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The effectiveness of alcohol interlocks in reducing repeat drink driving and improving road safety

Sara Rahman

AIM

To evaluate the impact of the first phase of the Mandatory Alcohol Interlock Program (MAIP), introduced in NSW in February 2015, on repeat drink-driving, driving while disqualified, traffic infringements, and crash outcomes.

METHOD

We use a dataset of 98,501 observations involving offenders with a proven 'exceed the prescribed concentration of alcohol' (PCA) offence or a 'refuse to provide a breath sample' offence finalised in a NSW court between 1 June 2012 and 30 April 2018. We identify the impact of taking up an alcohol interlock on reoffending and road crashes using a regression discontinuity design. This analysis compares outcomes for first-time PCA offenders in a small bandwidth on either side of the high range blood alcohol concentration (BAC) threshold of .15. We also estimate the overall impact of the introduction of MAIP on drink driving and road crashes using a difference-in-differences approach. This compares outcomes for eligible and ineligible offenders before and after the introduction of the program. We implement a range of robustness checks and analyse outcomes for various groups of offenders, including those receiving different interlock periods, and those with different demographic characteristics and criminal histories.

RESULTS

MAIP reduced the likelihood of drink driving during the interlock period for first-time high range PCA offenders who start the program by 11 percentage points (p.p.; a reduction of 86%) compared to mid range offenders just below the high range PCA threshold. We also observe reductions in PCA offending within 36 months of finalisation (of 3.4 p.p.; 43%) and within 60 months of finalisation (of 6.0 p.p.; 43%) among all eligible offenders compared to offenders committing eligible offences before the program's introduction. The program reduces traffic infringements committed after court finalisation, but these effects are concentrated among repeat low range PCA drink drivers. We do not find significant effects of the program on reducing the likelihood of involvement in an alcohol-related crash nor on crashes resulting in injuries and fatalities. The reductions in PCA offending are particularly large for offenders convicted of the most severe offences (i.e., repeat high range drink driving and repeat refuse to provide a breath sample offenders), those residing in disadvantaged areas, and to a lesser extent, those residing outside major cities.

CONCLUSION

Alcohol interlocks significantly reduce drink driving while interlocks are active and (to a modest extent) following their removal.

KEYWORDS Driving offences | Alcohol | Regression discontinuity | Difference-in-differences

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INTRODUCTION

Drink driving constitutes a substantial proportion of criminal prosecutions in New South Wales (NSW). In the three years to July 2019, 52,668 proven charges for exceeding the prescribed concentration of alcohol (PCA) were finalised in NSW Criminal Courts (NSW Bureau of Crime Statistics and Research, 2021), constituting 6.4% of all proven charges over that period. Furthermore, past research suggests that almost one-fifth (16%) of these individuals will likely be reconvicted of a further drink driving offence within 5 years (Trimboli & Smith, 2009).

A more concerning consequence of drink driving is its contribution to road injuries and fatalities. The Centre for Road Safety (2021) estimates that alcohol contributed to 61 (17%) fatalities and 285 (6%) serious injuries on NSW roads in 2019. The costs of these alcohol-related road crashes are substantial. A report from the Australian Institute of Criminology found that in 2010, the national social cost of alcohol-related crashes was $3.66bn (Manning, Smith & Mazerolle, 2013). These costs are likely to be much larger at present, with the most recent nationwide estimates from the National Drug Research Institute (Whetton et al., 2021) indicating that road crashes involving alcohol cost Australians $2.4b in 2017/18 in property damage, insurance costs, and lost productivity alone, outside of further substantial costs in terms of hospitalisations and premature death.[1] These costs are also additional to their estimates of $28.9m incurred by the criminal justice system on such offences each year.

A range of programs and policies, such as Random Breath Testing (RBT), advertising campaigns, zero blood alcohol concentration (BAC) limits for novice drivers, and legal sanctions, have been implemented to reduce the road trauma arising from drink driving. Many of these approaches are based on general deterrence principles, seeking to discourage people from drink driving by increasing the perceived likelihood of detection and apprehension by police and/or the severity of penalties imposed for these offences. Strategies designed to increase the perceived risk of detection and apprehension, like RBT, have been found to be highly effective in reducing drink driving and alcohol-related crashes, particularly in Australia (Erke et al., 2009), However, there is limited evidence for the effectiveness of harsher sanctions as a specific deterrent (i.e. those designed to reduce repeat offending) to drink driving. While imprisonment has been used as a penalty for serious and repeat drink driving in NSW, it is no more effective in reducing drink driving than alternative penalties (Rahman & Weatherburn, 2021).

A common sanction used to deter repeat drink driving is licence disqualification. Licence disqualification aims to reduce offending by prohibiting all driving (regardless of their alcohol consumption) during their disqualification period. Lengthy disqualification periods are applicable to serious drink driving offences in most Australian jurisdictions and are typically extended further if an individual drives unlawfully. Research suggests that lengthy licence disqualifications generally reduce drink driving and road crashes (Fell & Scherer, 2017; Wagenaar & Maldonado-Molina, 2007; Watson, 1998), but concerns have been raised about the cumulative impacts of long licence disqualification periods, particularly on vulnerable groups who may have few other transport options available to them (Audit Office of New South Wales, 2013; NSW Parliamentary Committee on Law and Safety, 2013). Further, it has been argued that long licence disqualification periods may inadvertently encourage unlawful driving, because of the substantial personal costs of not driving for lengthy periods (Lenton et al., 2010) and perceptions of a low detection rate for these offences (Pogarsky & Piquero, 2003). Both Australian and international studies (DeYoung & Gebers, 2004) indicate that driving while disqualified is associated with a heightened risk of motor vehicle crashes.

Interlock devices are an alternative method for reducing the risk of repeat drink driving. These devices require drivers to provide a (negative) breath test sample before a vehicle's engine can be started and are typically fitted with tamper-resistant features, like cameras, to prevent circumvention by the driver. Unlike prison sentences and long licence disqualifications, alcohol interlocks can work to prevent episodes of drink driving (see for example Willis et al., 2004) while still allowing an individual to continue to drive

1 The authors do not separate costs from premature deaths and serious injury accruing to road accidents, compared to those from other sources.

lawfully, typically following a shorter initial disqualification period. There have been some suggestions that interlock programs may even encourage longer-term sober driving (Beck et al., 2015) by changing individuals' drinking habits (e.g. they may drink less when going out and intending to drive home).

The Mandatory Alcohol Interlock Program (MAIP)

While interlock devices have been available in Australia since the early 2000s, they have only recently become a mainstay of NSW drink driving policy. The Mandatory Alcohol Interlock Program (MAIP), which commenced in NSW in February 2015, introduced alcohol interlocks as a mandatory penalty for high range and repeat PCA offences.[2] Under the *Road Transport Legislation Amendment (Mandatory Alcohol Interlock Program) Act 2014* (NSW) (hereafter referred to as the Act), three types of offenders were deemed eligible for MAIP: first-time offenders convicted of high range[3] drink driving; any offender convicted of drink driving with at least one prior drink driving conviction within the last five years; and any offender who refused a breath test when requested by police (this is known as Phase 1 of MAIP). MAIP was expanded on 3 December 2018 to include offenders convicted of first-time mid range drink driving and alcohol drive under the influence (DUI) offences (Phase 2 of MAIP) and from 28 June 2021, offenders convicted of a combined PCA and drug driving offence also became eligible for MAIP (Phase 3 of MAIP).

Table 1 shows the change in penalties for different drink driving offences following the introduction of MAIP. Prior to the reform, PCA offenders could receive prison, a licence disqualification, and/or a court imposed fine. The magnitude of these penalties varied by the severity of the offence Phase 1 of MAIP introduced interlock orders as an mandatory penalty to these offences, specifically:[4]

- A minimum disqualification period of 1 month and a maximum of 3 months, followed by an automatic interlock period of 12 months, OR a 12 month automatic (6 month minimum) disqualification (if exempted) for **repeat low range PCA offenders**;
- A minimum disqualification period of 6 months and a maximum of 9 months, followed by an automatic interlock period of 24 months, OR a 3 year automatic (12 month minimum) disqualification period (if exempted) **for first time high range PCA offenders, repeat mid range PCA offenders, and first time refuse breath test offenders**;
- A minimum disqualification period of 9 months and a maximum of 12 months, followed by an automatic interlock period of 48 months, OR a 5 year automatic (2 year minimum) disqualification period (if exempted) for **repeat high range PCA offenders and repeat refuse breath test offenders**.

2 Interlock devices were first introduced in NSW in 2003, as a voluntary program for drink drivers.

3 The severity of a PCA offence is based on the level of Blood Alcohol Concentration (BAC). For most drivers, the respective BAC thresholds for low, mid, and high range PCA offences are 0.05, 0.08, and 0.15 respectively. Novice range offences relate to learner and provisional licence holders exceeding 0 BAC and 0.02 BAC respectively. Special range offences relate to special licence holders' (i.e., drivers of vehicles of "gross vehicle mass" greater than 13.9 tonnes, drivers of vehicles carrying dangerous goods, and drivers of public vehicles such as taxi or bus drivers exceeding their respective BAC limits) being detected driving with a BAC of 0.02 or higher. See https://roadsafety.transport.nsw.gov.au/stayingsafe/alcoholdrugs/drinkdriving/bac/index.html for information.

4 These previous sanctions can still be applied by magistrates in addition to interlock orders.

MAIP stipulates that the court must issue a Mandatory Alcohol Interlock Order (MAIO) for all eligible persons convicted of a prescribed offence.[5] A MAIO has two parts: a "disqualification period" and an "interlock period". The disqualification period refers to the period an offender is not lawfully able to drive.[6] After the initial disqualification period is completed, the offender chooses between serving a five year automatic disqualification period[7] or alternatively, a (usually shorter) interlock period. The interlock period refers to how long an offender is required to have an alcohol interlock device installed in their vehicle. In order to begin an interlock period, the offender must first obtain a medical certificate stating that they do not have a condition that would prevent them providing a sufficient breath sample.[8] They must also meet with a general practitioner to discuss their drinking and driving, and, where appropriate, may be referred for further treatment, prior to commencement.[9] An eligible offender then has the device installed in their vehicle, at their own cost, by a registered provider and obtains an interlock licence from Service NSW.

Therefore, the program is 'mandatory' in the sense that magistrates must impose interlock orders (unless a person qualifies for an exemption), but offenders do not have to take them up. Offenders can choose not to install interlocks, at the cost of a 5 year automatic disqualification. However, under section 212(3) of the Act, the court may issue an interlock exemption order (for any type of mandatory interlock offence) if the court is satisfied that the offender either: (1) does not have access to a vehicle in which to install an interlock device; or (2) has a medical condition diagnosed by a registered medical practitioner that prevents them from providing a sufficient breath sample to operate an approved interlock device, and it is not reasonably practicable for an interlock device to be modified to enable the offender to operate the device. Interlock participants are required to cover the costs associated with the device including installation, servicing, and removal (approximately $2,200 to $2,500 per year in total). Some financial support is available from the NSW Government for interlock participants who have low incomes or who are experiencing severe financial hardship to enable them to access the program. Participants must apply for this support, and if found eligible, can have the costs of maintaining the interlock waived for a three-month period. Those who receive Severe Financial Hardship support must re-apply to extend this support beyond three months. Concession card holders can obtain discounts on the cost of interlock devices and their maintenance directly from interlock service providers for their entire interlock period.

A person may also be referred to their GP during the program if they have attempted to drive on several occasions while having alcohol in their system.[10] Towards the end of the program, those who have been detected attempting to drink and drive are required to see a GP again to have their fitness to drive assessed.[11] At this consultation the participant must provide the GP with a letter from Transport for NSW which lists any attempts to drink and drive, as well as any other information that may be relevant for this assessment. If they are assessed as being fit to drive, the participant's licence is restored at the completion of the interlock period.

5 Magistrates may still impose convictions without a penalty for these offenders.

6 *The Road Transport Act 2013 (NSW)* sets out the minimum and maximum periods for each offence. For novice, low and mid range offenders, the minimum interlock period is 12 months. For high range offenders, the minimum interlock period is 48 months. There is no maximum interlock period.

7 Time spent during the initial disqualification period counts toward the five-year total.

8 Medical reasons for not being able to provide a sample include a lung condition such as lung cancer which prevents the person from providing sufficient sample, or a facial condition which would prevent them forming a seal around the device which would prevent a sufficient sample..

9 See: https://roads-waterways.transport.nsw.gov.au/documents/roads/safety-rules/alcohol-interlock-program/ai-factsheet-gp-consultation-stage-1.pdf

10 See: https://roads-waterways.transport.nsw.gov.au/documents/roads/safety-rules/alcohol-interlock-program/ai-factsheet-gp-consultation-stage-2.pdf

11 See: https://roads-waterways.transport.nsw.gov.au/documents/roads/safety-rules/alcohol-interlock-program/ai-factsheet-gp-consultation-stage-3.pdf

Table 1. Penalties for PCA offences before and after Phase 1 of the Mandatory Alcohol Interlock Program

Type of offence	First offence		Second or subsequent offence	
Period	Pre-reform	Post-reform[a]	Pre-reform	Post-reform[a]
High range PCA	A maximum court imposed fine of $3,300 OR Maximum jail term of 18 months OR A 3 year automatic disqualification period (12 months minimum)	A minimum disqualification period of 6 months and a maximum of 9 months AND An automatic interlock period of 24 months OR A 3 year automatic disqualification period (12 months minimum)[b]	A maximum court imposed fine $5,500 OR A maximum jail term of 2 years OR A 5 year automatic disqualification period (2 years minimum)	A disqualification period with a minimum of 9 months and a maximum of 12 months AND An automatic interlock period of 48 months OR A 5 year automatic disqualification period (2 years minimum)[a]
Mid range PCA	A maximum court imposed fine of $2,200 OR A maximum jail term 9 months OR A 12 month automatic disqualification period (6 months minimum)	Not in MAIP Phase 1	A maximum court imposed fine of $3,300 OR A maximum jail term of 12 months OR A 3 year automatic disqualification period (12 months minimum)	A disqualification period with a minimum of 6 months and a maximum of 9 months AND An automatic interlock period of 24 months OR A 3 year automatic disqualification period (12 months minimum)[a]
Low range PCA, novice range PCA, and special range PCA	A maximum court imposed fine of $1,100 OR A 6 month automatic disqualification period (3 months minimum)	Not in MAIP Phase 1	A maximum court imposed fine $2,200 OR A 12 month automatic disqualification period (6 months minimum)	A disqualification period with a minimum of 1 month and a maximum of 3 months AND an interlock period of 12 months OR A 12 month automatic disqualification (6 months minimum)[a]
Refuse breath test	A maximum court imposed fine of $3,300 OR Maximum jail term of 18 months OR A 3 year automatic disqualification period (12 months minimum)	A minimum disqualification period of 6 months and a maximum of 9 months AND An automatic interlock period of 24 months OR A 3 year automatic disqualification period (12 months minimum)[a]	A maximum court imposed fine of $5,500 OR A maximum jail term of 2 years OR A 5 year automatic disqualification period (2 years minimum)	A disqualification period with a minimum of 9 months and a maximum of 12 months AND An automatic interlock period of 48 months OR A 5 year automatic disqualification period (2 years minimum)[a]

[a] Magistrates still have discretion to apply pre-reform penalties (such as fines and jail terms) with the interlock order as an additional penalty.
[b] These penalties apply to those who are exempted from MAIP; refusal to install an interlock (for any MAIP-eligible offence) carries a 5 year automatic disqualification period..

Once the interlock device is installed in a participant's vehicle, they are required to provide a breath sample into the device to start the engine. If the participant records a Blood Alcohol Concentration (BAC) greater than or equal to 0.02, the vehicle will not start. If the participant records a BAC between 0.01 and 0.019, a warning message is displayed, and the vehicle will start.[12] The participant is also prompted, at random intervals while operating the vehicle, to provide additional tests.[13] Participants are required to have their interlocks serviced every 2 months, or every 3 months if they live in a remote area. When the device is being serviced, breath test data from the device is downloaded. Any attempts to tamper with the device or have someone else provide the breath sample are checked by the provider (interlock devices are fitted with cameras), and a breach is issued by Transport for NSW if tampering has occurred.[14] Participants must not record any positive breath tests in the final six months of their interlock program to successfully complete the program. If they do, their interlock period may be extended.

Prior research

There is substantial international empirical evidence to support the effectiveness of interlock devices in reducing drink driving while they are installed but limited evidence for longer-term effects of interlocks on recidivism. A 2004 Cochrane review and meta-analysis (Willis et al., 2004) examined 11 studies (one randomised study; 10 quasi-experimental studies) of the effectiveness of ignition interlock programs on recidivism. The sole experiment included in this review (Beck et al., 1999) was conducted in Maryland, and randomly assigned 1,387 repeat drink drivers to receive either an interlock device or the default penalty (the imposition of a zero-alcohol licence restriction) and an educational program. The study found that drink drivers who received a device were 64% less likely to record a new offence in the first year compared to those who received the business-as-usual alternative, but there was no difference in the likelihood of drink driving once the device had been removed. Of the 13 non-randomised studies reviewed by Willis et al (2004), nine demonstrated statistically significant reductions in recidivism while the interlock was installed but the effects did not persist once the interlock was removed. Of these nine, seven programs reduced the risk of drink driving while the interlock was installed by over 65%, with effects ranging from 62% to 95%.

A more recent systematic review from Blais, Sergerie, and Maurice (2013) reaches similar conclusions. Their review included studies rated three or higher on the Maryland Scientific Methods Scale (i.e. high-quality controlled studies and randomised controlled trials). For all 17 studies included in the review, the authors identified significant reductions (an average relative risk ratio of 0.6) in drink driving reoffences among both first-time and repeat offenders who had an interlock installed compared with drivers who were disqualified. Only three studies estimated the impact of interlocks on crash rates, one of which found a reduction in crash risk. However, the authors noted that these studies could not disentangle the road safety benefits from interlock participants being unable to drive drunk from any increases caused by them being more likely to drive (and drive more often) compared to disqualified drivers.[15]

Several studies have also examined the impact of interlock programs on alcohol-related road fatalities. Kaufman and Wiebe (2016) analyse a panel dataset of alcohol-impacted fatal crash rates in U.S. states between 1994 and 2013, exploiting the introduction of mandatory interlock programs in 18 states from 2004. They find that after 3 years of implementation, alcohol-impacted fatal crash rates reduced by 0.8 per 100,000 persons, or a 15% reduction in the number of alcohol-impacted fatal crashes. A more recent study (Mcginty et al., 2017) using a longer study period (i.e., 1982 to 2013) found that mandatory interlock

12 Although if the offender is breath tested by police with a BAC above zero, this is recorded as an offence.

13 Following the prompt, the driver is given several minutes to pull over, disengage the engine and provide another test.

14 So far, breaches of the program, especially those involving tampering with the device or falsifying a breath sample are a relatively rare event. Between the commencement of Phase 1 of MAIP and 20 April 2020, Roads and Maritime Services recorded 243 breaches, with only 29 (11.9%) relating to driving with an interlock device that was not functioning or that had been circumvented, and 9 (3.7%) related to driving with a breath sample from another person. The vast majority (199; 81.9%) of the recorded breaches related to driving without having the interlock device installed.

15 Interested readers are directed to Howard, E., Harris, A., McIntyre, A., Parnell, H., & Banyer (2020) for a further discussion of evidence relating to interlock programs.

laws were associated with a 7% and 8% reduction in alcohol-involved fatal crashes where the BAC of the driver exceeded 0.08 and 0.15 respectively. Meanwhile, partial interlock programs (which only applied interlocks to certain categories of offenders) were not associated with reductions in crash rates.

One of the earliest studies of alcohol interlocks in Australia was a trial in Queensland which commenced in February 2001 (Freeman et al., 2003). The trial involved 11 courts, six of which offered the combination of the existing 11-week "Under the Limit" (UTL) educational program followed by the installation of an interlock device, while the rest only offered the UTL program. Two years later, only 15 offenders had installed an interlock out of the 225 who had been referred to the program. They only examined self-reported drinking data collected from participants and found that most continued to drink to harmful levels, and only five individuals intended to reduce alcohol consumption. The user cost of the program was a major barrier to uptake; around 70% of referrals were screened out because they could not afford the device. A final evaluation by Sheehan et al. (2006) examined reoffending rates for 29 offenders referred to the QLD program who had installed interlock devices, and 147 offenders recruited to the control group (consisting of both offenders in control courts and those in treatment courts who refused interlock devices). Of those who installed the interlocks, 14.3% recorded a further drink driving offence after the initial disqualification period compared to 22.5% in the control group but this difference was not statistically significant, possibly because of the low sample size.

To our knowledge, there has only been one published large-scale effectiveness study of interlock devices (VicRoads, 2016) in Australia. It examined the expansion of Victoria's interlock program to young drivers with a BAC over 0.07 and first time offenders with a BAC of 0.15 or higher. Comparing outcomes for cohorts of individuals between 13 May 2002 and 30 September 2014 who were eligible for the program's expansion to those who were not eligible, before and after the introduction of the interlock program on 11 October 2006, the study found that drink driving offending decreased by 26% over the entire licencing cycle (i.e., from offence to re-issue), and unlike most international studies, further 18% after licence re-issue (i.e., completion of the interlock program).

The NSW MAIP program has only been subject to a process evaluation so far (Centre for Road Safety, 2019). The evaluation analysed licensing and MAIP program data from Transport for NSW along with data from surveys and interviews with MAIP participants and key stakeholders. It found that the program was largely being implemented well and was viewed positively by participants. At the time of the evaluation (June 2017), 8,500 interlock orders had been issued. The report also noted that MAIOs were not always consistently applied (partly because of errors in applying the eligibility criteria). In 2015, there were 505 MAIOs issued to people who had an ineligible offence, and the report noted that there were cases where a person's offence history justified a MAIO but an order was not issued by the court. Of those who completed the initial disqualification period, 54% started the interlock program and 409 participants completed MAIP (between February 2015 and June 2017). Of those issued with an interlock order, 81% were male, 56% were under 40 years of age, 32% resided in the Sydney metropolitan area, and approximately 9% identified as Aboriginal. While there was limited data available on financial support received by participants, the process evaluation suggested that around 30% of those with an interlock surveyed had claimed a concession discount but only 9% severe financial hardship funding. Participants also had high rates of satisfaction with the program. Just over 80% of respondents said that they approved or strongly approved of the program, and the majority said that the devices enabled them to fulfil work responsibilities (60%) and family commitments (64%). The evaluation recommended improvements in several areas including: the take up rate of the devices; the accessibility of the program (in terms of service centres and financial support); communications to participants and GPs about their obligations under the program, and; improved governance and contract management with service providers.

The present study

Despite considerable international evidence to support the effectiveness of interlock devices in reducing drink driving (at least while the interlock is installed), to date there have been no major evaluations undertaken in New South Wales. Furthermore, few papers have considered the potential impact of interlock programs on other driving offences (e.g., driving while disqualified) or road safety. This paper is the first large-scale study in New South Wales to examine the impact of an alcohol interlock program on criminal justice and road safety outcomes. Specifically, the objectives of the present study are to answer the following research questions:

1. Has MAIP reduced drink driving related reoffences?
2. Has MAIP reduced driving whilst disqualified and other driving-related infringements?
3. Has MAIP reduced alcohol related road crashes and injuries?

METHOD

Data

We use a dataset extracted from the BOCSAR Re-offending Database (ROD) consisting of 98,501 proven drink driving offences (defined as Australia and New Zealand Standard Offence Classification (ANZSOC) 1431[16]) and refuse to provide a breath sample offences (defined by lawpart[17] codes 72588, 72597, 79364, 79365, 79366) committed between 1 February 2012 and 30 April 2018.[18] This includes records for 24,598 offenders convicted of an eligible MAIP offence, with 12,245 offenders committing such offences before the scheme was introduced and 12,353 offenders whose offences were committed after MAIP Phase 1 came into effect.

This data was linked to datasets from Transport for NSW (using the Justicelink case number) to obtain further information regarding Mandatory Alcohol Interlock orders (MAIO) issued by the court and other driving offences and infringements recorded up until 20 April 2020.[19] This data was then linked to MAIP operational datasets using a deidentified customer ID and the offence date, to obtain data relating to: 1) interlock device service records, which included the provider and date of service; 2) severe financial hardship letters; and 3) interlock breath test data. We also linked the dataset to an extract from the Transport for NSW's Crashlink database which contained records for 302,462 road crashes that occurred between 23 October 2013 and 20 April 2020. The Crashlink database contains information on the de-identified licence number of the controller of the traffic units (i.e., vehicle) involved in the crash, the severity of the crash, the number injured and killed in the crash, and a flag for whether the person was exceeding the legal alcohol limit on their licence at the time of the crash.

We also link our data to NSW Police data on roadside and station BAC readings for all PCA offences proceeded against by NSW Police between 1 January 2011 and 31 December 2018 using the police H-number. Offenders who fail a roadside breath test undergo a subsequent test at a police station. Because the station test forms the basis of criminal proceedings, we selected the highest station BAC reading within a case. We have valid BAC readings in the police data for 94.9% of court appearances (i.e., 93,603 appearances) in our sample. The BAC is missing in cases where a person was transported to the hospital (in which case a blood test forms the basis for prosecution) and where a person refused a breath test.

16 While driving under the influence (DUI) is also considered a drink driving offence, in Phase 1 it is only available to high range or repeat PCA offenders and refuse to provide a breath test offenders. Also included, however, are those who attempt to drink and drive, and those who supervise learners while exceeding the PCA limit.

17 Lawparts are codes for detailed offences and are maintained by the Judicial Commission. See https://lawcodes.judcom.nsw.gov.au/

18 We do this to ensure that there is a minimum follow-up time of 3 years for all criminal justice outcomes.

19 We were able to link 93,109 of the 98,587 (94.4%) appearances to either a MAIO or another driving offence recorded by Transport for NSW.

In this study, all offenders in the dataset who were eligible for Phase 1 of MAIP (including those who are exempted) are included in the treatment group. This consists of offenders who met one of the following three criteria: a high range drink driving offence; a special, novice, low, or mid range drink driving offence committed after 1 February 2015 with at least one prior drink driving conviction in the last five years or; a breath test refusal. Our control cohort consists of individuals who were not eligible for MAIP under Phase 1. That is, those convicted of either a first-time special, novice or low range drink driving offence, or offenders convicted of a first-time mid range drink driving offence after 1 February 2015. While these groups are ostensibly rather different, the subsequent sections describe how we mitigate for potential bias arising from such differences.

Variables

We examine five outcomes in this study.

1. Drink driving (PCA) reoffending: The probability of a driver reoffending with an exceed the prescribed content of alcohol (PCA) offence (ANZSOC 1431) or a drive under the influence offence (ANZSOC 411).[20]
2. Driving while disqualified (DWD): The probability of a driver reoffending with a drive while disqualified offence (ANZSOC 1411).
3. Traffic infringements: The number of infringements recorded by Transport for NSW which did not proceed to court.
4. Alcohol-related crashes: The probability of the driver involved in a crash with a BAC above the legal limit.[21]
5. Crashes resulting in an injury or fatality: The probability of a driver being involved in a crash resulting in an injury or fatality.

We measure outcomes 1 and 2 within 36 months of the index court finalisation and within 60 months of the index court finalisation when examining all offenders eligible for MAIP. The two different follow-up periods are examined for all eligible offenders because the length of the disqualification and interlock periods will vary depending on the type of offence and whether the offender opts into MAIP. The latter period also covers the entire automatic disqualification period for those who do not install an interlock. When examining groups of offenders with similar penalties, i.e., those illustrated in Table 1, we examine outcomes 1 and 2 within their respective maximum disqualification periods, within their automatic interlock period (assuming it starts after the expiry of the maximum disqualification period), and in the 24 months after the end of their (assumed) interlock period. For example, when we examine first-time high range PCA offenders in our regression discontinuity analysis (detailed in the next section), we examine PCA offending within the maximum disqualification period of 9 months, the subsequent (automatic) interlock period of 24 months and, for the 24 months after the end of the automatic interlock period. We choose these fixed periods (as opposed to actual disqualification and interlock periods) to enable comparison with offenders who were not on MAIP (who do not have are not assigned periods). Note that we cannot examine post-interlock offending for those with 48-month interlock periods as not enough time has elapsed to observe these outcomes.

Examining these periods provides an estimate of PCA and DWD offending before, within, and after the interlock is installed for different groups of offenders. The extent to which these periods provide “true” estimates of offending in each period depends on: a) the extent to which offenders are given the minimum and maximum disqualification periods; b) the extent to which people receive the automatic interlock periods; c) the delay between the end of the disqualification period and when offenders get interlock devices installed; d) how many orders are extended following repeated attempts to drink and

20 This refers to any offence where a driver exceeds the BAC limits on their licence. Offenders under an interlock order have a zero BAC limit.

21 We do not restrict these crashes to only those where the offender was the controller of the key traffic unit (i.e., the vehicle which was involved in the first impact) as alcohol impairment could cause another driver to cause an accident. The legal limit (in how this variable is recorded) is based on factors such as licecne status and class but not special conditions applied to the licence, such as an interlock condition.

drive with the interlock installed; and e) the proportions who exited the program early. First, examining a), we find that magistrates more commonly assign the minimum disqualification period, but a substantial proportion in each penalty group receive the maximum period.[22] In relation to b), we find that 13,049 (98.9%) of the 13,1915 MAIOs in our sample in Phase 1 specified the automatic interlock period specified in Table 1. In relation to c), the median duration from the expiry of the disqualification period to the start date of the interlock period is 23 days, and 25% of starters installed the interlock within 3 days of the end of their disqualification period. Last, in relation to d) and e): the vast majority (approximately 93%) of MAIOs were not extended[23] and early exits are also rare[24]. On balance, our periods are likely relatively conservative (in that the "interlock period" encompasses most, but not all, of the interlock periods for all offenders), and that at least a small proportion of offenders are still serving an interlock period in what we consider the post-interlock period.

For outcomes 3, 4, and 5, we examine whether these occurred in the 36 months following index finalisation. Since we only have traffic infringements and crash data up to 20 April 2020, these outcomes are missing for all individuals whose index matter was finalised after 20 April 2017. Therefore, these variables are missing for offenders with longer interlock periods and those appearing later in the sample, leaving 80,271 offenders when we examine these outcomes.

We use two treatment variables: eligible for MAIP (i.e., whether the offender had a proven high range PCA offence, a repeat PCA offence, or a refuse breath test offence on or after 2 February 2015), and second, commenced MAIP (recorded as having started the interlock program). The next section describes how these variables are used in our analyses.

Our dataset also includes a range of other covariates. These include:

- Demographic characteristics: Age at index contact (in years),[25] gender, Aboriginality (1 if ever recorded as Aboriginal by police), remoteness of the offender's residential postcode (Australian Bureau of Statistics, 2016a), socioeconomic index for the offender's residential postcode (categorised as quartiles from least to most disadvantaged) (Australian Bureau of Statistics, 2016b);
- Index offence characteristics: Whether found guilty of a repeat drink driving offence, a first-time high range offence, or a refuse breath test offence, and the number of concurrent charges;
- Criminal and driving history: Number of prior finalised court appearances with a proven offence, number of prior proven driving offences[26], age at first contact with the criminal justice system (categorised as 10-17 years, 18-24 years, 25-44 years, 45 years and older), and the number of traffic infringements (e.g., speeding, parking infringements, etc.) in the previous 24 months.

Identification strategy

We employ two strategies to determine the causal impact of MAIP. First, we use a regression discontinuity (RD) design to identify the impact of MAIP on first-time high range PCA offenders who take up the interlock devices. This method exploits the continuous nature of BAC readings to identify the effect of having an interlock device installed in a vehicle on reoffending and road safety outcomes by comparing observations just above (who received a MAIO) and below the eligibility threshold (who did not receive a MAIO). However, the estimates generated from these models only apply to first-time offenders with BACs

22 We observe that 227 (53.9%) and 146 (34.7%) of the 421 repeat high range PCA and repeat refuse breath sample offenders with a disqualification period recorded received the minimum and maximum disqualification periods respectively. For the 2,880 repeat mid range PCA, first time high range PCA, and first time refuse to provide a breath sample offenders with a disqualification period recorded, 1,676 (58.2%) and 904 (31.4%) offenders received the minimum and maximum periods respectively. Of the 1,393 repeat low range PCA offenders with a disqualification period recorded, 830 (59.6%) received the minimum disqualification period and 392 (28.1%) received the maximum disqualification period.

23 Of the 9,427 MAIOs within Phase 1 where a person started the program, 578 (6.1%) were extended. Restricting this to MAIOs issued for offences between 01 February 2015 and 02 December 2017 (a group with arguably more time to observe any extensions for), we observe 484 (7.0%) of 6,938 MAIOs were extended.

24 Of the 6,938 MAIOs issued for offences between 01 February 2015 and 02 December 2017, 458 (6.6%) recorded an early exit, including 292 (63.7%) for breaches of their MAIO.

25 In our subgroup analyses, we break age down into these categories: 18-24 years old, 25-34 years old, 35-44 years old, 45-54 years old, 55 years old and above.

26 This includes all offences under the following ANZSOC groups: 0132, 0411, 0412, 1419, 1411, 1412, 1421, 1422, 1431, 1432, 1433, and 1439.

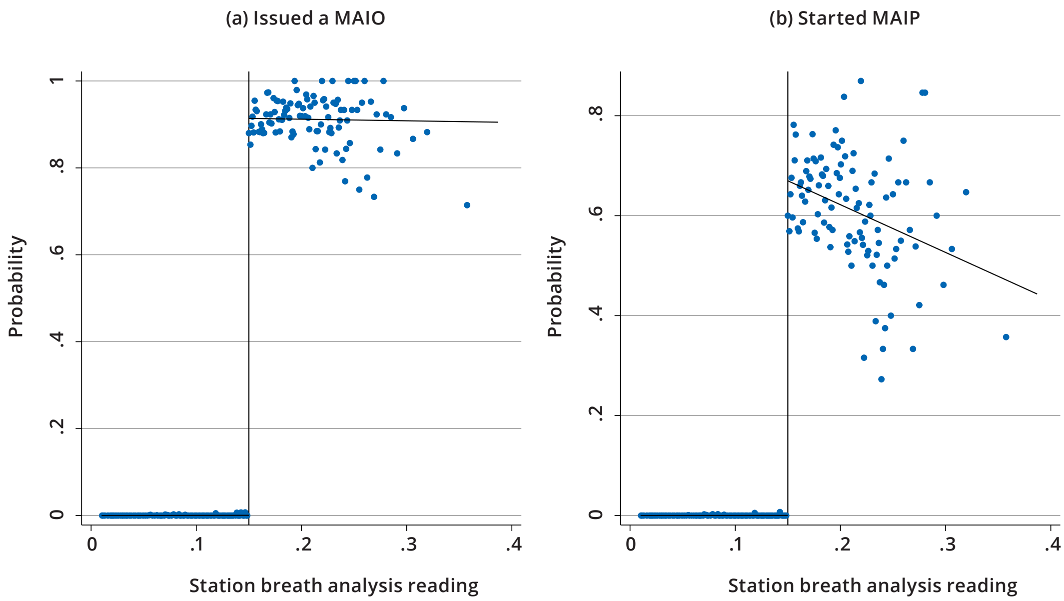
falling within a relatively narrow window above the .15 threshold. Therefore, we also employ a difference-in-differences strategy which compares outcomes for all eligible offenders with ineligible offenders, before and after the commencement of Phase 1 of MAIP. This analysis tests the overall impact of the policy on our reoffending and road safety outcomes. However, this approach likely results in an underestimate of the effectiveness of interlock devices because the treated group includes both offenders who opt into the program and those who do not (i.e., an intention-to-treat estimate).

The impact of interlock devices on reoffending

A first-time offender was eligible for MAIP under Phase 1 if they were detected driving with a BAC exceeding .15. Figure 1 shows the increase in the likelihood of being issued a MAIO and starting MAIP (i.e., taking up and interlock) for first-time offenders, by the breath analysis reading recorded at the police station. The probability of being issued a MAIO and starting MAIP increases by 89 percentage points (p.p.) [27] and by 63 p.p. respectively at the threshold (see Appendix Table A1 for the full regression models).

Offenders do not get a MAIO if they are exempted, or if they are mistakenly given an alternative penalty (such as a disqualification only). Meanwhile, there could be various reasons why a person does not choose to install an interlock, most of which are non-random. International studies (Romosz et al., 2021; U.S. Government Accountability Office, 2014) suggests that there are a range of reasons for not installing interlock devices including cost and preferences over waiting out the interlock period, risking detection for driving while disqualified, and using alternative transport. An analysis of NSW MAIP data (Rahman, 2022) suggests that existing disqualifications, concurrent prison sentences, age, and Aboriginality are all associated with a lower likelihood of starting an interlock order. Arguably, only being mistakenly given an alternative penalty is 'random' among these factors, and therefore, there is significant potential for selection bias in being issued a MAIO and starting MAIP.

Figure 1. The probability of receipt of a MAIO and of starting MAIP against BAC readings



27 Technically all eligible offenders should have been issued a MAIO following the commencement of Phase 1. There are a few reasons why this not all offenders were recorded as receiving a MAIO. The first reason is unsuccessful linkage: 1,536 (approximately 10% of MAIOs with an NSW Justicelink number) could not be linked to ROD. Second, a small number of offenders (755; 4% of eligible offenders) received an interlock exemption order. Third, the Centre for Road Safety (2018) identified that on occasion, offenders who were eligible for MAIOs were not given the orders.

This large increase in MAIP participation at and above the .15 threshold enables the use of a regression discontinuity (RD) design for this evaluation. A RD design can be used when selection into treatment is determined by a threshold or cutoff along a continuous variable ("a running variable"). It compares observations just above and below the threshold, for whom it can be argued that selection into the program is random. In this case, offenders who test above .15 are likely to be very different to the group of offenders who test in the medium or low concentrations (e.g., more prior offences, higher alcohol dependence). However, offenders who record a reading just above or below the high range threshold are arguably much more similar on observed and unobserved factors that influence the likelihood of reoffending. Effectively, the assumption of the RD is that within a narrow BAC range, recording a test just above or below the high range PCA threshold occurs by chance. This seems plausible as BAC is affected by many factors that are difficult for a driver to assess, for example the rate of alcohol consumption, food intake, hydration, and metabolism (Searle, 2015).

Since not all first-time offenders opt into MAIP, the threshold does not automatically determine participation in MAIP. Thus, we use a fuzzy regression discontinuity design (Imbens & Lemieux, 2008) which estimates the impact at the threshold for those who do participate. It is implemented using a two-stage local linear regression model around the high range PCA threshold. The first stage uses the threshold to determine the increase in likelihood of taking up an interlock device, specifically:

$$D_{it} = X'_{it}\ \beta_1 + \beta_2\ (BAC \geq 0.15) + g_k\ (BAC) + \varepsilon_{it} \qquad (1)$$

where D_{it} indicates whether an offender opts into receiving an interlock device, X'_{it} refers to an optional vector of covariates, $BAC > 0.15$ refers to being above the high range PCA threshold, g_k is a polynomial of order k[28]along the BAC distribution and ε_{it} is the error term.

The second stage uses the predicted probability from the first stage $\hat{D}_{it}$ to estimate the change in PCA reoffending and traffic outcomes associated with uptake of an interlock device.

$$Y_{it} = X\text{^}'\ \alpha_1 + \alpha_2\ (\hat{D}_{it}) + g_j\ (BAC) + \varepsilon_{it} \qquad (2)$$

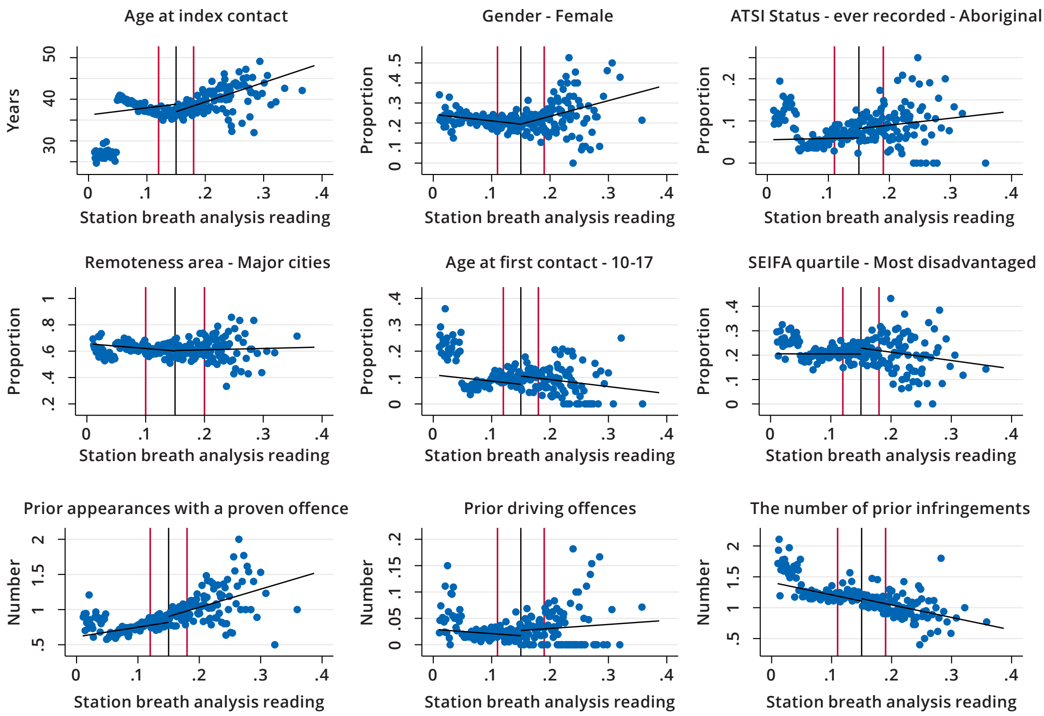
We do not examine DWD outcomes in this regression discontinuity analysis because offenders below the threshold are subject to a shorter disqualification period than what the treatment group would be had they not taken up an interlock device. Essentially, the comparison group does not provide a valid counterfactual as the counterfactual penalty (affecting the driving while disqualified outcome) also changes at the threshold. Specifically, they are only subject to a 12-month disqualification, instead of a three-year disqualification period (i.e., the licence disqualification period for first-time high range PCA offenders if MAIP was not in place), or the five-year automatic disqualification that offenders who do not install interlocks receive. Our difference-in-differences analysis, detailed in the next section provides an (intention-to-treat) estimate for this outcome.

We use optimal bandwidth selection to determine the window around the threshold for each outcome variable. In most cases, the bandwidth selected was 0.12 to 0.18. In other words, the bandwidth is selected to maximise the fit of the polynomials above and below the threshold as evaluated using the mean squared error (MSE) (Calonico, Cattaneo, & Titiunik, 2014).[29] We also include control variables listed in the previous section, (i.e., demographic characteristics, index offence characteristics, and criminal history) and month-by-year and court fixed effects in several specifications. Our preferred specifications use a linear polynomial and a uniform kernel and are presented in the main body of this report, with triangular kernel and quadratic specifications presented in the Appendix.

28 We choose a linear global function in our main analysis specifications as higher-level polynomials may perform poorly in these settings (Gelman & Imbens, 2019). We also test the robustness of these results when estimated using a quadratic global function (results presented in the Appendix).

29 This procedure also selects a secondary bandwidth to apply a bias correction to the estimate. We present the main bandwidth selected for each model in the regression tables in the Appendix.

Figure 2. Relationship between BAC and offender and case characteristics



Lines represent range within optimally-selected bandwidth around BAC cutoff for each outcome

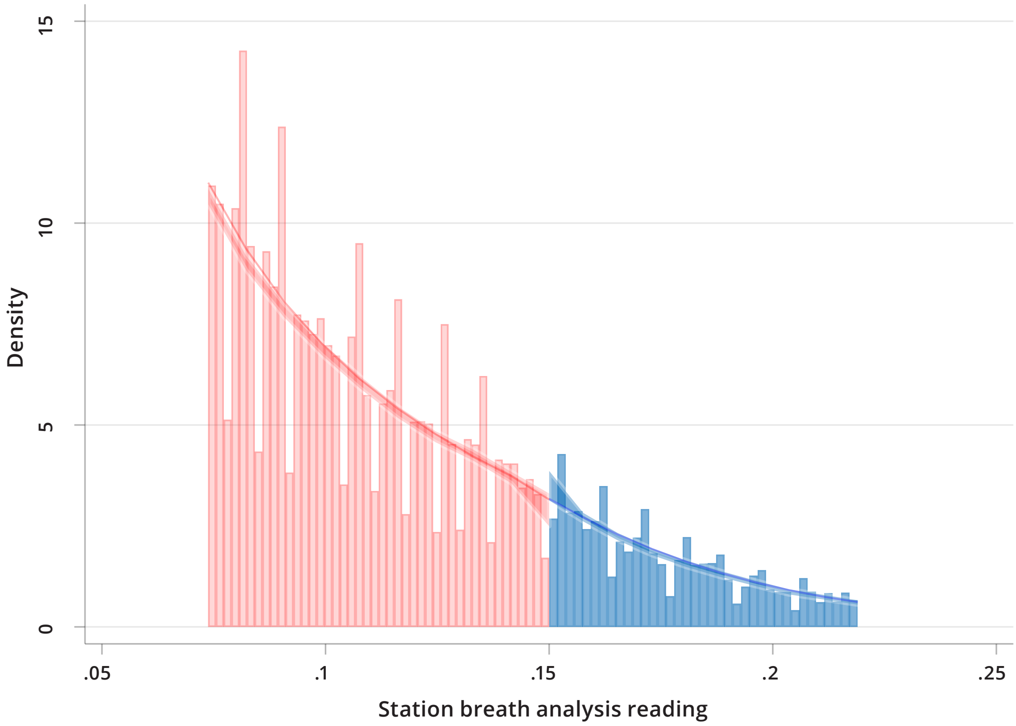
In addition to demonstrating a large increase in the likelihood of MAIP participation by BAC reading (shown in Figure 1), two further assumptions need to be met for the RD analysis to be valid. First, the design assumes that the .15 threshold is arbitrary and thus drivers recording a BAC within the narrow window around the threshold are likely to be identical, on average, except for their eligibility to participate in MAIP. To test this assumption, we examine the distribution of several key covariates over the range of BAC readings in our data (see Figure 2 and Table A2).[30] We find no significant differences at the .15 threshold in terms of average age, number of prior court appearances with a proven offence, number of prior driving offences, gender, Aboriginality, remoteness, socioeconomic status of area of residence, age at first contact with the criminal justice system, and the number of prior infringements. This provides visual evidence of the continuity of observed variables around the high range PCA threshold. For all these variables, the difference at the threshold is close to zero and not statistically significant (Table A2). This increases our confidence that any difference in outcomes at the .15 threshold is caused by participation in MAIP.

The second assumption is that BAC readings cannot be manipulated. That is, offenders and/or police are unable to tell which side of the threshold a driver is allocated to. If they were able to, we could not assume that being detected on either side of the threshold (within a narrow range) is random. Given that drivers cannot predict the precise location and timing of a random breath test and there is little scope for police to influence the reading, this assumption is highly plausible. Nonetheless we test this assumption using a simple density test (McCrary, 2008), shown in Figure 3. A disproportionate concentration of BAC readings on either side of the .15 threshold would be suggestive of manipulation of BAC readings and would invalidate our analysis. We do not find evidence to support that there are more readings on either side of the threshold (*p*=.124), but this result is sensitive to the choice of kernel and polynomial. One reason why this may not invalidate our estimate is peaks along the BAC spectrum are caused by a rounding

30 One feature of the plots above is that at extreme values of the BAC, there are fewer observations (and thus proportions displayed become more variable). The RD approach we use is largely robust to this because it focuses on observations within a narrow range, i.e., observations within the lines shown. A further point of interest is Panel (a) of the chart, where a large proportion of persons who are aged younger appear in an isolated cluster to the left. These represent those who are convicted of a novice range PCA offence; persons who are convicted of this tend to be disproportionately young compared to those convicted of a low range PCA offence, who are approximately 40 years old on average. We also present similar plots to Figure 2 examining only observations within the 0.12 to 0.18 range (Figure A1), with 95% confidence intervals, given the smaller sample.

procedure applied by the device used in the station breath analysis (J. Leary, personal communication, 9 February 2022). Specifically, it subtracts 10% from the reading, prior to deleting the fourth decimal place. This results in the spikes (followed by troughs) observed all along the distribution, and not just at the low, medium, and high range PCA thresholds. Even so, we estimate a "donut" RD (Eggers et al., 2015) specification as a robustness check. This excludes observations within a 0.02 range above and below the threshold (i.e., where the difference in densities is most apparent) in addition to those outside the selected bandwidth.

Figure 3. Density of observations at the high range PCA threshold



We run several other robustness checks of our regression discontinuity analysis. Most of our estimates use a rectangular kernel (i.e., all observations within the bandwidth are weighted equally regardless of distance from the threshold) and a linear global function, but we also include estimates using a triangular kernel (assigning a higher weight to observations closer to the threshold) and a quadratic polynomial in our main analyses. We also include control variables, and time and court location fixed effects in some specifications. We also conduct two falsification tests. First, we estimate the "impact" observed at various other points along the BAC range (0.14, 0.16, 0.18). Ideally, these estimates should be zero. Second, we undertake our analysis on a set of data from before the commencement of Phase 1 of MAIP (i.e., offences committed between 01 February 2012 and 31 January 2015) to ensure that any effects we observe did not exist prior to MAIP.

This regression discontinuity approach provides an "as good as randomised" (i.e., causal) estimate of the impact of MAIP on first-time offenders. However, this comes at the cost of precision and limits our ability to generalise our findings to other offenders. We lose precision because we effectively only include in the analysis the small proportion of first-time offenders who opted into MAIP after being detected with a BAC just above (in most cases between 0.15 and 0.18) the high range PCA threshold and those who were detected just below the high range threshold (in most cases between 0.12 and 0.15) who would likely have opted into MAIP.[31] As this estimate is only applicable to this narrow group, it is known as the Local Average Treatment Effect (LATE).

31 This is determined by predictions from equation (1) which estimates participation based on an offender's BAC and other characteristics.

Overall impact of the program on drink driving and crashes

The results from the analysis described above are not necessarily generalisable to drivers who record a BAC outside the narrow bandwidth specified and may not be applicable to repeat offenders or those who refuse breath tests. Therefore, we also undertake a difference-in-differences (DiD) analysis. In this DiD analysis, we compare outcomes for eligible and ineligible offenders before and after the commencement of Phase 1 of MAIP (i.e., 1 February 2015). Here eligible offenders are those with a high range PCA offence, a prior PCA offence (of any type) or a refuse breath test offence. Ineligible offenders are first-time medium, low, special, and novice range PCA offenders.

Equation 3 presents our difference-in-differences approach:

$$y_{jt} = \beta_0 + \beta_1 D_{jt} + (\beta_2 * eligible_j) + \lambda_t + \varepsilon_{jt} \quad (3)$$

Where y_{jt} is whether a person committed a drink driving related offence in group j, during month-year t. D_{jt} is a binary variable equal to one for the eligible cohort after the policy date, zero otherwise, $eligible_j$ is a binary variable equal to one for offenders who committed an eligible offence (either before or after the commencement of the policy), zero otherwise. λ_t represents a set of month-by-year fixed effects (FEs), which account for factors that influence recidivism common to both groups (e.g., unemployment rates, prices of alcohol and motor vehicles, police activity etc). ε_{jt} is the error term and all other terms are estimated coefficients. We estimate Equation 2 using Ordinary Least Squares (OLS) regression and report the Average Marginal Effect (AME) associated with β_1.[32] We also include specifications with the covariates listed in the previous section, (i.e., demographic characteristics, index offence characteristics, and criminal history) and court fixed effects.

This approach has two identifying assumptions (i.e., assumptions that need to be satisfied for this analysis to provide a causal estimate):

1. **The two cohorts have similar trends in outcomes, absent the intervention.** Although this assumption cannot be formally tested, we provide visual evidence of the credibility of this assumption in the next section and present corresponding statistical evidence in the Appendix (Figure A5, Table A8) using event-study specifications. The event-study specifications estimate the "impact" of MAIP relative to the period just before the intervention. Estimates before the introduction of MAIP close to zero support the common trends assumptions.
2. **No other concurrent changes specific to either group.** Any other systematic changes to either group over time can affect the validity of the estimates. For example, an escalation in disqualification periods for either group, or the introduction of other programs targeting only one of the groups. This assumption cannot be tested, but it is likely to hold as generally, few other road safety prevention and enforcement initiatives are targeted, let alone to this specific group of offenders. For example, the NSW Road Safety Plan 2021 specifies a range of initiatives for impaired drivers, most of which are general (i.e., not targeted). One potential confounder is the introduction of MAIP Phase 2, which applied to some offenders in the comparison group (i.e., first-time mid range PCA offenders). However, as we restrict this analysis to Phase 1 offenders only, this does not affect this analysis.

Provided that these assumptions hold, β_1 can be interpreted as the average marginal effect of MAIP on an eligible offender.[33] In other words, this technique is able to obtain a causal effect despite the groups being different. This is because it relies on the similarities in trends between to derive a valid counterfactual for eligible offenders, rather than directly comparing the groups' outcomes. An important implication is that the 'baseline' for eligible offenders is not the average outcomes of ineligible offenders after MAIP, but the average pre-MAIP outcomes for eligible offenders. As only 56.4% of eligible offenders take up MAIP, the ITT effect obtained via this analysis may underestimate the impact of MAIP. However, it is a more realistic estimate of the 'average impact' of the program as it is currently implemented.

32 In the Appendix we present estimates of the average marginal effects when estimating the model using logistic regression for the binary outcomes and negative binomial regression for the number of traffic infringements.

33 This is also known as the average treatment effect on the treated.

Impact of the program on different offenders

There are at least two ways in which program could impact participants differently. First, through the differences in the lengths of the program for offenders committing different offences. Second, the program could be more effective for offenders with particular characteristics, depending upon their existing propensity to commit PCA offences, and the extent to which these groups take up the devices. We repeat the above analyses on separate groups of: a) offenders receiving different penalties; and b) offenders with different demographic and other characteristics to determine the groups for whom the program is particularly effective for. For simplicity, we use a single specification for each analysis in doing this. We estimate a conditional fuzzy RD specification using a bandwidth of 0.3, a linear polynomial, a uniform kernel around the 0.15 PCA threshold, and fixed effects, and we present our fully controlled difference-in-differences estimates with court fixed effects for each subgroup examined.

RESULTS

Descriptive statistics

Table 2 descriptively compares characteristics and outcomes for first time offenders with a station breath analysis BAC reading between 0.12 and 0.18, who comprise our main RD sample. In other words, we contrast high range PCA offenders with readings between 0.15 and 0.18 (inclusive) against mid range offenders with readings between 0.12 and less than 0.15. Panel A presents demographic characteristics and indicates that in these groups, offenders were 37 years old, on average, and nearly 80% were male. As in our sample of all PCA and refuse to provide a breath sample offenders, Aboriginal offenders comprised a greater proportion of high range PCA offenders (8.8%) compared to mid range PCA offenders (7.1%). However, Aboriginality is unknown for more than a quarter of the offenders in each group and therefore the actual difference may vary. Approximately 60% offenders resided in major cities, and a further quarter resided in regional areas. There were slightly more offenders in the bottom two socioeconomic quartiles among high range PCA offenders in the treatment group (49.7%) than the mid range PCA offenders (49.0%).

We proceed to examine the characteristics of offenders' index appearance and criminal history in Panel B. Our treatment group had on average, 1.3 concurrent offences compared to 1.2 for the mid range offenders in our comparison group. Fewer high range PCA offenders had no priors (49.7%) than their ineligible counterparts (54.4%), and a larger percentage had three or more prior proven court appearances (11.4 vs. 9.2). Few in either group had any prior proven driving offences and the distribution of each group by age at first contact was roughly the same. Those in the first time mid range group had more prior traffic infringements in the 24 months before finalisation, on average (1.22) compared to the first time high range PCA offenders (1.13).

Panel C presents average outcomes for each group. First time high range offenders, on average, were less likely to have committed a PCA offence during the initial 9 month disqualification period (1.3% vs. 2.1%), the automatic interlock period (1.9% vs. 3.3%) and in the 24 months following that (0.8% vs. 0.5%) than first time PCA offenders. Mid range PCA offenders in our comparison group also committed more traffic infringements (0.8 vs. 0.4) in the 36 months following finalisation than first time high range offenders and were slightly more likely to have been involved in an alcohol-related crash (0.7% vs. 0.4%) and a crash involving an injury or fatality (1.7% vs. 1.2%) within 36 months post-finalisation. These are relatively small probabilities, indicating that the incidence of these types of crashes is low among the sample. This has implications for our analysis, reducing our ability to detect small differences in these infrequent events in this analysis.[34]

34 To illustrate, we would require 39,046 observations to detect a 0.2 percentage point reduction in the likelihood of an alcohol-related crash from a baseline of 0.06. This means our RD analysis is likely underpowered to detect significant impacts of the program on crash outcomes.

Table 2. Descriptive statistics, first-time offender sample within the 0.12 to 0.18 BAC range

Variable	Treatment group (n=3,273)	Comparison group (n=5,364)	Difference
Panel A. Demographic characteristics			
Age at index contact (mean)	37.46	36.56	0.90
	(0.18)	(0.22)	
Gender (%)			
Female	21.11	20.06	1.05
	(0.55)	(0.71)	
Male	78.89	79.94	-1.05
	(0.55)	(0.71)	
Aboriginality - ever recorded (%)			
Aboriginal	8.77	7.12	1.65
	(0.35)	(0.49)	
Non-Aboriginal	65.23	64.09	1.14
	(0.66)	(0.83)	
Unknown	26.00	28.78	-2.78
	(0.62)	(0.77)	
Remoteness area of residential postcode (%)			
Major cities	59.82	60.70	-0.88
	(0.67)	(0.86)	
Inner regional	25.91	25.41	0.50
	(0.59)	(0.77)	
Outer regional	7.85	7.89	-0.03
	(0.37)	(0.47)	
Remote/very remote	1.37	1.04	0.33
	(0.14)	(0.20)	
Missing remoteness	5.04	4.96	0.08
	(0.30)	(0.38)	
SEIFA quartile of residential postcode (%)			
Most disadvantaged	21.88	20.86	1.01
	(0.55)	(0.72)	
More disadvantaged	27.80	28.09	-0.29
	(0.61)	(0.78)	
Less disadvantaged	25.91	25.52	0.39
	(0.60)	(0.77)	
Least disadvantaged	19.31	20.56	-1.25
	(0.55)	(0.69)	
Missing	5.10	4.96	0.14
	(0.30)	(0.38)	

Table 2. Descriptive statistics, first-time offender sample within the 0.12 to 0.18 BAC range *(continued)*

Variable	Treatment group (n=3,273)	Comparison group (n=5,364)	Difference
Panel B. Index offence and criminal history			
Number of proven concurrent charges at index contact (including principal offence (mean)	1.31	1.20	0.11
	(0.01)	(0.02)	
Number of prior finalised court appearances (with proven offence/s) as a juvenile or an adult (%)			
0	49.65	54.38	-4.73
	(0.68)	(0.89)	
1	18.95	17.89	1.06
	(0.52)	(0.70)	
2	19.99	18.50	1.49
	(0.53)	(0.71)	
3 or more	11.41	9.23	-2.18
	(0.40)	(0.57)	
Prior proven driving offences (mean)	0.03	0.02	0.01
	(0.00)	(0.00)	
Age at first contact with CJS (%)			
10-17	10.40	10.15	0.25
	(0.41)	(0.54)	
18-24	29.60	30.89	-1.29
	(0.63)	(0.81)	
25-44	43.49	43.35	0.14
	(0.68)	(0.88)	
45+	16.51	15.61	0.90
	(0.50)	(0.66)	
The number of prior traffic infringements (mean)	1.13	1.22	0.09
	(0.02)	(0.02)	
Panel C. Outcomes			
PCA reoffending within initial disqualification period (%)	1.27	2.14	-0.88
	(0.20)	(0.20)	
PCA reoffending within the interlock period (%)	1.96	3.28	-1.32
	(0.24)	(0.25)	
PCA reoffending in the 24 months following the interlock period (%)	0.47	0.75	0.28
	(0.02)	(0.02)	
Number of traffic infringements in the 36 months after finalisation (mean)	0.43	0.83	0.40
	(0.01)	(0.01)	
Crash involving alcohol in the 36 months after finalisation (%)	0.40	0.70	-0.29
	(0.14)	(0.14)	
Crash involving an injury or fatality in the 36 months after finalisation (%)	1.15	1.71	-0.36
	(0.22)	(0.24)	

Standard errors in parentheses

Table 3 compares the characteristics of offenders in our sample who are eligible and ineligible for MAIP.[35] Panel A presents the demographic characteristics of these two groups of offenders. In both groups, the average age of offenders was approximately 38 years. The proportion of female offenders was 18.9% and 21.7% in the eligible and ineligible groups respectively. Aboriginal offenders comprised 11.3% of those with an eligible offence and 5.9% of those with an ineligible offence. However, in both groups a substantial proportion (15.4% and 31.9% of eligible and ineligible offenders respectively) of offenders were of unknown Aboriginality. Therefore, it is possible that the relative proportion of Aboriginal offenders in both groups may differ. In terms of areas of residence, 60.3% of offenders with an eligible offence resided in major cities, compared with 62.9% of offenders with ineligible PCA offences. Just over half (52.2%) of all eligible offenders resided in postcodes within the two most disadvantaged SEIFA quartiles, slightly more than the corresponding proportion in the ineligible group (46.4%).

Table 3. Descriptive statistics, offenders convicted of MAIP eligible offence vs. an ineligible offence

Variable	MAIP eligible offence (n=24,598)	MAIP ineligible offence (n=73,903)	Difference
Panel A. Demographic characteristics			
Age at index contact (mean)	37.95	37.37	0.58
	(0.05)	(0.08)	
Gender (%)			
Female	18.89	21.69	-2.79
	(0.15)	(0.25)	
Male	81.11	78.31	2.79
	(0.15)	(0.25)	
Aboriginality - ever recorded (%)			
Aboriginal	11.33	5.89	5.44
	(0.09)	(0.20)	
Non-Aboriginal	73.30	62.20	11.10
	(0.18)	(0.28)	
Unknown	15.37	31.90	-16.53
	(0.17)	(0.23)	
Remoteness area of residential postcode (%)			
Major cities	60.25	62.87	-2.62
	(0.18)	(0.31)	
Inner regional	25.87	23.29	2.58
	(0.16)	(0.28)	
Outer regional	8.42	7.63	0.79
	(0.10)	(0.18)	
Remote/very remote	1.31	0.95	0.36
	(0.04)	(0.07)	
Missing remoteness	4.15	5.25	-1.10
	(0.08)	(0.13)	
SEIFA quartile of residential postcode (%)			
Most disadvantaged	23.20	20.45	2.75
	(0.15)	(0.27)	
More disadvantaged	29.00	25.97	3.03
	(0.16)	(0.29)	
Less disadvantaged	24.68	24.50	0.19
	(0.16)	(0.27)	
Least disadvantaged	18.95	23.82	-4.87
	(0.16)	(0.25)	
Missing	4.16	5.26	-1.10
	(0.08)	(0.13)	

35 We do not present statistical testing as the large sample sizes render virtually all these differences significant at the 5% level.

Table 3. Descriptive statistics, offenders convicted of MAIP eligible offence vs. an ineligible offence *(continued)*

Variable	MAIP eligible offence (n=24,598)	MAIP ineligible offence (n=73,903)	Difference
Panel B. Index offence and criminal history			
Number of proven concurrent charges at index contact (including principal offence (mean)	1.43	1.14	0.29
	(0.00)	(0.01)	
Number of prior finalised court appearances (with proven offence/s) as a juvenile or an adult (%)			
0	26.40	59.32	-32.92
	(0.18)	(0.28)	
1	22.96	17.45	5.51
	(0.14)	(0.27)	
2	31.24	15.77	15.47
	(0.13)	(0.30)	
3 or more	19.40	7.47	11.93
	(0.10)	(0.25)	
Prior proven driving offences (mean)	0.45	0.03	-0.42
	(0.00)	(0.00)	
Age at first contact with CJS (%)			
10-17	12.81	9.05	3.76
	(0.11)	(0.21)	
18-24	30.53	29.31	1.22
	(0.17)	(0.29)	
25-44	42.61	41.26	1.35
	(0.18)	(0.32)	
45+	14.05	20.38	-6.33
	(0.15)	(0.22)	
The number of prior traffic infringements (mean)	1.12	1.21	0.08
	(0.00)	(0.01)	
Panel C. Outcomes			
PCA reoffending within 36 months of finalisation (%)	6.68	7.94	-1.26
	(0.10)	(0.16)	
PCA reoffending within 60 months of finalisation	10.85	11.01	-0.16
	(0.12)	(0.20)	
DWD offending within 36 months of finalisation (%)	9.16	6.22	2.94
	(0.09)	(0.18)	
DWD offending within 60 months of finalisation (%)	10.79	7.27	3.52
	(0.10)	(0.20)	
Number of traffic infringements (mean)	0.47	0.83	0.36
	(0.01)	(0.01)	
Crash involving alcohol in the 36 months after finalisation (%)	0.52	0.51	0.01
	(0.03)	(0.05)	
Crash involving an injury in the 36 months after finalisation (%)	1.09	1.78	-0.69
	(0.05)	(0.07)	

Standard errors in parentheses.

Panel B descriptively compares prior criminal history and prior traffic infringements for the two offender groups. Offenders eligible for MAIP have on average 1.43 proven concurrent offences compared with an average of 1.14 for ineligible offenders. A much larger proportion of ineligible offenders had no prior appearances (59.3% vs. 26.4% among eligible offenders). This is unsurprising as repeat PCA offenders are included in the eligible group and the comparison group consists entirely of first-time PCA offenders. Eligible offenders also have slightly fewer traffic infringements in the 24 months prior to finalisation (1.1) on average, when compared with ineligible offenders (1.2) in the 24 months prior to finalisation.

Panel C presents unadjusted outcomes for eligible and ineligible groups. We first examine PCA reoffending. Approximately 6.7% of eligible offenders and 7.9% of ineligible offenders committed a PCA offence in the first 36 months following the index court finalisation. Within 60 months of finalisation, eligible offenders were equally likely to commit a PCA offence (10.9%) than ineligible offenders (11.0%). The next set of outcomes relate to DWD offending over the same follow-up periods. Within 36 months of finalisation, eligible offenders were approximately 3 p.p. more likely to reoffend with a DWD offence than ineligible offenders (9.2% vs. 6.2%). Within 60 months after finalisation, eligible offenders were 3.5 p.p. more likely to commit a DWD offence than ineligible offenders (10.8% vs. 7.3%).

Finally, we examine traffic outcomes. Eligible offenders had on average, fewer traffic infringements in the 3 years following the index finalisation compared with their ineligible counterparts (0.47 vs. 0.83) and were slightly less likely to be involved in a crash involving an injury or fatality (approximately 0.7 p.p. less). An almost equal proportion in both groups were over the legal alcohol limit in a crash in the 36 months following the index court finalisation (0.52% and 0.51% of eligible and ineligible offenders respectively).

Table 4. Eligible offenders and commencement rates, by penalty group

Group	All post-MAIP eligible offenders (n=12,353)	Repeat low range PCA (n=1,734)	Repeat mid range PCA or first-time high range PCA or first time refuse breath test offenders (n=9,403)	Repeat high range PCA or repeat refuse breath test offenders (n=1,216)
Penalty				
Mandatory interlock order	10,315 (83.5%)	1,320 (76.1%)	8,043 (85.5%)	952 (78.3%)
Disqualified only	534 (4.3%)	164 (9.5%)	289 (3.1%)	81 (6.7%)
Interlock exemption order	547 (4.4%)	48 (2.8%)	453 (4.8%)	46 (3.8%)
Section 10 dismissal	254 (2.1%)	118 (6.8%)	133 (1.4%)	3 (0.2%)
Missing	703 (5.7%)	84 (4.8%)	485 (5.2%)	134 (11.0%)
Started MAIP	6,963 (56.4%)	951 (54.8%)	5,484 (58.3%)	528 (43.4%)

Penalties as recorded in Transport for NSW data

Table 4 presents the distribution of penalties (as recorded by Transport for NSW) and the participation rate for all eligible offenders following the commencement of Phase 1 of MAIP. It also presents these statistics by groups of offenders with the same penalties under Phase 1 of MAIP. Of the 12,353 offenders who met the observed eligibility criteria for MAIP, 83.5% were recorded as having a mandatory interlock order. Approximately 4.0% of offenders were disqualified or given an interlock exemption order. Of the 1,737 repeat low range PCA offenders, 76.1% had a mandatory alcohol interlock order. Notably, nearly 1 in 10 received a licence disqualification only and 6.8% received a Section 10 dismissal. The second group is the largest group of eligible offenders (9,403 of the 12,353 or 76.1% of MAIP eligible offenders), and consists of repeat mid-range PCA offenders, first time refuse breath test offenders, and first-time high range PCA offenders. Of these offenders, 8,043 (85.5%) received a MAIO, while 3.1% and 4.8% were disqualified or given an interlock exemption order respectively. Only 1.4% received a Section 10 dismissal and we did not identify a penalty type for 5.2% of the offenders. The last group are repeat high range PCA or repeat refuse breath test offenders. Of these 1,216 offenders, 78.3% received a MAIO, and 6.7% were disqualified, while 3.8% received an exemption order. Barely any were recorded as having received Section 10s dismissals (0.2%). We were unable to observe the penalty received by more than 1 in 10 of these offenders. An examination of court data indicates that 3 in 4 (76.8%) offenders without a penalty recorded in TfNSW data received a prison penalty.

The overall uptake of MAIP was under 60% for all groups, i.e., a large proportion of those in each group were recorded as not having installed interlocks despite their eligibility. Starting was lowest among highest risk offenders, i.e., repeat high range PCA and refused breath test offenders. Only 43.4% of this group started the MAIP program compared with the other groups (54.8% and above).

Regression discontinuity estimates

Figure 4 shows the difference in outcomes for all first-time offenders along the PCA threshold, with red lines highlighting the bandwidth just above and below the high range PCA threshold. The difference in average outcomes for observations within each window on either side of the threshold represents the sharp regression discontinuity estimates (Table A3). There is a small, statistically significant difference in PCA reoffending at the 0.15 BAC threshold during the initial disqualification period (i.e., within 12 months of index finalisation) as demonstrated in Panel (a), and a statistically significant reduction in PCA reoffending (of 6.4 p.p.) during the interlock period (Panel (b)). We estimate a small reduction of 1.8 p.p. in PCA reoffending following the interlock period (Panel (c)). There is a small reduction in the average number of traffic infringements committed in the 24 months following finalisation (-0.29 infringements on average; Panel (d)) but we find no difference in the probability of an alcohol-related crash (-0.2p.p.; Panel (e)) or any crash with an injury or fatality (Panel (f)).

Figure 4. Differences in average reoffending and road safety outcomes at the high range PCA threshold

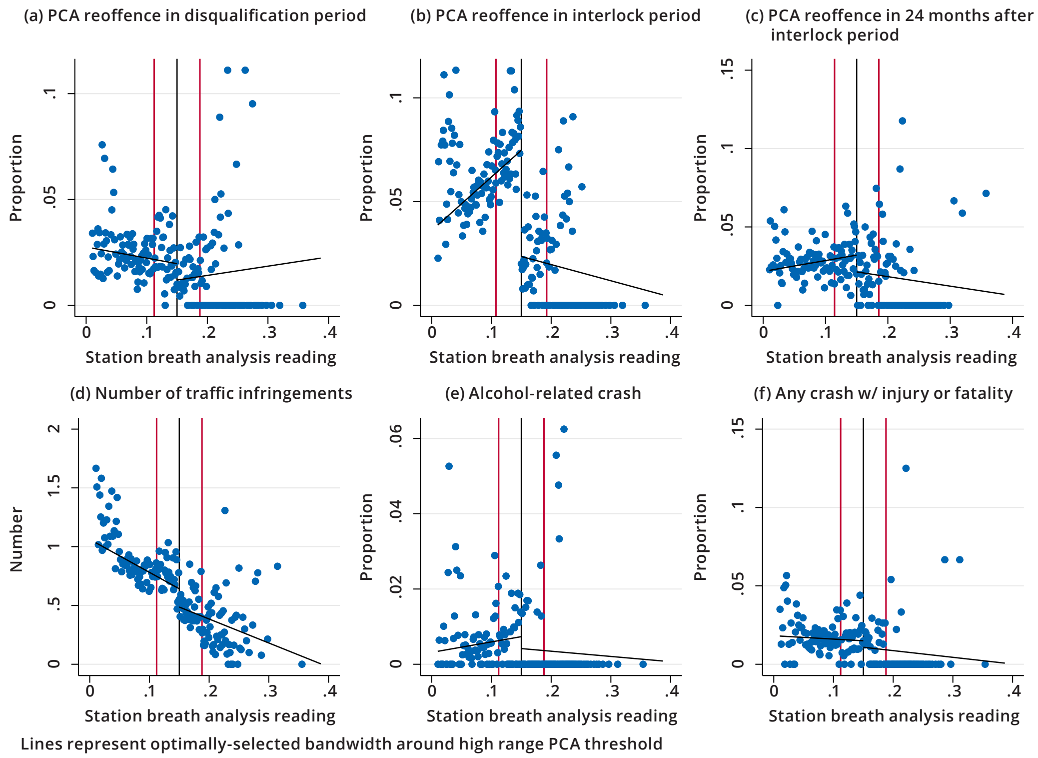
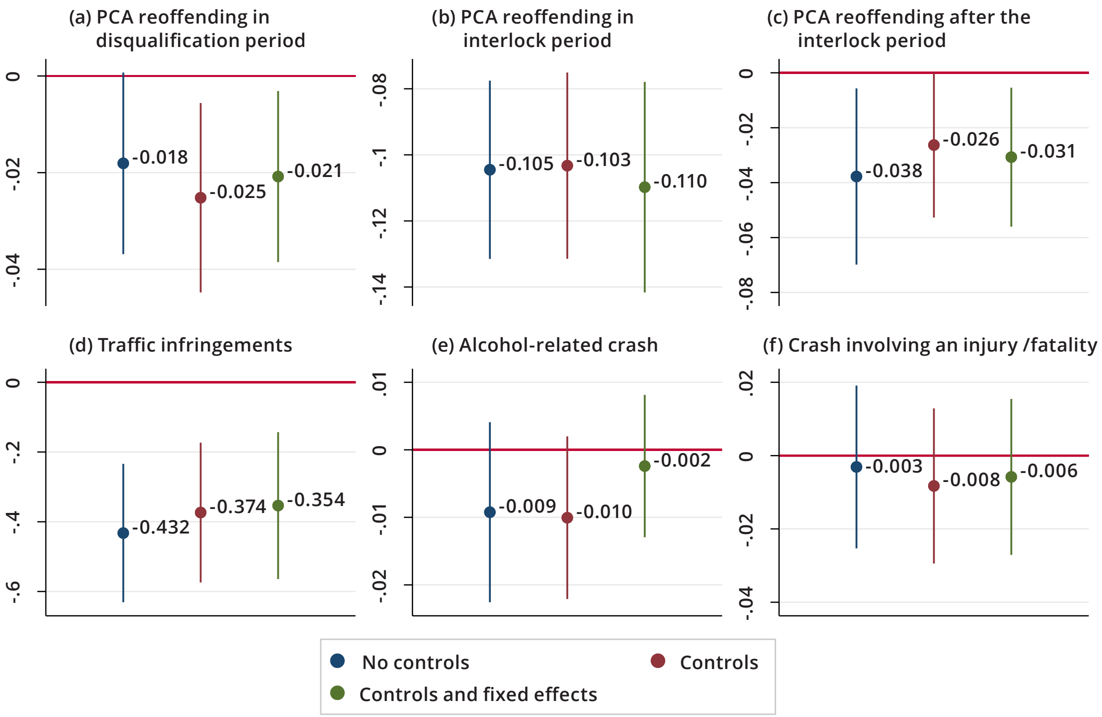


Figure 5 (and Appendix Table A4) presents fuzzy regression discontinuity estimates for the six outcomes we examined. Unlike Figure 4 (which considers all first time high range offenders) the fuzzy regression discontinuity estimates refer to the impact of MAIP only for first-time offenders who **start the program**. These estimates are more representative of the impact of the program on those who actually took part in it. Figure 5 shows that while there are negligible impacts on PCA offending during the initial disqualification period (Panel (a)), we observe a large, statistically significant 11 p.p. reduction in the probability of a PCA offence during the interlock period (Panel (b)). This is equivalent to a 86% reduction in PCA offending during this period, considering average PCA reoffending rates of 1.7% in the interlock period among those who started the program. This estimate is stable with the inclusion of control variables and fixed effects. We also observe a small, statistically significant decline in the probability of a PCA offence, of 3.1 p.p., in the 24 months following the interlock period (Panel (c)).

We then turn to our traffic and crash outcomes. Considering our preferred specifications (which include covariates and fixed effects), we estimate a significant reduction in the number of traffic infringements of 0.35 infringements in the 36 months following index court finalisation (Figure 6(d)). We observe non-significant reductions in the probability of an alcohol-related crash in the 36 months (of 0.2 p.p.) following index finalisation as shown in Figure 6(e), and in the probability of a crash involving an injury or fatality in the 36 months following finalisation (of 0.6 p.p.; Figure 6(f)).

Figure 5. Fuzzy regression discontinuity estimates of the impact of MAIP on first-time high range PCA offenders



Controls included are demographic characteristics, index case characteristics and criminal history variables outlined in the data section. Month-by-year and court fixed effects are also included.

In the Appendix, we also present estimates from the two falsification tests, and the "donut" specification which omits observations close to the threshold (where any manipulation and differences arising from rounding from breath testing equipment are more likely). The first falsification test involves varying the BAC threshold (Table A5; Figure A2) to see whether there are any major changes in our outcomes at BAC values where no discontinuity occurs (we use the BAC values of 0.14, 0.16, and 0.18 for this purpose). Except traffic infringements, all the estimates are close to zero and non-significant, suggesting that the changes we observe only occur at the high range PCA threshold of .15. This increases our confidence that the significant effects shown in Figure 5 can be attributed to MAIP.

Our second falsification test (Table A6; Figure A3) examines the "impact" at the .15 BAC threshold on a sample of first-time offenders who offended prior to the introduction of MAIP. Unlike our first falsification test, we do not expect these estimates to be zero. This is because there may be differences in outcomes arising from the previous penalty regime (see Table 1). Obtaining estimates similar in magnitude to the sharp RD estimates in Table A3 would be suggestive of either: 1) the presence of other differences between offenders at the threshold driving our results; or 2) that the current penalty regime is no more (or less) effective than what previously existed. We observe several statistically significant differences in reoffending in this test. Firstly, there is a reduction of 1 p.p. in PCA offending within the initial disqualification period and a 3 p.p. reduction during (what would be) the interlock period, but no reduction in the post-interlock period. We also find a reduction in the average number of traffic infringements in the 36 months following finalisation of 0.18, but no other impacts. The reduction in PCA offending in the initial disqualification period are marginally smaller than those we estimate in the fuzzy

RD but are statistically significant. Meanwhile the estimated reductions in PCA reoffending during the interlock period (3 p.p.; Table A6) are roughly half that estimated for the post-MAIP period (6 p.p., Table A3). This suggests that MAIP's effectiveness exceeds any other differences in reoffending between the groups, and the previous penalty regime.

Our last robustness check is the "donut" regression discontinuity specification (Figure A4; Table A7). This tests the sensitivity of our estimates to the observations closest to the threshold, which are likely to be the most susceptible to manipulation (if there was scope to do so). We estimate these checks using fully controlled RD model (including controls or fixed effects) with a uniform kernel and a linear polynomial. Our estimates for PCA reoffending within the initial disqualification and during the interlock periods are robust even when excluding the observations closest to the threshold, however the estimated reductions in PCA reoffending after the interlock period are smaller and are no longer statistically significant. The differences between the estimates for the remaining outcomes are small and qualitatively similar.

Difference-in-differences estimates

Figure 6. Trends in unadjusted outcomes between 1 Feb 2012 and 31 May 2018, MAIP eligible and ineligible offenders

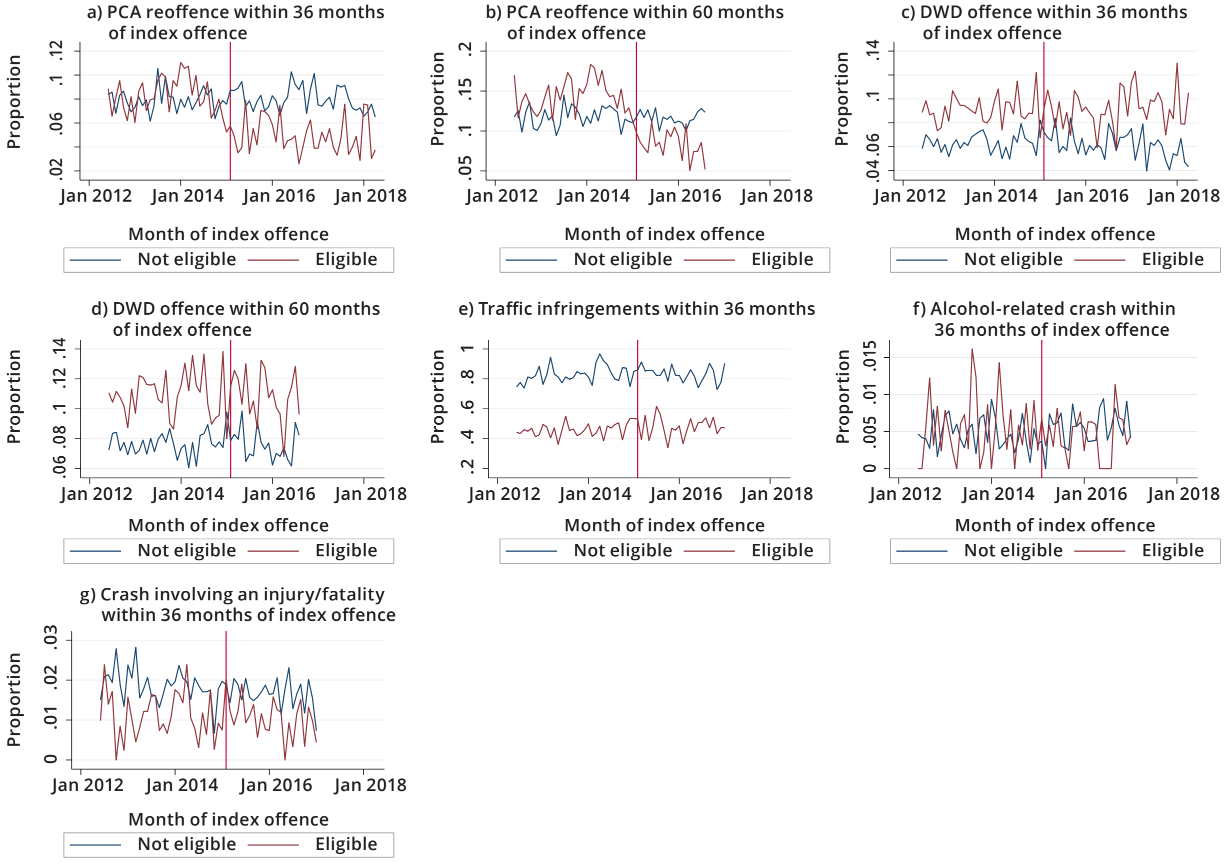
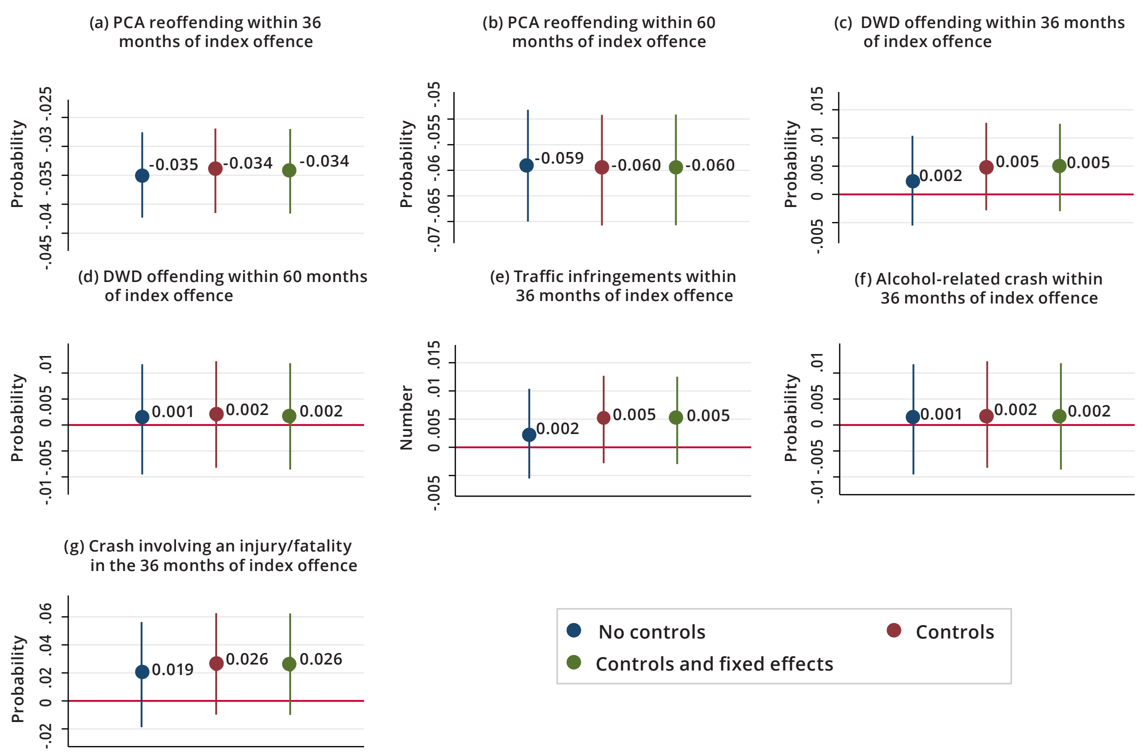


Figure 6 shows trends in our main outcome variables between 1 February 2012 and 31 May 2018 (i.e., before and after the introduction of MAIP) for both MAIP eligible and ineligible offenders. These provide visual evidence as to whether the common trends assumption for the difference-in-differences analysis is satisfied and allows us to observe any obvious changes in outcomes following the introduction of MAIP. Panel (a) shows the proportion in each group reoffending with a new PCA offence within 36 months of index court finalisation. As seen here, the two groups have mostly similar trends prior to the introduction of MAIP. There is also a clear reduction in the rates of PCA reoffending among eligible offenders after MAIP commences. Panel (b) shows PCA reoffending within 60 months following finalisation. Trends in offending diverge shortly before the commencement of Phase 1 but are otherwise similar for the two groups. Even so, we still observe a large decrease in offending among eligible defendants following the program's introduction. Panel (c) shows trends for DWD offending within 36 months. Here, prior trends appear more similar but there is no clear change in DWD offending for MAIP eligible offenders after the policy date. Panel (d) shows DWD offending within 60 months; there are clear differences in the trends for the two groups and no discernible change for eligible offenders post-policy. Trends in traffic infringements (Panel (e)) and the likelihood of a crash involving an injury or fatality (Panel (g)) in the 36 months post-finalisation appear similar but there are no obvious changes post-policy for the eligible offender group. Panel (f) shows trends in alcohol-related crashes within 36 months of finalisation. For this outcome, trends differ somewhat across the two groups, but there is also no discernible difference post-policy.

Our visual inspection suggests that the common trends assumption is credible for all our outcomes except for alcohol-related crashes. Estimates from our formal event study, which tests the common trends assumption for our differences-in-differences analyses, are presented in the Appendix (Figure A5; Table A8). These estimate the "impact" of MAIP at different leads and lags, relative to the period just before MAIP's introduction. If the common trends assumption holds, estimates for all the lags (i.e., periods prior to MAIP's introduction) should be zero and non-significant. These confirm that prior trends are similar (i.e., a joint test of the lags are non-significant) for all outcomes except crashes where the offender was above the legal blood alcohol limit.

So far, we have identified significant reductions in PCA reoffending during and after the interlock period for first-time offenders who took up an interlock device. Next, we present estimates from our difference-in-differences analyses (Table A9) which represent the overall impact of MAIP on all eligible offenders (regardless of whether they took up the interlock device) (Figure 7).[36] .

Figure 7. Difference-in-differences estimates of the impact of MAIP on eligible offenders



36 While the ineligible group act as a comparison group, in a difference-in-differences analysis they serve to provide the counterfactual trends for the treatment group. In other words, the changes in their outcomes are applied to the baseline for the treatment group to derive a counterfactual series for the treatment group.

We find significant reductions in PCA offending within 36 months of finalisation (of approximately 3.4 p.p.; Figure 7(a)) and within 60 months of finalisation (approximately 6.0 p.p.; Figure 7(b)). These represent reductions of approximately 43% in PCA offending during these periods, compared with the respective baseline average of 8.2% and 14.3% among eligible offenders.[37] At least some of the additional reduction in PCA offending observed within 60 months (compared to that estimated within 36 months of finalisation) would be caused by longer interlock periods for repeat high range PCA and refuse breath test offenders. A subgroup analysis in the following section examines this possibility in greater detail

We estimate no significant differences in the likelihood of DWD offending within 36 or 60 months of finalisation (Panels (c) and (d) of Figure 7). We also find no significant differences in the number of traffic infringements or the probability of an alcohol-related crash or a crash involving an injury or fatality in the 36 months following index finalisation. These results are robust to the use of non-linear methods.[38]

Impact of MAIP on various offender subgroups

Impacts by penalty group

We now turn to whether the program has differing impacts for various subgroups of offenders. First, we consider whether our estimates vary by the type of index offence. For this analysis, we classify offenders into three groups (corresponding to the different penalties described in Table 4, and examine offending within each group's maximum disqualification and automatic interlock periods applicable to their index offence:

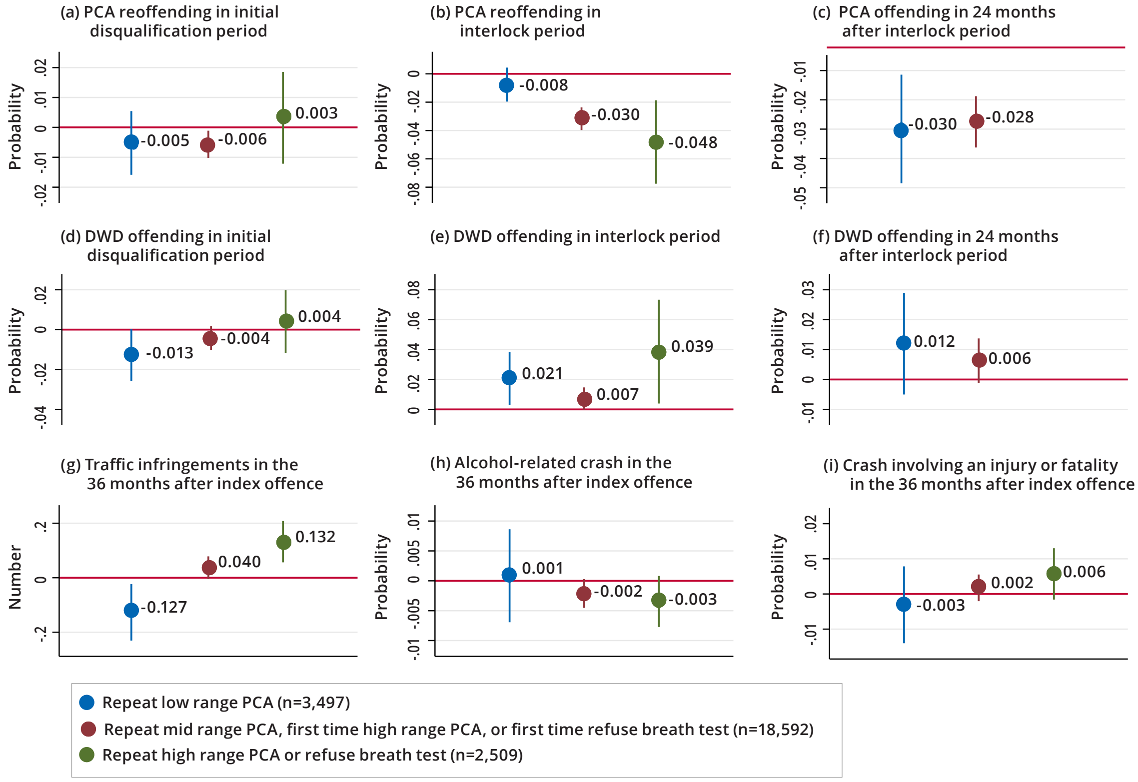
- Repeat low range PCA offenders (3 month maximum disqualification and a 12 month automatic interlock period);
- Repeat medium range offenders, first-time high range PCA offenders, and refuse breath test offenders (9 month maximum disqualification and a 24 month automatic interlock period);
- Repeat high range PCA and repeat refuse breath test offenders (12 month maximum disqualification and a 48 month automatic interlock period). We are unable to estimate the long-term impacts of MAIP for this group as the study ends in May 2021 (i.e, for a person to have 24 months follow-up time after a 12 month disqualification and a 24 month interlock program, they would need to have received a MAIO on or before 31 May 2014, before the program commenced).

Figure 8 (and Table A11) presents difference-in-differences estimates for offenders in each of these three groups. The only group who was significantly less likely to commit a PCA offence during their initial disqualification period (compared to those who committed the same offences before the introduction of MAIP) were repeat mid range PCA, first time high range PCA, and first time refuse breath test offenders (by 0.6 p.p.). We find greater reductions in PCA offending during the interlock period for each successive penalty group. We find no difference in PCA offending for repeat low range PCA offenders during their 12 month interlock period. However, we find a 3 p.p. reduction for the second penalty group (those who have a 24 month interlock period) and a nearly 5 p.p. reduction for the most serious offenders (who have a 48 month interlock period). This suggests that at least some of the reduction in PCA offending within 60 months after finalisation for the full sample comes from high range and repeat refuse breath test offenders still serving their interlock order. We do not have enough follow up time to examine post-interlock offending for our most serious offenders. However, we estimate a 3.0 p.p. and 2.8 p.p. reduction in PCA offending in the 2 years after the interlock period ceases for repeat low range PCA offenders, and repeat mid range PCA, first-time refuse breath test and first-time high range offenders respectively. Some of this may occur because of desistance, but we cannot rule out that some of this reduction occurs because of delays in starting the interlock program and because of extensions.

37 Note that the baseline in the difference-in-differences analysis is not the control group average (as displayed in Table 2), but the pre-MAIP average outcomes for eligible offenders.

38 In the Appendix (Table A10) we present marginal effects estimated from logistic and negative binomial regressions analogues to these analyses. The only important difference between these estimates and those we obtain from our linear specification is that we estimate slightly larger reductions in PCA offending within 36 months when using these methods (4.1 p.p. compared to 3.4 p.p.).

Figure 8. Estimates of the impact of MAIP on eligible offenders, by offence type



Next, we examine DWD offending. Repeat low range PCA offenders were 1.3 p.p. less likely to commit a DWD offence in the initial disqualification period. However, both the least serious offenders (repeat low range PCA) and the more serious offenders (repeat high range and refusals) exhibit a statistically significant increase in DWD offending during their interlock periods (of 2.0 p.p. and 3.9 p.p. respectively). One reason for the increase in DWD offending among repeat low range PCA offenders is that fewer among this group were placed on a mandatory interlock order (Table 4), i.e., more of these offenders were exempted. Repeat low range PCA offenders were also more likely to offend with this type of offence in the 24 months following the interlock period but this also is not statistically significant. High range offenders could be more likely to commit a DWD offence in the 24 months during their interlock period because more of them serve other penalties (such as imprisonment) prior to their disqualification period (and their disqualification period therefore extends into what we consider the 'interlock period').

MAIP appears to have different impacts on traffic offending for the three groups examined. Traffic infringements were lower among repeat low range PCA offenders but were higher for those who were convicted of a repeat high range PCA or refuse breath test offence after MAIP was introduced. This may be because it enables higher risk drivers to return to driving sooner. There was no change in traffic infringements after MAIP for the other group of offenders. None of the estimates of the reductions in the likelihood of involvement in an alcohol-related crash in the 36 months following finalisation and increases in the probability of a crash involving an injury in the 36 months following finalisation are statistically significant.

Impact for different types of offenders

Next, we examine whether the impacts of the program on PCA reoffending differ across groups of offenders with different demographic and prior offending characteristics.

Figure 9 displays our fuzzy regression discontinuity estimates of the impact of starting MAIP when we restrict our sample to each group shown on the y-axis (Table A12). To ensure comparability with our main estimates, we limit the bandwidth to a window of 0.3 points around the 0.15 threshold. Across all groups there was evidence for the effectiveness of the interlocks in that PCA offending within 36 months of finalisation was reduced, typically by at least 10 p.p., except for those with no prior infringements. When examining PCA reoffending within the interlock period (Figure 9(a)) we observe larger impacts for Aboriginal offenders (an 18.4 p.p. reduction at the threshold) than non-Aboriginal defendants. We do not find that this difference is statistically significant, however, which may not be surprising as Aboriginal offenders are a small (<10%) proportion of our sample. This result should also be considered with caution as more than one in five individuals in our sample are of unknown Aboriginality. The effects are also larger for offenders residing in areas with more socioeconomic disadvantage. The estimated reductions in this type of reoffending for those in the lower two quartiles of socioeconomic disadvantage are 12.8 p.p. and 14.7 p.p. respectively, compared to 7.1 and 8.5 p.p. for those in the higher two quartiles although the confidence intervals appear to overlap with the least disadvantaged figure reducing the certainty of this result. We also observe larger (but not significantly) effects for offenders with a previous court appearance (12.2 p.p.) compared to offenders with no prior court appearances (9.0 p.p.).

Figure 9. Subgroup analyses: regression discontinuity estimates

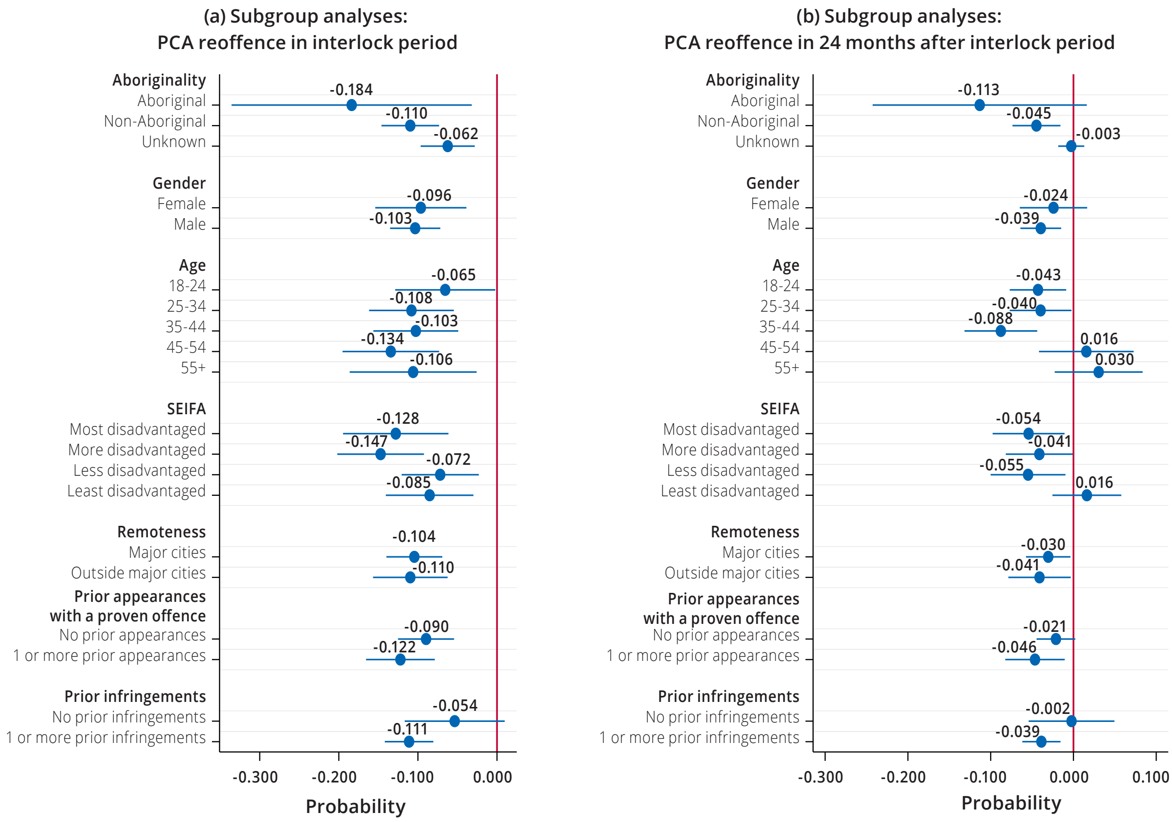
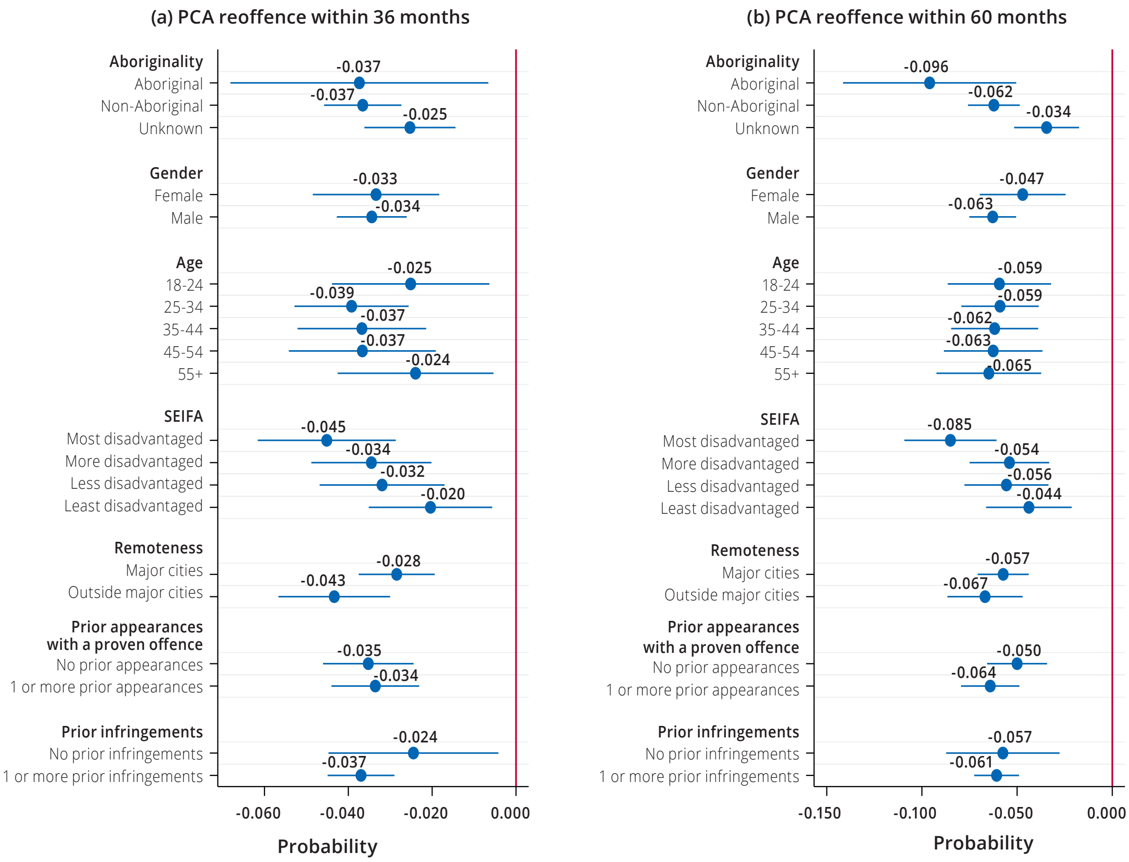


Figure 9 (b) also presents regression discontinuity estimates for PCA reoffending in the 24 months after the interlock period for the different demographic groups (Table A13). Over the longer term several subgroups did not maintain reduced offending" those with no prior infringements, those residing in the least disadvantaged postcodes, and offenders aged 45 and above. Again, we observe larger (albeit not significant) effects for Aboriginal offenders, with MAIP estimated to reduce the likelihood of a PCA offence by 11.3 p.p. compared with 4.6 p.p. for non-Aboriginal offenders. This result should be considered cautiously given that more than 20% of the sample were of unknown Aboriginality. Larger effects are observed for those aged between 35 and 44 (8.8 p.p.), and those with one or more prior traffic infringements (3.9 p.p.). When examining the impacts across SEIFA quartiles, we observe reductions in PCA reoffending after the interlock period for all quartiles except the least disadvantaged quartile.

Figure 10 presents difference-in-differences estimates for PCA reoffending for various groups of MAIP eligible offenders. Again, we find that the program reduces PCA reoffending virtually across all groups, over both the shorter and longer term. We find larger reductions in PCA reoffending for those residing in the most disadvantaged postcodes (4.5 p.p. and 8.5 p.p. reductions in PCA offending within 36 and 60 months respectively), and those residing outside major cities. The latter result is especially prominent within 36 months, where we estimate a reduction of close to 5 p.p. in PCA reoffending for offenders residing outside major cities compared with 3 p.p. for offenders residing in major cities, albeit we do not find these differences are statistically significant. These findings seem to indicate that interlock devices may be more effective for groups who are traditionally more recalcitrant (high risk offenders, those residing outside major cities, and in disadvantaged areas). It is unlikely that these differences arise because of a differential level of effectiveness (i.e., interlock devices do not incapacitate these drivers differently) but are more likely to be related to rates of uptake among these groups, and their baseline levels of drink driving.

Figure 10. Subgroup analysis, difference-in-differences estimates



DISCUSSION

This study aimed to estimate the impact of the first phase of the NSW Mandatory Alcohol Interlock Program (MAIP) on drink driving and road safety outcomes. Two approaches were used in this evaluation: (1) a regression discontinuity design comparing outcomes for first-time drink drivers recording BACs within a narrow bandwidth around the .15 threshold and; (2) a difference in difference design comparing outcomes for all eligible drink drivers with non-eligible drink drivers before and after the program commenced.

In the RD analysis we found large statistically significant reductions in the probability of drink driving offending among first-time high range offenders who took up an alcohol interlock device. Reductions in reoffending were greatest during the interlock period with a 11 p.p. reduction observed during this time. This reduction represents an 86% reduction in drink driving during this period, consistent with the results of other studies which find that interlocks are effective. We also identified a modest reduction in PCA reoffending (of between 3 and 4 p.p.) among this group of offenders in the two years following the interlock period. We also identified a small reduction of 0.35 traffic infringements, on average, in the 36 months post-finalisation among those who started MAIP but did not detect any difference in the likelihood of an alcohol-related crash or a crash involving injury or fatality. The results of several robustness tests suggest that these regression discontinuity estimates are highly reliable. We find evidence that virtually all of these effects occur exclusively at the 0.15 threshold (as opposed to being observed at other points along the continuum of BAC readings), and our estimates of the program's impact on PCA reoffending are larger than differences at the threshold before the program commenced in 2015. Finally, we find that these estimates are largely robust to the removal of observations closest to the threshold which are arguably the most vulnerable to manipulation.

The significant reductions in PCA reoffending for first time high range offenders found in the RD were also apparent when we examined outcomes for all offenders eligible for MAIP in the DiD analysis. We expected that these results would be smaller in magnitude as this analysis included all eligible offenders, not only those who install interlock devices. In effect, this provides a better estimate of the intention-to-treat effectiveness of the program on the target population. Specifically, we found significant reductions in PCA offending within 36 months of index finalisation (of 3.4 p.p.) and within 60 months of index finalisation (of approximately 6.0 p.p.) among eligible offenders. We found no significant changes in any of the other outcomes on average but identified significant heterogeneity when examining outcomes for different subgroups of offenders. Specifically, eligible offenders who were subject to the longest interlock periods experienced the largest reductions in PCA offending during their interlock period (5 p.p. compared to 3 p.p., for the next most serious penalty group, and no impact on repeat low range offenders). We also found that MAIP was associated with reduced traffic infringements among repeat low range PCA offenders (the least serious group of offenders we examined) but increased traffic infringements for repeat high range PCA and refuse breath test offenders (the most serious group of offenders). This latter result suggests that MAIP may deter traffic offending for the least serious offenders but may result in higher traffic infringements among riskier drivers by enabling them to return to driving sooner. We also examined differences based on offender characteristics, finding indicative evidence that MAIP may have greater effects for those residing in the most disadvantaged postcodes, and, to a lesser extent, those residing outside of major cities.

In summary, our findings contribute to the large body of evidence supporting the use of alcohol interlocks to reduce repeat drink driving, consistent with those found in prior studies in other jurisdictions (Tippetts & Voas, 1998; Voas et al., 1999). We provide strong causal evidence that the introduction of MAIP significantly reduced drink driving for first-time high range PCA offenders who started the program, and this significant effect remains (though is reduced in magnitude) when all offenders eligible for MAIP are considered. Given the low rates of detection for these offences (Terer & Brown, 2014), the program's impact on actual drink driving behaviour (as opposed to convictions) may be even larger than our estimates suggest. We do not detect any significant reductions in the probability of an alcohol-related crash (except for in one specification) or a crash involving an injury or fatality, which is possibly due to two limitations of the analysis. First, our RD analysis is underpowered to detect significant differences in these relatively low-probability events. Second, our DiD analysis suffers from 'dilution' as it estimates impacts on all eligible offenders in the post-MAIP period, rather than only those who install the devices. A competing explanation is that the effects of MAIP on crashes may be ambiguous because it reduces risk arising from drink driving but may enable offenders to drive more often (without risk of disqualification). Our finding that the program does not increase road crashes indicates that MAIP enables offenders to return to lawful driving sooner without any adverse impact on road safety.

Our findings are consistent with those from prior research in showing that the largest impact of interlock devices on drink driving offending occurs when the device is installed in the vehicle. However, contrary to most previous studies (Blais et al., 2013; Willis et al., 2004) we also find small reductions in offending after the standard interlock period has been completed. There are two possible explanations for this finding. Firstly, unlike other interlock programs, MAIP includes several points of contact with medical practitioners, including consultations where participants can be referred to treatment. This may lead to longer lasting effects if individuals alter their long-term drinking habits or learn to separate their drinking from their driving behaviours. Qualitative research into the role of medical interventions during MAIP may provide further insight into whether this aspect of the program has any rehabilitative benefit. Secondly, a small proportion of offenders would still have had their interlock installed during the "after interlock period" when reoffending was measured. It is impossible to know what interlock period comparison group offenders would have received, therefore our study defined the reoffending periods using the maximum disqualification periods and automatic interlock periods prescribed by legislation. While most offenders received the automatic interlock period, further analyses suggested that not all offenders were given the initial maximum disqualification period and others delayed installing the interlock devices in their vehicle until they had served disqualifications for other offences. This may account for some of the residual effect on reoffending observed during the post interlock period.

It is worth noting a few other limitations of this study. Our regression discontinuity analysis only examines a small group (of approximately 8,500) first-time PCA offenders on either side of the BAC threshold. Thus, the analysis is underpowered to detect any small differences in alcohol-related crashes and crashes involving an injury. Furthermore, our analysis of traffic infringements is not robust to a variation in the threshold, potentially undermining our confidence that the effects occur solely at the 0.15 threshold. Our DiD analysis includes more data but is less credible when examining the impact of the program on alcohol-related crashes due to differing trends among eligible and ineligible offenders prior to MAIP's implementation.

Improving commencement rates is an obvious pathway to augment the impact of MAIP. In our sample, nearly 40% of eligible first-time drink drivers did not commence the interlock program, and only 56.4% of all eligible offenders started the program. This is a major improvement compared to other alcohol interlock programs, including NSW's previous voluntary program, but still leaves considerable scope for improvement. Process evaluations of MAIP and of similar interlock programs (Centre for Road Safety, 2018; DeYoung et al., 2004; Schonfeld & Sheehan, 2004; Sheehan et al., 2006) identify a range of barriers to participation in interlock programs. Most prominent is the monetary cost of participation; unlike most criminal justice programs (which are funded), the offender bears the cost of the interlock. Other factors literature has found to deter participation are the non-monetary costs (inconvenience, embarrassment) of participation, participant perceptions that detection rates for driving while disqualified are low, and the availability of alternative transport options. A more minor issue is that some people who appear to be eligible for MAIP were not assigned MAIOs (albeit some of these people were given a more severe penalty). The previous process evaluation of MAIP (Centre for Road Safety, 2018), cited inaccurate determinations of eligibility as a possible reason why orders are not always issued by the court. Transport for NSW are currently undertaking further research into the implementation of MAIP which may highlight possible avenues for refining these aspects of the program.

The findings of our study are particularly promising when considering groups of offenders who, historically, have been found to be more disadvantaged by penalties for driving offences. We estimate larger reductions in drink driving reoffending for those residing in more disadvantaged areas, and those living in regional NSW. Both the NSW Auditor General and the NSW Parliamentary Committee on Law and Safety highlighted that the burden of long, accumulating disqualification periods was greater for these groups because they tend to place a higher value on driving (e.g. for employment purposes and for accessing essential services). Returning these offenders to lawful driving sooner without affecting road safety or rates of driving while disqualified is therefore an important outcome for MAIP and may result in broader social benefits for these individuals. It is also noteworthy that greater reductions in drink driving were observed amongst the most recalcitrant offenders (i.e. repeat mid and high range PCA offenders). Prior research has shown that repeat drink-drivers are less likely to comply with other court-imposed sanctions (e.g. licence disqualification), leading to higher rates of driving whilst disqualified and alcohol-related crashes (Freeman et al., 2006; Freeman & Liossis, 2002; Watson, 1998). Boosting MAIP participation for this group of offenders may be a worthwhile priority for policymakers seeking to improve road safety.

MAIP has since been expanded to include first time mid range drink drivers, persons convicted of a driving under the influence offence, and persons charged with combined drink and drug driving offences (Phase 2 and Phase 3 of MAIP). It is unclear whether the benefits of the program for these groups will be as large as those estimated in relation to Phase 1, especially if the propensity to drink and drive is lower among these offenders. A further evaluation estimating the impacts of the expansion of MAIP would be a worthwhile subject for future research. Further work to estimate the impacts of the program after interlock removal for those with the longest interlock periods, which we could not do in this report, may also be worthwhile.

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NSW BUREAU OF CRIME STATISTICS AND RESEARCH - 6 PARRAMATTA SQUARE, LEVEL 5, 10 DARCY STREET, PARRAMATTA NSW 2150
bcsr@justice.nsw.gov.au • www.bocsar.nsw.gov.au • Ph: (02) 8688 9800
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