock has changed my driving habits					
E12	I benefitted from using the Interlock					
E13	I think the advantages of using the Interlock are greater than the disadvantages					
E14	I wouldn't bother to try and beat the Interlock – it's got too many security measures					