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Contingency Management and Brief Motivational Interviewing Interventions for Impaired Driving Offenders

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Résumé

Cette thèse porte sur l'efficacité d'interventions visant la réduction de la consommation d'alcool et de drogues chez les contrevenants de la conduite avec les capacités affaiblies par l'alcool (CCA). Les probabilités des contrevenants d'être impliqués dans un comportement de CCA ou une collision routière mortelle sont plus élevées que celles des non-contrevenants. Le développement d'interventions efficaces pour réduire les comportements à risque dans cette population est donc important pour la sécurité routière.

Le premier article de cette thèse présente une revue systématique de la documentation sur l'entretien motivationnel (EM) dans la prévention de la CCA. Onze essais randomisés contrôlés publiés ont été identifiés. Les résultats ont montré que l'EM est prometteur chez les récidivistes et les patients hospitalisés ayant des problèmes de consommation d'alcool. Des travaux de recherche sont nécessaires pour déterminer l'efficacité de l'EM chez les jeunes contrevenants et les contrevenants primaires.

Le deuxième article a évalué l'efficacité d'une intervention de gestion de contingence avec un essai pilote contrôlé randomisé chez des contrevenants de la CCA. Des données objectives et subjectives sur la consommation d'alcool ont été recueillies auprès de 37 contrevenants primaires et récidivistes de sexe masculin. Les participants portaient des bracelets de surveillance d'alcool pendant 42 jours et ont été répartis dans l'un des trois groupes suivants : gestion de contingence, rétroaction non contingente et bracelet seulement. Les participants ont été interrogés sur l'acceptabilité du bracelet. Les résultats ont montré une réduction significative de la consommation objective d'alcool pour tous les groupes au fil du temps mais aucune différence entre les groupes. La perception générale du bracelet était plutôt

favorable, mais les participants ont rapporté certains désavantages. Les résultats suggèrent que la gestion de contingence est aussi efficace que les autres deux conditions de contrôle pour réduire la consommation d'alcool chez les contrevenants condamnés pour CCA. Le bracelet s'est avéré prometteur parce qu'il fournit une mesure sensible de la consommation d'alcool.

Le troisième article a évalué si des interventions ciblant la consommation d'alcool étaient associées à une réduction de l'utilisation de drogues chez les contrevenants. Des analyses secondaires ont été menées sur deux essais contrôlés randomisés : i) EM (n = 184, Brown et al., 2010); ii) gestion de contingence (n = 37). Aucun effet significatif n'a été détecté pour les deux interventions.

La réduction de la CCA chez les contrevenants nécessite de nouvelles approches de traitement. Les résultats de cette thèse suggèrent que : i) l'EM est prometteur chez les récidivistes avec un problème de consommation d'alcool ; ii) les interventions ciblant les sous-groupes de contrevenants de la CCA (p. ex., les jeunes, les contrevenants ayant un trouble d'utilisation de drogue) nécessitent une étude plus approfondie.

Mots-clés : conduite avec capacités affaiblies (CCA), prévention des collisions, alcool, toxicomanie, gestion de contingence, entretien motivationnel.

Summary

This thesis focuses on the efficacy of interventions to reduce alcohol and drug use among driving under the influence (DUI) offenders. Convicted offenders have higher likelihoods of engaging in DUI behaviour or being involved in fatal motor vehicle crashes than non-offenders. The development of effective interventions to reduce risky behaviour in this population is therefore imperative to traffic safety.

The first article of this thesis systematically reviews literature on motivational interviewing (MI) for preventing DUI. Eleven randomised controlled trials were identified. Results showed MI is promising among recidivists and hospital patients with alcohol problems while research is required to determine whether MI is efficacious for young and first-time offenders.

The second article evaluated the efficacy of a contingency management (CM) intervention with a pilot randomised controlled trial in DUI offenders. Objective and subjective data on alcohol consumption was gathered from 37 first-time and recidivist male DUI offenders wearing alcohol monitoring ankle bracelets for 42 days and assigned to one of three groups: CM, non-contingent feedback, bracelet-only control. Participants were also queried with regards to the acceptability of the bracelet. Results showed a significant reduction in objective alcohol consumption for all groups over time but no between-group differences. The bracelet was generally perceived favourably but some disadvantages were reported. Overall, results suggest CM is as effective as two control conditions in reducing alcohol consumption among DUI offenders. The bracelet showed promise for providing a sensitive measure of alcohol consumption.

The third article evaluated the potential of interventions targeting alcohol to reduce drug use among DUI offenders. Secondary analyses were conducted on two randomised controlled trials: i) brief motivational interviewing (BMI; n = 184; Brown et al., 2010); ii) and CM (n = 37). No significant effects were detected for either intervention.

Reducing DUI among offenders is a challenge requiring new approaches to treatment. The results of this thesis suggest that i) MI is promising for recidivists with alcohol use problems, ii) treatments targeting subgroups of DUI offenders (i.e., young offenders, those with drug use problems) warrant further study.

Key words: driving under the influence (DUI), crash prevention, alcohol, substance use, contingency management, motivational interviewing.

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LIST OF ACRONYMS AND ABBREVIATIONS

AUDIT: Alcohol Use Disorders Identification Test

BAC: Blood Alcohol Concentration

B-CTL: Bracelet-only Control Group

BMI: Brief Motivational Interviewing

CCA: *Conduite avec les capacités affaiblies par l'alcool*

CI: Confidence Interval

CM: Contingency Management

DAST: Drug Abuse Screening Test

DUI: Driving Under the Influence of Alcohol

DUID: Driving Under the Influence of Drugs

DWI: Driving While Impaired

E: *Groupe experimental*

EC: *Écart type*

EM: *Entretien motivationnel*

EM+: *Adaptation de l'entretien motivationnel*

FB: Feedback Group

M: Mean/ *moyenne*

MI: Motivational Interviewing

MMPI-MAC: Minnesota Multiphasic Personality Inventory (MacAndrew Alcoholism Scale)

NHTSA: National Highway Traffic Safety Administration

OMS: *Organisation mondiale de la Santé*

RCT: Randomised Controlled Trial

SAAQ: *Société de l'assurance automobile du Québec*

SD: Standard Deviation

SE: Standard Error

T: *Témoin*

TLFB: Time-Line Follow-Back

DEDICATION

It is with the deepest gratitude that I dedicate this thesis to the individuals who participated in the research studies contained herein as well as the clients I have had the honor of knowing during my studies at *Université de Montréal*. You have been inspiring teachers and without you this work would not have been possible.

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INTRODUCTION

Driving under the influence of alcohol (DUI), defined as operating a motor vehicle with a blood alcohol concentration (BAC) above that permitted for one's license class[1], and/or driving under the influence of drugs (DUID) are global public safety issues. In some high income countries such as Canada approximately 30% of the crash-related deaths are associated with these behaviors (World Health Organization, 2015). Drivers with a history of prior DUI convictions are over-represented in fatal crashes (Marowitz, 1998; Rauch et al., 2010; Simpson, Beirness, Robertson, Mayhew, & Hedlund, 2004), making this population an important target in efforts to prevent this risky behaviour and protect the public. Current treatment efforts to curb this behaviour in the DUI offender[2] population, however, are not effective with all offenders and much research remains to be done in order to elaborate and implement effective evidence-based interventions. The main purpose of this thesis is to examine two different interventions, contingency management (CM) and Motivational Interviewing (MI; referred to as brief Motivational Interviewing [BMI] when delivered in a condensed form), in a DUI offender population. The literature review that follows describes the scope of the impaired driving problem in Canada, and in Quebec specifically, and details the empirical work to date on certain risk factors for engaging in this behaviour. Current

[1] In Quebec, impaired driving or a BAC higher than 80 mg per 100 mL (or 0.08%) can lead to a criminal charge. Some drivers, however, are required to have a lower BAC in order to operate a motor vehicle; non-respect of these regulations might lead to administrative sanctions. For example, drivers of some heavy vehicles must have a BAC of less than 0.05%. Additionally, on-duty emergency vehicle drivers and taxi drivers as well as drivers under 22 years old and alcohol ignition interlock device users are not permitted to drive with alcohol in their bloodstream.

[2] In this thesis, the terms "DUI offender(s)" and "offender(s)" are used interchangeably to refer to DUI offenders. Offences other than DUI offences are referred to specifically by the offence(s) committed.

treatments, their efficacy, and challenges with their implementation are then reviewed. Three empirical articles are then presented. The first article (Ouimet, Averill, & Brown, 2014) is a published systematic review of the literature on the efficacy of MI in the context of DUI, with a specific focus on young offenders. The second (Averill et al., 2017) is an original randomised-controlled pilot study that examined whether a CM intervention could reduce drinking over a short-term (6-week) time frame among convicted DUI offenders (first-time offenders and recidivists). The third (Averill, Ouimet, Berbiche, Nadeau, & Brown, 2017) is a re-analysis of data from the CM study as well as a re-analysis of data from a previous study (Brown et al., 2010) on BMI with DUI recidivists. This article sought to explore whether interventions (CM and BMI) targeting the reduction of alcohol consumption would have carry-over effects on reducing drug use among two samples of DUI offenders. Although both CM and MI interventions have been extensively studied in relation to substance use disorders, there is a paucity of well-designed studies that apply these interventions to the DUI offender population, thus underscoring the need for the research presented in this thesis.

Scope of the Problem

In North America and in many high income countries, more than one-third of fatal motor vehicle crashes are attributable to DUI (Brown, Vanlaar, & Robertson, 2015; National Highway Traffic Safety Administration, 2016). Crash statistics are similar for Québec where between 2009 and 2013, 36% of fatally-injured drivers had a BAC above the legal limit of 80mg per 100 mL (or 0.08%) (Société de l'assurance automobile Québec [SAAQ], 2016). DUID crash statistics resemble those for DUI with 35% of drivers killed in motor vehicle

crashes in Québec in 2014 found to have legal or illegal drugs in their systems (SAAQ, 2016a). The consequences of DUI and DUID include lost lives, debilitating injuries and economic costs. For example, in Quebec, approximately 160 deaths and 370 serious injuries result from DUI (SAAQ, 2016) and compensating victims of DUI costs approximately 90 million dollars each year (SAAQ, 2016). The consequences of DUID are impossible to evaluate in most countries because many jurisdictions do not treat DUI and DUID as separate categories. Additionally, the detection of drugs in the body of a deceased driver does not necessarily indicate that they were driving under the influence of drugs as many drugs remain detectable in body fluids much longer than alcohol. The World Health Organization (2015) recognizes the need for many countries to alter their legislation and enforcement policies regarding DUID.

In order to reduce DUI, substantial efforts and resources in the form of public safety campaigns and tougher sanctions were mobilized in the 1980s in Canada. For example, a roadside survey conducted in Ontario in 1986 found that approximately 20% of drivers tested positive for alcohol while a similar survey in 2014 found that only 4% of drivers had a BAC over 0.00% (Beirness, Beasley, & McClaferty, 2016). Similarly, another study reported a 28% decline in DUI in Canada over the course of two decades (Sweedler, 2007). In Quebec, between 1987 and 2015, there was a 22.7% decrease in the number of deceased drivers with a BAC over 0.08% (SAAQ, 2016b). Despite these significant reductions, however, since 1999 the DUI rate in Canada has remained relatively stable (Sweedler, 2007). For instance, in a survey of 1,238 individuals conducted by the Traffic Injury Research Foundation, 17.6% of Canadian drivers admitted to operating a motor vehicle within two hours of drinking alcohol and 8.2% admitted to operating a motor vehicle with a BAC over 0.08 (Vanlaar, Emery, &

Simpson, 2007). A similar situation has been found in Quebec with a survey reporting that, over a one-year period, 18% of respondents admitted to driving within two hours of consuming two or more drinks and 8% of respondents indicated that they had driven after consuming five or more drinks (SAAQ, 2015). Additionally, the probability of being apprehended by law enforcement while driving under the influence of alcohol is extremely low, with some experts estimating that drunk drivers run the risk of being arrested only once every 200 impaired trips (Beck, Rauch, Baker, & Williams, 1999). Thus, this risky driving behaviour continues to be widespread.

Compared to alcohol-impaired driving, the scope of drug-impaired driving is poorly understood by both researchers and organizations concerned with public safety for several reasons (Beirness & Beasley, 2011). First, the term "drug" refers to a variety of substances, which vary by jurisdiction, and include illegal, prescription and over-the-counter substances in addition to products not intended for consumption as a drug (for example, cleaning fluids). Second, blood-drug concentrations at which it becomes unsafe to operate a motor vehicle have yet to be determined for a variety of drugs, the increase for crash risk when drugs are combined with other drugs or alcohol (polysubstance use) are often unknown, and as previously mentioned, a positive drug test does not necessarily indicate acute intoxication as many drugs remain detectable in body fluids much longer than alcohol. Additionally, the pharmacodynamic and pharmacokinetic profile of some drugs (for example, cannabis) mean that concentrations of the drug may differ significantly between what is detectable in blood plasma and levels of the drug present in the brain (Huestis, 2007), rendering it more difficult to determine when the drug was used and whether driving abilities are impaired. Finally, reliable, non-invasive toxicological testing for drugs lags behind the technology used for

alcohol detection, making it more difficult to identify drugged drivers. Though more limited data are available on DUID, a recent meta-analysis of 66 studies containing 264 estimates of crash risk across 13 countries found that driving under the influence of the 11 classes of drugs examined (amphetamines, analgesics, anti-asthmatics, anti-depressives, anti-histamines, benzodiazepines, cannabis, cocaine, opiates, zopiclone, and penicillin) was associated with a modest increase in odds ratio for crash involvement (Elvik, 2013). In Canada, the most frequently detected drugs among drivers fall into the categories of central nervous system depressants, cannabis, and central nervous system stimulants (such as cocaine) (Beirness, Beasley, & Boase, 2013). Amongst drivers in British Columbia, a random roadside survey of alcohol and drug use found that alcohol was detected in 10.7% of the sample, cannabis was detected in the salivary samples of 4.5% of drivers and cocaine was detected among 2.3% of drivers (Beirness & Beasley, 2011). In Quebec, data from toxicology reports conducted by the coroner's office between 2009 and 2013 indicated that cannabis, cocaine, benzodiazepines, amphetamines, and opioids were the most commonly detected drugs among fatally injured drivers (SAAQ, 2016a). In 2014 in Quebec, of the 70 fatally-injured drivers tested for drug use, cannabis was detected among 23.4% (SAAQ, 2017). Furthermore, in a survey of 1,350 drivers in Quebec, among the 8% who stated they had consumed cannabis, cocaine, or amphetamines in the past year, 28% admitted to driving after consuming these drugs (SAAQ, 2015a).

Taken together, research indicates that DUI and DUID are important and costly public safety issues. In order to increase road safety for all, risk factors for engaging in this behaviour must be better understood and measures that extend current approaches to preventing this risky behaviour must be explored.

Risk Factors in DUI and DUID Behaviour

There are many known risk factors for engaging in DUI and/or DUID. Certain risk factors, such as the personality traits of impulsivity and sensation seeking and factors related to driving, such as driving experience, have been more extensively researched (Brown et al., 2016; Curran, Fuertes, Alfonso, & Hennessy, 2010; Eensoo, Paaver, Pulver, Harro, & Harrow, 2005; González-Iglesias, Gómez-Fraguela, & Luengo, 2014; Glass, Chan, & Rentz, 2000; Jonah, 1997; Jonah, Thiessen, & Au-Yeung, 2001; McMillen, Adams, Wells-Parker, Pang, & Anderson, 1992; Moan, Norström, & Storvoll, 2013; Scott-Parker, Watson, King, & Hyde, 2013) while other risk factors such as neurocognitive deficits have been less well studied. The articles presented in this thesis review the following risk factors: sex, age, prior convictions for DUI or DUID, history of an alcohol use disorder or a drug use disorder, and neurocognitive deficits. In addition, though these factors have been identified as contributing to the risk of engaging in DUI and/or DUID, it is important to note that the majority of studies in the impaired driving field tend to be cross-sectional studies rather than prospective, longitudinal studies. The methodological limitations and biases associated with cross-sectional studies mean that risk factors found to be linked to impaired driving are not necessarily causal factors for this behaviour.

Sex

With regards to sex, 87.6% of fatally injured drivers testing positive for alcohol in Canada are male (Beirness et al., 2013). In Quebec specifically, among fatally injured drivers

in 2014, 8.7% were females (n = 23 tested for alcohol) and 31% were males (n = 129 tested for alcohol) with BACs in excess of 0.08% (SAAQ, 2016a). Additionally, males represent a higher proportion (close to three quarters) of apprehended DUI offenders (Armstrong, Watling, Watson, & Davey, 2014) and convicted young male DUI offenders are more at risk for recidivism compared to convicted female offenders (Lapham, Skipper, Hunt, & Chang, 2000; LaPlante, Nelson, Odegaard, LaBrie, & Shaffer, 2008). Reasons for the overrepresentation of males compared to females among DUI offenders requires further research. A meta-analysis in the general population as well as a cross-sectional study in the DUI offender population indicate that men show significantly higher risk taking and impulsive personality characteristics compared to women (Brown, Ouimet, Nadeau, Tremblay, & Pruessner, 2015; Cross, Copping, & Campbell, 2011). However, a recent study of sex differences among DUI offenders found that male DUI offenders did not have higher rates of impulsivity than males without a DUI conviction but female DUI offenders exhibited significantly higher rates of impulsivity than female drivers without a DUI conviction (Brown, Ouimet, Nadeau, Tremblay, & Pruessner, 2015). Gender expectations for both alcohol consumption and driving may also partially explain the overrepresentation of men among DUI offenders. Alcohol consumption has become more socially acceptable for women and driving has also increased among women, leading researchers to speculate that changing gender norms are associated with the increasing DUI rates observed among women over the past three decades (Armstrong, Watling, Watson, & Davey, 2014; Robertson, Liew, & Gardner, 2011).

Findings pertaining to DUID are less clear than those for DUI but suggest sex may be a risk factor for this behaviour. Using data compiled from medical examinations of fatally-injured drivers in Canada between 2000 and 2010, one study reported that 83% of fatally-

injured drivers testing positive for drugs were male and that males were more likely to drive after consuming alcohol, cannabis, or stimulants than females (Beirness et al., 2013). The same study also reported that fatally-injured male drivers were more likely to test positive for both alcohol and drugs (Beirness et al., 2013). However, females were more likely to test positive for opiates and central nervous system depressants (such as sedatives) than males (Beirness et al., 2013). In Quebec recent crash statistics show that among fatally injured drivers in 2014, 16% of females tested positive for drug use versus 38.9% of males (SAAQ, 2016b).

Age

Age also appears to be a predictive factor for risk of engaging in DUI and DUID behaviour. Among fatally-injured drivers in Canada, alcohol-only use is most prevalent among drivers aged 19-54 (Beirness & Beasley, 2011). Young drivers, particularly those between the ages of 19-24 and 25-34 years, are more likely to test positive for alcohol only (26.9% and 26.6%, respectively) compared to drivers 18 years of age and under (17.4%) and drivers 55 years and older (16.0% for those aged 55-64 and 10.7% for those aged 65+) (Beasley, Beirness, & Porath-Waller, 2011). In Quebec, drivers aged 16-44 years represent 42.4% of all license holders, with 22.9% of fatally-injured drivers from this demographic testing positive for alcohol (17.1% at a BAC $\geq$ 0.08 mg/100ml) (SAAQ, 2016b). In contrast, drivers over 45 years of age in Quebec represent 57.5% of all license holders and 11.8% of fatally-injured drivers from this demographic tested positive for alcohol (10.52% at a BAC $\geq$ 0.08 mg/100ml) (SAAQ, 2016b). Reasons for the overrepresentation of younger drivers in fatal crashes in which alcohol is present appear to be linked to driver inexperience, higher impulsivity and

sensation seeking, and incomplete maturation of brain regions involved in executive functions (González-Iglesias et al., 2014; Scott-Parker, Watson, King, & Hyde, 2013; Steinberg, 2007).

With regards to DUID in Canada, fatally-injured younger drivers between the ages of 19-34 are more likely to test positive for any substance (alcohol, drugs, and alcohol and drugs combined) compared to drivers 55 years of age or more (Beirness et al., 2013). However, drug use alone (without the presence of alcohol) appears to be more evenly distributed across age-range (Beirness & Beasley, 2011) though drug use alone is more prevalent than alcohol use alone among drivers 16-18 years of age as well as those 55 years or older (Beirness & Beasley, 2011; Beirness et al., 2013). The type of drug consumed also appears to be associated with age as fatally-injured drivers in the 16-34 year age range are most likely to test positive for cannabis and those aged 25-44 testing positive for drug-use alone have the highest rates of stimulant use (Beasley et al., 2011). The situation is similar in Quebec where 24.4% of fatally-injured drivers aged 16-44 tested positive for drug use while 10.4% of fatally-injured drivers aged 45 and older tested positive for drug use, thus suggesting that drug use among drivers peaks by middle-age (SAAQ, 2016b). Taken together, research suggests that male drivers younger than 35 years of age represent the highest risk group of drivers for involvement in an impaired driving fatality and this interaction of male sex and younger age as risk factors for impaired driving diminishes over time (Beasley et al., 2011).

Prior Convictions for DUI or DUID

Individuals who are convicted for DUI and/or DUID have a greater likelihood of recidivating as well as being involved in fatal crashes than drivers who do not have a history of impaired driving (Christophersen, Skurtveit, Grung, & Mørland, 2002; Elvik, 2013;

Hingson & Winter, 2003; Jones, Holmgren, & Ahlner, 2015; Li, Brady, & Chen, 2013; Marowitz, 1998; Rauch et al., 2010; Simpson et al., 2004; Tassoni et al., 2016). Indeed, within two-years of a first DUI offense, approximately one-third of DUI offenders will go on to be convicted of follow-up DUI offenses (Brinkmann, Beike, Köhler, Heinecke, & Bajanowski, 2002). Convicted offenders are therefore a higher-risk group in terms of public safety compared to drivers with no documented history of DUI or DUID and recidivist offenders are a higher-risk group for re-offending than first-time offenders (Rauch et al., 2010; Simpson, Beirness, Robertson, Mayhew, & Hedlund, 2004).

History of Alcohol Use Disorder or Drug Use Disorder

Research also suggests that for a segment of the impaired driving population the behaviour may be symptomatic of an underlying alcohol use disorder or a drug use disorder. For example, the probability for an offender to meet criteria for an alcohol use disorder increases when the offender has a high BAC at arrest (over 160mg/100ml) or has more than one prior conviction for DUI (Simpson et al., 2004). Additionally, research has found that alcohol use disorders are significantly under-diagnosed amongst DUI offenders taking part in re-licensing assessments associated with their offence and convicted DUI offenders are more likely to meet criteria for a life-time alcohol use disorder or drug use disorder compared to the general population, even among first-time DUI offenders (Lapham, C'de Baca, McMillan, & Hunt, 2004; Lapham, Stout, Laxton, & Skipper, 2011). DUI offenders have also been found to under-report their drug use in the context of court-ordered evaluations (Lapham, C'De Baca, Chang, Hunt, & Berger, 2002). Research on drug use disorders among DUID offenders is scant compared to research on substance use among DUI offenders but in the general

population, drug dependence has been found to be an important predictive factor in the likelihood of driving under the influence of drugs as well as being involved in a motor vehicle crash (Hingson, Heeren, & Edwards, 2008). Polydrug use has been reported to be high (ranging from 40% to over 70% of cases) among DUID offenders (Karjalainen, Lintonen, Impinen, Lillsunde, & Ostamo, 2010; Kriikku et al., 2015) and DUID offenders have a high-rate of re-offending (for example, 44% in Sweden; Holmgren, Holmgren, Kugelberg, Jones, & Ahlner, 2008) particularly if they have a history of drug or alcohol dependence (Linn, Nochajski, & Wieczorek, 2016). Additionally, Swedish researchers reported that among fatally-injured drivers testing positive for amphetamine use 75% had a history of prior arrest for DUID or other drug-related legal charges (Jones et al., 2015). Taken together, the literature on drug impaired driving suggests that drug use disorders are more prevalent in the DUID population compared to the general population or to non-offenders.

In keeping with much of the literature in the field, the studies presented in this thesis assume that among DUI offenders with an alcohol use disorder, reducing substance use will help reduce impaired driving as the more an offender can abstain from substance use, the more likely they will be driving sober. It is important to note, however, that not all impaired driving offenders have a pre-existing substance use disorder. Other factors, such as neurocognitive deficits, may play a role in the decision to drive while impaired by alcohol and/or drugs.

Neurocognitive Deficits

Neurocognitive factors may also affect the probability of engaging in impaired driving for some offenders. With regards to DUI, a growing body of evidence suggests that DUI recidivists suffer from impairments in visuospatial, memory and inhibitory abilities (Brown et

al., 2009; Glass, Chan, & Rentz, 2000; Ouimet et al., 2007). For example, one study found that among a sample of DUI recidivists, 70% exhibited some impairment in neurocognitive functioning (Ouimet et al., 2007). These neurocognitive deficits may hinder some offenders' abilities in several respects. For example, working memory impairment may result in poorer decision-making such as weighing the consequences of drunk driving versus the desire to drive home in one's own vehicle (Brown et al., 2013) and a tendency to choose immediate rewards over delayed rewards (i.e., short term benefits of driving immediately vs. re-licensing in the future [Ouimet, Brown, Robertson, & Averill, 2010]). Indeed, several studies have shown that some DUI offenders tend to make decisions that favour reward even when a disadvantageous risk is involved (Bouchard, Brown, & Nadeau, 2012; Kasar, Gleichgerrcht, Keskinkilic, Tabo, & Manes, 2010; Yechiam et al., 2008). Other studies, however, have found no difference in response inhibition, a measure of executive control, between first-time male DUI offenders and non-DUI offenders (Brown, Ouimet, Nadeau, Tremblay, & Pruessner, 2015), thus suggesting that subgroups of offenders (for example, DUI recidivists), rather than the broader DUI population, may be more likely to exhibit neurocognitive deficits. Finally, neurocognitive impairments may mean it is more difficult for some offenders to apply the information taught in remedial programs in the service of inhibiting DUI behaviour. This tendency may be particularly true in situations such as DUI in which offenders have engaged in the behaviour many more times than they have been caught (Bechara & Martin, 2004).

Compared to the DUI literature, there is a dearth of literature concerning the neurocognitive factors potentially at play in the likelihood of engaging in DUID behaviour among DUID offenders, making it impossible to draw firm conclusions on this topic. The literature is more abundant, however, with regards to neurocognitive impairments associated

with chronic use of many illicit drugs. For example, compared to non-cocaine users, cocaine users have been found to have deficits in attention and working memory (Vonmoos et al., 2014) as well as procedural memory (van Gorp, Wilkins, Hinkin, & et al., 1999). Additionally, impaired decision making in the form of insensitivity to future consequences has been associated with increased likelihood of relapse among cocaine users (Verdejo-Garcia et al., 2014). Similarly, neurocognitive impairments have been found among chronic marijuana users, including impairments in executive functioning, processing speed, spatial working memory, spatial planning, and decision-making in terms of a tendency to make more disadvantageous/risky decisions (Becker, Collins, & Luciana, 2014; Grant, Chamberlain, Schreiber, & Odlaug, 2012; Jovanovski, Erb, & Zakzanis, 2005; Meier et al., 2012). Finally, compared to non-users, current ecstasy users have also been reported to exhibit neurocognitive impairments such as diminished response inhibition, working memory impairments, impairments in planning, impairments in monitoring ongoing task performance, and procedural memory impairments (Blagrove et al., 2011; Hadjiefthyvoulou, Fisk, Montgomery, & Bridges, 2012). Some of the neurocognitive impairments exhibited by chronic drug users appear to be reversible, however, following cessation of regular drug use (Cannizzaro, Elliott, Stohl, Hasin, & Aharonovich, 2014; Hadjiefthyvoulou et al., 2012; Jovanovski et al., 2005; van Gorp et al., 1999; Vonmoos et al., 2014; Woicik et al., 2008). Taken together, existent research on neurocognitive deficits among chronic drug users suggests the possibility that DUID offenders with a current drug use disorder may exhibit neurocognitive deficits even when not acutely intoxicated and such deficits may impact driving abilities or influence the decision to engage in impaired driving.

However, though neurocognitive deficits have been observed in DUI offenders and

chronic users of certain drugs, caution must be exercised in interpreting directional effects. For example, though alcohol has a neurotoxic effect on the brain and both acute as well as long-term heavy use may negatively impact executive control functions necessary for driving (Brown et al., 2013), it is possible that pre-existing neurocognitive deficits may be a risk factor for the development of a substance use disorder. In order to disentangle directional effects of the pathways leading to impaired driving behaviour, more research into neurocognitive deficits in the DUI and DUID populations is needed.

Current Measures to Prevent DUI and DUID and Their Effectiveness

Solutions for reducing the incidence of DUI and DUID fall into three categories: primary, secondary and tertiary prevention strategies. Primary preventative strategies are aimed at the entire population and their purpose is to modify the driving environment and increase road safety for all. They include public advertising and information campaigns, establishing and enforcing a maximum BAC (0.08% in Quebec), establishing *per se* limits for commonly consumed drugs under which driving abilities would be impaired, designated driver programs, and road checkpoints. The effectiveness of these measures relies on the rigorousness of their application. Secondary prevention strategies, or targeted prevention strategies, focus on sub-groups at increased risk for impaired driving, including young drivers. Examples of secondary prevention strategies include educational programs in schools, increasing the legal drinking age, decreasing the legal BAC limit, and enforcing zero-tolerance limits (BAC $\leq$ 0.02%) for young drivers. Tertiary prevention strategies focus on preventing recidivism among individuals who have already committed an impaired driving offense. Once

an individual has been arrested and convicted for DUI or DUID, current strategies to discourage the individual from continuing to engage in this risky driving behaviour center around penalisation and rehabilitation. As this thesis focuses on convicted DUI offenders, this section will discuss the tertiary prevention strategies of penalisation/rehabilitation rather than primary preventative strategies for the general population.

Penalisation

Current punitive measures for DUI and DUID comprise license suspension periods and fines that increase according to the degree of offence committed. In Canada, operating a motor vehicle while impaired by either alcohol or drugs has been a criminal offence since 1951 and the *Criminal Code* governs convictions for DUI and DUID at the federal level (see articles 253 to 261, Minister of Justice, 2016). The *Criminal Code* stipulates that convicted first-time impaired driving offenders are subject to a minimum fine of $1,000 and convicted second-time offenders can be subject to imprisonment for a minimum of 30 days in addition to fines. Fines are determined according to the gravity of the circumstances surrounding the arrest (i.e., roadside check point, motor vehicle crash involving bodily injuries), degree of intoxication arrest (i.e., BAC above or below 0.16%), and number of prior convictions for DUI or DUID. In addition to fines, the *Criminal Code* stipulates that convicted first-time offenders are prohibited from operating a motor vehicle for a period of one year and second-time offenders have a two-year driving prohibition.

At the provincial level, each Canadian province operates its own re-licensing program for individuals convicted of DUI or DUID. In Quebec, the Highway Safety Code governs penalties associated with DUI and DUID. Upon arrest, all drivers apprehended for alcohol-

impaired driving can expect to have their license suspended for a 90-day period (SAAQ, 2016c). Drivers apprehended for drug-impaired driving can expect to have their license suspended for 24 hours (SAAQ, 2016d) Following these suspension periods, offenders are able to drive legally while they await their court date. If an offender is convicted for DUI or DUID, his or her license is revoked. For first-time DUI offenders the revocation period is one year for those with a BAC $\geq$ 0.08 at arrest and three years for those with a BAC $\geq$ 0.16 at arrest. For second-time DUI offenders, the revocation period is three years for those with a BAC $\geq$ 0.08 at arrest and five years for those with a BAC $\geq$ 0.16 at arrest. The license revocation period is one year for first-time DUID offenders and three years for second offences. At the end of the license revocation period, offenders in Quebec may apply to obtain a new driving license. Under certain conditions and following a specified time period, some offenders may apply to drive with an alcohol ignition interlock device and a special licence. Before obtaining a new license offenders are required to pass a summary assessment, which until December 2016 was conducted by the *Association des intervenants en dépendence du Québec*.

One purpose of this summary assessment is to determine whether or not offenders' substance use precludes the safe operation of a motor vehicle. A first-time offender with a favorable summary assessment is mandated to participate in the Alcofrein program which provides education to offenders regarding the effects of alcohol and drugs on the operation of motor vehicles with the aim of preventing recidivism. If the summary assessment is unfavourable a comprehensive assessment and supervision plan, lasting between seven to nine months and paid for by the offender, was required and rehabilitative treatments such as counseling for a substance use disorder may have been recommended. First-time offenders for

whom the comprehensive assessment is deemed favourable are required to install an alcohol ignition interlock device in their vehicle for a period of one year. Second-time offenders with a BAC $\geq$ 0.08 at arrest are required to undergo a comprehensive assessment and utilize an interlock device for three years if the assessment is favourable. The interlock device requires a driver to provide a breath sample prior to operating his or her vehicle and a positive reading for alcohol inhibits the vehicle's engine from starting. The ignition interlock appears to have a high success rate in preventing DUI offences while it is installed (Beck et al., 1999; Compton & Hedlund, 2007; Elder et al., 2011). Once the device is removed and the offender terminates participation in an interlock program, however, a return to drinking and driving has been reported to occur by most reviews (Elder et al., 2011; Willis, Lybrand, & Bellamy, 2004), though a randomised controlled trial not included in prior reviews found a 26% decrease in alcohol-related traffic violations two years following removal of the device (Rauch et al., 2010). Existent research therefore calls into question whether the long-term objectives of punitive measures, including the interlock device, are attained. In the context of a DUID offence, no device equivalent to the interlock is utilized to prevent drivers from operating a motor vehicle while impaired by drugs.

Deterrence is a major focus of the relicensing process and operates under the assumption that the punitive measures associated with DUI and DUID (such as fines, license revocation, ignition interlock usage) will motivate drivers to avoid engaging in impaired driving in the future. However, the effectiveness of punishment-based measures to discourage unwanted behaviour in the long-term is uncertain (Schacter, Gilbert, Wegner, & Hood, 2011), and thus in the context of DUI and DUID it may not be the most effective approach to preventing future impaired driving. Recent research on punishment-based interventions for

DUI offenders suggests a failure to induce persistent behaviour change in this population (Ahlin, Zador, Rauch, Howard, & Duncan, 2011), as witnessed by the previously mentioned return to drinking and driving following removal of the interlock device (Elder et al., 2011; Willis et al., 2004). These findings are consistent with a corpus of data on operant conditioning (Skinner, 1963). In operant learning theory punishment is defined as a negatively evaluated event contingent on a behaviour and while punishment may decrease behaviour while the punishment is present, the behaviour tends to return following removal of the punishment (Nuttin & Greenwald, 1968). The literature on the effectiveness of punitive interventions for DUID is scarce.

Rehabilitation

Rehabilitation for DUI or DUID offenses varies by jurisdiction. In Quebec, as previously mentioned, drivers wishing to reinstate their licenses must submit to an assessment, lasting one to nine months, conducted by a partner of the SAAQ (the *Association des intervenants en dépendence du Québec* as of December 2016). The outcomes of the assessment are utilized to recommend to the SAAQ whether or not an impaired driving offender requires additional treatment, and if so, what treatment and services would best suit the individual's needs (*Association des intervenants en dépendence du Québec*, 2016). For example, offenders with an alcohol use disorder and/or drug use disorder may be recommended to pursue addiction counseling or seek mental health services. Overall, research into remedial interventions for DUI has reported mixed results. An initial meta-analysis on remedial interventions for DUI found that compared to no intervention, remediation interventions (which included educational approaches, psychotherapy/counseling, self-help

groups, pharmacotherapy, and contact with a probation officer) produced an average of 7-9% improvement with regards to reduction in recidivism and that the combination of multiple approaches (such as education together with psychotherapy and follow-up) produced a larger effect size than a single intervention (Wells-Parker, Bangert-Drowns, McMillen, & Williams, 1995). A more recent review of the literature determined that there was a lack of high-quality studies regarding treatment effectiveness in the DUI field, thereby limiting conclusions that could be drawn, though multi-component and intensive treatments (i.e., education, treatment for substance use disorders, and supervision in the form of electronic monitoring) were found to potentially be most effective (Miller, Curtis, Sønderlund, Day, & Droste, 2015). For offenders with substance use disorders, common goals of rehabilitative programs are to reduce substance use and impaired driving recidivism. The efficacy of three common interventions for substance use disorders will be discussed, along with their applicability to the DUI and DUID offender population: i) cognitive behavioural therapy; ii) Motivational Interviewing (MI); iii) contingency management (CM).

Cognitive Behavioural Therapy

Cognitive behavioural therapy is a psychosocial intervention that aims to challenge a client's pattern of maladaptive cognitions (i.e., beliefs and attitudes about substance use, impaired driving), which influence feelings and behaviour, and increase adaptive behaviours (Beck, 2011).

A meta-analysis of cognitive behavioural therapy for substance use disorders found that it is associated with a small short-term treatment effect size, compared to no-treatment or other active treatments (including MI and CM), with regards to reducing problematic alcohol

and drug use (Magill & Ray, 2009). This treatment effect diminishes over time, both at 6-month and 12-month follow-ups (Magill & Ray, 2009). However, a review of meta-analyses of cognitive behavioural therapies for a variety of mental health conditions reported that compared to MI and CM, cognitive behavioural therapy was found to be less effective in the treatment of substance use disorders (Hofmann, Asnaani, Vonk, Sawyer, & Fang, 2012). In the field of impaired driving, results on the effectiveness of cognitive behavioural therapy appear to be mixed. When included as part of a broader, multifaceted rehabilitation program, it has been shown to be effective in changing the cognitive distortions of court-mandated DUI recidivists regarding criminal behaviour. For example, one study found that recidivism rate at 21-month follow-up was found to be 13% (Moore, Harrison, Young, & Ochshorn, 2008), a rate on par with that of other interventions such as MI (Ouimet et al., 2013). While results of this study suggested that cognitive behavioural therapy is a potentially promising intervention for DUI offenders with substance use disorders, it lacked a control group and therefore more definitive conclusions regarding the effectiveness of cognitive behavioural therapy in this population could not be drawn. Another study of cognitive behavioural therapy among DUI recidivists found that, compared to a standard treatment control group, offenders in the experimental group receiving cognitive behavioural therapy had significantly lower rates of recidivism at three year follow-up and significantly better scores on a measure of cognitive coping skills (Quinn & Quinn, 2015). A third study among DUI recidivists found that, compared to offenders receiving standard legal sanctions only, offenders who also completed group cognitive behavioural therapy had significantly lower rates of recidivism at two year follow-up as well as improved attitudes from baseline to post-treatment toward the risks of drinking and driving, though attitudes among the control group were not measured, preventing

comparisons between groups (Mills, Hodge, Johansson, & Conigrave, 2008). However, an earlier study of cognitive behavioural therapy among DUI recidivists found that while those exposed to an individualized behavioural treatment exhibited improved attitudes towards drinking and driving (specifically, spending more time contemplating how to avoid impaired driving) than those exposed to a general behavioural treatment, there were no significant differences between groups on recidivism rate at 3-year follow-up (Connors, Maisto, & Ersner-Hershfield, 1986). Finally, a fifth study of cognitive behavioural therapy in a DUI recidivist population found that there were no significant differences with regards to self-reported drinking between the standard-treatment control and cognitive behavioural therapy exposed groups, though the authors note that as all study groups were committed to reducing their drinking at intake, the non-significant findings may represent a floor effect (Rosenberg & Brian, 1986). To date, no published studies appear to specifically examine the effectiveness of cognitive behavioural therapy in the DUID population nor explore whether cognitive behavioural therapy targeting alcohol use problems may have carry-over effects on reducing drug use.

While cognitive behavioural therapy shows some promise in a DUI context as an evidence-based treatment, a major limitation of this approach is that it is more time-intensive for the treatment service provider compared to briefer interventions such as MI and CM. Cognitive behavioural therapy is typically delivered over the course of several weeks whereas MI can be deployed at opportune moments, such as in a hospital emergency room or at key points during the relicensing process (i.e., following an assessment for substance abuse). CM requires little to no specialised training for those delivering this intervention when monitoring of alcohol or drug use is accomplished via objective means. Therefore, the rationale for

selecting MI and CM as the focus of this research is the briefer time period required to implement these interventions.

Motivational Interviewing

Motivational Interviewing is a goal-oriented and client-centered empathic counselling style that aims to assist the client with verbalizing his/her willingness, ability, and reasons to change a targeted behaviour (referred to as "change talk"), such as reducing substance use, and to increase commitment to do so (Miller & Rollnick, 2002). In order to increase intrinsic motivation to change a target behaviour, MI counselors attempt to resolve a client's ambivalence toward changing by "rolling with resistance" (i.e., adopting a non-confrontational approach; Miller & Rollnick, 2002). A significant body of literature supports the use of MI for reducing alcohol and drug use. Meta-analyses of MI have reported that it shows moderate effect sizes (0.16 to 0.56) in the treatment of alcohol and drug use disorders, which is superior to no treatment and comparable to the effect sizes produced by other treatments, including cognitive behavioural therapy (Burke, Arkowitz, & Menchola, 2003; Lundahl, Kunz, Brownell, Tollefson, & Burke, 2010; Smedslund et al., 2011). MI's effects on substance use appear to be strongest post-intervention and become non-significant at long-term follow-up (Smedslund et al., 2011). Finally, MI has been reported to produce its best outcomes as an adjunct to other treatments (Miller & Rose, 2009), thus suggesting its potential utility as part of the overall DUI rehabilitative process. In the general population MI has been found to decrease the likelihood of driving following drinking among college students (Teeters, Borsari, Martens, & Murphy, 2015).

Despite its demonstrated efficacy for reducing problematic substance use, MI also has

some limitations. Individuals suffering from a substance use disorder may have comorbid disorders, including serious mental disorders, as well as other difficulties in functioning. While MI has been shown to have positive effects with complex cases, such as psychiatric emergency patients (Bagøien et al., 2013), it has not been found to be particularly effective with modifying certain behaviours (e.g., safe sex practices, self-care behaviours, and healthy eating behaviours; Lundahl et al., 2011), for which a more sustained therapeutic approach, such as cognitive behavioural therapy, may be more beneficial. In some cases, MI may therefore be most useful as one component of a larger treatment framework that includes repeated contact with a health care professional to shape and maintain new behaviours (i.e., reduced substance use/ abstinence; decoupling substance use from driving; building and maintaining adequate support networks).

Research into MI in the DUI offender population has reported fewer failed breathalyzer tests among DUI offenders using alcohol interlock ignition devices and receiving MI compared to an interlock-alone control group (Marques, Voas, & Timken, 2004; Marques, Voas, Tippetts, & Beirness, 1999). Among a group of first-time incarcerated DUI offenders, those randomly assigned to receive an MI intervention decreased alcohol consumption (measured by self-reported drinking) significantly more over the two-year study period compared to an incarcerated-only control group, though there was no differences between groups on DUI re-arrest rates at 5-year follow-up (Woodall, Delaney, Kunitz, Westerberg, & Zhao, 2007). Among incarcerated DUI recidivists, compared to a control group receiving treatment-as-usual, those receiving a MI and relapse prevention treatment showed a significant improvement in coping skills (Stein & Lebeau-Craven, 2002). Among non-incarcerated DUI recidivists, decreased self-reported drinking (measured as fewer risky drinking days on which

≥ 42 grams of alcohol for men and ≥ 28 grams of alcohol for women were consumed) between 6-month to 12-month follow-ups was found among offenders randomly assigned to an MI intervention compared to an information-only control group (Brown et al., 2010). Additionally, the same study sought to corroborate self-reported drinking by collecting objective measures of alcohol consumption and found that the group exposed to MI had greater reductions in a biomarker for alcohol use problems from baseline to 6-month follow-up compared to the control group (Brown et al., 2010). At 5-year follow-up, younger DUI recidivists (<43 years) who had received the MI intervention had fewer convictions for DUI and other traffic violations compared to the control group that had received information only, suggesting that MI may be preferentially effective among some sub-groups of offenders (Ouimet et al., 2013). To date, however, no systematic review on the topic has been conducted, and this is therefore the aim of the first article proposed in this thesis.

With regards to drug use among impaired driving offenders, no published studies appear to specifically examine the effectiveness of MI in the DUID population. Additionally, the possibility that MI for alcohol use may have carry-over effects on drug use has not yet been investigated in a DUI context. The third article in this thesis aims to examine this question.

Contingency Management

Contingency management interventions stem from the theory of operant conditioning (Skinner, 1953; 1963) whereby a behaviour that is reinforced or rewarded is more likely to be repeated. In CM interventions, participants are therefore rewarded for complying with the therapeutic target behaviour (such as avoiding drinking, avoiding drug use or avoiding DUI).

Reinforcement may take the form of letters of encouragement, vouchers redeemable for retail items, or some kind of financial remuneration. CM interventions were conceived for use in treating cocaine dependence in outpatients as pharmacological treatments at the time had produced disappointing results (Higgins et al., 1991). CM operates on the premise that a substance use disorder is at its core a reinforcement disorder and supposes that reinforcers associated with alcohol and drug use (e.g., the biochemical effects of the substance, social enhancement) utilize the reward pathways in the brain. In CM, recovery from drug dependence is therefore facilitated when a new reinforcer (i.e., vouchers) becomes associated with reinforcement pathways in the brain and the therapeutic behaviour (sobriety) (Higgins et al., 1991). Common components of contingency management interventions include: 1) the delay between performance of the target behaviour and reinforcement should be as minimal as possible; 2) reinforcement should increase over time with continual performance of the target behaviour; 3) failure to produce the target behaviour results in re-setting the reinforcement back to its starting limit (Higgins, Alessi, & Dantona, 2002).

An abundance of research over more than 20 years with a variety of substance use disorder populations has provided strong support for CM interventions in assisting with rehabilitation for alcohol use disorder and drug use disorder (Lussier, Heil, Mongeon, Badger, & Higgins, 2006; Prendergast, Podus, Finney, Greenwell, & Roll, 2006). Furthermore, a recent meta-analysis of 34 studies on psychosocial interventions for substance use disorders found that CM demonstrated a moderate to high effect size on outcome (0.58, CI = 0.25 - 0.90) compared to cognitive behavioural therapy alone or relapse prevention (0.28, CI = 0.06 - 0.51; and 0.32, CI = 0.06 – 0.56, respectively; Dutra et al., 2008). Additionally, CM yielded a higher level of adherence to treatment (70.6%) compared to cognitive behavioural therapy

alone (64.7%). Increases in treatment compliance are associated with treatment retention, which in turn is reliably associated with positive outcomes in the treatment of substance use disorders (Simpson, Joe, & Brown, 1997). Treatment retention, however, does not fully explain the increase in positive outcomes seen when employing a CM intervention as it appears that being rewarded (i.e., the vouchers themselves) exert a significant impact on both short term and long term drinking outcomes (Higgins et al., 2002). Incentives-based interventions have also been successfully applied to the modification of risky driving behaviour other than drunk driving, such as speeding or seat belt use (Hagenzieker, Bijleveld, & Davidse, 1997; Mazureck & Hattem, 2006). With regards to CM's limitations, similar concerns as those mentioned for MI arise. That is, while CM may be useful as an initial treatment for substance use disorders, it may be most effective as adjunct treatment rather than a stand-alone treatment given the high relapse rates of substance use disorders.

To date, only one study has attempted to implement a reinforcement-based approach in a DUI context; none were published in the DUID context. Participants in the study by Ersner-Herschfield et al. (1981) were male (n = 62) and female (n = 5) DUI recidivists court-referred to a community mental health center. After participants were randomized to groups, the experimental group was asked to provide a $50 deposit that was potentially refundable. For each rehabilitative treatment session that participants attended, they were given $5 back. Failure to attend a session resulted in the offender having to return $5 to the research team. The control group was simply offered treatment as usual. Outcomes in this study were differences between groups in the number of weekly forms completed assessing alcohol consumption and the number of excused absences at rehabilitative treatment meetings. The results of this study found that compared to the control group, the experimental group had

fewer unexcused absences at meetings as well as a higher rate of completing weekly forms. The results of this study suggest that CM may be potentially effective as an intervention in a DUI context, but this study relied exclusively on self-report data and is the only study in over 30 years to examine this topic. To date, no studies have explored the potential effect of CM on reducing risky drinking in DUI offenders, and by extension, potentially reducing risky driving behaviour. The second article presented in this thesis employs a randomised controlled trial design to examine this topic and hypothesizes that a CM intervention, in which alcohol is continuously and objectively monitored via a transdermal alcohol monitoring bracelet, can reduce alcohol consumption in DUI offenders compared to controls. Additionally, like MI, the potential carry-over effects on drug use of a CM intervention targeting alcohol use has not yet been investigated in a DUI context and it is therefore the focus of the third article in this thesis.

Current Issues with Remedial Programs

Offenders most in need of intervention are those with problematic substance use, at high-risk for reoffending, or those with recidivist status (Robertson, Wood, & Holmes, 2014). However, adequate treatment delivery can be hindered by several challenges. First, under-reporting of alcohol and drug use problems by offenders and under-diagnosis of alcohol use disorders and drug use disorders by treatment providers means that offenders may not be guided toward appropriate treatment and thus quickly relapse to impaired driving behaviour after completing re-licensing requirements. Additionally, impaired-driving rehabilitation programs tend to focus more on alcohol use compared to drug use (Maxwell, Freeman, &

Davey, 2009) so individuals with a drug use disorder may miss treatment opportunities. Indeed, the high prevalence of recidivism among DUI and DUID offenders found in the literature suggests that more effective methods for assessing and treating substance use disorders in this population are necessary in order to improve current DUI/DUID rehabilitation programs and reduce impaired driving relapse rates.

Second, many impaired-driving rehabilitation programs lack important follow-up measures. While attitudinal changes and other subjectively measured variables are frequently accounted for post-program, long-term objective behavioural outcomes are often unknown (Robertson & Wood, 2013). For example, clinicians making treatment recommendations often do not know the outcomes associated with their cases (such as whether or not an offender is re-arrested and/or re-convicted), thereby rendering it more difficult to evaluate the effectiveness of treatment recommendations (Robertson & Wood, 2013).

Finally, no data exist to suggest that the neuropsychological limitations of impaired driving offenders are taken into account in current rehabilitation programs though there appears to be consensus in the field that rehabilitative treatments should be tailored and delivered according to offender characteristics and needs (Robertson et al., 2014). However, neuropsychological factors may impact treatment retention (process outcomes) and by extension the likelihood of relapse.

Taken together, these findings suggest that what may be required to prevent future DUI and DUID episodes are interventions that take into account key factors underlying DUI/DUID behaviour (such as substance use disorders and neurocognitive deficits) and an ability to adequately measure long-term effectiveness of interventions. This thesis will focus on two interventions (Motivational Interviewing and contingency management) designed to tap into

specific offender characteristics that have shown promise in both substance use disorder research and DUI/DUID research. As previously mentioned, the first article will review randomised controlled trials of MI in order to comment on the efficacy of this intervention in the DUI offender population. The second article addresses the need for alcohol treatments in a DUI context to be tailored to offender characteristics, such as reward sensitivity. A CM intervention, theoretically based on the conceptualization of a substance use disorder as a reinforcement disorder, is examined for its potential to reduce alcohol use among DUI offenders. Finally, the third article presented in this thesis addresses the need for effective treatment of drug use disorders among DUI offenders by examining whether interventions designed to target alcohol use (CM and MI) can have carry-over effects on reducing drug use among DUI offenders, a population for whom drug use disorders are frequently comorbid.

Presentation of Thesis Articles

The first article presented here features a published systematic review of MI (Ouimet, Averill, & Brown, 2014). Following a search of computerised databases, the findings of eleven studies which included randomisation to groups were described in detail. Methodological biases for all studies were examined using the Cochrane Collaboration protocol and reported in the review. The aim of this review was to examine the efficacy of MI in randomised controlled trials conducted in a DUI context between 1983 and 2014. A further goal of this study was to examine MI's efficacy in young offenders. This review also highlights methodological considerations for future studies on MI's efficacy.

The second study presented in this thesis is a randomised controlled trial of CM

utilising a sample of first-time and recidivist DUI offenders (Averill et al., 2017). Participants were asked to provide self-report data at the study's start and end regarding their alcohol consumption and they were asked to wear an ankle bracelet to continuously and objectively monitor their alcohol consumption for the six week duration of the study. There were three study groups: i) a group receiving daily feedback on drinking with financial compensation contingent on abstinence (the CM group); ii) a group receiving daily feedback on drinking where financial compensation was not associated with alcohol consumption (the feedback [FB] group); iii) a group that received no feedback regarding drinking but wore the bracelet for the study's duration (the bracelet-only control group [B-CTL]). Chief objectives of this research study were to explore whether exposure to CM (coupled with the bracelet) would reduce both subjective and objective measures of drinking over time significantly more compared to the other study groups. A secondary objective of this research study was to explore acceptability of the alcohol monitoring bracelet in this volunteer sample of DUI offenders.

Finally, the third article (Averill et al., 2017a) presented in this thesis consists of secondary analyses of data from two previous studies: i) Averill et al. (2017); ii) Brown et al. (2010). The former study refers to the CM study presented as the second article in this thesis. The latter refers to a randomised controlled study of BMI in a sample of DUI recidivists receiving either a 30-minute BMI intervention or a 30-minute control intervention. In the original studies though alcohol reduction was the target of each intervention, drug use outcome variables were measured. As previously mentioned, as treatment during the relicensing process tends to focus more heavily on alcohol use compared to drug use, drug use disorders in impaired driving offenders may remain untreated. The chief objectives of this

study were to examine whether interventions (CM and BMI) that targeted alcohol reduction had carry-over effects on reducing subjectively reported and objectively measured drug use. Secondary goals of the study were to explore whether subgroups of DUI recidivists from Brown et al. (2010) showed preferential carry-over effects compared to other study groups. Specifically, younger drivers and those with greater problematic drug use were targeted for subgroup analyses.

L'efficacité de l'entretien motivationnel dans la prévention secondaire et tertiaire de la conduite avec les capacités affaiblies par l'alcool : une revue systématique de la documentation

Titre abrégé : Entretien motivationnel et conduite avec capacités affaiblies

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Conflit d'intérêt. Les auteurs (MCO, TGB) aimeraient rapporter qu'ils ont évalué trois de leurs articles dans le cadre de cette revue de la documentation. Toutefois, deux des trois articles ont aussi été évalués dans une revue Cochrane avec des résultats similaires à ceux rapportés dans cet article (Smedslund et al., 2011).

Résumé

La consommation d'alcool est liée à environ 30 % des collisions routières mortelles. Dans plusieurs juridictions, des programmes d'évaluation et de traitement de la consommation d'alcool chez les contrevenants sont mis en place afin de réduire leur consommation et leur récidive. De par sa forme brève, l'entretien motivationnel (EM) suscite l'intérêt du milieu clinique. Cette revue systématique de la documentation scientifique examine l'efficacité de l'EM dans la prévention secondaire et tertiaire de la conduite avec les capacités affaiblies par l'alcool (CCA) chez les contrevenants et chez les patients recrutés à la suite d'une collision routière, notamment chez les jeunes. La recherche de la documentation dans les banques de données CINAHL, MEDLINE, PsychINFO et PubMed a couvert la période de 1983 à 2014. Elle a permis d'identifier 11 essais contrôlés avec répartition aléatoire des participants dans les groupes expérimentaux ou témoins. Une évaluation des risques de biais a été effectuée à l'aide de la grille de la collaboration Cochrane. La disparité des résultats n'a pas permis le regroupement quantitatif des donnés. Bien que les études disponibles soient encore peu nombreuses (n = 6), les résultats sur l'efficacité de l'EM sont prometteurs chez les récidivistes et les patients recrutés en milieu hospitalier avec une consommation d'alcool problématique. De plus, quatre de ces études présentent des biais méthodologiques moyennement faibles ou faibles. Les résultats sont mixtes en ce qui a trait aux études (n = 5) portant sur les jeunes contrevenants et les contrevenants ayant commis une première infraction de CCA, sans consommation problématique d'alcool comme critère d'inclusion dans l'étude. Une seule de ces études présente des biais méthodologiques faibles. D'autres essais contrôlés avec répartition aléatoire, menés et rapportés selon les règles proposées par le *Consolidated Standards of Reporting Trials (CONSORT) Statement*, sont donc nécessaires afin de démontrer

l'efficacité de l'EM dans la prévention secondaire et tertiaire de la CCA chez les jeunes contrevenants et les contrevenants à leur première infraction de CCA. Ils permettraient aussi de corroborer les résultats préliminaires obtenus auprès de récidivistes et de patients recrutés en milieu hospitalier.

Mots-clés : Consommation d'alcool, conduite avec les capacités affaiblies par l'alcool, traitement, entretien motivationnel, contrevenants et patients, jeunes adultes.

The effectiveness of Motivational Interviewing in secondary and tertiary prevention of alcohol-impaired driving: a systematic review of the documentation

Abstract

Alcohol use is linked to approximately 30% of all fatal traffic crashes. In many jurisdictions, evaluation and treatment programs for offenders are in place to reduce alcohol misuse and recidivism. Due to its brevity, Motivational Interviewing (MI) has captured the attention of the clinical community. This systematic review of the scientific literature examines the effectiveness of MI for secondary and tertiary prevention of driving while impaired by alcohol (DWI) in offenders and in drivers recruited from hospital settings following a traffic crash – with a specific focus directed at young drivers. Search of CINAHL, MEDLINE, PsychINFO and PubMed databases covering the 1983–2014 period identified 11 studies that described randomization to experimental and control groups. Bias in results was examined using the Cochrane Collaboration protocol. Meta-analysis was not appropriate given significant disparities between studies. Despite the limited number of studies (n = 6), the findings were judged promising for effectiveness in MI among recidivists and patients seen in hospital settings with alcohol problems. Four of these studies were evaluated to possess moderate or little methodological bias. Results were mixed in studies (n = 5) with young offenders and first-time DWI offenders in which problem alcohol use was not a recruitment inclusion criterion. Only one of these studies possessed little methodological bias. Additional randomized controlled trials conducted and reported according to the *Consolidated Standards of Reporting Trials (CONSORT) Statement* are needed to establish MI's effectiveness in secondary and tertiary prevention of DWI in young drivers and first-time offenders.

Confirmation is needed for its effectiveness in recidivists and injured patients recruited from hospital settings.

Key words: Alcohol use, driving while impaired by alcohol, treatment, motivational interviewing, offenders and patients, young adults.

Introduction

Les collisions routières sont l'une des principales causes de blessures mortelles dans le monde, particulièrement chez les adolescents et les jeunes adultes (Organisation mondiale de la santé [OMS], 2009). De 2006 à 2011 au Québec, les conducteurs âgés de moins de 25 ans, titulaires de moins de 12 % des permis de conduire, étaient impliqués dans 24 % des collisions entraînant des blessures mortelles, et dans près de 30 % de celles causant des blessures graves et légères (Société de l'assurance automobile du Québec, 2012). Les facteurs humains sont associés à plus de 90 % des collisions (Evans, 2004; Petridou & Moustaki, 2000). La conduite avec les capacités affaiblies par l'alcool (CCA) est l'un des facteurs humains présents dans environ 30 % des collisions entraînant des blessures mortelles (*National Highway Traffic Safety Administration* [NHTSA], 2013; Transport Canada, 2008). Les hommes et les jeunes sont surimpliqués dans les collisions liées à la CCA (Keall, Frith & Patterson, 2004; NHTSA, 2013).

Les interventions pour réduire la conduite avec capacités affaiblies

Les stratégies de prévention pour réduire le risque s'adressent à la population générale (prévention primaire), à des sous-groupes plus à risque (prévention secondaire) et à des sous-groupes ayant déjà manifesté les comportements à risque (prévention tertiaire). Les stratégies de prévention primaire incluent les lois, leur renforcement et la promotion des lois et de comportements sécuritaires. Par exemple, la présence d'alcool dans le sang lors de la conduite est soumise à des sanctions administratives, pénales et criminelles dans une majorité de pays (OMS, 2009). La limite maximale permise à ne pas dépasser pour éviter les sanctions pénales

et criminelles est de 50 mg d'alcool par 100 ml de sang (ou 0,05 %) dans les pays de l'Union européenne et de 0,08 % au Canada et aux États-Unis.

Les stratégies de prévention secondaire visent les jeunes conducteurs particulièrement à risque de CCA alors que les stratégies tertiaires ciblent les conducteurs de tous âges arrêtés et condamnés pour CCA. Parmi les stratégies de prévention secondaire spécifiques aux jeunes conducteurs (généralement jusqu'au début de la vingtaine), on retrouve la tolérance zéro pour la consommation d'alcool avec des maximum permis de 0,00 % à 0,02 %. Outre les amendes et les peines de prison possibles pour les contrevenants de la CCA, les stratégies de prévention tertiaire visent principalement les comportements suivants : les problèmes de consommation chronique et la consommation excessive d'alcool lors d'une même occasion (évaluation et traitement de la consommation), l'accès à un véhicule (saisie du véhicule), la propension à l'utiliser (développement de stratégies d'anticipation et de planification) et la possibilité de le démarrer une fois sous l'influence de l'alcool (programme antidémarreur). La prévention tertiaire de la CCA peut donc agir sur chacun de ces éléments en traitant les problèmes de consommation, en découplant la consommation et la conduite, en travaillant en amont sur des stratégies alternatives de déplacement lors d'épisodes possibles de consommation et en ne permettant pas le démarrage du véhicule en cas de consommation.

L'évaluation et le traitement de la consommation d'alcool font partie intégrante de programmes de plusieurs juridictions dans le monde visant à prévenir la récidive chez les contrevenants. L'efficacité de ce type d'intervention, qui présente souvent une grande hétérogénéité dans la forme et le contenu, a été démontrée dans la prévention de la CCA, quoique les effets soient plutôt modestes (Wells-Parker & Bangert-Drowns, 1995). Depuis les 20 ou 30 dernières années, une grande attention est donnée aux interventions brèves de type

motivationnel pour des problèmes liés à la surconsommation d'alcool. Les interventions brèves peuvent être utilisées à des moments clés (p. ex. : après l'arrestation, avant la comparution en cour, en salle d'urgence), qui représentent souvent l'une des premières conséquences négatives liées à la consommation d'alcool. Les interventions brèves se sont avérées efficaces auprès des populations à risque, dont celles ayant des caractéristiques similaires aux conducteurs ayant été arrêtés et condamnés pour CCA (O'Donnell, et al., 2014; Tanner-Smith & Lipsey, 2014). Cette revue systématique de la documentation s'intéresse plus spécifiquement à la prévention secondaire et tertiaire de la CCA à l'aide de l'entretien motivationnel (EM), notamment chez les jeunes.

Qu'est-ce que l'entretien motivationnel?

L'EM est l'une des interventions brèves utilisées pour réduire la consommation de substances psychoactives ainsi que d'autres comportements à risque pour la santé. L'EM intègre deux aspects principaux : un style de communication empathique et centré sur le client, tout en étant directif. L'un des buts de l'EM est d'explorer et de résoudre l'ambivalence du client qui peut se manifester, par exemple, face à l'admission d'un problème de consommation de substances ou face au besoin de modifier ses comportements. L'EM vise à augmenter la motivation au changement du client, entre autres, en l'encourageant à manifester verbalement son désir de changer (*change talk*), en « *roulant avec la résistance* » — une stratégie pour maintenir le rapport thérapeutique face à l'ambivalence du client — et en favorisant l'application des stratégies que le client a choisi de mettre en place ou de consolider afin de réduire sa consommation (Miller & Rollnick, 2013). Bien que l'EM a été développé pour

réduire la consommation d'alcool, il est maintenant utilisé dans plusieurs domaines de la santé, dont la réduction de la consommation de cigarettes, de drogues illicites et, plus récemment, de la CCA. Plusieurs interventions s'inspirent de l'EM en respectant ses principes fondamentaux. Toutefois, les interventions qui n'en respectent pas tous les éléments, ou qui y ajoutent certains éléments (p. ex. : la rétroaction sur la consommation de substances psychoactives), sont souvent appelées « adaptation de l'EM » (pour *adaptation of motivational interviewing*) (Burke, Arkowitz & Menchola, 2003).

Efficacité de l'entretien motivationnel dans la réduction de la consommation de substances

Une revue systématique Cochrane de la documentation scientifique a porté sur l'efficacité de l'EM dans la réduction des problèmes de consommation d'alcool et d'autres substances psychoactives (Smedslund et al., 2011). Cinquante-neuf études, dont 57 essais contrôlés avec répartition aléatoire et deux essais avec répartition quasi aléatoire, sont incluses dans la revue, totalisant près de 14 000 participants. La revue a comparé l'EM à quatre groupes : aucun traitement (p. ex. : liste d'attente), le traitement habituel, l'évaluation et la rétroaction ainsi que d'autres types de traitements. La taille de l'effet ou l'importance de la différence observée entre les groupes est obtenue par le calcul de la différence de moyenne standardisée (c.-à-d., le d de Cohen). La taille de l'effet est estimée faible (0,20), moyenne (0,50) ou élevée (0,80). Les résultats indiquent une réduction de la consommation d'alcool et de drogues plus importante chez les participants soumis à l'EM, comparativement à ceux n'ayant pas reçu de traitement. L'effet est le plus élevé lorsqu'il est mesuré tout de suite après

le traitement (d = 0,79; intervalle de confiance à 95 % [IC95 %] : 0,48–1,09). Il est plutôt faible lors de suivi jusqu'à six mois (d = 0,17; IC95 % : 0,09–0,26) et entre 6 et 12 mois (d = 0,15; IC95 % : 0,04–0,25). Aucun effet significatif n'est présent lorsque mesuré à 12 mois et plus (d = 0,06; IC95 % : -16–0,28). L'EM s'est aussi avéré plus efficace que l'évaluation et la rétroaction lors de suivi entre 6 et 12 mois (d = 0,38; IC95 % : 0,10–0,66). Il n'y avait pas d'effet significatif jusqu'à 6 mois (d = 0,12; IC95 % : -0,01–0,24) et aucune étude n'a mesuré les effets immédiatement après le traitement ou 12 mois ou plus suivant le traitement. Enfin, aucune différence significative n'a été trouvée entre l'EM et le traitement habituel ou les autres types de traitement. De plus, il n'y a aucune différence significative entre l'EM et les trois autres groupes auquel il a été comparé en ce qui a trait aux taux de rétention en traitement, à la récidive ou au stade de changement. Toutefois, un nombre assez peu élevé d'études a été mené sur ces sujets. Enfin, les auteurs indiquent que la qualité de la majorité des études était plutôt faible, ce qui jette un doute sur l'importance des résultats. En conclusion, les résultats de cette revue de la documentation suggèrent que l'EM est plus efficace que l'absence de traitement (court et moyen terme), l'évaluation et la rétroaction (moyen terme). Plusieurs autres interventions plus longues (p. ex. : la thérapie cognitivo-comportementale) ont aussi été associées à une meilleure efficacité – comparable à celle de l'EM – que l'absence de traitement (Project Match Research Group, 1998). Toutefois, la particularité de l'EM est, entre autres, sa brièveté pour des résultats similaires.

Une autre revue systématique a porté sur l'efficacité de l'EM chez les jeunes âgés de 13 à 21 ans dans la réduction de la consommation d'alcool et d'autres substances (Jensen et al., 2011). La revue a identifié 21 études incluant plus de 5 400 participants. Les études devaient inclure un groupe expérimental et un groupe témoin, non limité aux essais contrôlés

avec répartition aléatoire. L'effet global de l'EM dans la réduction de substances psychoactives est de petite taille (d = 0,15; IC95 % : 0,06–0,23). L'effet est plus prononcé dans les six mois suivant l'intervention (d = 0,32; IC95 % : 0,04–0,61; n = 4) que lors d'un suivi sur une période plus longue (d = 0,13; IC95 % : 0,02–0,24; n = 7). L'EM est donc une intervention brève efficace, particulièrement à court terme (≤ six mois), pour réduire la consommation de substances chez les adultes et les adolescents.

Le but de la présente revue systématique de la documentation est d'examiner les effets de l'EM, ou des adaptations de l'EM, dans la prévention secondaire et tertiaire de la CCA, à savoir la réduction de la consommation d'alcool et de la CCA chez les contrevenants ou les patients ayant été impliqués dans une collision routière, notamment chez les jeunes. Les résultats de cette revue permettront de dégager des pistes de recherches futures et de guider la réflexion clinique.

Méthodologie

Critères d'inclusion et d'exclusion des études

Les études sélectionnées devaient porter sur l'EM ou sur des adaptations de l'EM. Les interventions devaient viser à réduire la consommation d'alcool, la CCA ou les deux. L'efficacité d'une intervention, particulièrement lorsqu'elle est déjà démontrée dans d'autres domaines de recherche, doit être évaluée à l'aide de l'essai contrôlé avec répartition aléatoire. Cet article inclut donc des études qui évaluent l'efficacité de différentes interventions dans lesquelles les participants sont aléatoirement répartis dans un ou plusieurs groupes expérimentaux, ou dans un ou plusieurs groupes témoins. Il inclut aussi des études portant sur

des interventions de type prévention secondaire et tertiaire qui ciblent des sous-groupes considérés à plus haut risque ou déjà impliqués dans les comportements à risque. Ceux-ci comprennent les jeunes, les contrevenants arrêtés ou condamnés pour CCA ainsi que les patients blessés à la suite d'une collision routière, recrutés en milieu hospitalier, ayant consommé de l'alcool avant la collision ou ayant une consommation problématique d'alcool. Sont exclues les études portant plus largement sur des patients recrutés en salle d'urgence ayant été impliqués dans un accident lié à l'alcool, mais ne comportant aucune analyse spécifique sur ceux impliqués dans une collision routière. La sélection des articles fut effectuée par deux auteurs et leurs différences ont été discutées afin d'obtenir un consensus.

Recherche et sélection des articles

Une recherche systématique de la documentation scientifique fut effectuée afin d'identifier les articles permettant de répondre à la question de recherche, à savoir si l'EM (ou les adaptations de l'EM) est efficace dans la prévention secondaire et tertiaire de la CCA. La recherche bibliographique s'est faite en interrogeant les bases données CINAHL, MEDLINE, PsycINFO et PubMed à l'aide de la séquence de mots suivante : « (*intervention* and (motivat* or brief)) and (driving or driver* or crash* or DUI or DWI or ((offen* or violation* or convict* or arrest*) and alcohol*)). » La période visée pour la recherche s'étendait de 1983, année de la première publication sur l'EM, au début du mois d'août 2014. Les articles en français, en anglais ou en espagnol indexés dans les bases de données étaient retenus dans la sélection. À la suite de l'identification des articles et de l'exclusion des doublons, trois étapes menèrent à la sélection finale des articles, soit la lecture des titres, des résumés et des textes

complets. La lecture des titres et des résumés permettait d'exclure des articles d'emblée. En cas de doute, les articles étaient lus et évalués dans leur intégralité.

Évaluation des risques de biais des études sélectionnées

L'évaluation des risques de biais des études sélectionnées a été effectuée à l'aide de la grille développée par la collaboration Cochrane (Higgins & Green, 2011). Les biais évalués étaient liés à la sélection, la performance, la détection, l'attrition, la description complète des résultats et l'identification d'autres biais selon le domaine de recherche.

L'évaluation de la sélection vise à déterminer s'il y a une différence entre les groupes quant aux données de référence recueillies avant l'intervention. Les articles sont évalués sur la façon dont la répartition aléatoire et la dissimulation des séquences de répartition aléatoire ont été effectuées. Plus spécifiquement pour cette étude, les questions étaient les suivantes : Y a-t-il eu une génération adéquate des séquences de répartition aléatoire (la méthode utilisée a-t-elle été spécifiée)? Y a-t-il eu une dissimulation de la répartition des séquences (*allocation concealment*)? Ou, plus simplement, de quelle façon et jusqu'à quel moment la répartition aléatoire dans le groupe expérimental ou témoin a-t-elle été dissimulée aux participants et aux intervenants lors du déploiement de l'intervention? L'évaluation de la performance réfère à la présence possible de différences dans l'exposition à des facteurs non liés aux interventions évaluées entre les groupes répartis aléatoirement. S'agissait-il d'un essai à l'insu? Sinon les participants et le personnel de recherche connaissaient-ils les détails de la répartition aléatoire? L'évaluation de la détection permet de s'assurer que les agents de recherche qui ont évalué les effets de l'intervention au moment de la période de suivi ne connaissaient pas le groupe dans lequel le participant a été réparti aléatoirement avant l'intervention. L'évaluation de l'attrition

permet de comparer l'importance des données manquantes dans chaque groupe. Par exemple, la perte au moment de la période de suivi ne devrait pas être de plus de 20 %, les taux de suivi devraient être équivalents entre les groupes, les raisons pour les pertes de données au moment de la période de suivi devraient être décrites et une analyse de l'intention de traiter (*intention to treat*) devrait être menée. Les autres biais évalués dans le cadre de cet article incluent : i) l'évaluation de la fidélité des interventions afin de s'assurer que les principes de l'EM ont bien été suivis durant les interventions auprès du groupe expérimental (et non suivis auprès du groupe témoin); ii) le temps équivalent accordé par le personnel de recherche aux interventions expérimentales et à celles données aux groupes témoins afin de s'assurer que les effets ne puissent pas être attribués à l'attention portée aux participants; et iii) l'utilisation de mesures biologiques visant à corroborer la consommation d'alcool et du dossier d'infractions pour la CCA autodéclarée. Les évaluations sont données selon les principes de la collaboration Cochrane pour risque faible de biais (+), risque de biais incertain (?) et risque élevé de biais (-). La classification a été effectuée par deux auteurs et les différences ont été discutées afin d'obtenir un consensus.

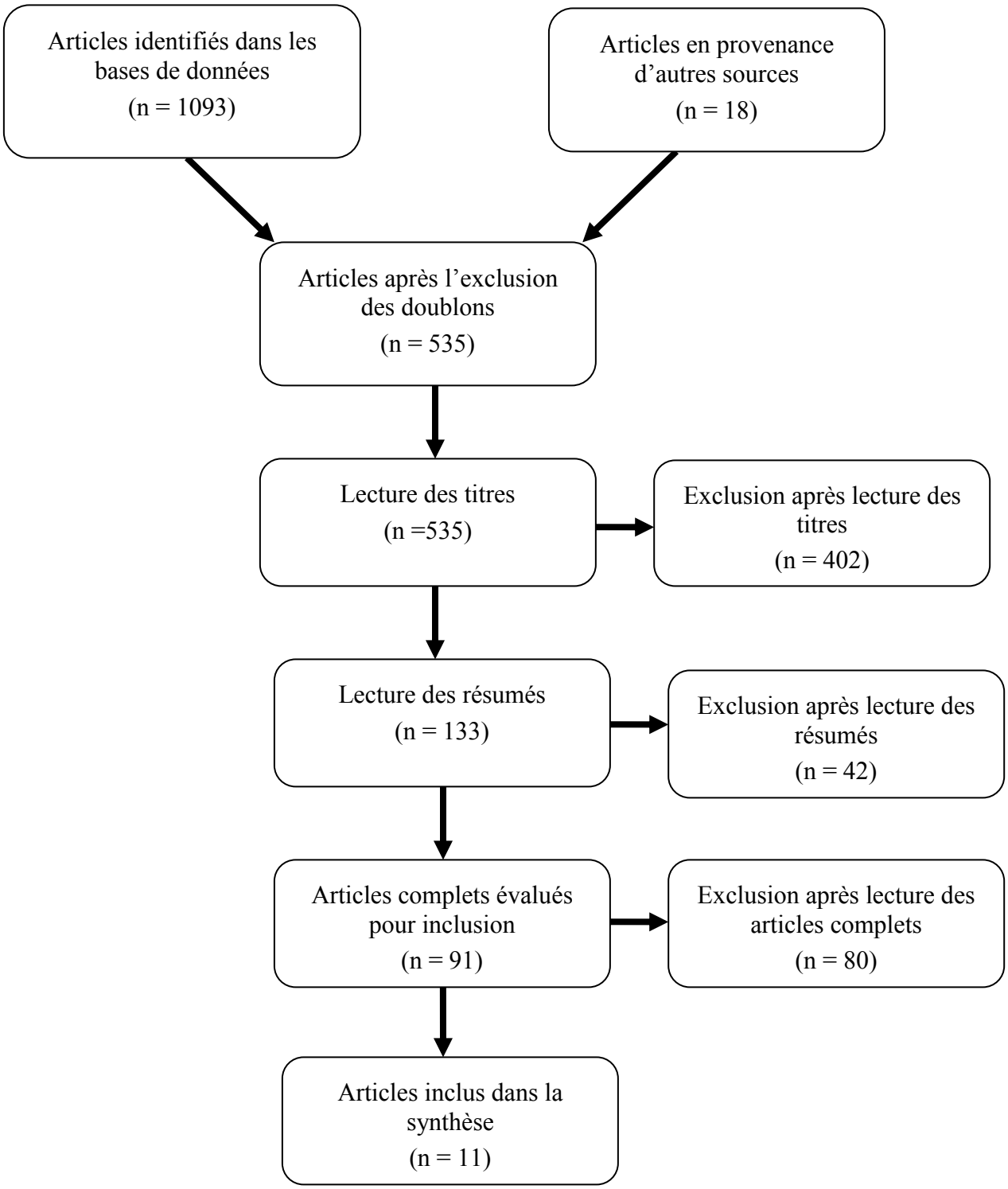
Résultats

Sélection des études

Les étapes de la recherche systématique de la documentation sont présentées à la Figure 1. La recherche a identifié 535 articles après l'exclusion des doublons. De ce nombre, la lecture des résumés a permis d'exclure 402 articles; celle des résumés, 42 articles et celle des articles complets, 80 articles. Les études sont exclues aux trois étapes, principalement

quand il ne s'agit pas de CCA, d'une intervention avec groupe témoin, de prévention secondaire ou tertiaire, de l'EM ou d'une adaptation de l'EM. Onze articles ont été inclus dans la revue systématique.

Figure 1. Diagramme de sélection des articles



Caractéristiques des études

Le Tableau 1 présente les caractéristiques des participants aux études sélectionnées. La recherche systématique de la documentation n'a permis d'identifier que trois études portant sur l'efficacité de l'EM auprès de jeunes contrevenants (âgés de 21 ans et moins) arrêtés pour diverses infractions liées à la conduite, l'alcool ou la CCA, ou avec un historique de consommation. Les huit autres études portent sur des sous-groupes plus âgés (moyennes d'âge variant de 27 à 46 ans) : les contrevenants de la CCA à leur première infraction ou contrevenants primaires (deux études), les contrevenants, principalement récidivistes, ayant un problème de consommation d'alcool (trois études) et les patients impliqués dans une collision routière**,** recrutés en milieu hospitalier, ayant consommé de l'alcool avant la collision ou ayant une consommation problématique d'alcool (trois études). Plus de 75 % des participants sont des hommes avec une étendue variant de 50 % à 90 %. Les 11 études sélectionnées, publiées de 2005 à 2014, ont été menées dans trois États américains et au Québec. Le Tableau 1 décrit aussi les critères d'inclusion et d'exclusion des études portant sur la consommation de substances et la CCA. Les études sur les jeunes contrevenants et les contrevenants primaires n'avaient pas de critères d'inclusion sur la consommation d'alcool problématique alors que les études sur les récidivistes et les patients incluaient ce critère.

Tableau 1. Caractéristiques des participants aux études sélectionnées (n = 11)

Auteurs[a]	**Age** Moyenne (M),[b] écart-type (ÉT) et/ou étendue (E)	**N**[c]	**% hommes**
Stein et al., 2006	M : 17,1; ÉT : 1,1; E : 14-19	125	90

Baird et al., 2013	M : 17,7; E : 16-21	337	77
Nirenberg et al., 2013	M : 18,0; E : 16-20	1007	72
Woodall et al., 2007	M : 27,1; ÉT : 8,7	305[d]	87
Utter et al., 2014	M : 30; ÉT : 10	200	50
Chanut et al., 2007	M : 41,7; ÉT : 12,0	51	82
Brown et al., 2010	M : 46,1; ÉT : 8,8	197	90
Ouimet et al., 2013	M : 45,9; ÉT : 9,0 (EM+) M : 45,2; ÉT : 8,0 (Témoin)	197	89
Mello et al., 2005	M : 27; ÉT : nd; E : nd	(t) 539[e] (c) 133 (a) 300	68
Mello et al., 2008	M : 28; ÉT : 9,8 (EM+) M : 31; ÉT : 10,7 (Témoin)	(t) 285[e] (c) 147 (a) 138	61
Schermer et al., 2006	M : 32,5 ÉT : 11,6 (EM+) M : 33,4; ÉT : 11,9 (Témoin) E : 16-80	126	69

Tableau 1 continué. Caractéristiques des participants aux études sélectionnées (n = 11)

Auteurs[a]	Lieu	Population et critères d'inclusion et d'exclusion liés à la consommation de substances et la CCA
Stein et al., 2006	Rhode Island, États-Unis	Contrevenants incarcérés • Inclusion : consommation mensuelle d'alcool ou de marijuana ou consommation excessive d'alcool au moins une fois au cours de la dernière année; consommation d'alcool ou de marijuana dans les 4 semaines avant l'infraction ou l'incarcération • Exclusion : aucun
Baird et al., 2013	Rhode Island, États-Unis	Contrevenants référés par la cour pour infractions liées à la conduite (incluant CCA) • Inclusion et exclusion : aucun
Nirenberg et al., 2013	Rhode Island, États-Unis	Contrevenants référés par la cour pour infractions liées à l'alcool ou à la conduite (incluant CCA) • Inclusion et exclusion : aucun
Woodall et al., 2007	Nouveau-Mexique, États-Unis	Contrevenants (1re infraction; en prison); 76 % sont Amérindiens • Inclusion autre que 1re infraction : aucun • Exclusion : aucun
Utter et al., 2014	Californie, États-Unis	Contrevenants (1re infraction; recrutés en prison, avant présence en cour) • Inclusion autre que 1re infraction : aucun • Exclusion : aucun
Chanut et al., 2007	Québec, Canada	Contrevenants (1 infraction ou plus) • Inclusion : au moins 1 condamnation pour CCA; abus ou dépendance à l'alcool • Exclusion : surveillance médicale requise pour réduire ou cesser la consommation; un taux d'alcool 0,08 % lors de l'entrevue
Brown et al., 2010	Québec, Canada	Contrevenants récidivistes • Inclusion : 2+ condamnations pour CCA au cours des 15 dernières années; consommation problématique d'alcool au cours des 6 derniers mois; absence de participation courante au programme québécois menant à la ré-obtention du permis de conduire • Exclusion : absence de documents officiels corroborant la récidive; surveillance médicale requise pour réduire ou cesser la consommation; taux d'alcool 0,08 %, présence de drogues dans l'urine ou autres signes d'intoxication lors de l'entrevue
Ouimet et al., 2013	Québec, Canada	Contrevenants récidivistes • Inclusion : avoir donné accès au dossier de conduite; l'article ne mentionne que deux autres critères d'inclusion (2+ condamnations pour CCA et consommation problématique d'alcool), mais réfère à l'article de Brown et al. (2010) pour plus de détails (voir plus haut)

		• Exclusion : voir Brown et al. (2010)
Mello et al., 2005	Rhode Island, États Unis	Patients blessés non gravement dans une collision routière (c) en tant que conducteur ou passager, ou dans un autre type d'accident (a) • Inclusion : consommation d'alcool détectée lors de l'arrivée à l'urgence, consommation dans les 6 heures avant la collision ou consommation problématique d'alcool • Exclusion : dépendance à l'alcool
Mello et al., 2008	Rhode Island, États-Unis	Patients blessés non gravement dans une collision routière (c) (pas de détails s'il s'agit de conducteurs, passagers, ou les deux) ou dans un autre type d'accident (a) • Inclusion : consommation problématique d'alcool • Exclusion : aucun
Schermer et al., 2006	Nouveau-Mexique, États Unis	Patients blessés dans une collision routière en tant que conducteur ou passager • Inclusion : un taux d'alcool ≥ 0,08 % lors de l'admission à l'hôpital ou consommation problématique d'alcool

Notes. [a] Les articles sont présentés en ordre chronologique pour chaque sous-groupe ou dans un ordre permettant un suivi logique du développement de la recherche dans le domaine. [b] Lorsque disponibles, les moyennes et les écart-types sont donnés avec une décimale. [c] Il s'agit du nombre total de participants randomisés aux différents groupes. [d] Le nombre rapporté dans l'étude ne semble pas être le nombre de participants randomisés. On note au moins 12 participants randomisés qui ne sont pas inclus dans le nombre total. [e] Le nombre total représente le nombre de participants randomisés aux différents groupes alors que le nombre pour chacun des sous-groupes représente celui après le suivi. (a) = autre type d'accident; (c) = collision; CCA = conduite avec capacités affaiblies; E = expérimental; EM+ = adaptation de l'entretien motivationnel; nd = non disponible; (t) = total.

Le Tableau 2 présente les informations suivantes : les caractéristiques des interventions, les périodes de suivi et le pourcentage de participation, les variables dépendantes liées à la consommation d'alcool et à la CCA, certaines variables secondaires et la façon dont les variables sont mesurées. L'EM est souvent combiné à d'autres types d'interventions comme la présence en salle d'urgence qui vise à exposer les contrevenants aux conséquences possibles de leur comportement (Baird, Nirenberg, Longabaugh & Mello, 2013; Nirenberg, Baird, Longabaugh & Mello, 2013). Des adaptations de l'EM sont présentes dans toutes les études sélectionnées et seront appelées EM+ dans la description des résultats de la présente revue de la documentation. Toutes les études dans lesquelles l'EM+ n'était pas combiné à d'autres interventions comportaient des interventions brèves (Stein et al., 2006;

Utter et al., 2014) et même très brèves (Brown et al., 2010; Chanut et al., 2007; Ouimet et al., 2013) sur une ou deux séances. Les études combinées à d'autres types d'interventions ont pu s'échelonner sur au moins quatre séances sur une période d'un mois. Les suivis sur les effets de l'EM+ sur la consommation d'alcool varient de trois mois à deux ans. Pour la CCA, les périodes de suivi peuvent aller jusqu'à cinq ans.

Tableau 2. Autres détails méthodologiques et résultats des études sélectionnées (n = 11)

Auteurs[a]	**Interventions, nombre de séances et durée de l'intervention**	**Périodes de suivi et % de participation (variables principales)**
Stein et al., 2006	E : EM+ (2 séances : 150 min) durant incarcération (accès à d'autres traitements durant cette période) T : Relaxation (2 séances : 150 min) durant incarcération (accès à d'autres traitements durant cette période)	• 3 mois après fin incarcération (CCA et autres comportements autodéclarés; 84 %)
Baird et al., 2013	E : EM+ en groupe (6-10 participants), 4 séances (720 min) + 2 séances présence dans une urgence (360 min) T : travaux communautaires (960 min) + 2 séances information (240 min)	• 6 et 12 mois (CCA et autres comportements autodéclarés; 80 %) • 12 mois (infractions-dossier; 99 %)
Nirenberg et al., 2013	E_1: EM+ en groupe, 4 séances (720 min) + 1 séance individuelle (60 min) + 2 séances travaux communautaires (360 min) E_2: EM+ en groupe, 4 séances (720 min) + 1 séance individuelle (60 min) + 2 séances présence dans une urgence (360 min) T : travaux communautaires (960 min) + 2 séances information et discussions (180 min)	• 6 mois (alcool, CCA et autres comportements autodéclarés; 93 %) • 6 mois (infractions-dossier; 98 %)
Woodall et al., 2007	E : 28 jours de prison avec thérapie individuelle avec EM+, séances de groupe couvrant plusieurs sujets et suivi possible jusqu'à 12 mois T : 28 jours de prison	• 6, 12, 24 mois (alcool; 81 %);[c] • Jusqu'à 60 mois (CCA; 90 %)[c]
Utter et al., 2014	E : EM+ (1 séance : 30-45 min) T : aucune intervention	• 3 mois (alcool; 91 %) • 24 mois (infractions-dossier; 100 %)
Chanut et al., 2007	E : EM+ (1 séance : 20-30 min)	• 3 et 6 mois (alcool; 71 %)

	T : information et rétroaction (1 séance : 20-30 min)	
Brown et al., 2010	E : EM+ (1 séance : 20-30 min); même intervention que celle développée par Chanut et al. (2007)	• 6 et 12 mois (alcool; 88 %)
	T : information et rétroaction (1 séance : 20-30 min)	
Ouimet et al., 2013	E : EM+ (1 séance : 20-30 min); même intervention que celle développée par Chanut et al., 2007; suivi de l'étude Brown et al., 2010	• 60 mois (infractions-dossier; 91 %)
	T : information et rétroaction (1 séance : 20-30 min)	
Mello et al., 2005	E_1: EM+ (1 séance : 40 min) + 1 suivi (40 min) E_2: EM+ (1 séance : 40 min)	• 12 mois (blessures liées consommation alcool; 81 %)
	T : intervention médicale standard	
Mello et al., 2008	E : EM+ (1 séance par téléphone : 30 min) + 1 séance par téléphone (15 min)	• 3 mois (alcool et CCA autodéclarés; 95 %)
	T : intervention médicale standard	
Schermer et al., 2006	E : EM+ (1 séance : 30 min)	• 36 mois (CCA; 100 %)
	T : remise aux participants de numéros de téléphone de centres de traitement (consommation d'alcool) près de leur domicile	

Tableau 2 continué. Autres détails méthodologiques et résultats des études sélectionnées (n = 11)

Auteurs[a]	**Variables dépendantes et mesures utilisées**[b]	**Résultats**
Stein et al., 2006	• CCA (alcool et marijuana) en tant que conducteur et passager d'un conducteur CCA : *Risky Behaviors Questionnaire* • Mesure secondaire : dépression (*Center for Epidemiological Studies Depression Scale)*	E vs T = *effet attendu* : ↓ conducteur CCA (alcool); *effets non significatifs* : conducteur CCA (marijuana), passager d'un conducteur CCA (alcool et marijuana) Autres effets = E vs T (si peu de symptômes de dépression) : ↓ conducteur CCA (alcool), ↓ passager d'un conducteur CCA (alcool) E vs T (si plusieurs symptômes dépression) : aucun effet significatif Pour E (si plusieurs symptômes dépression vs peu) :

		aucun effet significatif Pour T (si plusieurs symptômes dépression vs peu) : ↓ conducteur CCA (alcool et marijuana), ↓ passager d'un conducteur CCA (alcool et marijuana)
Baird et al., 2013	• CCA, inattention et conduite sécuritaire (autodéclarées) : questionnaire adapté du *Risky Behavior Questionnaire* et de la *High Risk Driving Scale* • Infractions-dossier (CCA et autres types d'infractions) : banques de données de l'état	E vs T = *effets non significatifs* : CCA autodéclarée à 12 mois, infractions au dossier de conduite à 12 mois (CCA et autres), inattention et conduite sécuritaire à 6 et 12 mois; *effet contraire* : ↑ CCA autodéclarée à 6 mois
Nirenberg et al., 2013	• Consommation d'alcool : sévérité (AUDIT) • CCA, conduite dangereuse, vitesse-distraction (autodéclarées) : questionnaire *High Risk Driving Behaviors Scale* • Infractions-dossier (CCA et autres types d'infractions) : banques de données de l'état	E1 vs T = *effet attendu* : ↓ infractions-dossier; *effets non significatifs*: CCA, conduite dangereuse; *effet contraire*: ↑ vitesse-distraction E2 vs T = *effets non significatifs* : CCA, conduite dangereuse, infractions-dossier; *effet contraire*: ↑ vitesse-distraction E1 et E2 vs T = *effet contraire* : ↑ alcool E1 vs E2 = *effets non significatifs* : alcool, CCA, conduite dangereuse, vitesse-distraction, infractions-dossier
Woodall et al., 2007	• Consommation d'alcool : nombre de consommation standard, nombre de jours de consommation, taux d'alcool (*Form 90*) • Infractions-dossier (CCA) : banques de données de l'état • Autres variables (hypothèses) : trouble de la personnalité antisociale (*Diagnostic Interview Schedule*) • Mesure secondaire : CCA au cours des 30 derniers jours (examinée avec personnalité antisociale)	E vs T = *effets attendus* : ↓ nombre de consommation standard, ↓ nombre de jours de consommation, ↓ taux d'alcool; *effet non significatif* : infractions-dossier (CCA) Autre effet = E vs T en fonction de la personnalité antisociale (oui vs non) : aucun effet significatif sur la CCA au cours des 30 derniers jours
Utter et al., 2014	• Consommation d'alcool : sévérité (AUDIT) • Infractions-dossier (CCA et autres types d'infractions) : banques de données de l'état • Mesures secondaires : consommation excessive, fréquence consommation alcool, abstinence, consommation de drogues, traitements pour alcool, santé générale, symptômes de dépression (*Patient Health Questionnaire 9*), collisions	E vs T = *effets non significatifs :* alcool (AUDIT) et infractions-dossier ainsi que mesures secondaires (consommation excessive, fréquence consommation alcool, abstinence, consommation de drogues, traitements pour alcool, santé générale, symptômes de dépression, collisions)
Chanut et al., 2007	• Consommation d'alcool : nombre de jours de consommation d'alcool à risque (*Timeline followback*) et sévérité (AUDIT)	E vs T = *effet attendu* : EM+ : ↓ nombre de jours de consommation d'alcool à risque à 6 mois; *effets non significatifs* : nombre de jours de consommation d'alcool à 3 mois; AUDIT à 3 et 6 mois; *autres* : EM vs

	• Mesures secondaires : nombre de séances de traitements au cours des 3 derniers mois; corroboration consommation alcool par les proches (analyse descriptive uniquement)	T : ↓ nombre de séances de traitements
Brown et al., 2010	• Consommation d'alcool : changement dans le nombre de jours de consommation à risque (*Timeline followback*) • Changement dans marqueurs biologiques associés à la consommation chronique : alanine aminotransférase, aspartate aminotranférase, gamma-glutamyl transférase, volume globulaire moyen (VGM) • Mesures secondaires : mesure visant à corroborer autres mesures alcool (*MacAndrew Alcoholism Scale from the Minnesota Multiphasic Personlity Inventory*-2; MMPI-MAC); stade de changement (*Readiness to Change Questionnaire*); nombre de séances de traitement au cours des 6 derniers mois	E vs T = *effets attendus* : ↓ nombre de jours de consommation d'alcool à risque au 12^{e} vs 6^{e} mois; ↓ MMPI-MAC au 6^{e} vs 1er mois; ↓ VGM au 6^{e} vs 1er mois; *effets non significatifs* : nombre de jours de consommation à risque au 6^{e} vs 1er mois et au 12^{e} vs 1er mois, MMPI-MAC au 12^{e} vs 6^{e} et 1er mois; VGM au 12^{e} vs 6^{e} et 1er mois; autres marqueurs biologiques; stade de changement et nombre de jours de traitement suivant l'intervention
Ouimet et al., 2013	• Infractions-dossier (CCA et autres types d'infractions) et collisions : banques de données de la province • Mesures secondaires : âge, stade de changement (*Readiness to Change Questionnaire*), sévérité consommation alcool (AUDIT), condamnations CCA passées	E vs T = *effets attendus* : EM+ : ↓ infractions chez le groupe des jeunes contrevenants (26-43 ans); *effets non significatifs*: effet principal de l'EM+ pour infractions-dossier et collisions et pour mesures secondaires (stade de changement, sévérité de la consommation et condamnations passées)
Mello et al., 2005	• Blessures liées à la consommation d'alcool : *Injury Behavior Checklist*	E1 vs T = *effet attendu* : ↓ blessures liées à la consommation d'alcool chez patients blessés dans collision routière (contrôlée pour blessures avec les données de référence recueillies avant l'intervention) E2 vs T et E1 vs E2 = *effet non significatif :* blessures liées à la consommation d'alcool chez patients blessés dans collision routière Autres effets = E1 vs T, E2 vs T et E1 vs E2 = *effet non significatif :* blessures liées à la consommation d'alcool chez patients blessés dans autres types d'accidents
Mello et al., 2008	• Consommation d'alcool : sévérité (AUDIT) • CCA (*Impaired Driving Scale*) • Mesures secondaires : port de la ceinture de sécurité et vitesse (pas de détails sur le questionnaire utilisé)	E vs T = *effet attendu* : ↓ CCA; *effets non significatifs*: consommation d'alcool, port de la ceinture de sécurité et vitesse; *autres* : effet d'interaction entre score AUDIT et traitement (avec un score à l'AUDIT élevé, ↓ CCA pour E, mais non pour T) Autres effets = E vs T = *effet non significatif* : CCA chez patients impliqués et non impliqués dans une collision routière

Schermer et al., 2006	• Infractions-dossier (CCA) : banques de données de l'état • Mesures secondaires (co-variables) : âge, taux d'alcool lors de l'admission à l'urgence, sévérité consommation alcool (AUDIT), arrestations CCA passées	E vs T = *effet attendu :* ↓ CCA (analyse contrôlée pour âge (autre facteur protecteur), AUDIT, taux d'alcool et arrestations CCA passées (facteur de risque))

Notes. [a] Les articles sont présentés en ordre chronologique pour chaque sous-groupe ou dans un ordre permettant un suivi logique du développement de la recherche dans le domaine. [b] Lorsque non spécifié, la mesure est un questionnaire; seules les variables utilisées dans les analyses principales sont rapportées. [c] Le nombre rapporté dans l'étude ne semble pas être le nombre de participants randomisés. On note au moins 12 participants randomisés qui ne sont pas inclus dans le nombre total. Les pourcentages rapportés pourraient être surestimés. AUDIT = Alcohol Use Disorders Identification Test; CCA = conduite avec capacités affaiblies; E = expérimental; EM+ = adaptation de l'entretien motivationnel; T = Témoin.

Évaluation des risques de biais des études sélectionnées

Le Tableau 3 présente l'évaluation des risques de biais des études sélectionnées à l'aide de la grille développée par la collaboration Cochrane (Higgins & Green, 2011). Seulement 55 % des études décrivent la méthode utilisée pour la génération des séquences de répartition aléatoire dans les groupes expérimentaux et témoins. Deux études (18 %) rapportent comment s'est faite la dissimulation des séquences de répartition aléatoire. Moins de la moitié des études rapporte qu'il s'agit d'un essai à l'insu des participants et du personnel de recherche pendant l'intervention (27 %) ainsi que du personnel de recherche pendant les périodes de suivi (45 %). Bien que le rapport sur les données soit généralement complet, plus de la moitié des articles ne rapportent pas l'ampleur des données manquantes. Un peu plus de la moitié des études indique avoir maintenu la fidélité des interventions (64 %) ainsi que des interventions de durée similaire pour les groupes expérimentaux et témoins (55 %). Une seule étude a corroboré les données autodéclarées par l'utilisation de marqueurs biologiques (Brown et al., 2010); une autre a utilisé la corroboration de la consommation par les proches (Chanut et al., 2007). La majorité des études suivant la récidive de la CCA (75 %) ont utilisé le dossier de conduite obtenu auprès d'agences gouvernementales.

Tableau 3. Évaluation des risques de biais des études sélectionnées à l'aide de la grille développée par la collaboration Cochrane (n = 11)

Article[a]	Randomisation (Génération adéquate séquences)	Dissimulation répartition des séquences de randomisation	Essai à l'insu	
			Participants et personnel recherche	Personnel recherche pendant suivi
Stein et al., 2006	?	?	?	?
Baird et al., 2013	?	?	?	?
Nirenberg et al., 2013	?	?	?	?
Woodall et al., 2007	?	?	-	?
Utter et al., 2014	+	+	+	+
Chanut et al., 2007	+	?	?	?
Brown et al., 2010	+	?	+	+
Ouimet et al., 2013	+[c]	?	+[c]	+[c]
Mello et al., 2005	?	?	?	+
Mello et al., 2008	+	?	-	+
Schermer et al., 2006	+	+	?	?

Tableau 3 continué. Évaluation des risques de biais des études sélectionnées à l'aide de la grille développée par la collaboration Cochrane (n = 11)

Article[a]	Ampleur des données manquantes			Rapport complet sur les données	Autres biais			
	Alcool auto-déclaré	CCA auto-déclarée	Infractions-dossier		Fidélité intervention	Temps intervention	Corroboration alcool	Infractions-dossier
Stein et al., 2006	nsp	-	nsp	+	+	+	nsp	-
Baird et al., 2013	nsp	-	+	+	?	+	nsp	+
Nirenberg et al., 2013	?	?	+	+	+	+	?	+
Woodall et al., 2007	-	nsp	-	+	?	-	?	+
Utter et al., 2014	+	nsp	+	+	-	-	?	+
Chanut et al., 2007	?	nsp	nsp	+	+	+	?[b]	nsp
Brown et al., 2010	+	nsp	nsp	+	+	+	+	nsp
Ouimet et al., 2013	nsp	nsp	?	+	+[c]	+	nsp	+
Mello et al., 2005	nsp	nsp	nsp[d]	+	+	-	nsp	nsp[d]
Mello et al., 2008	+	+	nsp	+	+	-	?	-
Schermer et al., 2006	nsp	nsp	+	+	?	-	nsp	+

Note. + : risque faible de biais; ? : risque de biais incertain; - : risque élevé de biais; CCA : conduite avec capacités affaiblies; nsp : ne s'applique pas.
[a] Les articles sont présentés en ordre chronologique pour chaque sous-groupe ou dans un ordre permettant un suivi logique du développement de la recherche dans le domaine.[b] La consommation a été corroborée par les proches mais chez seulement environ 30 % des participants. [c] L'article réfère à celui de Brown et ses collègues (2010) pour plus de détails. [d] Les variables mesurées sont les blessures autodéclarées. Le risque de biais est élevé et les données autodéclarées ne sont pas corroborées par d'autres types de données.

Efficacité des interventions

Six études ont porté sur la consommation d'alcool, quatre sur la CCA autodéclarée, six sur les dossiers d'infraction et une sur les blessures (voir Tableaux 2 et 3). Aucune analyse quantitative des résultats (p. ex. : méta-analyse) n'est menée compte tenu du faible nombre

d'études pour chacune des variables. Les résultats des variables principales (c.-à-d., consommation d'alcool, CCA ou les deux) et secondaires (p. ex. : autres comportements à risque), décrits à la dernière colonne du Tableau 2, sont donc présentés uniquement de façon descriptive. Les biais méthodologiques des études sont aussi discutés pour chacun des sous-groupes (c.-à-d., les jeunes, les contrevenants primaires, les récidivistes et les patients).

Études sur les jeunes contrevenants

L'étude de Stein et ses collaborateurs (2006) s'est intéressée aux effets de l'EM+ sur la diminution de la CCA (alcool ou marijuana) et de la présence de passagers à bord d'un véhicule dont le conducteur a consommé de l'alcool ou de la marijuana. L'étude a été menée auprès de 105 adolescents et jeunes adultes incarcérés pour une période de 4 à 12 mois dans un centre de détention pour jeunes. Ces participants n'ont pas nécessairement été incarcérés pour des délits liés à la CCA ou à la consommation de substances, mais les critères d'admissibilité ont permis de s'assurer, notamment, qu'ils avaient consommé de l'alcool et de la marijuana dans le mois précédent l'incarcération. Les participants ayant bénéficié de l'EM+ rapportent moins de CCA trois mois après leur libération que ceux du groupe témoin. Les résultats n'étaient pas significatifs pour la CCA (marijuana) ou pour le fait d'être passager à bord d'un véhicule dont le conducteur avait consommé de l'alcool ou de la marijuana. Des effets modérateurs de la dépression ont aussi été observés (voir Tableau 2 pour plus de détails).

Baird, Nirenberg, Longabaugh et Mello (2013) se sont intéressés aux effets de l'EM+ sur la CCA autodéclarée et sur les infractions inscrites au dossier de conduite (incluant la CCA) chez 337 jeunes contrevenants référés par la cour. L'EM+ était présenté dans le cadre

de quatre séances de trois heures chacune, en plus de deux séances de trois heures dans une urgence où les participants pouvaient constater les conséquences des collisions routières. Le groupe témoin devait assister à deux séances d'information de deux heures chacune et faire ensuite des travaux communautaires pendant 16 heures. À l'encontre de l'hypothèse, le groupe témoin a rapporté moins de CCA six mois après l'intervention que le groupe EM+; aucun effet n'était présent à 12 mois. Les résultats n'ont indiqué aucune différence significative entre les groupes pour les infractions inscrites au dossier de conduite, incluant la CCA. Dans cette étude, l'EM+ fut combiné à une présence en salle d'urgence. Toutefois, les preuves scientifiques concernant ce type de traitement suggère sa non-efficacité (C'de Baca, Lapham, Liang & Skipper, 2001; Polacsek et al., 2001; Wheeler, Rogers, Tonigan & Woodall, 2004).

Nirenberg, Baird, Longabaugh et Mello (2013) ont recruté leurs participants dans le même programme que celui de Baird et al. (2013). L'étude a porté sur les effets de l'EM+ sur la consommation d'alcool et les infractions liées à la conduite, aux substances psychoactives et à la CCA chez 1 007 jeunes contrevenants référés par la cour (moins de 10 % étaient référés pour CCA). Deux interventions EM+ ont été testées (13 heures), la première (E_1) demandant aussi la présence des contrevenants dans une urgence (+ 6 heures) et la seconde (E_2) demandant des travaux communautaires (+ 6 heures). Pour le groupe témoin, l'intervention comportait surtout des travaux communautaires (16 heures) et des séances d'information et de discussion (+ 3 heures). Six mois après l'intervention, les résultats indiquent un nombre d'infractions (incluant la CCA) moins élevé au dossier de conduite des contrevenants ayant bénéficié de l'E_1 comparativement au groupe témoin. Les résultats ne sont pas significatifs pour le groupe E_2, comparativement au groupe témoin et au groupe E_1. Les résultats n'indiquent aucune différence significative entre les trois groupes pour la CCA et la conduite

dangereuse autodéclarées. Finalement, contrairement aux hypothèses, les groupes E_1 et E_2 présentent une sévérité de la consommation d'alcool plus élevée et davantage de comportements de vitesse et d'inattention que le groupe témoin. À l'instar de l'étude de Baird et al. (2013), l'EM+ est combiné à la présence à l'urgence ou à des travaux communautaires. Toutefois, la présence de travaux communautaires dans le groupe témoin permet une meilleure évaluation des effets de l'EM+. Les trois études sur les jeunes contrevenants (Baird et al., 2013; Nirenberg et al., 2013; Stein et al., 2006) ne rapportent pas plusieurs éléments essentiels à l'évaluation des biais méthodologiques (voir Tableau 3).

Études sur les contrevenants primaires de la CCA

Woodall, Delaney, Kunitz, Westerberg et Zhao (2007) ont examiné l'effet de l'EM+, associé à une peine de prison de 28 jours et à un programme incluant plusieurs autres éléments, sur la consommation d'alcool et la CCA chez plus de 300 contrevenants primaires. Environ 76 % des contrevenants étaient d'origine amérindienne et 17 % ont été diagnostiqués avec un trouble de la personnalité antisociale. Le suivi des participants s'est fait à 6, 12 et 24 mois après l'intervention pour la consommation d'alcool et jusqu'à cinq ans pour la CCA. Chez les contrevenants détenus en milieu carcéral, les résultats indiquent une baisse de la consommation d'alcool chez ceux répartis aléatoirement dans le groupe EM+, comparativement à ceux répartis aléatoirement dans le groupe témoin, sans intervention spécifique. Les résultats indiquent aussi une baisse plus marquée chez les participants ayant un désordre de la personnalité antisociale. L'effet général de l'EM+ dans la réduction de la CCA n'était pas significatif. Cette étude comporte plusieurs biais méthodologiques pouvant affecter les résultats. Par exemple, les participants sont décrits comme étant répartis aléatoirement dans

l'un ou l'autre des groupes, mais sans autres détails sur le processus de répartition. Cependant, la taille des groupes est très différente pour le groupe expérimental (n = 177) et le groupe témoin (n = 128), une situation peu fréquente dans la répartition aléatoire. Par ailleurs, le manque de rigueur dans la répartition aléatoire pourrait expliquer des différences importantes dans la composition des groupes sur des variables clés, à savoir la présence plus importante de contrevenants avec un problème de consommation d'alcool et un trouble de la personnalité antisociale dans le groupe expérimental. Les auteurs n'excluent pas la possibilité que les résultats puissent être dus à la régression à la moyenne et non pas aux effets du traitement.

Utter et ses collaborateurs (2014) ont testé l'emploi d'une intervention brève de 30 à 45 minutes centrée sur les principes de l'EM dans la diminution de la consommation d'alcool et de la CCA. Les 200 participants ont été recrutés en prison après une arrestation pour CCA, mais avant leur comparution à la cour. Le suivi sur la consommation après trois mois et sur la CCA après deux ans ne démontre pas de différence significative entre l'EM+ et le groupe témoin. L'étude tient compte de plusieurs biais méthodologiques.

Études sur les contrevenants de la CCA, principalement récidivistes, avec un problème de consommation d'alcool

L'étude pilote de Chanut et ses collaborateurs (2007) a permis de développer une intervention très brève de 20 à 30 minutes adaptée des principes de l'EM. Dans cette étude, 51 participants ont été répartis aléatoirement dans le groupe EM+ ou dans le groupe témoin. Les participants avaient des problèmes d'abus ou de dépendance à l'alcool lors du recrutement et plusieurs d'entre eux étaient des récidivistes. Les résultats n'étaient pas significatifs à trois mois, mais indiquaient une réduction significative du nombre de jours de consommation à

risque à six mois. Cette étude pilote omet de rapporter plusieurs éléments essentiels à l'évaluation des biais méthodologiques.

L'étude de Brown et ses collaborateurs (2010), qui a utilisé l'intervention EM+ développée par Chanut et coll. (2007), est l'une des premières à porter exclusivement sur des contrevenants récidivistes (N = 197) ayant des problèmes de consommation d'alcool, tel que suggéré par des scores à l'Alcohol Use Disorders Identification Test de huit et plus. Il s'agit aussi de la seule étude sélectionnée qui a corroboré les données autodéclarées à l'aide de marqueurs biologiques associés à la consommation chronique (c.-à-d. : alanine aminotransférase, aspartate aminotranférase, gamma-glutamyl transférase, volume globulaire moyen). Comparativement aux participants du groupe témoin, les participants répartis aléatoirement dans le groupe EM+ ont déclaré un nombre moins élevé de jours de consommation d'alcool à risque à 12 mois (pas de différence significative à 6 mois) et ont eu des scores significativement moins élevés à un test visant à corroborer les mesures d'alcool autodéclarées. Les analyses des marqueurs biologiques démontrent aussi une réduction du volume globulaire moyen à 6 mois (mais non à 12 mois); aucune autre différence n'a été démontrée pour les marqueurs biologiques. Cette étude présente peu de biais méthodologiques.

L'étude de Ouimet et ses collaborateurs (2013) présente les résultats d'un suivi de l'étude de Brown et al. (2010) sur les contraventions liées à la conduite, incluant la CCA, et les collisions, cinq ans après l'intervention. Les effets de l'âge, du stade de changement, de la sévérité de la consommation et du nombre de condamnations pour CCA sont aussi examinés comme des modérateurs potentiels des effets de l'intervention. Les résultats ne suggèrent pas de différence significative entre les groupes pour la CCA et les collisions. Toutefois, le délai

pour la première infraction après l'intervention EM+ était plus long chez les plus jeunes contrevenants (26 à 43 ans). Il n'y a pas eu de résultats significatifs pour l'effet modérateur du stade de changement, de la consommation d'alcool et du nombre de condamnations passées pour CCA. Le nombre de biais méthodologiques de cette étude est moyennement faible.

Études sur les patients impliqués dans une collision routière

Il existe plusieurs études sur l'efficacité de l'EM ou de l'EM+ auprès de patients en salle d'urgence. Toutefois, seulement trois études ont porté spécifiquement sur les patients blessés à la suite d'une collision routière, recrutés en milieu hospitalier, ayant consommé de l'alcool avant la collision ou ayant une consommation problématique d'alcool.

L'étude de Mello et ses collaborateurs (2005) a comparé deux séances de 40 minutes chacune (E1) à une séance de 40 minutes (E2) et à une intervention médicale standard dans la réduction des blessures liées à la consommation d'alcool. Les patients traités à l'urgence ont été blessés dans une collision routière ou dans un autre type d'accident. Lors du suivi 12 mois après l'intervention, les résultats montrent une réduction des blessures liées à la consommation d'alcool chez le groupe E1 comparativement au groupe témoin chez les patients blessés dans une collision routière. Cette différence ne se retrouve pas chez les patients blessés dans d'autres types d'accidents. Aucune différence ne se retrouve entre les patients répartis aléatoirement dans le groupe E2 ou dans le groupe témoin. Cette étude présente plusieurs biais méthodologiques potentiels.

Une étude subséquente menée en 2008 par Mello et ses collaborateurs a porté sur l'efficacité d'une séance de 30 minutes en personne et d'une séance de 15 minutes par téléphone (EM+) comparées à une intervention médicale standard sur la consommation

d'alcool et la CCA. Elle a aussi réduit un certain nombre de biais méthodologiques retrouvés dans l'étude de Mello et ses collaborateurs (2005). Les patients de l'urgence ont été blessés dans une collision routière ou dans un autre type d'accident. Les résultats démontrent une baisse significative de la CCA dans le groupe EM+ comparativement au groupe témoin, mais n'indiquent aucune différence significative concernant la consommation d'alcool. Une analyse secondaire indique que l'effet significatif de l'EM+ dans la réduction de la CCA n'est présent que chez les participants avec une consommation problématique d'alcool.

L'étude de Schermer et ses collaborateurs (2006) a comparé une séance de 30 minutes d'EM+ à la remise de numéros de téléphone de centres de traitement de la consommation problématique d'alcool dans la réduction de la CCA trois ans après l'intervention. Les résultats indiquent une baisse de la CCA pour le groupe EM+ comparé au groupe témoin. Le nombre de biais méthodologiques de cette étude est moyennement faible.

Discussion

Caractéristiques des études et biais méthodologiques

Âge et sexe. Peu d'études ont porté sur l'EM+ dans la prévention secondaire et tertiaire de la CCA. Trois études ont porté sur de jeunes contrevenants âgés de 14 à 21 ans arrêtés pour diverses infractions liées à la conduite, l'alcool ou la CCA. Deux études ont été menées chez des contrevenants primaires de la CCA et trois études ont été menées auprès de patients blessés dans des collisions routières. Dans ces études, la moyenne d'âge des participants se situe de la mi-vingtaine à la mi-trentaine. Trois autres études se sont intéressées aux contrevenants de la CCA, principalement récidivistes, avec un problème de consommation

d'alcool. La moyenne d'âge des participants à ces études se situe dans la mi-quarantaine. De plus, dans la presque totalité des études, le pourcentage d'hommes est plus important que le pourcentage de femmes, ce qui reflète la réalité des arrestations et du nombre de collisions, mais qui soulève la possibilité de difficultés liées à la généralisation des résultats chez les femmes.

Type d'intervention. Toutes les études dans lesquelles l'EM a été employé ont été qualifiées d'EM+ afin de tenir compte du fait qu'elles sont toutes des adaptations de l'EM, souvent par l'ajout de composantes comme la rétroaction sur la consommation de substances psychoactives. L'EM+ est aussi souvent combiné à d'autres types d'interventions comme les travaux communautaires. Les résultats des études EM+ ne permettent donc pas d'identifier l'apport spécifique de l'EM, ni l'apport de ses composantes.

Biais méthodologiques. Plusieurs études n'ont pas indiqué les éléments importants permettant de juger de la façon dont les auteurs ont réduit les biais méthodologiques potentiels. Plus de la moitié des études présentent des risques élevés de biais (Baird et al., 2013; Chanut et al., 2007; Mello et al., 2005; Nirenberg et al., 2013; Stein et al., 2006; Woodall et al., 2007), trois études présentent des risques de biais moyens (Mello, Longabaugh, Baird, Nirenberg & Woolard, 2008; Ouimet et al., 2013; Schermer, Moyers, Miller & Bloomfield, 2006) et deux études présentent de faibles risques de biais (Brown et al., 2010; Utter et al., 2014). Les essais avec répartition aléatoire devraient rapporter les éléments importants liés à la méthode employée de manière à permettre aux lecteurs d'évaluer les biais méthodologiques, comme suggéré par le *CONSORT Statement* (Altman et al., 2001; Moher, Schulz & Altman, 2001).

Preuves scientifiques de l'efficacité des adaptations de l'entretien motivationnel

Les trois études sur les jeunes contrevenants (Baird et al., 2013; Nirenberg et al., 2013; Stein et al., 2006) et les deux études sur les contrevenants primaires (Utter et al., 2014; Woodall et al., 2007) présentent des résultats mixtes et plusieurs biais méthodologiques. Ces études n'incluaient pas de critère de consommation problématique d'alcool. Les résultats des études sur les contrevenants récidivistes (Brown et al., 2010; Chanut et al., 2007; Ouimet et al., 2013) et sur les patients recrutés en salle d'urgence (Mello et al., 2005, 2008; Schermer et al., 2006) présentent plus de résultats soutenant l'efficacité de l'EM que les études menées auprès des jeunes contrevenants et des contrevenants primaires. Les études sur les récidivistes et les patients incluaient des critères liés à la consommation d'alcool. À l'exception de l'étude pilote de Chanut et ses collaborateurs (2007) et de l'étude de Mello et ses collaborateurs (2005) qui présentent plusieurs biais méthodologiques, les autres études chez ces sous-groupes présentent des biais méthodologiques moyens ou peu élevés. Trois des six études ont porté sur la consommation d'alcool. Les résultats n'indiquent pas d'effet de l'EM+ lorsque mesuré à 3 mois (Chanut et al., 2007; Mello et al., 2008), mais des effets sont présents à 6 ou à 12 mois (Brown et al., 2010; Chanut et al., 2007). Trois études ont mesuré l'effet de l'EM+ sur la réduction de la CCA ou d'infractions liées à la conduite incluant la CCA (Mello et al., 2008; Ouimet et al., 2013; Schermer et al., 2006). Les résultats indiquent une baisse de la CCA autodéclarée après trois mois (Mello et al., 2008), une baisse de la CCA dans les infractions inscrites au dossier de conduite après trois ans (Schermer et al., 2006) ainsi qu'une présence moins importante des infractions inscrites au dossier de conduite chez les contrevenants les plus jeunes (26 à 43 ans) (Ouimet et al., 2013). Il y a donc quelques preuves d'efficacité de

l'EM chez les récidivistes et les patients recrutés en salle d'urgence avec une consommation d'alcool problématique. D'autres études sont nécessaires afin de corroborer ces résultats préliminaires.

Implications cliniques

Une majorité d'études décrites dans le cadre de cet article ont évalué la fidélité des interventions menées par le personnel de recherche. Dans l'étude de Brown et al. (2010), par exemple, l'intervention suivait une procédure systématique et incluait un protocole visant à évaluer objectivement l'intégrité des interventions, à savoir le protocole du *Motivational Interviewing Treatment Integrity* (Moyers et al., 2005). Cette supervision de la qualité des interventions n'est pas une tâche facile en milieu clinique. Toutefois, le personnel peut être formé dans les règles de l'art au départ et être suivi par la suite. Bien que cette formation puisse entraîner des coûts supplémentaires, des études coût-efficacité suggèrent que l'EM est associé à des coûts moindres. Par exemple, une étude coût-efficacité menée auprès de jeunes rencontrés en salle d'urgence suggère que l'EM engendre des coûts moins élevés en ce qui a trait au déploiement de l'intervention que le traitement usuel. Elle suggère aussi la supériorité de cette intervention en ce qui concerne les années de vie ajustées pour la qualité (ou *quality-adjusted life years*) (Neighbors et al., 2010). Aucune étude coût-efficacité ne semble avoir été menée auprès des contrevenants.

Conclusion

Les résultats des études sur l'efficacité de l'EM auprès des jeunes contrevenants et des contrevenants primaires de la CCA, qui n'avaient pas de critères d'inclusion pour consommation d'alcool problématique, présentent des résultats mixtes. De plus, une seule des cinq études présente des biais méthodologiques faibles. Les résultats auprès des récidivistes de la CCA et des patients recrutés en milieu hospitalier, dont les critères d'inclusion portaient sur la consommation d'alcool problématique, présentent des résultats prometteurs soutenant l'efficacité de l'EM. De plus, quatre des six études présentent des biais méthodologiques moyennement faibles ou faibles. D'autres études devront être menées afin d'évaluer l'efficacité de l'EM ou de l'EM+ dans la prévention secondaire et tertiaire de la CCA chez les jeunes contrevenenants et les contrevenants primaires et de corroborer les résultats préliminaires obtenus auprès des récidivistes et des patients en salle d'urgence. L'efficacité spécifique de l'EM devrait aussi être évaluée plus en détail, comparativement à l'EM+. Les essais avec répartition aléatoire devraient rapporter les éléments importants liés à la méthode employée de manière à permettre aux lecteurs d'évaluer les biais méthodologiques, comme suggéré par le *CONSORT Statement* (Altman et al., 2001; Moher et al., 2001).

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Contingency Management for DUI Offenders Using Transdermal Alcohol Sensors: A Pilot Randomised Controlled Study

Abridged title: Contingency management for DUI offenders

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Abstract

Introduction: Alcohol is associated with more than one-third of fatal crashes in North America. Some driving under the influence (DUI) offenders are sensitive to reward and at high risk for chronic excessive drinking. Contingency management (CM) is an effective intervention for reducing substance use that shapes behaviour through reward, but is untested in the DUI offender population. This randomised controlled trial hypothesized that DUI offenders assigned to CM would exhibit less drinking over time compared to those assigned to control conditions. In order to objectively measure and reward target behaviours, alcohol-monitoring ankle bracelets provided continuous data on transdermal alcohol concentration. Acceptability of transdermal alcohol-monitoring bracelets among DUI offenders was assessed using quantitative and qualitative methods. *Methods*: Thirty-seven males with one or more DUI convictions reporting problematic alcohol use in the last 6 months were randomised to one of three groups for 6 weeks: i) CM and bracelet; ii) non-contingent feedback and bracelet; iii) bracelet only. *Results*: A fixed effects model revealed no significant group x time interactions for either transdermal alcohol concentration or self-reported alcohol use. Significant reductions on weekly peak transdermal alcohol concentration were experienced by all groups over time ($p = 0.020$), but not on self-reported alcohol use. Quantitative and qualitative data regarding acceptability of the transdermal alcohol monitoring device indicated both advantages and disadvantages to using this device. *Conclusion*: The preferential efficacy of CM for reducing alcohol consumption among DUI offenders compared to the control procedures was not supported. More comprehensive appraisal of CM's benefits for the DUI population may require exploration of selective treatment responsivity in sub-groups of

offenders, such as those who are younger or more reward-sensitive. Measurement of transdermal alcohol concentration shows promise as a more sensitive measure of change in alcohol intake compared to self-report.

Key words: driving under the influence (DUI), crash prevention, alcohol, substance use disorder, contingency management, transdermal alcohol concentration.

1. Introduction

Globally, motor vehicle crashes are a leading cause of death (World Health Organization, 2010), with alcohol present in more than one-third of fatal crashes in North America (National Highway Traffic Safety Administration, 2016). Among all drivers, as blood alcohol concentration (BAC) increases, so too does the risk for fatal crash involvement (Hingson & Winter, 2003). Among drivers involved in a fatal crash in which alcohol was implicated, those with a BAC $\geq$ 0.15 have a greater likelihood of being identified by their social group as problem drinkers compared to drivers fatally-injured in non-alcohol related crashes (Hingson & Winter, 2003). Additionally, fatally-injured drivers in alcohol-involved crashes have a greater likelihood of having a prior conviction for driving under the influence (DUI[1]) compared to drivers fatally injured in crashes that did not involve alcohol (Hingson & Winter, 2003). Finally, drivers with prior DUI convictions are at greater risk of a subsequent conviction and involvement in a fatal crash compared to drivers without a history of convictions (Marowitz, 1998; Rauch et al., 2010; Simpson, Beirness, Robertson, Mayhew, & Hedlund, 2004). Hence, reducing the risk of impaired driving recidivism is the primary target of selective DUI prevention programs. Controlled studies supporting the efficacy of DUI interventions are sparse (Brown & Ouimet, 2013; Ouimet, Averill, & Brown, 2014), but the available evidence points to generally modest effects (Wells-Parker, Bangert-Drowns, McMillen, & Williams, 1995).

Interventions that are adapted to the specific attributes of the population they target

[1] The abbreviation DUI (driving under the influence) is used to describe the offense typically associated with drunk driving. Other jurisdictions may use alternative terms, such as DWI (driving while impaired; driving while intoxicated) or OUI (operating under the influence) to refer to comparable offenses.

hold promise for delivering better outcomes in DUI and criminal settings (Bonta & Andrews, 2007; Wells-Parker & Williams, 2002). The underpinnings of DUI behaviour are multifaceted. For a segment of the DUI population, DUI behaviour is symptomatic of an alcohol use disorder (Lapham, C'de Baca, McMillan, & Hunt, 2004), though not all DUI offenders are problem drinkers. Moreover, similar to groups suffering from other behavioural addictions (Bechara, Dolan, & Hindes, 2002), DUI offenders are prone to show heightened sensitivity to reward compared to non-offenders (Brown et al., 2016; Starkey & Isler, 2016). Hence, an intervention to reduce alcohol consumption that has proven benefits in individuals with these propensities could be an advantageous strategy for reducing recidivism.

Contingency management (CM) rewards individuals with substance use disorders for measurable improvements in substance use (e.g., via urinalysis) and treatment adherence. Rewards usually take the form of financial remuneration or vouchers redeemable for retail items. Several meta-analyses support CM's efficacy for reducing drug use (Benishek et al., 2014; Lussier, Heil, Mongeon, Badger, & Higgins, 2006), while individual studies have demonstrated CM's efficacy for reducing problematic alcohol consumption in alcohol-dependent patients, as signalled by negative breathalyser results (e.g. Petry, Martin, Cooney & Kranzler, 2000). In addition, a handful of studies have used contingency-based interventions akin to CM in risky driving contexts. For example, one investigation (Lange, Reed, Johnson, & Voas, 2006) found that young male designated drivers who were monetarily rewarded for safe driving were more likely to return sober from a Friday night social excursion compared to those who were not rewarded, but the follow-up period was markedly brief (≤ eight hours). A meta-analysis evaluating different types of incentive programs to reduce beltless driving (Hagenzieker, Bijleveld, & Davidse, 1997) generally supported their positive effect, with the

strongest effects achieved when rewards were administered closely in time with the targeted behaviour. While these results are promising for reducing risky driving behaviours, a challenge in orchestrating CM for problematic alcohol use in the DUI context is objectively and continuously monitoring recent alcohol consumption over time (i.e., several hours or days) to punctiliously link reward contingencies to targeted behaviour.

1.1 Transdermal detection of alcohol

Recent developments in technology for continuous monitoring of alcohol use are promising in this regard. Transdermal devices (e.g., monitoring bracelets) can monitor alcohol consumption by measuring transdermal alcohol concentration in evaporated perspiration. The main advantage of transdermal devices compared to other technologies for detecting alcohol consumption (e.g., breath BAC from a Breathalyzer®) is that it passively (i.e., without action from the wearer or another agent) and continuously gathers alcohol use data in real-time. Transdermal alcohol concentration and BAC from a Breathalyzer® are not equivalent measures, however. Transdermal alcohol concentration data lag behind breath acquired BAC data by approximately two hours, as alcohol takes more time to evaporate through skin than to be exhaled in breath (Hawthorne & Wojcik, 2006). Moreover, breath-acquired BAC generally peaks at higher relative levels than TAC, though both measures are highly correlated (Sakai, Mikulich-Gilbertson, Long, & Crowley, 2006). Hence, while not a complete replacement for breath-acquired BAC, devices for acquiring transdermal alcohol concentration are advantageous for CM's applicability as an intervention for curtailing alcohol use problems.

Preliminary results from research using CM in combination with transdermal devices for reducing problem alcohol consumption are encouraging. A pilot study in a sample of 13

heavy drinkers exposed to CM and transdermal monitoring observed reduced transdermal alcohol concentration and self-reported drinking over the two-week CM intervention period compared to the initial one-week non-intervention baseline period (Barnett, Tidey, Murphy, Swift, & Colby, 2011). The absence of a control group, however, precluded causal inferences. In another study (Dougherty et al., 2014), 26 community-recruited risky drinkers were randomly assigned to receive both CM and a control procedure in counterbalanced order. CM exposure in both groups resulted in less drinking compared to the control condition, but when received first, reduction in drinking was carried over to the control condition. In a follow-up study by the same research group (Dougherty et al., 2015), 82 non-treatment seeking heavy drinkers were submitted to a pre-post study involving a 4-week observation phase, a 12-week CM phase and a 12-week follow-up phase. Analysis of transdermal alcohol concentration data, categorized as no, low, moderate, and heavy drinking days, revealed a reduction in heavy drinking days and an increase in low to moderate drinking days during the CM phase.

Studies using CM in combination with transdermal monitoring in DUI offenders are sparse. Nevertheless, a report of a quasi-experimental study (Tisson, Nichols, Casanova-Powell, & Chaudhary, 2015) suggested that latency to recidivism in DUI offenders court-ordered to wear a transdermal monitoring device was longer compared to offenders who were not. The punishment contingencies related to violation of a parole condition involving abstinence (i.e., indicated by positive transdermal alcohol concentration) in this report significantly digresses from the remedial strategy combining CM with transdermal monitoring used in the studies described above. Nevertheless, it does hint at the possibility that alcohol monitoring alone could have effects on alcohol use without the added demands of a CM component. Overall, controlled trials are needed not only to evaluate the therapeutic effect of

CM combined with use of transdermal devices under conditions resembling those encountered in many DUI remedial programs, but also to disentangle the potential benefits of monitoring with transdermal devices alone.

The main goal of this pilot randomised controlled trial was to provide preliminary evidence for the effect of CM in combination with use of a transdermal device for reducing alcohol use in DUI offenders. We hypothesized that DUI offenders randomly assigned to a CM condition in combination with use of a transdermal device would show greater reduced drinking over a 6-week study period compared to offenders assigned to one of two control conditions: i) exposure to a device that provided daily feedback on alcohol use based upon transdermal alcohol concentration data, but with no exposure to CM; and ii) exposure to a transdermal device with neither daily feedback on alcohol use nor exposure to CM. Baseline alcohol use was measured using self-report questionnaires, while alcohol use after assignment to conditions was measured by both self-report questionnaires and transdermal alcohol concentration. Given the relative novelty of using transdermal devices in a DUI intervention context, acceptability of their use in DUI offenders was also addressed using quantitative and qualitative methods.

2. Materials and methods

2.1 Recruitment and participants

The study protocol was approved by the Sherbrooke Hospital Ethics Committee (*Comité d'éthique de la recherche en santé chez l'humain du Centre hospitalier universitaire de Sherbrooke*). Participants for this study were recruited via letters included in the

information packages sent to DUI offenders seeking re-licencing by Quebec's DUI risk assessment program (*Programme d'évaluation des conducteurs automobiles)* as well a newspaper advertisement and word of mouth. Individuals who indicated their willingness to be contacted were screened for inclusion by telephone. Study inclusion criteria were: i) male drivers above 18 years of age; ii) documented evidence of one or more DUI offences in the past 10 years; iii) problematic alcohol use in the last six months as indicated by a score of ≥8 on the Alcohol Use Diagnostic Identification Test (AUDIT; Babor, Higgins-Biddle, Saunders, & Monteiro, 2000); iv) a home telephone line or access to a residential phone line; and v) access to a computer, internet and email. Exclusion criteria were: i) reading skills of less than a sixth grade level; and on presentation to the experimental session: ii) a risk for withdrawal syndrome as indicated by the Clinical Institute Withdrawal Assessment for Alcohol protocol (Sullivan, Sykora, Schneiderman, Naranjo, & Sellers, 1989); or iii) positive BAC on a breath test. Males were recruited exclusively for this pilot study due to the added difficulty of recruiting female offenders, given their under-representation in the DUI population, i.e., proportion of less than ¼ to males (Armstrong, Watling, Watson, & Davey, 2014).

2.2 Study design

This randomised controlled trial assigned participants to one of three groups: 1) transdermal device + CM (CM); 2) transdermal device + feedback (FB); 3) transdermal device-only (B-CTL). Minimisation was used to determine treatment allocation (Altman & Bland, 2005). Minimisation ensured approximately equal number of participants per group and prevented imbalances in participant characteristics that could affect outcomes. Intake variables (participant age [18-35, 36-55, 56+], AUDIT score [8-11, 12-15, 16+] and number of

DUI convictions [1, 2+]) were entered as categorical data into the computer-assisted randomisation protocol to mitigate unbalanced assignment to groups.

2.3 Blinding and allocation concealment

Baseline assessments were completed with participants prior to randomisation, hence the research team members and participants were both blinded to group assignment at this time. Participants were informed that there were several groups in the study, but were not informed of the unique conditions involved, nor which one represented the experimental group. Participants were informed that they would receive instructions according to their group assignment on week 2 of the study. They were further informed of the different instructions (e.g., to abstain from drinking) and conditions (e.g., feedback about their drinking from transdermal device data) they could receive. A research team member not involved in either testing or communicating with participants conducted the randomisation procedure on Day 6 of the study. She revealed group assignment to another research team member tasked with forwarding messages to participants just prior to the first message. This latter team member did not participate in testing or data analysis. Another team member blind to group assignment conducted the baseline interview, reviewed the data on a daily basis, and provided the alcohol readings to the team member responsible for communicating with participants. Research assistants who were blind to group assignment administered the exit interview, while the team member who conducted the baseline interview debriefed participants. Data analysts were blind to group assignment until analyses testing the main hypotheses were completed.

2.4 Interventions

All participants continuously wore a transdermal alcohol detection ankle bracelet for the entire 6-week study period. During week 1, all participants were informed that they would receive $5 per day for wearing the bracelet. At the start of week 2, participants were sent a one-time email containing instructions for weeks 2 through 5 according to their group assignment. All participants were informed that they had an "at-risk" alcohol use profile and were advised to reduce their drinking. CM participants were informed that they would receive daily feedback regarding their drinking and that abstinence would be rewarded, with the value of rewards specified (see below). FB participants were informed that they would only receive feedback regarding their drinking during weeks 2 through 5. B-CTL participants would not receive either CM or feedback, but just wore the transdermal device. During weeks 2 through 5, participants' alcohol use data from the transdermal device, covering the 24-hour period beginning at 08:00 the previous day to 08:00 the following morning, was reviewed daily. Then, feedback was sent according to group assignment to FB and CM participants via email or text message (according to participant preference). At the start of week 6, all participants received an email reminding them of their second scheduled laboratory appointment and that they would receive $5 compensation per day during that period.

CM During weeks 2 through 5, participants received daily feedback on their alcohol consumption, specifically whether or not alcohol had been detected on the previous day. Criteria for alcohol consumption having occurred were: 1) three successive transdermal alcohol concentration readings of ≥ 0.02 on the ascending limb of a drinking episode; and 2) a confirmation from Alcohol Monitoring Systems, the company hosting the transdermal device

data, that a drinking episode had occurred based upon their proprietary algorithm. The message also contained information about participant study earnings to date. Participants earned increasing amounts of money for each day of abstinence from alcohol (e.g., Monday = $5, Tuesday = $6, Wednesday = $7, Thursday = $8, Friday = $9, Saturday = $10, Sunday = $11). If transdermal alcohol concentration data suggested drinking had occurred, participants retained their earnings to date, but were told that they would receive $0 for that day and the reinforcement amount was re-set to $5 for the following day. The amount was reset to $5 each Monday.

FB During weeks 2 through 5, participants received daily feedback regarding whether or not the bracelet had detected alcohol the previous day, based upon the criteria for alcohol consumption described above for the CM condition, and their earnings to date, which was fixed at $5 per day.

B-CTL At the start of week 2, participants were informed they would earn $5 per day during weeks 2 through 5 and would receive no other messages.

2.5 Measures

Sociodemographics A sociodemographic questionnaire was administered at baseline to gather information on age and DUI convictions for the purposes of randomisation. Data on education, income, and ethnicity were gathered for the purpose of sample description.

Transdermal alcohol use monitoring device The Secure Continuous Remote Alcohol Monitor ankle bracelet is a transdermal device that has been used and validated in other CM studies and is currently deployed in forensic DUI contexts. Denominalised data from the

bracelet were transmitted wirelessly via participants' home modem and viewable on a password-protected web site at Recovery Science Corporation, the Canadian Secure Continuous Remote Alcohol Monitoring distributor. The alcohol monitoring bracelet has three sensors to provide information at 30-minute intervals on: 1) evaporation of ethanol from the skin, resulting in an estimate of transdermal alcohol concentration; 2) user body temperature; and 3) infrared voltage that signals device removal. These data were accessible to the research team, Recovery Science Corporation, and Alcohol Monitoring Systems staff. Alcohol Monitoring Systems provided daily notifications regarding: 1) detection of alcohol consumption; 2) attempts to tamper with or remove the device; and 3) technical information about the device and modem, such as battery life. Outcome variables for statistical analysis were based upon a macro and criteria developed by another research group (Barnett, Souza, Rosen, Swift, & Glynn, 2015); drinking was deemed to have taken place if a minimum of one transdermal alcohol concentration reading at ≥ 0.02 was detected by the device with an absorption rate $< 0.05\%$ or elimination rates within the following range: $> 0.003\%$ to $< 0.025\%$ for a peak $\leq 0.15\%$ and $> 0.003\%$ to $< 0.035\%$ for a peak $> 0.15\%$. Outcome variables were: i) number of days per week on which alcohol use was detected (a drinking day was operationally defined as any day on which alcohol was detected using the above mentioned criteria); ii) number of drinking episodes per week (a drinking episode was operationally defined as drinking meeting the above mentioned criteria with the additional criteria that transdermal alcohol concentration return to ≤ 0.02 before another drinking episode could be counted); iii) average transdermal alcohol concentration per week (operationally defined as the mean of all transdermal alcohol concentration measures for a given week); and iv) peak transdermal alcohol concentration per week for alcohol use episodes (operationally

defined as the highest transdermal alcohol concentration reached in a given week).

Self-reported alcohol use Number of risky drinking days and percentage of risky drinking days were gathered using a computer-assisted version of the Timeline Followback (TLFB) (Sobell, Sobell, Connors, & Agrawal, 2003). Alcohol use at baseline during the previous 42 days and at study's end during the 6-week study period was recorded. As the consumption of 20 to 40 grams of alcohol per day (or the equivalent of 1.5 to 3 standard drinks) has been associated with an increased risk of DUI crashes (Dawson, Grant, & Li, 2005), 3 standard drinks per day (≥ 42g of alcohol) was used as the cut-off indicating a risky drinking day. The AUDIT screened participants for alcohol use problems in the preceding six months for study inclusion. This 10-item questionnaire is widely used in alcohol use research and health settings and has been validated in numerous countries. For descriptive purposes, the Readiness to Change Questionnaire (Rollnick, Heather, Gold, & Hall, 1992) was administered at baseline to classify respondents into one of three categories (pre-contemplation, contemplation and action) according to their motivation to alter alcohol use.

Acceptability of transdermal device At study termination, five questions using a five-point Likert scale from "strongly agree" to "strongly disagree" probed participants' perceptions concerning the transdermal device's precision, convenience, attractiveness, comfort, and the reactions of others to their wearing of the device. Responses are reported as percentages who agreed or strongly agreed with the statement. In addition, open questions queried participants about the advantages and disadvantages associated with their participation in the study, and the perceptions of their entourage with regards to the bracelet. Responses were then coded. Initial qualitative thematic analysis was conducted on responses to the open-

ended questions about the bracelet's advantages/disadvantages by two coders, with these results validated by a second analysis by two other coders, who also reconciled differences by consensus. (The scoring grid utilised by the team can be found in Annex III.)

2.6 Procedures

A telephone-screening interview was used to determine if participants met study eligibility criteria. After receiving informed consent, participants submitted to a breath test using the Alco-Sensor IV (Intoxicometer Inc.), and then completed the Clinical Institute Withdrawal Assessment for Alcohol with a trained nurse. At baseline, participants were administered sociodemographic, Readiness to Change Questionnaire and TLFB questionnaires. The bracelet was also installed. After wearing the bracelet and following the instructions for their respective group for 6 weeks, participants returned to the study site to remove their bracelet, complete the TLFB and the questionnaire assessing the acceptability of the transdermal device, and receive compensation for participation. All participants received $60 per visit to the lab at the beginning and end of the study, $35 for participation during both the first and last week of the study, and $56 per week while involved in the four-week intervention period. While those in the contingency group could earn more money than the two other groups during the trial, all participants who completed the study were ultimately compensated equally. Participants leaving prior to the study's end were compensated according to the number of days of study participation.

2.8 Data analyses

A basic power calculation using G-Power (version 3.1) was conducted and determined

that 36 participants were required for this pilot study (12 participants per group) in order to enable power calculation for larger randomised controlled trials.

Fixed effects modelling for repeated, non-normally distributed measures was used to examine the efficacy of intervention condition (group) and time on main outcomes, i.e., number of days on which alcohol was detected per week, number of drinking episodes per week, average weekly transdermal alcohol concentration, peak transdermal alcohol concentration per week, and self-report alcohol consumption (number of risky drinking days and percentage risky drinking days). An intent-to-treat approach was used to deal with missing data when participants dropped out of the study after randomisation. In these cases, the last day of available data was repeated and carried through for all remaining days in the study. Statistical Analysis System v. 9.3 was used for these analyses.

3. Results

3.1 Sample description and participants' characteristics

Figure 1 illustrates participant flow-through from recruitment to randomisation and attrition. A total of 214 study candidates were interviewed for participation. Of these, 89 were non-eligible: 3 did not meet criteria for DUI offences in the last 10 years; 65 had an AUDIT score below 8; 18 did not have access to a residential phone; 3 had French reading skills at less than a sixth grade level. Sixty candidates declined to participate for various reasons, including lack of interest in the study, scheduling issues, distance from home to study site, and health reasons. The initial phone interview included questions on demographic information, access to equipment (i.e., home phone line, internet and email), DUI convictions, past 6-months alcohol

use, and health questions but most participants who declined to participate did so before we had access to this information. We were able to establish that six of them met study eligibility criteria and the remainder did not provide sufficient information in order to assess their eligibility. In terms of the study features, five candidates did not want to wear the bracelet, three reported that compensation was too low and one reported that the study was too long. Another 24 were contacted but were lost prior to screening or baseline assessment, leaving 41 participants. Four of these dropped out prior to being randomised. Of the 37 participants randomised, 4 were lost to attrition: 2 because the bracelet interfered with their daily activities, 1 due to illness, and 1 due to an allergy to rubber in the bracelet strap. Table 1 presents the demographic characteristics of participants by group compared to the total sample (N = 37), including dropouts. Analyses showed that the sample was mostly Caucasian and approximately forty years of age, had post-high school education, an income less than $30,000 per year, an average of one conviction in the past 10 years, and AUDIT scores above 15, and over half were in the action stage of change on the Readiness to Change Questionnaire.

Figure 1. Flow of study recruitment and participant retention

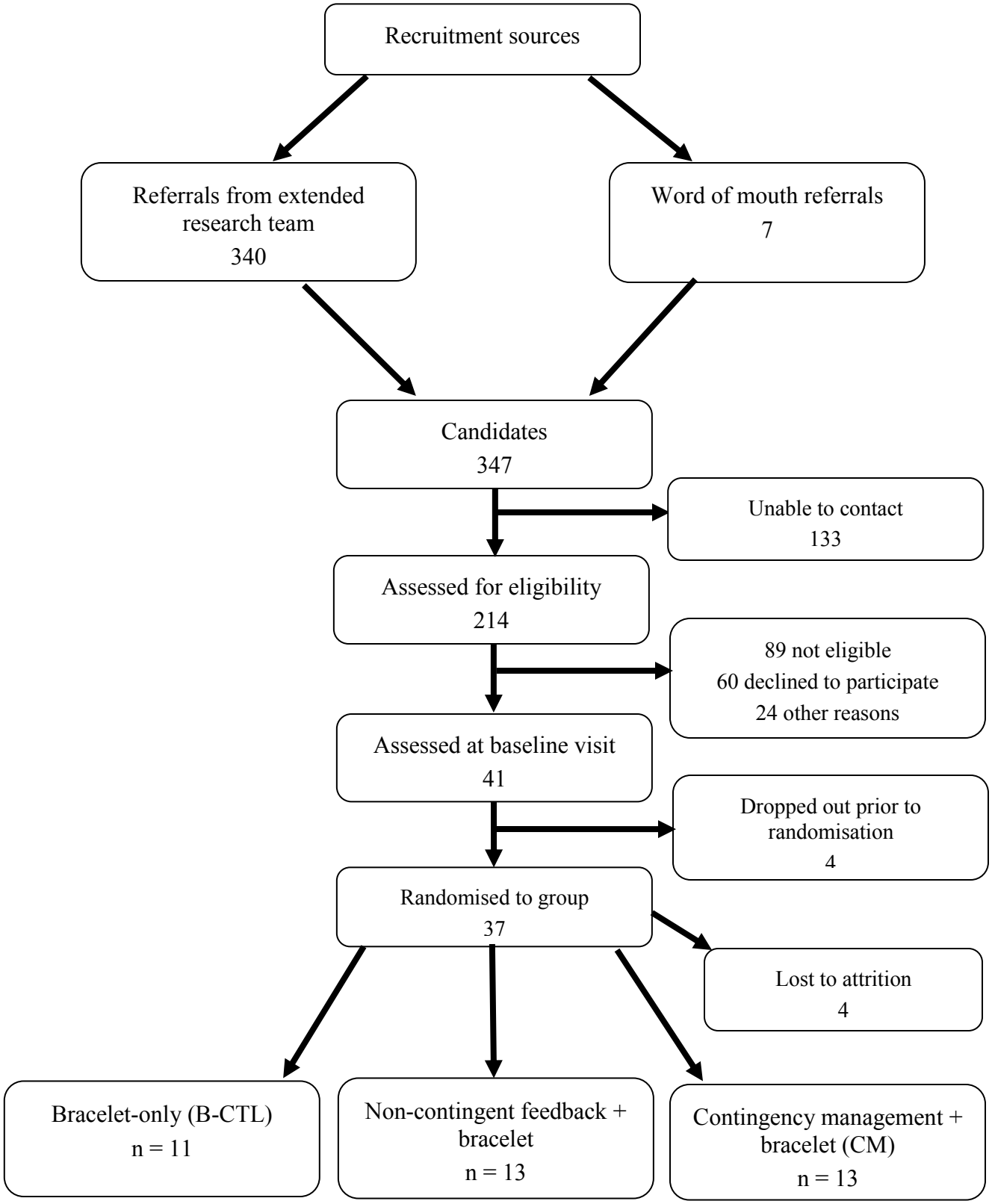

Table 1. Demographic and DUI conviction characteristics of groups at baseline

Variables	Group						Total (N=37)	
	B-CTL (n=11)		FB (n=13)		CM (n=13)			
	Mean (or %)	SD	Mean (or %)	SD	Mean (or %)	SD	Mean (or %)	SD
Stratification factors								
Age	38.91	18.32	40.46	16.13	42.00	14.58	40.54	15.88
Past DUI convictions	1.27	0.47	1.15	0.38	1.23	0.44	1.22	0.42
AUDIT score	14.27	6.96	16.46	7.32	17.23	6.88	16.08	6.97
Other characteristics								
Post high school education	(63.64)		(61.54)		(61.54)		(62.16)	
Income[a] (below $30,000)	(81.80)		(76.90)		(69.2)		(75.70)	
Ethnicity (Caucasian)	(81.82)		(92.31)		(84.62)		(86.49)	
Action stage of readiness to change	(63.64)		(53.85)		(53.85)		(56.76)	

Note. Income[a]: Mean income in Quebec from 2006 Canada Census was $32,074. AUDIT: Alcohol Use Disorders Identification Test; B-CTL: transdermal device-only; CM: transdermal device + contingency management; DUI: Driving Under the Influence of alcohol; FB: transdermal device + feedback; SD: standard deviation.

3.2 Main outcomes

A Wald test was performed on all residual covariance matrices and in all cases, $p < 0.001$, indicating that a first-order autoregressive structure (AR1) was the best fit for the data. Table 2 summarizes objective drinking outcome variables derived from transdermal measures. A significant time effect in peak transdermal alcohol concentration per week ($p = 0.020$) was detected, with a significant decrease between weeks 1 and 6 (week 1, M = 0.15, SE = 0.02 vs. week 6, M = 0.09, SE = 0.02; $p = 0.005$) and a trend for decrease between the mean of weeks 2-5 and week 6 (weeks 2-5 M = 0.13, SE = 0.02 vs. week 6 M = 0.09, SE =

0.02; p = 0.062). No significant time effects were detected on the number of days per week on which alcohol use was detected, the number of drinking episodes per week and the average weekly transdermal alcohol concentration. No significant between-group differences were revealed on any dependent variables. The model revealed no significant group by time interactions for the number of days per week on which alcohol use was detected (p = 0.764), the number of drinking episodes (p = 0.276), average weekly transdermal alcohol concentration (p = 0.277) or peak transdermal alcohol concentration per week (p = 0.285).

Table 2. Means, standard errors (SE), and 95% confidence intervals (95% CI) of objectively measured alcohol use by group and time.

	Time											
	Week 1						Weeks 2-5					
	B-CTL		FB		CM		B-CTL		FB		CM	
Variables	Mean (SE)	95% CI	Mean (SE)	95% CI	Mean (SE)	95% CI	Mean (SE)	95% CI	Mean (SE)	95% CI	Mean (SE)	95% CI
Number of days per week on which alcohol was detected	3.18 (0.66)	1.85 – 4.50	2.46 (0.61)	1.25 – 3.68	2.54 (0.61)	1.32 – 3.75	2.86 (0.66)	1.54 – 4.19	2.19 (0.61)	0.97 – 3.41	2.54 (0.61)	1.32 – 3.75
Drinking episodes per week	2.09 (0.65)	0.78 – 3.40	2.61 (0.60)	1.41 – 3.82	2.15 (0.60)	0.95 – 3.36	2.73 (0.65)	1.42 – 4.03	1.87 (0.60)	0.66 – 3.07	2.15 (0.60)	0.95 – 3.36
Average weekly transdermal alcohol concentration	0.01 (0.00)	0.00 – 0.02	0.01 (0.00)	0.00 – 0.02	0.01 (0.00)	0.00 – 0.02	0.01 (0.00)	0.00 – 0.02	0.01 (0.00)	0.00 – 0.02	0.01 (0.00)	0.00 – 0.01
Peak weekly transdermal alcohol concentration	0.18 (0.03)	0.12 – 0.24	0.12 (0.03)	0.07 – 0.18	0.16 (0.03)	0.11 – 0.22	0.11 (0.03)	0.05 – 0.16	0.14 (0.03)	0.08 – 0.19	0.13 (0.03)	0.08 – 0.18

Note. B-CTL: transdermal device-only; CI: confidence interval; CM: Transdermal device + contingency management; DUI: Driving Under the Influence of alcohol; FB: transdermal device + feedback (FB); SE: standard error.

Table 2 continued. Means, standard errors (SE), and 95% confidence intervals (95% CI) of objectively measured alcohol use by group and time.

	Time					
	Week 6					
	B-CTL		FB		CM	
Variables	Mean (SE)	95% CI	Mean (SE)	95% CI	Mean (SE)	95% CI
Number of days per week on which alcohol was detected	3.09 (0.66)	1.77 – 4.41	1.62 (0.61)	0.40 – 2.83	2.62 (0.61)	1.40 – 3.83
Drinking episodes per week	2.90 (0.65)	1.60 – 4.22	1.38 (0.60)	0.18 – 2.59	1.92 (0.60)	0.72 – 3.12
Average weekly transdermal alcohol concentration	0.01 (0.00)	0.00 – 0.01	0.00 (0.00)	0.00 – 0.01	0.01 (0.00)	0.00 – 0.02
Peak weekly transdermal alcohol concentration	0.06 (0.03)	0.00 – 0.12	0.10 (0.03)	0.04 – 0.16	0.11 (0.03)	0.06 – 0.16

Note. B-CTL: transdermal device-only; CI: confidence interval; CM: Transdermal device + contingency management; DUI: Driving Under the Influence of alcohol; FB: transdermal device + feedback (FB); SE: standard error.

Results for self-reported drinking variables indicated no significant time effect differences in the number of risky drinking days or the percentage of risky drinking days 6 weeks prior to study entry and during the 6-week study period. No significant between-group differences were detected on the number of drinking days or percentage of risky drinking days either at baseline or 6-week study follow-up. No significant group by time interactions were detected for the number of self-reported risky drinking days ($p = 0.163$) or the percentage of risky drinking days ($p = 0.374$).

Acceptability Participants' responses to the questionnaire regarding the transdermal device for measuring alcohol use indicated that 92.7% agreed or strongly agreed with the precision of the bracelet. Qualitative analyses revealed that the most common personal advantage reported by participants was that the device helped them to reduce their alcohol consumption and/or led to a better understanding of their alcohol consumption. Benefits for others, i.e., science, other offenders, and people suffering from alcohol use disorder were also

noted.

Three types of disadvantages were reported in relation to the device: interference with normal activities (i.e., water activities, sports, sleeping, working), characteristics of the bracelet, and social reactions. Quantitative analyses indicated that 12.2% reported that the bracelet interfered with their daily activities. During the open-ended question, however, many participants reported some issues with daily activities. The most common interference with normal activities was the lack of ability to immerse the bracelet in water, which interfered with bathing and swimming. Other sports were mentioned, mostly playing hockey, during which some felt the bracelet interfered with blood circulation and increased the risk of injury (e.g., a fall while playing). Trauma to the ankle while running was also reported. Some issues with sleeping, sleeping positions, getting tangled up with sheets and covers, or vibration while trying to sleep were reported. The necessity to wear construction boots at work was reported and resulted in one dropout because of important discomfort or lack of ability to properly close the working boots.

In terms of the characteristics of the bracelet, quantitative probing indicated that 19.5% agreed or strongly agreed that the bracelet was attractive and 41.5% that it was comfortable. During the open-ended question about disadvantages, the most common comments were related to the bracelet size, its vibration (mostly because of awkward moments, such as during an exam, or an interview), itchiness and skin irritations, including an allergy to rubber that forced one participant to drop out of the study. The rubber, plastic, rigidity, non-extensible material, and the inability to take off the bracelet for a few minutes every day were also among its disadvantages. The lack of comfort was mainly mentioned at the beginning of the study and

at specific moments. Some technological problems were also noted. Most comments were related to the lack of access to a home phone line for data transfer, which necessitated a visit to family or neighbours. As access to a phone line was an inclusion criteria, those who could not be accommodated by others were excluded from the study. Comments were also related to the device occasionally interrupting phone calls when connecting with the company for a data transfer.

Regarding social reactions to the device, 63.4% reported in the quantitative questionnaire that that they agreed or strongly agreed that family, friends, colleagues and others reacted positively to the device. Most participants reported that it elicited curiosity from others (mostly family and friends, less with strangers), or positive feedback when others learned of their participation in a study for a good cause, such as the advancement of science, rehabilitation, or drinking cessation. The most frequent comments the device elicited from others, often in jest, involved being under surveillance or house arrest, coming out of jail or being a criminal, or that the device was a GPS or pedometer. A minority of the participants reported feeling negatively judged by others, mostly by the facial expressions of strangers. It is worth noting that the possibility of hiding the bracelet underneath pants and showing it only to selected people was appreciated and used by almost all participants. Some mentioned not wearing shorts on hot days to avoid showing the bracelet and that shorts attracted the attention of others to the bracelet and generated questions. We abandoned recruitment in the summer months because of the difficulty of recruiting and recruited mainly from September to the end of May. This situation might have affected the rather low report of interactions with strangers.

4. Discussion

The present study investigated whether the addition of CM to two control conditions would be more effective in reducing alcohol consumption. Results from analysis of transdermal alcohol concentration and self-reported drinking failed to support this hypothesis. In contrast, significant decreases over time on peak transdermal alcohol concentration per week were found in all groups. Specifically, while participants did not alter their overall frequency of drinking days, they consumed less alcohol when they did drink in week 6 compared to week 1. One interpretation of the present findings is that all conditions in this study were active and comparably effective in reducing alcohol use. This suggests that simply monitoring DUI offenders can have significant benefits for reducing one facet of alcohol use, namely peak alcohol intake. Given the direct relationship between BAC and injury risk generally (Taylor & Rehm, 2012), it is plausible to infer that decreasing peak alcohol intake would also mitigate crash risk. At the same time, in the absence of a no-intervention group, alternative hypotheses are possible. The majority of participants appeared to be in a heightened state of readiness to change alcohol use, as suggested by their categorization in the action stage on the Readiness to Change Questionnaire. Hence, these participants may have self-selected into the study in order to augment a pre-existing intention to reduce their drinking, a phenomenon akin to the natural recovery process frequently observed prior to entry into intervention studies (Worden, Epstein, & McCrady, 2015).

The lack of support for the advantage of CM exposure over and above monitoring alcohol use with a transdermal device in this study, at least in our hands, is at odds with a recent randomised controlled trial (Dougherty et al., 2014) indicating the advantage of CM in

a young community-recruited cohort of heavy drinkers (mean age = 28.5 years, range of 21-39 years). It is possible that the small sample recruited for this pilot study limited the statistical power of analyses to detect interaction effects. Another intriguing possibility relates to sample differences in age between the two studies. In previous work with DUI offenders, we found that two forms of brief intervention were selectively effective in younger drivers compared to older drivers (i.e., < 43 years of age) in reducing alcohol use (Brown et al., 2012) and in increasing latency to re-arrest for risky driving (Ouimet et al., 2013). Though we did not have the sample size to adequately test this hypothesis here, it is conceivable that the impact of CM is more marked in younger individuals like those sampled by Dougherty et al. (2014), possibly through the greater reward sensitivity observed in younger individuals (Steinberg, 2008). In sum, future studies testing CM's effectiveness in DUI samples should account for potential age interactions, an analysis that would also address the specificity hypothesis common to forensic (Bonta & Andrews, 2007), alcohol (Kranzler & McKay, 2012) and traffic safety fields (Ball, Jaffe, Crouse-Artus, Rounsaville, & O'Malley, 2000; Wells-Parker & Williams, 2002): namely, that interventions to mitigate refractory behavioural disorders and criminal behaviour show better outcomes if they respond to the unique characteristics of their recipients.

Acceptability of transdermal device monitoring This study afforded us a preliminary opportunity to access perceptions of participants with respect to the transdermal alcohol monitoring technology used here as an intervention tool. Most notably, the perception that the device was precise in detecting alcohol use and acceptable to friends, family members and colleagues was almost unanimous. In particular, the acceptability of an intervention by an individual's entourage is an important correlate of enhanced compliance (DiMatteo, 2004). In contrast, a majority found the device to be uncomfortable, mostly at the beginning of the study

and at specific moments. Indeed, some attrition from this study could be attributed to the device, with one case due to an apparent medical contraindication (i.e., allergy to the rubber bracelet). Also, some candidates reported the bracelet as their main reasons for refusing participation. In sum, the device provides researchers and clinicians with objective and timely reports on alcohol use, thereby overcoming a concern for CM's applicability for alcohol use problems in the DUI context. On the other hand, given the well-established relationships between factors such as convenience, comfort and side effects in compliance to treatment (Griffith, 1990; Sergl, Klages, & Zentner, 1998), the intrusiveness of transdermal devices poses a non-negligible challenge to its voluntary deployment in future research and practice. Additional research is clearly needed to more thoroughly appraise the impact of this factor on outcomes when evaluating interventions that deploy transdermal devices in real world DUI settings.

4.1 Strengths and limitations

Notable strengths of the present study include randomisation to groups, the use of two distinct control conditions, blinding, intent-to-treat analysis, objective monitoring of alcohol consumption in addition to self-report, and collection of both quantitative and qualitative information of bracelet device acceptability. Additionally, the use of transdermal alcohol monitoring technology in conjunction with CM offered several benefits for the delivery of *bona fide* CM, including: i) relatively brief delay between the performance of the target behaviour and reinforcement[2]; ii) objective evidence of target behaviour; and iii)

[2] Note that in a CM protocol, reinforcement should be provided as soon as possible following performance of the target behaviour. In an ideal situation, a participant might be rewarded every few hours for complying with a target behaviour but this scenario is also difficult to implement on a practical level. This study utilized a procedure similar to other studies of CM targeting alcohol use (Barnett et al., 2011; Dougherty et al., 2014;

reinforcement reliably applied when the target behaviour was manifested.

This pilot study also possessed several important limitations. One was its modest sample size, which reduced the sensitivity of analyses for subtle effects. As well, participants self-referred to the study by responding to an invitation to participate in research studies on DUI and received financial compensation. Thus, the findings may not generalize to offenders who are court-mandated to wear the device (e.g., as in Tison, Nichols, Casanova-Powell, & Chaudhary, 2015) or in order to re-acquire their license. Second, this study utilized abstinence from alcohol as the target behaviour. This target might not necessarily be realistic for individuals with an alcohol use disorder, with failure to achieve the target potentially being demotivating for some, thereby encouraging a return to usual drinking behaviour. However, abstinence is the target behaviour most commonly employed in CM studies (e.g., Barnett et al., 2011; Dougherty et al., 2014; Petry, Martin, Cooney, & Kranzler, 2000) for alcohol. Given that this study tested CM in a new population, we elected to follow methods from previous studies. As part of a therapeutic program, however, if CM was used in combination with an alcohol monitoring ankle device, it would be possible to set targets in line with what might be more realistically achievable on an individual basis. Third, this 6-week pilot study targeted reduction in alcohol consumption rather than DUI recidivism as a main outcome variable. Studies on recidivism usually include a longer follow-up period and use recidivism as reported in driving records as the main outcome. For example, other interventions targeting alcohol reduction among DUI offenders, such as studies on motivational interviewing, showed that in addition to reduced alcohol use, offenders receiving the intervention also had a reduced risk

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Dougherty et al., 2015; Petry et al., 2000), where the reward period ranged from one day to one week. The design of our study is closer to that of Barnett et al. (2011) where reinforcement was provided as soon as possible on a practical level.

for recidivism on a validated instrument measuring alcohol problems (Brown et al., 2010) and younger offenders had a longer time to re-arrest for subsequent DUIs and other traffic violations at 5-year follow-up (Ouimet et al., 2013). In the current study, participants gave permission for the research team to access their driving records via the *Société de l'assurance automobile du Québec* (the province's licensing and insurance bureau) for a period of 10 years. Effects of the contingency management intervention on recidivism could then be explored in the future. Fourth, as only males were included in the current study, results may not generalize to female DUI offenders. A larger follow-up trial of CM with DUI offenders should include females, who are a growing at-risk subgroup (Robertson, Holmes, & Marcoux, 2013). Finally, the six-week follow-up period of this study was relatively short and may have failed to detect differential carry-over effects on alcohol consumption from any of the interventions. Future studies should implement a longer follow-up period during and after bracelet removal.

5. Conclusion

This pilot randomised controlled trial represents the first attempt to systematically examine the effect of a contingency management intervention on reducing risky drinking behaviour in the DUI population. While support for the benefits of CM over and above the control interventions for reducing alcohol use is inconclusive, the results warrant further investigation. At the same time, preliminary results regarding the acceptability of transdermal alcohol monitoring bracelets as an adjunct to CM in this context, while promising, also warrant more systematic investigation.

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Carry-over Effects on Drug Use of Two Brief Interventions for Alcohol Use Problems Among DUI Offenders[☆,☆☆]

Abridged title: Carry-over effects on drug use of alcohol use interventions for DUI offenders

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Abstract

Background: Driving under the influence of alcohol (DUI) and driving under the influence of drugs (DUID) pose significant challenges to road safety worldwide and alcohol and drugs are often consumed together. While some DUI offenders with problematic alcohol use may also have drug use disorders, drug problems may not always be addressed in evaluation programs leading to relicensing, and may become important factors in recidivism. In order to provide effective treatment for DUI offenders, it is important to know whether interventions targeting alcohol use have carry-over effects on drug usage. The goal of this study is to examine whether alcohol-based interventions for DUI offenders have carry-over effects on drug use. *Methods:* Secondary analyses were conducted on two previous randomised controlled trials evaluating brief motivational interviewing (BMI; N = 184; Brown et al., 2010) and contingency management (CM; N = 37; Averill et al., 2017). Main outcomes were percentage days (BMI) or change in percentage days (CM) of self-reported cannabis and cocaine use and likelihood of positive urine drug screens for both drugs (BMI). Subgroups analyses on age and severity of drug use were also conducted. Fixed effects models and ANOVA was used to analyse self-reported drug use data and objective drug use data was analysed with logistic regression. *Results:* Neither BMI or CM data showed significant main effects of group (BMI; CM) or time (BMI). There were also no significant interactions for self-reported drug use and for objectively measured drug use in the BMI study. Subgroup analyses in the BMI study did not reveal any significant main or interaction effects for self-reported and objectively measured drug use. *Conclusions:* Results from the current study suggest that interventions

specifically focused on drug use may be required for some DUI offenders as carry-over effects from alcohol-focused interventions were not supported by this study.

Key words: driving under the influence of alcohol, driving under the influence of drugs, motivational interviewing, contingency management, carry-over effects, risk prevention.

1. Introduction

As a major contributor to deaths worldwide, road traffic crashes are a significant public safety concern (World Health Organization, 2015). In North America, driving under the influence of alcohol (DUI) is implicated in more than one-third of fatal road traffic crashes (National Highway Traffic Safety Administration, 2015; Transport Canada, 2011). While alcohol remains the most widely consumed psychoactive substance associated with road traffic crashes (Brown, Vanlaar, & Robertson, 2015), driving under the influence of drugs (DUID) is also an important public safety issue. Unlike alcohol, however, the presence of drug metabolites in the blood stream is not necessarily indicative of recent usage. Nevertheless, it is worth noting that 40% of drivers killed in road traffic crashes in Canada in 2012 were found to have legal or illegal drugs in their systems (Brown et al., 2015). More specifically, a large scale Canadian study found that among 5,929 drivers who perished in road traffic crashes and were tested for alcohol and drugs, 21.9% tested positive for alcohol alone, 18.5% tested positive for drugs alone, and 14.2% tested positive for both alcohol and drugs (Beasley, Beirness, & Porath-Waller, 2011). Road-side surveys of drivers in Quebec and British Columbia reported that cannabis and cocaine were the most commonly detected illicit drugs among drivers (Beirness & Beasley, 2010; Brault, Dussault, Bouchard, & Lemire, 2004). Additionally, while some studies have found no significant difference in crash risk among fatally injured drivers when only alcohol is present versus when both alcohol and drugs are present (Compton & Berning, 2015), a review of the literature reported that some drugs and the combination of alcohol and certain drugs, when recently consumed in a laboratory setting, results in decreased driving performance (Ramaekers, Berghaus, van Laar, & Drummer, 2004).

DUID may therefore be associated with increase crash odds when drugs are consumed in combination with alcohol.

The motivation for DUI and DUID appears multi-factorial. For some offenders, an alcohol use disorder or a drug use disorder can underlie the risky behaviour of DUI or DUID (Lapham, C'De Baca, McMillan, & Hunt, 2004; Lapham, Stout, Laxton, & Skipper, 2011). For other offenders, however, a propensity toward risk-taking behaviour in general, alone or in combination with a substance use disorder, may be an important factor in engaging in impaired driving. For example, research shows that DUI recidivists are more likely to have polysubstance use problems (McCutcheon et al., 2009). Additionally, a study by Brown et al. (2016) found that DUI offenders with one or more DUI convictions and one or more other traffic violations over a 10 year period were more likely to have drug use problems compared to a group of DUI only offenders. However, though population surveys suggest that up to 30% of drivers self-report engaging in DUID, the difficulty of enforcing drug driving laws mean that arrests and convictions for DUI are more common than for DUID (World Health Organization, 2016). Additionally, while relicensing programs in North America address alcohol use disorders and may also include recommendations for other substance use disorder treatment, DUI offenders often do not benefit from these interventions as they tend to delay completing the required stages in the lengthy process of re-obtaining their driving license (Voas, Tippetts, & McKnight, 2010). Moreover, education programs associated with the relicensing process are more likely to focus on alcohol-impaired driving than drug-impaired driving (Maxwell, Freeman, & Davey, 2009). It is unknown in the DUI offender population, where polysubstance use problems are frequent, whether these interventions, when applied to targeting alcohol use only, may have carry-over effects on reducing drug use. This study seeks

to examine whether carry-over effects may occur in the DUI offender population for two interventions: i) a brief adapted form of Motivational Interviewing (BMI); and ii) contingency management (CM).

1.1 Motivational Interviewing

MI is a client-centered counselling style that addresses ambivalence about modifying problematic behaviour and attempts to simultaneously increase intrinsic motivation to change (Miller & Rollnick, 2002). MI has been shown to be efficacious in reducing both problematic alcohol and drug use in substance abusing populations in diverse settings, including emergency rooms and outpatient treatment programs (Burke, Arkowitz, & Menchola, 2003; Hettema, Steele, & Miller, 2005; Lundahl, Kunz, Brownell, Tollefson, & Burke, 2010; Smedslund et al., 2011; Vasilaki, Hosier, & Cox, 2006).

Efficacy for MI has also been shown in the DUI offender population. A systematic review on the effects of MI on alcohol and driving-related outcomes showed that its effects appear most promising in recidivists and individuals with alcohol problems or recent alcohol consumption who were recruited in emergency room settings following involvement in traffic crashes (Ouimet, Averill, & Brown, 2014). Additionally, researchers have reported positive effects following exposure to MI, including: lower percentage of risky drinking days (Brown et al., 2010; Woodall, Delaney, Kunitz, Westerberg, & Zhao, 2007); increased coping skills for relapse prevention (Stein & Lebeau-Craven, 2002); and fewer traffic violations, including DUI convictions, at 5-year follow-up amongst younger recidivist offenders (Ouimet et al., 2013).

Though studies are few in number, MI applied to reduce drinking has been shown to have mixed results on carry-over effects on other substance use. When alcohol use has been

the primary target of intervention, some studies have found a concomitant decrease in polysubstance use among college students (Kazemi et al., 2011) and young adults admitted to hospital emergency (Magill, Barnett, Apodaca, Rohsenow, & Monti, 2009). A meta-analysis examining carry-over effects of MI for alcohol use problems on smoking, however, failed to find any significant effects (McCambridge & Jenkins, 2008). Finally, a study by Grossbard et al. (2010) reported that college students receiving either a BMI or control intervention increased marijuana use at follow-up. In the DUI offender population, however, no published studies to date report examining carry-over effects on drug use for MI interventions targeting alcohol use problems.

1.2 Contingency Management

CM is an intervention that provides rewards (typically vouchers or financial remuneration) upon demonstration of measurable decreases in substance use. Efficacy of CM for alcohol use problems has been demonstrated by several studies (Barnett, Tidey, Murphy, Swift, & Colby, 2011; Dougherty et al., 2014; Dougherty et al., 2015; Dougherty et al., 2015a; Petry, Martin, Cooney, & Kranzler, 2000). Meta-analyses have also found CM to be effective in reducing drug consumption and poly-substance consumption (Benishek et al., 2014; Dutra et al., 2008; Lussier, Heil, Mongeon, Badger, & Higgins, 2006; Prendergast, Podus, Finney, Greenwell, & Roll, 2006). Studies on reinforcement-based interventions in the DUI population are limited, with one study demonstrating increased compliance with treatment attendance (Ersner-Herschfield, Connors, & Maisto, 1981) and one study finding no significant effect of CM compared to control conditions on reducing alcohol consumption (Averill et al., 2017). To our knowledge, no studies to date have investigated whether or not CM for alcohol use

problems may have carry-over effects on drug use, either in the general population or amongst DUI offenders.

The current study presents secondary analyses on the carry-over effects on drug use of two previous randomised controlled trials (RCT) targeting alcohol use problems in DUI offenders: Study 1 (BMI; Brown et al. 2010) and Study 2 (CM; Averill et al. 2017). In Study 1 participants received either BMI or an information and advice focused control intervention (CTL). In Study 2 participants received either CM, non-contingent feedback on alcohol use (FB), or monitoring of alcohol use only (B-CTL). In the current study, the following hypotheses were tested. Compared to control condition(s): 1) one 30-minute BMI intervention delivered at baseline (T0) would decrease subjective and objective reports of cannabis and cocaine use at 6-month (T1) and 12-month (T2) follow-ups; 2) a CM intervention would decrease subjective reports of cannabis and cocaine use by the end of the 6-week study period (T1) compared to the 6-week period prior to study entry (T0). Due to greater sample size in Study 1, in contrast to Study 2, it was also possible to examine results by subgroups. Specifically, the effect of age group and problematic drug use were examined.

2. Materials and Methods

Complete details regarding recruitment and participants, inclusion and exclusion criteria, study design, blinding, interventions, procedures, and attrition can be found in the initial studies (Averill et al., 2017; Brown et al., 2010). A comparison of materials and methods between the two studies can be found in Table 1.

2.1 Participants, Recruitment, Study Design, and Interventions

2.1.1 Study 1: Brief Motivational Interviewing Study

Participants in Study 1 (Brown et al., 2010) were mostly males with two or more DUI convictions in the past 15 years who had delayed their participation in DUI relicensing programs and exhibited problematic drinking as indicated by a score of 8 or more during screening with the Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Babor, De La Fuente, & Grant, 1993). Participants were recruited using three strategies: i) letters offering the possibility to participate in research studies sent to DUI recidivists by Quebec's relicensing evaluation program *(Programme d'évaluation des conducteurs automobiles)* along with the organization's standard information package; ii) newspaper advertisements; iii) word of mouth. Individuals interested in participating in research studies contacted the research center by telephone to receive further information about the study and for screening. The study site was the Addiction Research Program of the Douglas Mental Health University Institute, a McGill University-affiliated research facility in Montreal, Quebec, Canada. The Douglas Hospital Ethics Committee approved the study protocol. Data collection took place between July 2005 and January 2007.

Study 1 utilized a RCT design with participants randomly assigned to receive either a manualized 30-minute BMI intervention or a 30-minute information/advice control (CTL) intervention. BMI consisted of techniques adapted from MI (Miller & Rollnick, 2002). In the CTL intervention, scripted information was given orally to participants regarding DUI and treatment services for alcohol use problems. Treatment fidelity for both interventions was ensured by an experienced MI therapist using the Motivational Interviewing Treatment Integrity Coding protocol (MITI version 2; Moyers, Martin, Manuel, Hendrickson, & Miller,

2005).

2.1.2 Study 2: Contingency Management Study

Participants in Study 2 (Averill et al., 2017) were males with one or more DUI convictions in the past 10 years who displayed alcohol problems in the last six months as indicated by a score of 8 or more on the AUDIT at screening. The recruitment strategies employed in this study were the same as Study 1 (i.e., letters, newspaper advertisement and word of mouth). Potential participants who had received letters and indicated that they would like to be contacted for research studies were contacted by a member of the research team to determine interest in the CM study. The study site was the University of Sherbrooke, Longueuil campus, in Montreal, Quebec, Canada. Sherbrooke Hospital Ethics Committee (*Comité d'éthique de la recherche en santé chez l'humain du Centre hospitalier universitaire de Sherbrooke*) approved the study protocol. Data collection took place between October 2013 and April 2015.

As in Study 1, Study 2 employed a RCT design. For a 42-day period, all participants wore an alcohol monitoring ankle bracelet that detected alcohol concentration in perspiration, resulting in a measure of transdermal alcohol concentration every 30 minutes. Each day, information regarding participant's transdermal alcohol concentration was transmitted via a modem provided to participants to a secure site where it could be accessed by a member of the research team blind to group assignment. Participants were assigned to the following three groups: 1) bracelet-only (B-CTL); 2) bracelet + non-contingent feedback (FB); 3) bracelet + CM. During Week 1 of the study, no specific advice or information regarding alcohol consumption was shared with participants. From Weeks 2-5, B-CTL received no feedback from the research team. FB and CM groups received a daily e-mail from a member of the

research team not blind to group assignment regarding their alcohol consumption for the previous day. The FB group was simply informed of whether or not the device had detected alcohol consumption. A reinforcement scheduled was employed with the CM group whereby participants earned incremental amounts (up to $11 per day) for each consecutive day of abstinence and reinforcement was re-set to baseline ($5) following days on which drinking took place. During Week 6 of the study participants were reminded of the date for their second visit to the study site but were not provided any instructions or feedback with regards to drinking. During Weeks 1 and 6, the CM group received $5 per day for study participation. FB and B-CTL groups received $5 per day for the 6-week duration of the study.

2.2 Measures

2.2.1 Study 1: Main Dependent Variables

Self-reported drug use was measured in Study 1 using a computerised version of the Timeline Followback (TLFB; Sobell, Brown, Leo, & Sobell, 1996). This semi-structured interview is designed to facilitate participant recall of substance use up to the past 180 days. This instrument has been shown to have adequate test-retest reliability and convergent and discriminant validity for collecting data on self-report drug use (Fals-Stewart, O'Farrell, Freitas, McFarlin, & Rutigliano, 2000). The TLFB was administered at baseline (T0; covering a period of 180 days prior to study entry) and at 6- (T1) and 12-month (T2) follow-ups. Self-report drug use was operationally defined as any day on which a participant reported consuming drugs (drugs consumed for medical reasons that did not exceed recommended dosage were not included). Percentage days of self-report cannabis use and self-report cocaine use was utilised in statistical analyses as main dependent variables.

Objectively assessed short-term drug use was achieved using urine screening tests from Bio Rad at T0, T1 and T2. Precision for Bio Rad screening tests is reported at 99%. Cannabis and cocaine, two of the drugs most commonly found in drivers (Beirness & Beasley, 2010; Brault et al., 2004), were the drugs for which participants were consistently screened. The presence of 11-norΔ^9-THC-9-COOH, a cannabis metabolite (cut off $\geq$ 50ng/ml), and benzoylecgonine, a cocaine metabolite (cut-off $\geq$ 300 ng/ml), in a urine sample resulted in a positive screen for cannabis and cocaine use, respectively. Using Bio Rad screens, THC-9-COOH can be detected up to 28 days after cannabis use and benzoylecgonine can be detected up to 3 days after cocaine use. Other classes of drugs (amphetamines, barbiturates, benzodiazepines, heroin, methadone, methamphetamine, morphine, phencyclidine, tricyclic antidepressants) were screened inconsistently and results are not reported here. The main dependent variables for urinalysis are the likelihood of positive drug screens for i) cannabis; and ii) cocaine, presented as odds ratios.

2.2.2 Study 1: Subgroup Analyses

Severity of self-report drug use was measured at baseline (T0) by administering the Drug Abuse Screening Test (DAST; Skinner, 1982), a brief questionnaire shown to have satisfactory psychometric properties for self-report drug use data (Yudko, Lozhkina, & Fouts, 2007). Subgroup analyses were conducted on data from Study 1 in order to explore whether age group and severity of drug use measured with DAST impacted self-reported (i.e., percentage days of cannabis and cocaine use) and objectively measured (i.e., likelihood of positive drug screens for cannabis and cocaine) drug use.

2.2.3 Study 2: Main Dependent Variables

Study 2 also used the TLFB to collect information on self-report drug use. It was administered at baseline (T0; covering a period of 42 days prior to study entry) and at the study's end (T1; 42-days following study entry). Self-report drug use was operationally defined in the same manner as Study 1. The main dependent self-report drug use variables are the percentage change (with values ranging from -100.00 to 100.00) in days of: i) cannabis consumption; and ii) cocaine consumption.

Table 1. Comparison of Materials and Methods Between BMI and CM Studies

	BMI	CM
Inclusion criteria		
Sex	Males and females	Males
DUI convictions	Two or more DUI convictions in the past 15 years + delayed involvement in relicensing program	One or more DUI convictions in the past 10 years
Alcohol consumption	AUDIT ≥ 8 (past 6-months drinking)	
Recruitment	Letters, newspapers, word of mouth	
Interventions		
Treatment conditions	BMI: 30-minute manualized brief motivational interview CTL: 30-minutes information and advice session	CM: alcohol monitoring bracelet + daily feedback on prior 24-hour drinking with contingency schedule FB: alcohol monitoring bracelet + daily feedback on prior 24-hour drinking B-CTL: alcohol monitoring bracelet only
Study time frame	T0 = 180 days prior to study entry T1 = 180 days post-intervention T2 = 180 days post T1	T0 = 42 days prior to study entry T1 = 42 days following study entry
Main outcomes		
Self-reported	TLFB: i) % change in days on which cannabis was consumed; ii) % change in days on which cocaine was consumed	
Urine analysis	Cannabis: presence of 11-norΔ^9-THC-9-COOH (cut off ≥ 50ng/ml) Cocaine: presence of benzoylecgonine (cut-off ≥ 300 ng/ml)	None

Note. AUDIT = Alcohol Use Disorder Identification Test; BMI = Brief Motivational Interviewing; B-CTL = bracelet-only control group; CM = contingency management; DUI = driving under the influence; FB = non-contingent feedback on drinking; THC-9-COOH = tetrahydrocannabinol-*9-carboxylic* acid; TLFB = Timeline Follow Back.

2.3 Data Analyses: Current Study

A basic power calculation using G-Power (version 3.1) was conducted for both studies and determined that 42 participants (26 per group) were required for the detection of

significant differences in Study 1. In Study 2, in order to enable power calculation for a larger randomised controlled trial, 36 participants were required for this pilot study (12 participants per group). Missing data for main outcomes was dealt with by calculating mean drug use based on age group, randomisation group, and sex and this mean replaced missing data at those time points. Main and subgroup analyses were tested using Statistical Analysis System v. 9.3.

For Study 1, a fixed effects model for repeated, non-normally distributed measures was used to examine whether intervention condition for alcohol use problems (treatment group) and time and treatment group x time interaction impacted self-reported drug use (i.e., percentage days of cannabis and cocaine use). The effect of treatment group, time, and the treatment group x time interaction on objectively measured drug use (i.e., likelihood of positive drug screens for cannabis and cocaine) was tested with logistic regression. For Study 2, a one-way ANOVA tested whether treatment group impacted self-reported drug use (i.e., percentage change in days of self-reported cannabis and cocaine use).

For subgroup analyses on data from Study 1, a median split was performed on the variable age (≤ 46.29 years = younger cohort vs. > 46.30 years = older cohort). Participants were also divided based on severity of drug use; those with DAST scores ≥ 6 (n = 68) were considered to have problematic drug use and those with DAST scores < 6 (n = 116) were not considered to have problematic use. The effect of age on self-reported drug use was examined with a fixed effects model with the following variables included in the model: i) treatment group; ii) time; iii) age group; iv) interaction of treatment group x time; v) interaction of treatment group x age group; vi) interaction of time x age group; vii) interaction of treatment group x time x age group. The effect of DAST score on self-reported drug use was also

examined with a fixed effects model with the following variables included in the model: i) treatment group; ii) time; iii) DAST score; iv) interaction of treatment group x time; v) interaction of treatment group x DAST score; vi) interaction of time x DAST score; vii) interaction of treatment group x time x DAST score. Logistic regression tested the effect of the following factors on objectively measured drug use: i) treatment group; ii) time; iii) age group; iv) DAST score; v) interaction of treatment group x time; vi) interaction of group x age group; vii) interaction of treatment group x DAST score; vii) interaction of treatment group x time x age group; ix) the interaction of treatment group x time x DAST score.

3. Results

3.1 Characteristics of the Samples

As shown in Table 2, there were missing drug outcome data only in Study 1. Of the 184 participants from Study 1, self-report data for drug consumption was available for 184 participants at T0, 180 participants at T1 (2.2% missing) and 166 participants at T2 (9.8% missing). With regards to objective measurements of drug use, 182 participants in the original study provided a urine sample to test for drug use at T0 (1.1% missing), 172 at T1 (6.5% missing) and 166 at T2 (9.8% missing). Analyses comparing baseline with T2 showed no significant differences between participants present and those with missing data in terms of age, AUDIT scores, and number of DUI convictions.

Sociodemographic characteristics for participants in Study 1 and Study 2 can also be found in Table 2. Participants in Study 1 were mostly male with a mean age in the mid-forties, a mean AUDIT score higher than 20 and an average of more than three DUI convictions in 15

years. Participants in Study 2 were all males with a mean age in the early forties, a mean AUDIT score of 16, and an average of about one DUI conviction in the past 10 years. There were no significant differences between experimental and control group at baseline on sociodemographic variables in either study. Additionally, significant between-group differences were not detected at baseline on self-reported drug use in either study nor on objectively measured drug use in Study 1.

Table 2. Descriptive Statistics of Participants in Study 1 (With and Without Missing Data) and Study 2

	Study 1						Study 2	
	T0 (N = 184)		T1 missing (n = 4)		T2 missing (n = 18)		Total sample (N = 37)	
	Mean (or %)	SD	Mean (or %)	SD	Mean (or %)	SD	Mean (or %)	SD
Age	46.11	8.83	48.33	6.98	44.06	11.07	40.54	15.88
Male sex	(89.70)		(100.00)		(94.40)		(100.00)	
AUDIT score	21.30	8.35	30.00	9.56	25.11	9.80	16.08	6.97
Past DUI convictions	3.39	1.80	2.75	0.50	3.11	1.68	1.22	0.42

Note. Study 1: brief motivational interviewing (Brown et al., 2010); Study 2: contingency management (Averill et al., 2017). AUDIT: Alcohol Use Disorders Identification Test; DUI: driving under the influence; SD: standard deviation; T0: baseline; T1: 6-month follow-up; T2: 12-month follow-up.

3.2 Main Outcomes

For fixed effects models, the best fit for the data was a first-order autoregressive structure (AR1), as indicated by the Wald test which was performed on all residual covariance matrices. In all cases, $p < 0.001$.

3.2.1 Study 1

Self-reported Drug Use. The fixed effects portion of the model revealed no significant differences between treatment groups for percentage days of cannabis use ($p = 0.75$) and cocaine use ($p = 0.99$). It also revealed no significant differences across time for percentage days of cannabis use ($p = 0.23$) and cocaine use ($p = 0.33$). Table 3 summarizes the interaction of treatment group and time for self-report drug use variables. No treatment group by time interactions were found for percentage days of cannabis use ($p = 0.73$) and cocaine use ($p = 0.28$).

Objectively Measured Drug Use (Urine Test). Table 4 summarizes the main effect findings, presented as odds ratios, for objectively measured drug use variables in Study 1. Logistic regression detected no significant main effect for treatment group and time or treatment group x time interaction for objectively measured cannabis use and cocaine use.

Table 3. Study 1: Interaction of Group by Time for Self-report Drug Use Outcome Variables (n = 184)

	Time											
	T0 (baseline)				T1 (6-month follow-up)				T2 (12-month follow-up)			
	CTL		BMI		CTL		BMI		CTL		BMI	
Outcome	Mean (SE)	95% CI	Mean (SE)	95% CI	Mean (SE)	95% CI	Mean (SE)	95% CI	Mean (SE)	95% CI	Mean (SE)	95% CI
% days of use (self- reported)												
Cannabis	17.14 (3.19)	10.86–23.42	19.01 (3.19)	12.74–25.29	15.91 (3.19)	9.63–22.18	16.18 (3.19)	9.91–22.46	14.30 (3.19)	8.02–20.58	16.12 (3.19)	9.85–22.40
Cocaine	7.30 (1.57)	4.20–10.40	8.43 (1.57)	5.34–11.53	7.20 (1.57)	4.10–10.29	5.36 (1.57)	2.67–8.46	5.85 (1.57)	2.76–8.95	6.63 (1.57)	3.54–9.73

Note. Study 1: brief motivational interviewing (Brown et al., 2010). There were no significant main effects for time or group nor significant interactions. BMI: brief motivational interviewing; CI: confidence interval; CTL: control group; SE: standard error.

Table 4. Study 1: Summary of Urinalysis Data Using Logistic Model (n = 184)

	Urinalysis (Positive Screen)			
	Cannabis		Cocaine	
Parameter	OR	95% CI	OR	95% CI
Treatment group				
CTL vs. BMI	0.96	0.56–1.63	1.31	0.75–2.27
Time				
T0 vs. T1	0.86	0.65–1.14	0.85	0.61–1.18
T0 vs. T2	0.93	0.69–1.25	1.00	0.71–1.41
T1 vs. T2	1.08	0.81–1.44	1.18	0.86–1.63

Note. Study 1: brief motivational interviewing (Brown et al., 2010). BMI: brief motivational interviewing; CI: confidence interval; CTL: control group; OR: Odds ratio; T0: baseline; T1: 6-month follow-up; T2: 12-month follow-up.

3.2.2 Study 2

The ANOVA on percentage change in days of cannabis use between T1 and T0 revealed no significant differences between treatment groups [$F(2,34) = 1.35$, $p = 0.27$]. Similarly, no significant differences between treatment groups were found for percentage change in days of cocaine use [$F(2,34) = 1.59$, $p = 0.22$]. Table 5 shows a summary of these findings.

Table 5. Study 2: Between Group Differences for Self-report Drug Use Outcome Variables (n = 37)

	Treatment Group					
Outcome	B-CTL		FB		CM	
% change in days of use (self-reported)	Mean (SD)	95% CI	Mean (SD)	95% CI	Mean (SD)	95% CI
Cannabis	0.00 (7.60)	-5.11–5.11	-5.39 (14.85)	-14.36–3.59	0.39 (2.90)	-1.37–2.14
Cocaine	0.00 (0.00)	0.00–0.00	7.15 (20.52)	-5.25–19.55	-0.77 (3.42)	-2.84–1.30

Note. Study 2: contingency management (Averill et al., 2017). B-CTL: bracelet-only; CI: confidence interval; CM: contingency management and bracelet; FB: non-contingent feedback and bracelet; SD: standard deviation.

3.3 Subgroup Analyses

Subgroup analyses were conducted on data from Study 1 in order to explore whether age group impacted self-reported and objectively measured drug use as a function of treatment group and time. Table 6 summarizes the model exploring the impact of age on self-report cannabis use in Study 1. No significant differences were found for the main effects of treatment group, time or age group. No significant interactions were detected. For self-reported cocaine use, no significant main or interactions effects were found for percentage days of cocaine use.

Table 6. Study 1: Subgroup Analyses Mixed Model Coefficients Exploring Age Group on Self-report Cannabis Use (n = 184)

	Beta	t	p
Constant	14.09	3.16	0.001
Treatment Group	-7.21	-1.12	0.75
Time			
T0	-1.22	-0.34	0.73
T1	-1.88	-0.72	0.47
T2	0		
Age group	4.06	0.64	0.53
Treatment group x Time			
T0	3.72	0.73	0.47
T1	3.14	0.84	0.40
T2	0		
Time x Age group			
T0	8.22	1.62	0.11
T1	3.89	1.03	0.30
T2	0		

Treatment group x Age group	10.60	1.17	0.40
Treatment group x Time x Age group			
T0	-7.54	-1.05	0.29
T1	-3.19	-0.60	0.55
T2	0		

For urine testing, logistic regression revealed a significant main effect of age group on objectively measured cannabis and cocaine use ($p < 0.01$), showing 2.14 increased odds of producing a positive cannabis screen and 2.97 increased odds of producing a positive cocaine screen in younger participants. No main effect of treatment group or time was detected and no significant interactions were detected.

Subgroup analyses were also conducted to examine whether drug use problems measured with DAST impacted self-reported and objectively measured drug use as a function of group and time. A fixed effects model revealed no main effects of treatment group, time, or DAST score for percentage days of cannabis use. No significant interactions were found for percentage days of cannabis use. For cocaine use, a main effect of DAST score for percentage days of cocaine use was found with participants scoring ≥ 6 on the DAST reporting significantly more cocaine use ($M = 14.03$, $SE = 1.28$ participants scoring ≥ 6; $M = 2.53$, $SE = 0.98$ participants scoring < 6; $p < 0.01$). There were no main effects of treatment group or time and no significant interactions for percentage days of cocaine use.

For urine testing, logistic regression revealed no main effects for group and time, but an expected main effect for the DAST score ($p < 0.01$). Results showed a 2.50 increased odds

of producing a positive cannabis screen and a 5.64 increased odds ($p < 0.001$) of producing a positive cocaine screen in participants with DAST scores ≥ 6. Finally, no significant interactions were detected for cannabis and cocaine presence in urine.

4. Discussion

Using data collected from two previous studies (Averill et al., 2017; Brown et al., 2010), the present study investigated whether two interventions (BMI and CM) targeting alcohol use problems would have carry-over effects on drug use among samples of DUI offenders. It was hypothesized that BMI and CM for alcohol use problems would decrease subjective reports of cannabis and cocaine use on the TLFB compared to control conditions and that BMI would reduce objectively measured drug use. Subgroups analysis were also conducted to examine whether age group and severity of drug use would impact subjectively and objectively measured cannabis and cocaine use at follow-ups in those receiving BMI compared to control.

This study did not find significant carry-over main effects of BMI and CM interventions for alcohol use problems on subjective or objective cannabis and cocaine use in samples of DUI offenders. While not rejecting the null hypothesis does not indicate that there are no between-group differences, it is possible that carry-over effects on drug use of interventions targeting alcohol use are negligible for many drivers.

In the MI study, subgroup analyses on age were generally non-significant apart from a higher likelihood of cannabis and cocaine presence in urine for younger participants, though this finding was not replicated in self-reported data. It is probable that the measure used, i.e.,

percentage days of self-reported use, does not reflect the quantity consumed which is better captured by urine analysis. Subgroup analyses on age were undertaken as MI has previously demonstrated selective effects for younger drivers with regards to DUI and other traffic violations at 5-year study follow-up (Ouimet et al., 2013). In this study, however, MI for alcohol use did not appear to have carry-over effects on reducing drug use among younger drivers.

Subgroup analyses on DAST score for the MI study were also generally non-significant. However, an expected main effect of DAST score was detected, whereby participants with a score ≥ 6 were more likely to produce positive urine screens for cannabis and cocaine. For cocaine, this result was corroborated by self-report data as participants with a score of ≥ 6 on the DAST reported a higher percentage of days of cocaine use. Subgroup analyses were undertaken on DAST score as cannabis use among younger drivers is a growing concern (Beasley et al., 2011) and polydrug use problems are common in offenders (Hels et al., 2011; Snenghi et al., 2015). In this study, however, MI for alcohol use did not appear to have any carry-over effects on reducing drug use among participants with greater severity of self-report drug use problems.

Given that the alcohol-reduction interventions examined here did not appear to impact drug use, DUI rehabilitative programs that focus largely on alcohol use problems would be predicted to have little impact on an offender's likelihood of driving under the influence of drugs. In order to ensure DUI offenders reduce risky driving (under the influence of alcohol and/or drugs), careful assessment of comorbid drug use disorders for those convicted of DUI as well as appropriate referral to addiction counseling services for drugs may need to be incorporated into standard rehabilitative procedures.

At the same time, the lack of significant findings does not indicate that carry-over effects may not exist in important specific subgroups. While age and drug use severity were examined in the MI study, traits such as impulsivity and reward sensitivity were not examined in either the MI or CM study. CM was originally conceived to achieve abstinence among cocaine dependent outpatients (Higgins et al., 1991), a group known to exhibit impulsivity (Moreno-Lopez et al., 2012) and high reward sensitivity (Volkow et al., 2010). Additionally, MI specifically targets resistance to treatment, with individuals exhibiting higher levels of impulsivity and lower readiness to change more likely to be resistant (Treasure, 2004). More specifically, among DUI offenders, those exhibiting decision making suggestive of impulsivity have been found to have more DUI convictions compared to DUI offenders exhibiting more advantageous (i.e., less impulsive) decision-making (Bouchard, Brown, & Nadeau, 2012). Future studies of carry-over effects may therefore focus on subgroups showing characteristics more likely to benefit from these interventions, such as impulsivity and reward sensitivity.

Finally, it is possible that some participants in one or both studies did not perceived their drug consumption as problematic, thereby lowering motivation to reduce drug use while also attempting to alter alcohol use. Motivation is an important ingredient in producing behaviour change in substance users (DiClemente, Bellino, & Neavins, 1999). Future research in the DUI offender population of potential carry-over effects of alcohol use interventions on drug use may wish to measure readiness-to-change with regards to drug use behaviour.

4.1 Strengths and Limitations

Strengths of the original studies included randomisation to experimental and control groups, blinding procedures, high retention in both studies, and replacement of missing data

for statistical analyses. In addition, in Study 1 treatment fidelity to the BMI intervention was closely monitored, and drug use was both subjectively and objectively measured. Study 2 was able to adhere to guidelines for CM delivery through the inclusion of transdermal alcohol monitoring technology. The limitations included the possibility that subgroups of DUI offenders or those mandated to receive treatments for alcohol use problems may have different drug use outcomes following interventions for alcohol use than the samples described in this study. Finally, sensitivity of statistical analyses was reduced for Study 2 due to a modest sample size and drug use was measured exclusively via self-report with no corroboration via other instruments (i.e. the DAST) or objective measurement.

5. Conclusion

Both DUI and DUID pose significant challenges to road traffic safety and alcohol and drugs are often consumed together. In order to provide effective treatment for DUI offenders, it is important to know whether interventions targeting alcohol use problems have carry-over effects on drug usage. This study represents the first study to test this hypothesis in a DUI offender population. It utilised data from two prior randomised trials, testing a BMI intervention (Brown et al., 2010) and a CM intervention (Averill et al., 2017). The results of the present study did not support the hypothesis that interventions for reducing alcohol consumption would show secondary effects on reducing drug use.

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DISCUSSION

Review of the Results

The first article presented in this thesis was a systematic review of the efficacy of MI among at-risk groups such as users of emergency services following a motor vehicle accident in which alcohol was implicated, first-time offenders, recidivists, and young offenders. Eleven studies of adapted MI with randomization to groups were reviewed. This systematic review of the literature on randomised controlled trials of MI in a DUI context concluded that MI was promising for reducing alcohol consumption and/or DUI behaviour among DUI recidivists with alcohol use problems and patients presenting in emergency room settings following a motor vehicle collision (in which alcohol was a factor in the collision or alcohol problems were present). Efficacy for MI among offenders younger than 21 years of age and first-time offenders, both groups in which problem alcohol use was not a recruitment inclusion criteria, was deemed inconclusive.

In the second article of this thesis it was hypothesized that, compared to two control groups, DUI offenders receiving a CM intervention would decrease their alcohol consumption by the study's end. This hypothesis was not supported by the data. More specifically, there was no significant difference at the study's end between DUI offenders receiving a CM intervention and the control groups (FB and B-CTL) with regards to alcohol consumption as measured objectively (number of days per week on which alcohol use was detected; number of drinking episodes per week; average transdermal alcohol concentration per week; peak transdermal alcohol concentration per week for alcohol use episodes) by a transdermal alcohol-monitoring bracelet. There were also no

significant differences at the study's end between participants receiving the CM intervention and control groups with regards to subjectively measured alcohol consumption (number of risky drinking days and percentage of risky drinking days) using the TLFB. Despite the lack of significant group by time interactions with regards to alcohol consumption, a significant difference across time was found for all groups on objectively measured alcohol consumption. That is, all groups showed a reduction in objectively measured alcohol consumption (reduced peak transdermal alcohol concentration per week) from study onset to study end. More specifically, although the number of days per week on which alcohol use was detected as well as the number of drinking episodes per week did not differ significantly over time, participants in all groups had significantly lower peak transdermal alcohol concentration over time, indicating that they consumed less alcohol on drinking days. In this study CM was therefore equally as effective as non-contingent feedback on alcohol consumption and bracelet-only monitoring of alcohol consumption in reducing alcohol consumption among a heterogeneous group of DUI offenders comprised of first time offenders and recidivists. Acceptability of the transdermal alcohol monitoring device was also assessed in this study using quantitative and qualitative methods. Quantitative results showed that most participants believed the device was accurate in terms of detecting alcohol consumption and qualitative analyses indicated that participants believed a major advantage of the device was that it could assist them with reducing their alcohol consumption. Quantitative and qualitative analyses indicated that the device had several disadvantages, the most common being some form of physical discomfort or interference

with daily activities. Qualitative analyses revealed that participants believed the device was generally perceived positively by members of their entourage.

The hypothesis of the third article of this thesis stated that DUI offenders receiving BMI and CM interventions for alcohol use would show carry-over effects with regards to reducing drug use compared to control groups. This hypothesis was also not supported by the data. Specifically, no significant treatment group (BMI and CM), time (BMI), or interactions (BMI) were detected with regards to self-reported drug use as measured on the TLFB. Additionally, the data revealed no carry-over effects for objectively measured drug use (cannabis and cocaine measured by urinalysis) among participants receiving the BMI intervention for alcohol use compared to the information/advice control group. Subgroup analyses from the BMI study detected main effects of age and DAST score for cannabis and cocaine measured by urinalysis but no treatment group or time main effects and no interactions. Finally, subgroup analyses revealed no treatment group or time effects and no interactions for either cannabis use or cocaine use measured on the TLFB. In summary, in a heterogeneous group of first-time and recidivist DUI offenders, BMI and CM interventions for alcohol use did not appear to be effective in reducing drug use..

Interpretation and Generalisation of the Results

Present legislation under the Highway Traffic Safety Code of Quebec states that all persons convicted of driving under the influence of alcohol or drugs must submit to an assessment during the relicensing process, a portion of which is designed to evaluate an offender's substance use. However, research has suggested that a significant portion of

offenders (up to 50% in Quebec between 1997 and 2002) delay participation in the re-licensing process (Brown et al., 2002). Additionally, research shows that those who delay relicensing show a trend toward higher scores on the Mortimer-Filkins questionnaire, which is designed to assess problem drinking, compared with offenders who do not delay relicensing, and that approximately 30% of offenders delay relicensing due to a reluctance or perceived inability to modify their alcohol consumption (Brown et al., 2008). Individuals who delay relicensing are at greater risk for recidivism (Voas, Tippetts, & McKnight, 2010).

Among offenders who do undertake the relicensing process, research has shown that there is significant under-reporting and under-diagnosis of alcohol and drug problems (Lapham, C'De Baca, Chang, Hunt, & Berger, 2002; Lapham, C'de Baca, McMillan, & Hunt, 2004). Additionally, when offenders become involved in educational programs associated with DUI rehabilitation, these programs tend to focus largely on alcohol use problems, resulting in a lack of assistance for drug use disorders (World Health Organization, 2016). Finally, there is little follow-up regarding long-term outcomes, both with regards to measuring substance use and impaired driving behaviour (such as alcohol or drug-related arrests), among offenders participating in rehabilitative programs and research has shown that an important proportion (approximately one-third) of relicensed DUI offenders recidivate (Brinkmann, Beike, Köhler, Heinecke, & Bajanowski, 2002). The efficacy of current efforts to reduce impaired driving among convicted DUI offenders, especially those at high risk for re-offense, can therefore be questioned. Adequate and accessible treatment for alcohol and drug use disorders among

DUI offenders, including those who delay relicensing, seems to be of paramount importance in reducing risky driving behaviour.

This thesis examined the potential of two interventions (CM and BMI) to encourage reduction in alcohol and drug use in this population. The first article presented in this thesis reviewed randomised controlled trials of MI in an impaired driving context (N = 11) and evaluated the methodological biases for each study using Cochrane Collaboration protocol (Altman, Schulz, Moher, & et al., 2001). Seven of the eleven studies included for review were found to have a moderate to high risk for bias and suggestions for improving study design for future research were detailed. The need for well-designed research studies in this field was underscored by this article as without more rigorous randomised controlled trials, it is difficult to draw firm conclusions regarding the efficacy of MI (and other interventions including CM). This review suggested that efficacy for MI showed more promise when alcohol problems for participants were a study inclusion criteria (i.e., recidivists, emergency room patients) than when it was not an inclusion criteria, suggesting that some participants in these studies could have had a low alcohol consumption (i.e., first-time offenders, young offenders). In effect, this review examined a specific technique (MI), asking the questions of for whom this intervention works and under which circumstances. High quality research is needed to better answer these questions and also to understand the non-specific factors (i.e., therapeutic alliance, self-efficacy, motivation) that may impact change in drinking behaviour among DUI offenders.

Results from the second article presented in this thesis, a pilot study of CM targeting alcohol reduction, found that all study groups reduced drinking over time,

suggesting that when CM is coupled with objective monitoring of alcohol consumption it is an effective intervention that can be added to the growing list of possible interventions for DUI offenders. Some DUI offenders may prefer this intervention as it may augment motivation to change and it was therefore concluded that future studies of CM in a DUI context could test this intervention with participants who: i) have a higher sensitivity to reward and/or; ii) are at higher risk for recidivating, such as younger drivers, offenders with multiple convictions, and offenders meeting criteria for an alcohol use disorder and/or comorbid drug use disorders. The major finding from this study that all treatment groups were equally effective in reducing drinking over time raises the question of how this change was produced. Three non-specific factors that may contribute to this study's findings are discussed: i) initial participant motivation; ii) therapeutic alliance; iii) participant self-efficacy.

The first factor that potentially explains the reduction in drinking across all groups is participant motivation at study onset. Motivation to reduce drinking has been identified as a moderator of treatment outcome in interventions for an alcohol use disorder (DiClemente, Bellino, & Neavins, 1999; Morgenstern et al., 2016). In the CM study, a majority of participants (56.76%) were found to be in the Action stage of change on the *Readiness to Change Questionnaire* thus providing strong evidence that participants were motivated to change their drinking behaviour upon study entry. The low response rate during the study screening process (17.29%) also suggests a possible bias towards over sampling the most motivated participants. With a motivated sample, such as the one in this study, the specificities of CM may have exerted less of an impact on drinking

outcomes than participant's initial level of motivation. A larger sample in which motivation at study entry is normally distributed is needed to test this hypothesis.

With regards to therapeutic alliance, while the CM study did not involve therapeutic work (i.e., a formal therapeutic session) per se, the thesis author, a doctoral student trained in clinical psychology, conducted all telephone screenings and baseline visits to the lab. She employed active listening skills and empathic communication during all contact with participants in an effort to foster trust in the research team and increase comfort during screening and study participation. Anecdotally, many participants relayed their experience of being arrested for DUI and confided that they viewed study participation as a way to assist themselves with reducing drinking. Analysis of qualitative data at the study's end supported these anecdotal observations as the most common advantage perceived by participants vis-a-vis the transdermal alcohol monitoring bracelet was that it had helped them reduce their alcohol consumption and/or gain a better understanding of their drinking. A receptive and understanding listener who was also tasked with surveying alcohol consumption without moral judgment about the results may therefore have fostered an effective therapeutic alliance. A number of studies, including meta-analyses of randomised controlled trials, have consistently found that therapeutic alliance is associated with a moderate effect size in determining treatment outcomes (Baldwin, Wampold, & Imel, 2007; Flückiger, Del Re, Wampold, Symonds, & Horvath, 2012; Martin, Garske, & Davis, 2000; Meier, Barrowclough, & Donmall, 2005). This effect size holds across a wide variety of treatment types and study designs (Flückiger et al., 2012).

A third factor which may explain the reduction in drinking over time for all study groups is participant self-efficacy, a concept not measured in this study. Self-efficacy is the belief that one can succeed at a given task or challenge (Bandura, 1982), which differentiates this concept from motivation, which is defined as the desire/reason to engage in a particular behaviour. In the alcohol use disorder literature, self-efficacy has been found to moderate drinking outcomes (Morgenstern et al., 2016), with higher scores on measures of self-efficacy correlated with superior drinking outcomes. Inclusion criteria for the CM study included alcohol problems in the past six months as indicated by an AUDIT score ≥ 8 and study instructions for all groups at week 2 suggested that participants reduce their alcohol consumption. While the CM group was provided incentives to alter their alcohol consumption, no group was provided psychosocial resources to assist them with the behaviour change process. Alcohol interferes with affective and cognitive processes and given the alcohol problems of this sample, self-efficacy to reduce drinking may have been low. Anecdotally, many participants mentioned during visits to the study site that they had made several attempts over the course of their lives to reduce their alcohol consumption and/or abstain from alcohol. Without additional assistance (for example, in the form of sustained psychotherapy or community support), participants were clearly able to reduce their drinking but the addition of financial incentives to the CM treatment group may have done little to alter self-efficacy.

Altogether, a high initial motivation to reduce drinking, surveillance of drinking behaviour by a clinically trained and empathic researcher, and low self-efficacy, or some combination of these factors, may have contributed to the finding that all groups showed

decreased drinking over the course of the study. The finding of non-significant differences between treatment groups is consistent with larger scale, multi-site studies, such as Project MATCH (Project MATCH Research Group, 1993), which examined three different interventions (Motivational Enhancement, Cognitive-Behavioural Therapy and Twelve-Step Facilitation) among problem drinkers and attempted to examine whether specific participant attributes were associated with superior outcomes in one of the three treatments. While drinking outcomes improved for participants in all groups, few differences were found between treatment groups and no support was found for the majority of hypotheses matching participant attributes to type of therapy at one-year follow-up (Project MATCH Research Group, 1997). At three-year follow-up, readiness-to-change (a measure of motivation) and self-efficacy were the strongest predictors of improved drinking outcomes (Project, 1998). Similarly, a large, multisite trial by another research team found reductions in drinking over time among participants with alcohol problems receiving one of two interventions targeting alcohol use (Motivational Enhancement Therapy and social behaviour and network therapy) but differences between treatment groups were generally non-significant (UKATT Research Team, 2005).

The second article in this thesis also demonstrated how a therapeutic intervention (such as CM) could be combined with a technology to objectively monitor alcohol consumption. The reduction in alcohol consumption over time that was detected for all groups introduces the possibility that exposure to objective monitoring of alcohol consumption may reduce alcohol consumption among a heterogeneous sample of DUI offenders. This finding is important because while other forms of objective alcohol

monitoring, notably the alcohol ignition interlock device, record attempts to operate a motor vehicle equipped with the device when BAC is greater than 0.02, it does not provide information regarding an individual's general alcohol consumption patterns. Individuals may therefore choose to consume alcohol and drive a vehicle not equipped with an interlock device. In contrast, continuous and objective monitoring of an individual's alcohol consumption provides more detailed information with regards to whether or not an offender has reduced his or her alcohol consumption and whether or not he or she maintains gains over time. Information about a DUI offender's alcohol consumption pattern has the potential to improve follow-up with clients involved in DUI rehabilitation programs as well as the possibility of effecting longer-term behavioural change when combined with therapeutic interventions. Implementing the use of continuous alcohol monitoring technology in DUI rehabilitation programs may be particularly beneficial to DUI offenders meeting criteria for an alcohol use disorder or for those with multiple DUI convictions. In addition, qualitative data from the CM study regarding acceptability of the transdermal alcohol monitoring device suggested that DUI offenders viewed it as a tool to assist them with reducing their alcohol consumption. However, the discomfort caused by the device and interference with daily activities reported by many offenders indicates that further study is required to determine the utility and acceptability of this device in a rehabilitative field setting, particularly if offenders are mandated to wear the device.

Taken together, the results of the second study presented in this article indicate the need for larger follow-up studies on CM and alcohol monitoring technologies in a DUI offender population in order to explore the efficacy of this intervention and better

understand the variables that may contribute to mechanisms of change. If efficacy for CM can be established in larger samples of DUI offenders, or among subgroups of offenders, there may be multiple benefits to incorporating this intervention into the DUI rehabilitative process. For example, CM has been shown to increase treatment retention among individuals with an alcohol use disorder or drug use disorder (Petry, 2000; Petry, Martin, Cooney, & Kranzler, 2000), which is in turn associated with superior treatment outcomes (Simpson, Joe, & Brown, 1997). Additionally, while increasing sanctions for DUI offences requires increasing judicial resources, it is possible that therapeutic interventions may be more cost-effective as research has estimated that CM is a cost-effective intervention in some settings (Sindelar, Elbel, & Petry, 2007; Sindelar, Olmstead, & Peirce, 2007). In order to determine whether or not CM is cost-effective for reducing DUI behaviour, however, a cost-benefit analysis of this intervention specifically within the DUI field would need to be undertaken as there are no published studies to date on this topic.

The third article of this thesis investigated the potential for two interventions targeting alcohol reduction (BMI and CM) to have carry-over effects on decreasing drug use among DUI offenders. In some jurisdictions DUID appears to be on the rise (Rudisill, Zhao, Abate, Coben, & Zhu, 2014; Sigona & Williams, 2015) but rehabilitation programs tend to focus on alcohol (Maxwell, Freeman, & Davey, 2009). Main findings from this study showed no significant effects of group (BMI and CM), time (BMI), or group by time interactions (BMI) of alcohol interventions on cannabis and cocaine use. Furthermore, subgroup analyses for the MI study did not indicate that MI targeting alcohol use was effective in reducing drug use among younger offenders or those with

greater severity of drug use problems. That most results showed no carry-over effects of BMI and CM on drug use means that drug usage among participants in these studies did not change significantly when the focus was on alcohol use. A major limitation of the study was that both BMI and CM interventions were designed to target alcohol use rather than drug use and therefore no specific interventions for drug use were applied though drug use outcomes were measured. This situation, however, reflects the reality of most DUI rehabilitation programs whereby drug use disorders are often not adequately assessed or treated. While non-significant findings do not suggest that the null hypothesis of no between-group differences can be accepted, results highlight the potential need for rehabilitation programs to: i) effectively detect drug use disorders; ii) include drug use counseling as part of the treatment plan for offenders with drug use disorders as interventions for alcohol use may target only a portion of these offender's substance use difficulties. Both MI and CM have demonstrated effectiveness for treating drug use disorders in a variety of populations and therefore could be incorporated into rehabilitative programs that currently utilize these interventions to treat an alcohol use disorder. Accurately detecting and treating drug use disorders in impaired driving offenders could translate to increased safety on roads.

Altogether, the body of research presented in this thesis indicates that additional research is needed in order to develop and elaborate effective interventions for reducing substance use, and by extension potentially reducing DUI and DUID, among impaired driving offenders. Systematic studies with larger sample sizes and rigorous methodology, including objective monitoring of substance use, are required to determine the feasibility and efficacy of CM in an impaired driving population as well as the efficacy of MI in

some offender subgroups. In addition, exploration of treatment response among subgroups of DUI offenders is imperative to understand for whom these interventions may be effective. Subgroups on which to focus further research on CM include offenders with an alcohol use disorder, offenders with a drug use disorder, recidivists, and offenders with high-sensitivity to reward. Further research on MI could focus on young offenders, first-time offenders, offenders with a drug use disorder, and those with either low self-efficacy or low motivation to change substance use. Non-specific factors that may also influence treatment responsiveness, including therapeutic alliance and participant attributes should also be explored.

Critique of the Thesis

This thesis has several limits and therefore caution should be exercised in interpreting and generalising its results. Conclusions from the results of the studies presented in this thesis were made in the context of the experiences of DUI offenders in Quebec and therefore may not necessarily be applicable to samples of DUI offenders in jurisdictions that are significantly different from Quebec in terms of laws, sanctions and measures taken to deal with DUI and DUID offenders.

Participation in both studies was voluntary. In the CM study, of the 214 individuals assessed for eligibility to participate in the study, only 37 participants were randomised to group, thus the response rate was 17.29%. In the BMI study, of the 720 individuals assessed for eligibility, 184 participated in the study, thus the response rate was 25.56% (Brown et al., 2010). While the low response rates of these studies are typical in this field of research, the voluntary nature of study participation may therefore

mean that these results cannot be generalised to DUI offenders who chose not to participate in the studies. For example, those participating in these studies may have been in greater financial need and thus potentially motivated by remuneration ($445 in the CM study and $210 in the BMI study). Participants in these studies may also have been more inclined to seek out assistance for their difficulties. Anecdotally, several participants in the CM study indicated that they were motivated to participate in order to reduce their alcohol consumption. Finally, samples of voluntary participants for both studies mean that these results may not be generalisable to samples of DUI offenders mandated to receive interventions for alcohol use problems.

Sample characteristics of the studies presented in this thesis also limit the conclusions that may be drawn from these studies. The CM study consisted of a heterogeneous group of DUI offenders (first time as well as recidivist offenders). For the purpose of conducting an exploratory study of CM and given the low response rate typical of research in this field coupled with the added study demand of wearing an alcohol monitoring ankle bracelet for a six-week period, a decision was made to include all individuals with one or more DUI convictions in the past 10 years. First-time and recidivist offenders differ in several respects, however, and it is possible that CM may be preferentially effective among sub-groups of offenders, though it was not possible to test such hypotheses due to the small sample size of this pilot study. Similarly, it was not possible to test hypotheses regarding any possible carry-over effects of a CM intervention on drug use among subgroups of offenders in the second study presented in this thesis. The BMI study, in contrast, consisted of DUI recidivists. Results from the study of carry-over effects can therefore not be generalised to first-time DUI offenders. Finally, results

of studies in this thesis might not be generalisable to female DUI offenders. The systematic review included 11 studies and between 61 to 90% of the participants in these studies were male. The CM study included only male offenders and while the BMI study included female offenders, about 90% of participants were male (Brown et al., 2010). It was therefore not possible to examine whether BMI had selective carry-over effects on drug use for female DUI offenders. It is worth noting, however, that the proportion of female offenders in the population is much lower than males (Armstrong et al., 2014; Beirness et al., 2013), leading to difficulty in recruitment (Armstrong et al., 2014) and that females, contrary to males, differ from their matched-aged controls, showing more alcohol use and impulsivity problems (Brown et al, 2015). These findings present the possibility that females could have a different responsivity to DUI treatment and therefore the results found in this thesis might not generalise to them. More research in general is required with female offenders and on sex-based responsivity to treatment specifically.

A further limitation of this thesis and the studies presented herein is that it does not enable conclusions to be drawn that would clarify the causal pathways to a first-time DUI conviction or from a first-time offense to recidivism. Though the thesis posits that factors such as sex, age, prior DUI/DUID convictions, a history of a substance use disorder, and neurocognitive deficits contribute to impaired driving behaviour, it does not elaborate on how these factors fit into a comprehensive and predictive model of impaired driving. Furthermore, other factors such as impulsivity and driver experience, which interact with variables such as sex, gender and age, are not accounted for in this thesis in terms of their contribution to a predictive model of impaired driving. In an effort to

clarify the pathways to DUI behaviour more research is required. For example, with regards to better understanding the role neurocognitive deficits play in impaired driving, prospective, longitudinal studies may be instructive.

This thesis also contains several strengths. First, it builds on previous intervention studies in the DUI field as there is a dearth of well-designed randomised controlled studies in the literature. Both interventions (CM and BMI) presented in this thesis used a randomised controlled design with blinding procedures. As highlighted by the review article presented in this thesis more randomised controlled trials with methodological descriptions permitting the evaluation of potential biases are needed in order to determine which interventions may be effective with a DUI offender population before they can be integrated into field trials within the rehabilitative system. Additionally, the CM study builds on previous studies of alcohol monitoring technologies. Though other jurisdictions (mainly in the United States) have incorporated such technologies into the court systems associated with DUI and other crimes, the use of alcohol monitoring technology to continuously monitor an individual's alcohol consumption is its infancy in the context of DUI in Quebec. The results of the CM study suggest the possibility that use of this technology may assist offenders with reducing their alcohol consumption and provides an impetus for further research on this topic. With regards to the originality of this thesis, no published studies to date have examined CM (where alcohol reduction was the target) in a DUI context. Finally, in suggesting that interventions for alcohol use do not necessarily have carry-over effects on reducing drug use, this thesis emphasizes the need for current rehabilitative programs to focus on drug use reduction in addition to alcohol use reduction in the rehabilitation of DUI offenders with substance use disorders. By

focusing on interventions that could be adapted to DUI/DUID, we hope to have illuminated future avenues of research that will lead to effective interventions for treating substance use problems in impaired driving offenders and thereby increase road safety.

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ANNEX I

Permission to Include Published Article in Thesis

RE: Permission to use article

Fallu Jean-Sebastien <jean-sebastien.fallu@umontreal.ca>

Thu 2017-02-16 9:30 PM

To:Farah Therese Averill <farah.averill@mail.mcgill.ca>;

Hi,

You can use the article if the original citation is mentioned.

Best,

Jean-Sébastien Fallu

De : Farah Therese Averill [mailto:farah.averill@mail.mcgill.ca]
Envoyé : 16 février 2017 16:57
À : Fallu Jean-Sebastien
Objet : Permission to use article
Importance : Haute

Dear Professor Fallu,

In 2014 I was the second author on the following paper:
Ouimet, M. C., Averill, F., & Brown, T. G. (2014). L'efficacité de l'entretien motivationnel dans la prévention secondaire et tertiaire de la conduite avec les capacités affaiblies par l'alcool : une revue systématique de la documentation. *Drogues, Santé et Société*, *13*(2), 84. http://doi.org/10.7202/1032274ar

I am a doctoral student at UdeM and I am preparing to submit my doctoral thesis. I would like to obtain the authorization to include this paper (as a Microsoft Word document) in my thesis. I can't seem to find the instructions on the website. Could you please let me know how I should proceed?

Best regards,
Farah Averill

ANNEX II

Contingency Management Study Consent Form (French)

UNIVERSITÉ DE SHERBROOKE

UNIVERSITÉ DE SHERBROOKE (Campus de Longueuil)
150, Place Charles-Le Moyne, bureau 200
Longueuil, QC, J4K 0A8
450-463-1835

FORMULAIRE D'INFORMATION ET DE CONSENTEMENT À LA RECHERCHE

Titre du projet :	Mesure de la consommation d'alcool chez les personnes ayant conduit avec les capacités affaiblies
Numéro et date du projet :	**13-021**
Organisme subventionnaire :	Équipe des Instituts de recherche en santé du Canada en études transdisciplinaires sur la conduite avec capacités affaiblies.
Chercheure principale :	Marie Claude Ouimet, Ph.D.
Chercheurs associés :	Thomas Brown, Ph.D., Institut universitaire en santé mentale Douglas; Louise Nadeau, Ph.D., Université de Montréal; Robyn Robertson, M.C.A., Fondation de recherches sur les blessures de la route; Farah Averill, M.A., candidate au doctorat, Université de Montréal.

Nous sollicitons votre participation à un projet de recherche parce que vous avez été condamné pour conduite avec capacités affaiblies. Avant d'accepter d'y participer et de signer ce formulaire d'information et de consentement, veuillez prendre le temps de lire, de comprendre et de considérer attentivement les renseignements qui suivent. Si vous acceptez de participer au projet de recherche, vous devrez signer le consentement à la fin du présent document et nous vous en remettrons une copie pour vos dossiers.

Ce formulaire d'information et de consentement vous explique le but de ce projet de recherche, les procédures, les avantages, les risques et inconvénients, de même que les personnes avec qui communiquer au besoin. Il peut contenir des mots ou renseignements que vous ne comprenez pas. N'hésitez pas à poser toutes les questions nécessaires au chercheur responsable du projet ou aux autres personnes affectées au projet.

POUR PLUS D'INFORMATION

Si vous avez des questions concernant le projet de recherche, vous pouvez communiquer avec la chercheure responsable du projet :

Marie Claude Ouimet au : 450-463-1835, poste 61849

CÉR chez l'humain du CHUS
APPROUVÉ 10 décembre 2013 ej

NATURE ET OBJECTIFS DU PROJET DE RECHERCHE

Ce projet vise à évaluer l'efficacité d'un bracelet qui mesure la consommation d'alcool chez des personnes ayant été condamnées pour conduite avec capacités affaiblies par l'alcool. Le but est de déterminer si ce bracelet, se portant autour de la cheville, est utile pour aider certaines personnes à réduire leur consommation d'alcool.

DÉROULEMENT DU PROJET DE RECHERCHE

Pour participer à cette étude, nous vous demandons de :

1) Vous présentez deux fois à l'Université de Sherbrooke (Campus de Longueuil) pour une durée maximale de 3 heures (à chaque rendez-vous) afin de :
    a. répondre à des questionnaires (aujourd'hui et dans six semaines)
    b. faire installer le bracelet (SCRAMx) qui mesure la consommation d'alcool (aujourd'hui) et le faire enlever (dans six semaines);
2) Porter le bracelet pendant les six semaines;
3) Respecter les conditions d'utilisation du bracelet;
4) Accepter de recevoir des informations et des instructions par courriel durant la durée de l'étude.

Première rencontre à l'Université. Au cours de cette rencontre, d'une durée maximale de 3 heures, nous vous demandons de :

- Recevoir de l'information sur cette étude;
- Recevoir et signer le formulaire de consentement;
- Présenter votre permis de conduire afin d'établir votre âge et votre connaissance de la conduite;
- Présenter une preuve de condamnation pour conduite avec capacités affaiblies;
- Compléter une brève évaluation médicale avec une infirmière, qui va évaluer votre santé (p. ex., pression artérielle) afin de s'assurer que vous êtes en bonne forme pour participer à l'étude;
- Répondre à des questionnaires qui portent sur vous, vos opinions et vos comportements;
- Compléter une entrevue portant sur vos habitudes de consommation d'alcool et de drogues;
- Faire installer autour de votre cheville le bracelet qui mesure votre consommation d'alcool;
- Accepter de porter le bracelet pendant six semaines;
- Recevoir de l'information sur le bracelet.

Ce qu'il faut savoir sur le bracelet SCRAMx (conditions d'utilisation) :

- Le bracelet SCRAMx fait une lecture de la consommation d'alcool à toutes les 30 minutes. Lors de la lecture, une vibration peut être ressentie et un son discret peut être entendu.
- Il n'est pas possible de submerger le bracelet dans l'eau.
    - Il est seulement possible de prendre une douche.

- Il vous est donc demandé de ne pas prendre de bain ou de vous baigner (dans un jacuzzi, une piscine, un lac, etc.) durant votre participation à l'étude car une telle activité détruirait le bracelet.

- Nous vous demandons de ne pas utiliser de produits contenant de l'alcool sur votre peau autour du bracelet (crème, parfum, etc.). Seuls l'eau et le savon devraient être utilisés près du bracelet. Quand vous prenez une douche, vous pouvez nettoyer la peau en-dessous du bracelet avec du savon et de l'eau et bien le sécher avec une serviette.
- Il est nécessaire d'avoir une ligne téléphonique fixe à votre domicile ou chez un proche pour pouvoir transférer l'information enregistrée par votre bracelet à l'équipe de recherche.
- Vous devez être près de la station de base, qui vous sera remise avec le bracelet, au moins une fois par jour. S'il vous arrive de ne pas être près de la station de base pendant une période de plus de 24 heures, vous pourrez transférer manuellement l'information enregistrée sur votre bracelet. L'équipe de recherche vous montrera comment faire.
- Vous devez porter vos bas par-dessus le bracelet ou en-dessous de votre cheville. Si vous trouvez le bracelet inconfortable, vous pouvez porter un bracelet éponge sous le bracelet qui mesure l'alcool. Le bracelet éponge vous sera fourni et donnera plus de soutien au bracelet.
- Le bracelet peut détecter si vous essayez de l'obstruer ou de l'enlever.
- Si vous devez recevoir un test en imagerie par résonance magnétique, veuillez nous contacter afin que nous enlevions le bracelet durant votre test.
- Nous vous demandons de rapporter le matériel de recherche (le bracelet et sa base) lors de votre deuxième rendez-vous à l'Université.

Port du bracelet

Il y a plusieurs groupes dans l'étude et vous serez assigné par notre ordinateur à l'un des groupes. Nous demandons à toutes les personnes de chaque groupe de porter le bracelet qui mesure la consommation d'alcool. Toutefois, chaque groupe aura des tâches uniques à faire durant la durée de l'étude. Vous recevrez par courriel les instructions pour votre groupe.

Au cours des six prochaines semaines, nous vous demandons de :

- Confirmez la réception des messages envoyés par l'équipe de recherche dans les 48 heures suivant la réception; vous n'avez qu'à répondre à notre message, vous n'avez pas besoin d'écrire un texte. Vous n'avez donc qu'à peser sur « répondre » et « envoyer ».

Semaine 1 :

- Porter le bracelet.
- Confirmez la réception d'un courriel qui va vous être envoyé aujourd'hui.
- Recevoir un appel par téléphone pour que nous puissions vérifier que tout se passe bien et que votre équipement (le bracelet et la station de base) fonctionne bien.

Semaines 2-5 (en plus de porter le bracelet) :

- Au début de la semaine 2, vous recevrez des instructions envoyées par courriel. Dans les instructions qui vous seront envoyées, il est possible que nous vous demandions de :
  - Réduire votre consommation d'alcool;
  - Noter votre consommation d'alcool chaque jour sur le calendrier remis lors de votre premier rendez-vous aujourd'hui à l'Université;
  - Recevoir un message texte ou un courriel à chaque jour afin que vous puissiez être informé si le bracelet que vous portez a détecté (ou non) une consommation d'alcool.

Semaine 6 (en plus de porter le bracelet) :

- Au début de la semaine 6, vous recevrez de nouvelles instructions envoyées par courriel ainsi qu'un rappel de votre deuxième rendez-vous.

Deuxième rencontre à l'Université. Au cours de cette rencontre, d'une durée maximale de 3 heures, nous vous demandons de :

- Vous présentez une dernière fois à l'Université pour faire enlever le bracelet qui a mesuré votre consommation d'alcool et rapporter la station de base;
- Répondre à des questionnaires qui portent sur vous, vos opinions et vos comportements ainsi que sur votre expérience avec le bracelet;
- Compléter une entrevue portant sur vos habitudes de consommation d'alcool et de drogues;
- Recevoir de l'information sur cette étude.

Par ailleurs :

- Au cours de la première et de la deuxième rencontre, certains questionnaires menés sous forme d'entrevue par l'agent de recherche seront enregistrés (en audio seulement); vous serez avertis avant le début de chaque enregistrement.
- À des fins de recherche, les chercheurs aimeraient obtenir votre autorisation afin d'accéder à votre dossier de conduite :
  - Si vous acceptez, vous devrez remplir un document séparé, intitulé «Autorisation de communication de renseignements personnels par la Société de l'assurance automobile du Québec.»

RISQUES ET INCONVÉNIENTS POUVANT DÉCOULER DE LA PARTICIPATION DU SUJET AU PROJET DE RECHERCHE

Il y a peu de risques associés à cette étude. Toutefois, il est possible que le bracelet qui mesure votre consommation d'alcool devienne inconfortable. Parmi les éléments pouvant causer l'inconfort : i) le non-port du bracelet éponge sous le bracelet mesurant l'alcool pourrait irriter votre peau, nous vous suggérons donc de le porter; ii) une vibration peut être ressentie et un son discret peut être entendu lors de la lecture du bracelet qui se fait à toutes les 30 minutes; iii) il n'est pas possible de submerger le bracelet dans l'eau; vous pourrez prendre une douche mais vous ne pourrez pas, par exemple, prendre un bain, nager, aller dans un jacuzzi, etc.; iv) certaines personnes curieuses au sujet du bracelet pourraient vous poser des

questions. Si vous sentez que le bracelet est inconfortable, veuillez nous appeler au 450-463-1835, poste 61480. Un agent de recherche pourra vous conseiller afin de réduire l'inconfort ou vous donner un rendez-vous pour ajuster ou enlever le bracelet.

D'autres inconvénients possibles liés à l'étude sont le déplacement pour venir à l'Université et le temps de participation au projet. Par ailleurs, pendant les séances de questionnaires et les entrevues sur vos habitudes de consommation, il est possible que la nature des questions qui vous seront posées soulève un malaise chez vous; dans un tel cas, vous pouvez décider de ne pas répondre à ces questions.

AVANTAGES

Il se peut que vous retiriez un bénéfice personnel de votre participation, mais nous ne pouvons pas le garantir. Les informations découlant de ce projet pourraient contribuer à l'avancement des connaissances dans le domaine de la prévention des blessures sur la route et nous aider à développer de meilleurs programmes de prévention dans le futur.

PARTICIPATION VOLONTAIRE ET POSSIBILITÉ DE RETRAIT DU PROJET DE RECHERCHE

Votre participation à ce projet de recherche est volontaire. Vous êtes donc libre de refuser d'y participer. Vous pouvez également vous retirer de ce projet à n'importe quel moment, sans avoir à donner de raisons, en faisant connaître votre décision à l'agent de recherche.

Par ailleurs, vous devez savoir que l'équipe de recherche peut décider d'interrompre votre participation à l'étude si elle a des raisons de croire que votre participation pourrait vous causer plus de risques que de bénéfices.

CONFIDENTIALITÉ

Durant votre participation à ce projet, le chercheur responsable ainsi que son équipe de recherche recueilleront et consigneront dans un dossier de recherche les renseignements vous concernant. Seuls les renseignements nécessaires pour répondre aux objectifs scientifiques de ce projet seront recueillis.

Les informations que vous fournirez et qui font partie du dossier de recherche, comme les réponses aux questionnaires, sont strictement confidentielles et seront codifiées par un numéro. Une autre liste de ces numéros établissant la correspondance avec votre nom, adresse et numéro de téléphone sera conservée séparément avec votre formulaire de consentement, sous clé. Seuls certains membres de l'équipe de recherche y auront accès afin de pouvoir communiquer avec vous si nécessaire. Ces données personnelles seront détruites cinq ans après la fin de la collecte qui devrait se terminer en 2014.

Seules les données ne permettant pas de vous identifier pourront être conservées par le chercheur responsable pour une durée de 25 ans. Les présentations ou publications dans des revues scientifiques qui découleront de ce projet de recherche ne permettront en aucun cas de vous identifier. Les données pourraient aussi servir pour d'autres analyses reliées au projet ou pour l'élaboration de projets de recherches futurs.

À noter : bien que toutes les informations recueillies dans le cadre de cette étude soient confidentielles, vous devez savoir que si vous indiquez à un membre de l'équipe de recherche votre intention de vous faire du mal (p. ex., suicide) ou de faire du mal à autrui, nous pourrions alors devoir communiquer cette information à un tiers parti, incluant des professionnels de la santé et les autorités compétentes afin de s'assurer de votre bien-être physique et mental en tout temps.

Vous avez le droit de consulter votre dossier de recherche pour vérifier les renseignements recueillis et les faire rectifier au besoin et ce, aussi longtemps que le chercheur responsable du projet détient ces informations. Cependant, afin de préserver l'intégrité scientifique de l'étude, vous pourriez n'avoir accès à certaines de ces informations qu'une fois l'étude terminée.

À des fins de surveillance et de contrôle, votre dossier de recherche pourrait être consulté par une personne mandatée par le Comité d'éthique de la recherche en santé chez l'humain du Centre hospitalier universitaire de Sherbrooke responsable de ce projet. Cette personne et cet organisme adhèrent à une politique de confidentialité.

COMPENSATION

Pour votre participation à ce projet de recherche, vous serez compensé de la façon suivante :

Aujourd'hui :

60 $ pour compléter les questionnaires et l'entrevue sur vos habitudes de consommation pendant votre première rencontre à l'Université de Sherbrooke.

Lors de votre rendez-vous dans 6 semaines :

- Pendant les semaines 2 à 5, vous obtiendrez une compensation si vous portez le bracelet et que vous suivez les consignes envoyées par courriel et/ou texte.
- 60 $ pour compléter les questionnaires et l'entrevue sur vos habitudes de consommation pendant votre deuxième rencontre à l'Université de Sherbrooke.
- Un bonus pour compléter l'étude et pour rapporter le matériel de recherche à l'Université (bracelet et base).
- 0,25 $ pour répondre à chaque courriel ou texte que vous recevrez de l'équipe de recherche dans les 48 heures suivant la réception; vous n'avez qu'à répondre à notre message, vous n'avez pas besoin d'écrire un texte. Vous n'avez donc qu'à peser sur « répondre » et « envoyer ».
- Pour un total possible de 385 $ lors de votre deuxième visite.
- Donc, un total possible de 445 $ pour toutes les étapes de l'étude.
- De plus, un graphique de votre consommation d'alcool détectée par le bracelet pendant les six semaines vous sera remis lors de votre deuxième rendez-vous à l'Université ou par courrier ou courriel après votre deuxième rendez-vous.

Si vous décidez de mettre fin à votre participation à l'étude, votre compensation sera établie en fonction du nombre de journées auxquelles vous aurez participé à l'étude.

DROITS DU PARTICIPANT ET INDEMNISATION EN CAS DE PRÉJUDICE

Si vous deviez subir quelque préjudice que ce soit dû à votre participation au projet de recherche, soyez avisé que vous êtes sous la protection des lois en vigueur du Québec. En acceptant de participer à cette étude, vous ne renoncez à aucun de vos droits ni ne libérez les chercheurs, le commanditaire ou l'établissement où se déroule ce projet de recherche de leurs responsabilités civile et professionnelle.

FINANCEMENT DU PROJET DE RECHERCHE

Les chercheurs ont reçu des fonds des Instituts de recherche en santé du Canada (Équipe des Instituts de recherche en santé du Canada en études transdisciplinaires sur la conduite avec capacités affaiblies) pour mener à bien ce projet de recherche.

PERSONNES-RESSOURCES

Si vous avez des questions supplémentaires, des commentaires ou des préoccupations concernant le projet de recherche, vous pouvez communiquer avec la chercheure responsable du projet, Marie Claude Ouimet, au : 450-463-1835, poste 61849.

Si vous avez des questions concernant le port du bracelet entre vos deux rendez-vous au Campus de Longueuil de l'Université de Sherbrooke, vous pouvez contacter Martin Paquette au : 450-463-1835, poste 61480.

SURVEILLANCE DES ASPECTS ÉTHIQUES

Le Comité d'éthique de la recherche en santé chez l'humain du Centre hospitalier universitaire de Sherbrooke a approuvé ce projet de recherche et en assure le suivi. De plus, l'équipe de recherche s'engage à lui soumettre pour approbation toute révision et toute modification apportée au protocole de recherche ou au formulaire d'information et de consentement. Si vous désirez rejoindre l'un des membres de ce comité vous pouvez communiquer avec le Service de soutien à l'éthique de la recherche du CHUS au numéro 819-346-1110, poste 12856.

CONSENTEMENT

Je déclare avoir lu et compris le présent formulaire d'information et de consentement, particulièrement quant à la nature de ma participation au projet de recherche et l'étendue des risques qui en découlent. Je reconnais qu'on m'a expliqué le projet, qu'on a répondu à toutes mes questions et qu'on m'a laissé le temps voulu pour prendre une décision.

Je consens librement et volontairement à participer à ce projet.

□ oui □ non

Je consens à être recontacté pour une prolongation éventuelle à cette étude

□ oui □ non

Nom du participant (lettres moulées)	Signature du participant	Date

Nom de la personne qui obtient le consentement (lettres moulées)	Signature de la personne qui obtient le consentement	Date

ENGAGEMENT DU CHERCHEUR

Je certifie qu'on a expliqué au participant de recherche les termes du présent formulaire d'information et de consentement, que j'ai répondu aux questions que le participant avait à cet égard et que j'ai clairement indiqué qu'il demeure libre de mettre un terme à sa participation, et ce, sans préjudice.

Je m'engage à respecter ce qui a été convenu au formulaire d'information et de consentement et à en remettre une copie signée au participant.

Nom du chercheur ou de son représentant (lettres moulées)	Signature du chercheur ou de son représentant	Date

ANNEX III

Grille de cotation des questions ouvertes posées aux participants à la fin de leur participation

Avantages

A aidé à contrôler ou à réduire la consommation d'alcool (CTLALCCONS)

- la consommation a été surveillée (par l'équipe de recherche) (CONSSURV)

A aidé à contrôler la consommation d'alcool au volant (CTLDWI)

A aidé à comprendre ou à réfléchir à la consommation personnelle (UNDERSTANDCONS)

A permis de recevoir une rétroaction (ou un graphique) par rapport à la consommation (CONSFEEDBACK+)

Ça peut aider en Cour (HELPCOURT)

Il n'était pas possible de falsifier les données du bracelet (FALSIFY)

A aidé à faire avancer ou améliorer:

- la science ou la recherche (HELPSCIRES)
- le système policier ou judiciaire (HELPJUD)

Peut aider les autres (dans le futur) à réduire :

- la consommation d'alcool en général (HELPOTHALC)
- l'alcool au volant (avec ou sans la technologie) (HELPDWI-HELPTECH)
- d'autres méfaits (p. ex. violence, etc.) (HELPOTHHARM)

La compensation financière (FINCOMP)

- aide à payer le permis de conduire ou d'autres frais (PAYLIC&FEES)

Pas eu d'avantages personnels à utiliser le bracelet (NOPERSADV)

Désavantages

N'a pas reçu de rétroaction dans sa catégorie ou la rétroaction était contraire à ce qui était attendu (pas assez élevée ou trop élevée) (CONSFEEDBACK-)

A rendu difficile certaines activités : (ACTDIFF)

Les sports : (SPORTS)

- la bicyclette (BIKING)
- le ski (SKIING)
- le patinage/le hockey (SKATHOCKEY)
- Autres : incluent course, football (OTHERSPORTS)

L'interaction avec l'eau :

- la baignade (piscine, la mer, le bain) (BATHING)
- le jacuzzi /le spa (JACUZZI/SPA)
- la douche (SHOWER)

D'autres activités quotidiennes : (EVERYDAYACTS)

- la marche (WALK)
- les rapports sexuels (SEX)
- le sommeil/ se coucher (SLEEP)

La technologie (du bracelet) peut être utilisée de façon négative (NEGATIVE)

L'apparence du bracelet :

- le bracelet n'est pas attrayant (UNATTRACT)
- le bracelet est gros (BIG)
- il n'est pas discret/ il est visible (VISIBLE)

Le bracelet est inconfortable : (UNCOMFORT)

- parce qu'il est encombrant (ENCOMBR)
- parce qu'il interfère avec mon emploi (JOBINTERF)
- parce qu'il est lourd (HEAVY)
- parce qu'il est présent 24/24, ne peut être enlevé (NOREMOVE)
- parce qu'il peut provoquer la vérification récurrente de l'objet, des piles (CHECKING)
- à cause du matériel plastique ou caoutchouc (MATERIAL)
- à cause de la vibration (VIBRATION)
- à cause du frottement ou du contact avec la peau (RUBBING/CONTACT)
- à cause des démangeaisons qu'il peut provoquer (ITCHY)
- au début de l'étude (les premiers jours) (STUDYSTART)
- à la fin de l'étude (les derniers jours) (STUDYEND)

Inconfort par rapports aux vêtements :

- bottes (BOOTS)
- pantalons (PANTS)
- sandales (SANDALS)
- bas (SOCKS)

Saison, vêtement et cacher le bracelet

- short; été; n'aurait pas participé à l'été; a provoqué une tendance à l'évitement, à dissimuler le bracelet ou au camouflage sous les pantalons (SHORTS-ÉTÉ-HIDE)

C'est un objet tolérable, facile à s'y habituer, pas tellement inconfortable (TOLERABLE)

Des contraintes reliées à l'utilisation d'une ligne téléphonique pour utiliser le bracelet (RESTEL)

Nécessaire d'être en contact régulier avec la station de base (REGCONT)

Aspects sociaux liés au port du bracelet

- A provoqué de la curiosité, on s'explique devant les autres (CURIOS/EXPL)
    - des proches (EXPLAINCLOS)
    - au travail (EXPLAINWORK)
    - des inconnus (EXPLAINSTR)
- A suscité des préjugés (PREJUDICE)
- A suscité des rétroactions positives (POSFEEDB)
- A suscité des blagues ou on le trouve drôle (HUMOR)
- A évoqué quelqu'un qui est en prison ou sous surveillance (SURVEILL)
- A évoqué un alcoolique (ALCOHOLIC)
- A évoqué un GPS (GPS)