BAC Classification as Predictor of DUI Recidivism in the Context of Offenders' Demographic, Criminal, and Behavioral Characteristics

This project assessed the risk of DUI recidivism attributable to regularly used BAC classifications while controlling offenders' demographic, criminal, and behavioral profiles. Observations were drawn from the Florida Driver Risk Inventory (DRI; Behavior Data Systems, Ltd., 1985) online database collected between 2009 and 2010 (*N* = 56,190). Cox regression analyses revealed that low BAC was associated with increased recidivism rates and follow-up multinomial logistic regression analyses indicated probable underage drunk driving and drug use among offenders with low BAC. The study's implications, limitations, and future directions are noted. This study was funded by Behavior Data Systems, Ltd.

Keywords: DUI recidivism, Blood alcohol content, Driver Risk Inventory, Florida, Cox regression, Multinomial logistic regression

Glossary

Driver Risk Inventory (DRI) - The DRI is a DUI/DWI offender assessment instrument developed by Behavior Data Systems, Ltd. The DRI test booklet contains 140 items contributing to five scales (alcohol use risk, driver risk, drug use risk, stress risk, and truthfulness) as well as reformatted DSM-IV substance abuse and dependency classifications. The DRI is Florida's statewide DUI offender test and numerous other states mandate or require the DRI for their DUI/DWI offender testing.

Blood alcohol content (BAC) classification - Blood alcohol content (BAC) is conventionally measured as the percent of alcohol in whole blood. All 50 US States enforce illegal *per se* laws where driving a motor vehicle with a BAC at or above .08% is illegal. BAC classifications are the thresholds commonly used by law enforcement to identify DUI offenders' level of intoxication by alcohol, and include offenders who were arrested for DUI with BAC levels below .08% or who refused the BAC test.

Cox regression – Cox regression is a semi-parametric statistical method estimated through maximum partial likelihood used for studying event outcomes and their timing.

Multinomial logistic regression – Multinomial logistic regression is a method for predicting an un-ordered categorical variable using individual-level characteristics.

Declaration of Interest

There exists a possible conflict of interest in the funding of this project. This manuscript was produced under an employment contract between myself, Nicholas Bishop, Ph.D., and the developer of the DRI, Behavior Data Systems, Ltd. Behavior Data Systems, Ltd. or representatives of the state of Florida in no way suggested nor informed the research design or statistical methods used in this study. The manuscript was not reviewed by representative of Behavior Data Systems, Ltd. or the state of Florida before submission for review. These statements can be confirmed by Behavior Data Systems, Ltd. who can be contacted at:

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INTRODUCTION

The identification of individuals arrested for driving under the influence of alcohol and/or drugs (DUI) is an international public health concern (Peden et al., 2004), with nearly 32% of annual traffic fatalities in the United States being alcohol related (NHTSA, 2010a) and drugs being found in 5 to 25% of American drivers involved in motor vehicle accidents (Kelly et al., 2004). Measurement of blood alcohol concentration (BAC) at time of arrest for DUI is a central tool for law enforcement, but BAC cannot inform decisions in DUI cases where the offender refuses the BAC test or when the arrest involves underage drinking or drugs where the collected BAC value can be below national illegal *per se* levels. Being arrested for DUI with a BAC within legal driving limits, having a high BAC, or refusing to submit to a BAC test at time of arrest have been associated with DUI recidivism (Marowitz, 1996, 1998), as have multiple demographic, criminal, and behavioral characteristics (Nochajski and Stasiewicz, 2006). The risk of recidivism has not been previously assessed using categorical BAC classifications commonly used by law enforcement for the identification and processing of DUI offenders, nor have extant studies included measures of offenders' demographic, criminal, and behavioral characteristics when predicting BAC classification at time of arrest.

This project assessed the risk of DUI recidivism attributable to BAC classification in the context of offenders' characteristics and examined how offenders' profiles were associated with their BAC classification at time of arrest. Using the Driver Risk Inventory (DRI; Behavior Data Systems, Ltd., 1985) online database provided by the state of Florida, offenders' BAC classification was initially tested as a predictor of DUI

recidivism in combination with demographic, criminal history, and behavioral measures. Cox regression analyses revealed that offenders with low BAC (between .00 and .07%) were more likely to be identified as recidivists than those with moderate (.08 - .14%) or severe BAC (≥ .15%), as well as those who refused to submit to a BAC test at time of arrest. Follow up analyses used offenders' characteristics to predict membership in the low BAC category relative to high-risk offenders with severe BAC or who refused the BAC test, with results suggesting that being under legal drink age and drug use were the measures most closely associated with membership in the low BAC group. These findings indicate that those arrested for DUI with low BAC were at an especially high risk of re-arrest and suggest that among offenders arrested for DUI with a BAC below national illegal *per se* limits, rehabilitative efforts should focus on reducing underage drunk driving and drug use.

Blood Alcohol Content and DUI Recidivism

Blood alcohol content (BAC) is conventionally measured as the percent of alcohol in whole blood and all 50 States in the US enforce illegal *per se* laws where driving a motor vehicle with a BAC at or above .08% is illegal. Numerous states also enforce harsher penalties for drivers with a BAC at or above a threshold indicative of severe or extreme DUI. If an officer has probable cause for arresting a driver suspected of DUI, the offender will be asked to submit to a test of their BAC, typically through breath but sometimes through urine or blood (Berning et al., 2007). For offenders who consent to a BAC test and are assumed to be under the influence of alcohol alone, BAC is a convenient and reliable measure of intoxication. Blood alcohol content has been

consistently associated with driving-related skills (Kelly et al., 2004) and risk of fatal traffic accidents (Zador et al., 2000). Blood alcohol content has also been associated with DUI recidivism (Marowitz, 1996, 1998; C'de Baca et al., 2002), although the relationship between BAC and DUI recidivism is equivocal (Nochajski and Stasiewicz, 2006). The BAC of a driver arrested for DUI can be a crucial piece of evidence used for sentencing the DUI offender, but confounding factors reduce the ability to completely rely on BAC as an indicator of intoxication.

A factor limiting the use of BAC at time of arrest as evidence of DUI and predictor of future outcomes is that offenders have the legal right to refuse to have their BAC tested, although refusals typically result in license sanctions (Berning et al., 2007). Also, the BAC test is most informative in cases where the offender has been consuming only alcohol, but in many cases offenders may be driving under the influence of drugs (DUID) or a combination of alcohol and drugs. With offenders' ability to refuse to provide a BAC, and a variety of intoxicating substances potentially responsible for DUI, BAC classification at time of arrest embodies a number of complexities that can make the use of BAC as grounds for prosecution and intervention less than optimal.

Those who refuse to submit to a BAC test at time of arrest are a distinct group of DUI offenders. Individuals who refuse the BAC test are more likely to be identified as recidivists than test-takers (Marowitz, 1998; Nochajski and Wieczorek, 2000). The percentage of people who refuse to submit to a BAC test varies across states, and as of 2005, Florida had one of the highest refusal rates in the United States (Berning et al., 2007). While the administrative and legal sanctions for those who refuse are often strictly enforced, the lack of information created when a BAC test is refused becomes a problem

for those responsible with the sentencing and treatment of the DUI offender.

Those arrested for DUI with blood alcohol concentrations below illegal *per se* limits are typically below the age of 21 or under the influence of drugs. It is illegal for any driver under the age of 21 to have any alcohol in their system, which is generally defined as a BAC of .02% or greater (DuPont et al., 2011). Underage drivers have been found to be especially susceptible to the effects of alcohol on driving (Peck et al., 2008). Regardless of age, a BAC of .00% among those arrested for DUI is a probable indicator of drug intoxication (Marowitz, 1998), with nearly 90% of drivers arrested for DUI with a BAC of .00% testing positive for drugs (Phillips, 1995). In the United States during 2009, 18% of all fatally injured drivers tested positive for drugs other than alcohol, with the percent attributable to drugs in only those cases with known test results increasing to 33% (NHTSA, 2010b). To add to the complexities of assessing intoxication through BAC, alcohol and drugs are often consumed together, with interactions between drugs and alcohol being linked to risk of involvement in various types of crashes (Romano and Voas, 2011) and poly-drug use being common among drivers involved in accidents (Kelly et al., 2004).

Findings on the relationship between BAC at time of arrest and future DUI related outcomes suggest that BAC classification at time of arrest can be a proxy for multiple risk factors for DUI recidivism, including intoxication by alcohol, drugs, or underage drunk driving. Analyzing BAC as a categorical variable allows explicit comparisons regarding the risk of recidivism among offenders across the different BAC classifications and makes it possible to include cases who have missing values on the BAC test not attributable to refusal; a problem that has been explored at length elsewhere (Berning et

al., 2008; Subramanian, 2002). Additionally, using BAC thresholds commonly utilized by law enforcement to sentence the DUI offender provides practical information on the utility of BAC classifications in identifying potential recidivists and allows the examination of characteristics that place offenders at differential risk for falling within the various BAC classifications.

Characteristics of DUI Recidivists

Studies focusing on the relationship between BAC and DUI recidivism can benefit from including measures controlling for offenders' characteristics previously associated with risk of re-arrest. Examining the capacity of BAC to predict recidivism with controls for offenders' demographic, criminal, and behavioral profiles provides a stricter test of the relationship between BAC and later re-arrest, as well as gives prosecutors and clinicians additional information on what characteristics should be of focus when processing DUI offenders.

A number of demographic and criminal history characteristics have been related to the risk of DUI recidivism. Age, gender, race/ethnicity, education, and marital status have each been associated with DUI recidivism (Nochajski and Stasiewicz, 2006). Multiple DUI offenders are more likely to have poor driving records, be involved in more traffic accidents, and have more non-driving criminal offenses than their single-DUI counterparts (Nochajski and Stasiewicz, 2006). Demographic and criminal history measures represent information commonly available to law enforcement agencies and are often used to inform the sentencing and rehabilitation of offenders.

Beyond offenders' demographics and criminal history, a number of behavioral factors have been associated with DUI recidivism. Alcohol and drug use patterns represent a set of behaviors closely tied to DUI and DUI recidivism. The severity of alcohol use problems are associated with frequency of use, quantities consumed, and the consequences of alcohol use (Maisto and Saitz, 2003). While drug use cannot be directly compared to alcohol use due to its illicit nature, drug use severity varies by the types of drugs used, frequency of use, amounts consumed, and outcomes associated with drug use.

Other behavioral characteristics associated with DUI recidivism include driving habits and ability to manage stress. DUI recidivists have more traffic related offenses than non-recidivists (Nochajski and Stasiewicz, 2006). Poor driving habits not identified by driving records such as aggressive driving and speeding make the individual more likely to be identified by law enforcement, and when paired with previous alcohol and/or drug consumption, increase the chances of being arrested for DUI. Psychiatric disorders have been associated with likelihood of DUI recidivism (Lapham et al., 2001), and amounts of perceived stress and stress coping abilities have been related to driving under the influence (Bradstock et al., 1987).

Research Questions

Blood alcohol content at time of arrest represents an indicator of intoxication for those suspected of driving under the influence of alcohol, but the potential for BAC test refusal, underage drunk drivers, and drugged driving present problems that make BAC an imperfect predictor of future DUI arrests. The first priority of this research was to assess if BAC classifications commonly used by law enforcement were associated with DUI

recidivism while controlling for the demographic, criminal, and behavioral measures that have been previously associated with risk of drunk driving and DUI recidivism. To elaborate on the results provided by the analysis of DUI recidivism, the demographic, criminal history, and behavioral measures included in the DRI were used to examine what offender characteristics were able to differentiate between offenders found to be at the greatest risk of DUI recidivism. The combination of these research goals will provide evidence of the differential risk of DUI recidivism associated with BAC classification at time of arrest and the individual attributes that predict an offender's BAC classification at time of arrest.

METHOD

To examine the relationship between BAC classification, DUI recidivism, and the demographic, criminal, and behavioral profiles of DUI offenders, this study used data collected by the state of Florida between January 1st, 2009 and December 31st, 2010 using the Driver Risk Inventory (DRI; Behavior Data Systems, Ltd., 1985). Observations were taken from the online Florida DRI database held by Behavior Data Systems, Ltd., in cooperation with Florida's Bureau of Driver Education DUI program. All DUI offenders in Florida are mandated to complete the DRI. DUI offenders complete the DRI at private agencies using a computer or they complete the DRI in a pencil-and-paper format with the test administrator inputting answers from the offender's answer sheet into the online DRI database. Offenders included in analysis were arrested for DUI regardless of whether they were formally charged for DUI or their case was plea-bargained to a reduced charge. The Florida Alcohol Testing Program enforces implied consent laws and

data collected using the DRI is HIPAA compliant (federal regulation 45 C.F.R. 164.501).

Data Cleaning and Defining Recidivism

Offenders included in the study completed an online DRI test between January 1st, 2009 and December 31st, 2010, while actual arrest dates ranged from January 17th, 2004 to December 27th, 2010. On average, 252 days elapsed between DUI arrest and completion of the DRI.

The initial online DRI-II database contained 82,357 cases. DRI materials indicate that offenders with a truthfulness score at or above the 90th percentile have invalidated their responses, thus these offenders were removed from the dataset (n = 9,905). Offenders were also removed if they provided an invalid or missing driver's license number (n = 5,200) or had more than 5 years between DUI arrest and completion of the DRI (n = 6,499). Also, cases identified as duplicates but that shared the same DUI date were removed (n = 903). Finally, cases with missing values in predictor variables were removed (n = 3,660). The final dataset contained 56,190 offender observations.

BAC Classification

BAC classification was examined as a predictor of DUI recidivism and was used as the outcome variable in follow-up analyses. When completing the Florida DRI, individuals self-report their BAC at time of arrest. BAC classification consisted of five-categories. Three categories captured those who provided valid BAC measures on their DRI (.00 - .07%, .08 - .14%, .15% and above), one category for offenders who reported that they had refused to submit to a BAC test at time of arrest, and finally, one category

for offenders who had a missing BAC value not attributable to refusal.

Independent Variables

DRI Scales: The DRI collects offenders' self-reports of demographic characteristics, criminal history, and 140 responses used to develop 5 percentile scales including alcohol use risk, driving risk, drug use risk, stress risk, and truthfulness, in addition to reformatted substance abuse and dependence classification scales derived from the DSM-IV (American Psychiatric Association, 2000). The DRI has been shown to have adequate concurrent validity for identifying alcohol use disorders or problem drinkers and all DRI scales show acceptable reliability ($\alpha > .80$; Chang et al., 2002). The DRI has been criticized as not being sufficiently validated (Change et al., 2002; Popkin et al., 1988) though recent studies have shown the DRI to distinguish between first and multiple DUI offenders (Bishop, 2011a) as well as identify rapid DUI recidivists (Bishop, 2011b). The Behavior Data Systems, Ltd. website (www.bdsltd.com) provides more information on the DRI and the DRI test booklet can be viewed at www.online-testing.com.

DRI behavioral scales included in analyses measured offenders' risk regarding alcohol use, drug use, driving habits, and stress coping. Individual scores on each scale item were summated with DRI truthfulness percentile scores being used to adjust raw scores. The DRI truthfulness scale attempts to identify offenders who intentionally minimize the severity of their responses. Truth-adjusted raw scores were transformed to a percentile score relative to all other offenders in the dataset.

For each DRI scale, percentile scores between 0 and 39% represent low risk, percentile scores between 40 to 69% represent medium risk, scores between 70 and

89% represent problem risk, and those with percentile scores between the 90th and 99th percentile are identified as having a severe problem concerning the given scale topic (Behavior Data Systems, Ltd., 2007). The DRI alcohol risk, drug risk, driver risk, and stress risk percentile scores were coded according to these risk levels, with the low risk group in each scale being used as the reference category in all analyses.

The DRI alcohol risk scale identifies the severity of respondents' alcohol abuse. Alcohol is defined as beer, wine, and other liquors. History of alcohol use and abuse are part of the alcohol risk scale, helping to differentiate between those who currently abuse alcohol and those who had an alcohol use problem but currently abstain from use. The DRI drug risk scale measures severity of drug use, with drugs being defined as marijuana, crack, cocaine, amphetamines, methamphetamines, barbiturates, and heroin. The DRI drug scale also takes special measures to differentiate between current and recovering drug users. The DRI driver risk scale captures offenders' driving risk, measuring the respondent's aggressiveness and attitude towards driving. The National Highway Traffic Safety Administration reports that the DRI is the only major DUI/DWI test that measures driver risk (Popkin et al., 1988). Finally, the DRI stress coping risk scale measures the offender's ability to cope effectively with stress, tension, and pressure.

The reformatted DSM-IV substance abuse and dependency classifications in the DRI distinguish between offenders with non-pathological substance use behaviors and offenders with substance abuse or dependency problems. If a DUI/DWI offender admits to one of the four substance abuse symptoms, the offender is classified as a substance abuser. If the respondent admits three of the seven substance dependency symptoms, the offender is classified as substance dependent. If an offender is identified with both

substance abuse and substance dependency problems, the offender is only identified as substance dependent.

Demographic and Criminal History Variables: Demographic measures included age, dichotomized to represent offenders under the legal drinking age (0 = 21 years or older, 1 = less than 21 years old), gender (0 = female, 1 = male), race/ethnicity (White, Black, Native American, and Hispanic, using White as the reference group), education (less than a high school degree, high school graduate/GED, some college/trade school, and college graduate/advanced degree, with less than high school degree as the reference group) and marital status (single, married, divorced, and separated/widowed, using single as the reference group). Individuals were asked if there was an accident in the current DUI arrest (0 = no, 1 = yes). Criminal-history variables included number of at-fault motor accidents, moving violations, misdemeanor or felony arrests not related to alcohol or drugs, and non-driving alcohol or drug arrests 5 years prior to current arrest. These variables were dichotomized (0 = no offense, 1 = 1 or more offense).

Data Analysis

The relationship between DUI recidivism, BAC classification, and measures included in the DRI was initially assessed using a Cox proportional hazards model. The exact method of approximating rank order was used for ties and the assumption of proportional hazards was satisfied. Exposure to the risk of recidivism began on the date of offenders' first arrest with failure occurring at the date of second arrest. Offenders not found in the dataset twice by December 31st, 2010 were considered censored.

To build on the results of the Cox regression, follow-up analyses included testing for interactive effects in the model predicting recidivism and using the DRI variables to predict BAC classification at time of arrest for offenders in high-risk BAC categories. Maximum-likelihood multinomial logistic regression was used to understand how the demographic, criminal history, and DRI behavioral measures were associated with blood alcohol classification at time of arrest for those with low BAC (.00 - .07%), severe BAC (≥ .15%), and those who refused the BAC test. Offenders with a low BAC were used as the reference category in the multinomial logit analysis. Due to the risk of specious precision associated with the large sample size under analysis, only variables that were statistically significant at the $p < .001$ were deemed meaningful predictors in the logit models. All statistical procedures were completed using SAS version 9.2 (SAS Institute Inc., 2008).

RESULTS

Table 1 provides descriptive statistics for the demographic and criminal history variables included as controls in the Cox regression analyses, and Table 2 presents descriptive statistics for the outcome of recidivism, the DRI scales, and the reformatted DSM-IV classifications. Due to length restrictions, only the descriptive statistics related to DUI recidivism are discussed here.

Of the 56,190 offenders included in analyses, 555, or approximately 1%, were identified as recidivists. For those identified as recidivists, an average of 270 days separated the first and second DUI arrest ($M = 269.94$, $SD = 277.23$). For non-recidivists, an average of 630 days fell between initial arrest and censoring ($M = 629.89$, $SD =$

349.43). Concerning BAC at time of arrest, about 8% of offenders were classified with low BAC, 16% were classified with moderate BAC, and 32% were classified with a BAC at or above .15%. Around 29% of offenders refused the BAC test at time of arrest, and 15% of offenders had a missing value for BAC.

Cox Regression Results

Cox regression models were used to estimate whether BAC classification was able to identify DUI recidivists in models controlling for demographic, criminal, and behavioral measures. An initial model controlling for offenders' demographic, criminal, and behavioral characteristics was produced to assess the baseline fit of the model without BAC classification (Model 1), followed by a model including, in addition to all variables in Model 1, the BAC classification (Model 2). Table 3 presents the hazard ratios for significant predictor variables, corresponding significance values, 95% confidence intervals, as well as likelihood ratio chi-square tests and degrees of freedom for each test.

Beginning with Model 1, being under the age of 21 and reporting an accident in the current arrest were the only demographic and criminal history variables associated with likelihood of recidivism. Individuals who were underage at their first arrest had a recidivism rate 64% greater than those age 21 or over at time of first DUI arrest (HR = 1.64, CI [1.22, 2.20]). Offenders reporting an accident in their first arrest had 29% lower recidivism rate than those not reporting an accident in the initial arrest (HR = 0.71, CI [0.56, 0.89]). Those identified with substance abuse problems according to the reformatted DSM-IV classification had a predicted rate of recidivism 34% greater than

offenders not classified with substance abuse problems (HR = 1.34, CI[1.10, 1.63]), and those classified as substance dependent had a 50% greater recidivism rate than those without identified substance dependency issues (HR = 1.50, CI [1.14, 1.98]).

Model 2 was used to asses the predictive capacity of BAC classification in the context of controls for offenders' demographic, criminal, and behavioral characteristics. The addition of BAC classification significantly improved the fit of the predictive model compared to the baseline model ($\chi^2_{diff} = 10.09$, $df_{diff} = 4$, $p < .05$). Compared to those with a BAC below nationally recognized illegal *per se* limits, the rate of recidivism for individuals with a moderate BAC was 30% lower (HR = .70, CI [0.51, 0.97]), for those with a severe BAC 30% lower (HR = .70, CI [0.52, 0.94]), and for those who refused the BAC 40% lower (HR = .60, CI [0.44, 0.81]), than those with a low BAC, respectively.

With the addition of BAC classification, the demographic, criminal, and behavioral measures found to be significant predictors of recidivism in the baseline model remained significant with the DRI alcohol risk scale emerging as a significant predictor of recidivism. Underage drivers arrested for DUI continued to have higher rates of recidivism than offenders of legal drinking age, and those reporting an accident in the initial arrest continued to have lower recidivism rates than those not reporting an accident. Those with medium alcohol risk were at 29% greater odds, and those with problem alcohol risk were at 37% greater odds of being identified as recidivists, than offenders with low alcohol risk, respectively (Alcohol risk medium HR = 1.29, CI [1.02, 1.64]; Alcohol risk problem HR = 1.37, CI [1.03, 1.83]). The reformatted DSM-IV classifications remained significant predictors of recidivism, with the addition of BAC classification producing virtually no change in the magnitude of these estimates.

Follow-Up Analyses

Complimentary analyses were undertaken to support the Cox regression results. Interactions between BAC classification and all variables were tested with no significant interactions found. To provide supporting information for the finding that those with low BAC were generally more likely to be identified as DUI recidivists, multinomial logistic regression including all variables in the final Cox regression model was used to estimate the likelihood of providing a low BAC measurement at time of arrest compared to a severe BAC or a BAC refusal, groups that have been previously identified with a high risk of DUI recidivism. The low BAC group was used as the reference group in both models.

Low BAC versus Severe BAC: A number of demographic and criminal history variables were able to distinguish between membership in the low BAC and the severe BAC classes (Table 4, Model 1). Underage individuals had 50% greater odds of being found in the low BAC than the severe BAC category (OR = .50, CI [0.44, 0.56]). Hispanics were more likely than Whites to be found in the low BAC group, and college graduates were more likely than those without a high school degree to be found in the severe BAC group. Those who were separated or widowed were more likely than those who were single to be found in the severe BAC categories. For measures of criminal history, offenders reporting an accident in the current arrest were more likely to be found in the severe BAC group than the low BAC group. Having a previous felony or drug-related arrest was associated with greater likelihood of having a low BAC.

The DRI alcohol, drug, driving, and stress risk scales distinguished between membership in the low versus severe BAC classes. Increasing alcohol risk was associated with greater likelihood of membership in the severe BAC group, where those with severe alcohol risk were at 420% greater odds of being found in the severe than the low BAC group (OR = 5.20, CI [4.51, 5.99]). Increasing drug risk was negatively associated with measured BAC at time of arrest, where those with severe drug risk were at 79% lower odds of being in the severe BAC group than the low BAC group (OR = .21, CI [0.19, 0.24]). Increased driver risk was associated with greater likelihood of membership in the low BAC group, where offenders with increased stress risk were more likely to be found in the severe BAC group. Regarding the reformatted DSM-IV substance abuse and dependence classifications, those classified with a substance abuse problem were more likely to have had a severe BAC than a low BAC at time of arrest.

Low BAC versus BAC Refusal: A number of measures were also able to distinguish between membership in the low BAC versus BAC refusal classes (Table 4, Model 2). For demographic variables, underage individuals were at 75% lower odds of being in the group who refused the BAC test (OR = .25, CI [0.22, 0.28]). Males were more likely than females to have refused the BAC test than to have provided a low BAC at time of arrest. Offenders who were White were more likely than offenders of all other race/ethnicities to have refused the BAC. Those who had graduated college were more likely to have refused the BAC test than to those with less than a high school education, and offenders who were divorced were more likely to have refused the BAC than offenders who were single.

For criminal history variables, those reporting previous at-fault accidents were less likely to have refused the BAC test than to have tested with a low BAC. Past misdemeanor arrests increased the likelihood of being in the group who refused the BAC test, where those with past felony arrests were more likely to be found in the low BAC group. Previous alcohol-related arrests were associated with greater odds of being found in the refused BAC class, where previous drug arrests were associated with greater odds of being in the low BAC class.

The DRI alcohol, drug, and stress risk scales and reformatted DSM-IV classifications were significant predictors when comparing the low BAC and refused BAC classes. Increasing alcohol risk was associated with greater odds of refusing the BAC test, where increasing drug risk was associated with greater odds of being in the low BAC group. For example, those with severe alcohol risk had 227% greater odds of being in the refused BAC than the low BAC groups (OR = 3.27, CI [2.83, 3.78]), where those with severe drug risk had 69% lower odds of being found in the refused BAC group (OR = .31, CI [0.27, 0.35]). Those with increased stress risk were at greater odds of being found in the refused BAC group.

DISCUSSION

This study assessed the risk of DUI recidivism attributable to BAC classification while controlling for offenders' demographic, criminal, and behavioral characteristics. Results indicated that those who provided a BAC measurement below national illegal *per se* levels were more likely to be re-arrested for DUI than offenders with moderate or severe BAC, as well as those who refused to submit to the BAC test. Follow-up analyses

suggested those arrested for DUI with low BAC values were more likely to be under the age of 21 and have drug-related criminal history and behavioral drug use problems. Due to the nature of the database providing observations for the study, a relatively small proportion of offenders were identified as recidivists. Discussion of these findings is followed by a description of the limitations and future directions of this research.

In the Florida online DRI dataset, offenders with BAC values below illegal *per se* limits were more likely to be identified as recidivists than practically all other BAC classifications. It is especially noteworthy that offenders with low BAC at initial arrest had a higher rate of recidivism than offenders with BAC values at or above .15 % who are considered and prosecuted as severely intoxicated. Previous studies of BAC and DUI recidivism have found a similar recidivism rate for those with low BAC and those with a severe BAC (Marowitz, 1996, 1998). Being under legal drinking age at time of arrest was associated with increased risk of recidivism and likelihood of having a low BAC at time of arrest. Results from the multinomial logit models also suggest that those with low BAC at time of arrest were more likely to have criminal history and behavioral issues associated with drug use. These findings suggest that those arrested for DUI with BAC levels below illegal *per se* limits are an especially high-risk group of offenders whose characteristics of underage drinking and drug use warrant special attention since these factors may be placing the offender at greater risk of re-arrest.

Individuals arrested for DUI who were under legal drinking age in the United States were more likely to be identified as recidivists and were more likely to be arrested with a low BAC than a severe BAC or to have refused the BAC test. Underage drinkers who drive have been found to be more susceptible to the effects of alcohol on

driving than those of legal drinking age (Zador et al., 2000; Peck et al., 2008) and age is consistently shown to be negatively related to number of lifetime DUI arrests (C'de Baca et al., 2001). Adding complexity to the issue of underage DUI offenders and recidivism, young drivers have been found to be more likely to be under the influence of drugs while driving than the influence of alcohol (Fergusson et al., 2008).

Offenders' drug-use severity was potentially the second-most identifiable characteristic of the group of offenders with low BAC at arrest, although drug-related variables did not predict recidivism directly. When predicting recidivism, significant interactions between underage status and drug use severity or drug-related criminal history were not found, but the independent associations between age, drug-use behavior, and BAC classification do suggest that both underage status and drug use problems are placing offenders in the BAC category with the highest risk of recidivism.

Other than BAC at time of arrest, few demographic, criminal history, and behavioral indicators were significantly associated with the likelihood of recidivism. The DRI alcohol risk scale, measuring alcohol use severity, was able to identify between recidivists and non-recidivists, and highlights the direct relationship between alcohol use severity and DUI recidivism. Both the reformatted DSM-IV substance abuse and dependency classifications were significantly associated with recidivism, indicating the need for those with reckless alcohol use behaviors or problems with alcoholism to receive special assessment and rehabilitative measures to reduce the potential for future DUI arrests. In combination with BAC classification at time of arrest, information provided by the DRI alcohol risk scale and substance abuse and dependence classifications can provide law enforcement and administrators of remedial education

programs an indication of an offender's potential for re-arrest, and therefore develop suitable responses to their specific needs.

Limitations and Future Directions

A limitation of this research was the low rate of recidivism identified in the Florida DRI online database, meaning the Cox regression analysis may have been under-powered to detect the true predictive capacity of the measures included. The dataset analyzed represents only offenders who completed the DRI within a two-year interval, meaning the majority of individuals in the dataset had less than 2 years to be identified as recidivists. Also, the average time between arrest and completion of the DRI was around 252 days, meaning those arrested for DUI in 2010 were unlikely to be observed in the analytic dataset. In light of this limitation, this study is scheduled to continue up to 2017, representing 9-years of Florida DUI offenders who complete the online DRI. In cooperation with the state of Florida, this effort will provide a source of data allowing predictors of DUI recidivism to be studied over extended periods of time.

The use of the Florida online DRI database for a study of DUI recidivism differs from datasets used by other studies that have found greater rates of DUI recidivism (Lapham, Skipper, and Simpson, 1997; C'de Baca, Miller, and Lapham, 2001). For the observations available in the Florida online DRI database, no single testing agency was responsible for the entry of offenders' observations into the database, but multiple agencies across the state entered data throughout the measurement interval. Offenders completed the DRI on a computer or filled out a paper-and-pencil test which was later input into the database by an agency administrator, with both processes potentially introducing error into the drivers' license numbers used to identify offenders as

recidivists. The decentralized nature of the Florida online DRI database and the potential for errors in the entry of identifying information each likely contributed to the relatively low rate of recidivism observed in this study.

The results reported here show that even in a setting where analyses were potentially underpowered to identify predictors of recidivism, a number of measures were able to successfully identify recidivists. Future elaboration of this work will employ longer intervals of measurement and advanced record matching techniques to increase the identification of recidivists in the Florida DRI database with the end goal of contributing to the reduction of DUI recidivism through the identification of offender characteristics consistently found to influence the likelihood of re-arrest.

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Table 1: Descriptive statistics for demographic and criminal history measures among Floridian DUI offenders, 2009-2010

	%	Mean	SD
Age		36.03	12.46
Under 21 years old	6.51		
Male	72.70		
White	72.82		
Black	8.43		
Hispanic	15.84		
Other race/ethnicity	2.90		
Less than HS degree	11.46		
HS degree/GED	42.92		
Some college/trade school	24.60		
College graduate	21.02		
Single	56.99		
Married	20.43		
Divorced	16.50		
Separated/Widowed	6.08		

Accident in arrest		19.92		
At-fault traffic accidents	(% with 1 or more)	(21.03)	0.26	0.58
Moving violations	(% with 1 or more)	(48.01)	1.04	1.61
Alcohol arrests	(% with 1 or more)	(9.64)	0.14	0.54
Drug arrests	(% with 1 or more)	(8.24)	0.12	0.46
Misdemeanor Arrests	(% with 1 or more)	(0.20)	0.31	0.79
Felony Arrests	(% with 1 or more)	(0.10)	0.15	0.56

*Note*s: $N = 56{,}190$.

Table 2: Descriptive statistics for DUI recidivism, BAC classification, and behavioral measures among Floridian DUI offenders, 2009-2010

		%	Mean	SD
Recidivism Descriptives				
Identified Recidivists		00.99		
Time b/w DUI arrest for recidivists			269.94	277.23
Censoring time for non-recidivists			629.89	349.43
Time b/w DUI arrest and completing DRI			252.22	280.86
Blood Alcohol Classification				
Low BAC	(.00 - .07%)	7.84		
Med BAC	(.08 - .14%)	15.78		
Severe BAC	(≥ .15%)	32.17		
Refused BAC test		28.80		
Missing BAC test		15.40		
DRI Risk Scales				
Alcohol Risk Percentile			0.50	0.30
Low risk	(0-39%)	34.89	0.53	0.29
Medium risk	(40-69%)	32.76		
Problem risk	(70-89%)	15.03		

Severe risk	(90-99%)	17.31		
Drug Risk Percentile			0.52	0.30
Low risk	(0-39%)	35.86		
Medium risk	(40-69%)	29.16		
Problem risk	(70-89%)	17.88		
Severe risk	(90-99%)	17.10		
Driver Risk Percentile			0.53	0.30
Low risk	(0-39%)	36.43		
Medium risk	(40-69%)	32.67		
Problem risk	(70-89%)	13.90		
Severe risk	(90-99%)	17.01		
Stress Risk Percentile			0.44	0.30
Low risk	(0-39%)	46.57		
Medium risk	(40-69%)	27.87		
Problem risk	(70-89%)	18.38		
Severe risk	(90-99%)	6.31		
DSM-IV Classifications				
Substance abuse		42.38		
Substance dependency		14.44		

*Note*s: $N = 56{,}190$.

Table 3: Hazard ratios for DUI recidivism among Floridian DUI offenders by BAC classification and behavioral risk measures, 2009 - 2010

	Model 1		Model 2	
	HR	[95% CI]	HR	[95% CI]
BAC Classification				
Moderate BAC at arrest			0.70*	[0.51, 0.97]
Severe BAC at arrest			0.70*	[0.52, 0.94]
Refused to provide BAC			0.60***	[0.44, 0.81]
Missing BAC value			0.75†	[0.55, 1.03]
Demographics and Criminal History				
Underage	1.64**	[1.22, 2.20]	1.56**	[1.16, 2.09]
Accident in current arrest	0.71**	[0.56, 0.89]	0.70**	[0.56, 0.89]
Previous at-fault accidents	1.20†	[0.97, 1.48]	1.19	[0.97, 1.47]
Previous felony arrests	1.25†	[0.96, 1.61]	1.24	[0.95, 1.60]
DRI Risk Scales				
Alcohol risk medium	1.28†	[1.01, 1.62]	1.29*	[1.02, 1.64]
Alcohol risk problem	1.33†	[1.00, 1.78]	1.37*	[1.03, 1.83]
Alcohol risk severe	1.31	[0.95, 1.82]	1.38†	[0.99, 1.91]
DSM-IV Classifications				
DSM-IV Substance abuse	1.34**	[1.10, 1.63]	1.34**	[1.10, 1.63]
DSM-IV Substance dependency	1.50**	[1.14, 1.98]	1.49**	[1.13, 1.97]
χ^2 (*df*)	62.01**(32)		72.91*** (36)	

Notes: $N = 56{,}190$. Low BAC (reference). 00 - .07 %, moderate BAC .08 - .14 %, severe BAC ≥ .15 %. †$p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 4: Multinomial logit with odds ratios for the association between BAC classification and demographic, criminal history, and behavioral measures among Floridian DUI offenders, 2009-2010

	Odds ratio [95% CI]					
	Model 1			Model 2		
Under 21 years old	0.50***	[0.44,	0.56]	0.25***	[0.22,	0.28]
Male	0.94	[0.87,	1.02]	1.23***	[1.14,	1.34]
Black	0.97	[0.86,	1.10]	0.61***	[0.53,	0.69]
Hispanic	0.80***	[0.73,	0.88]	0.69***	[0.63,	0.76]
Other	0.87	[0.72,	1.06]	0.68***	[0.56,	0.84]
High School Graduate/GED	1.11	[1.00,	1.23]	1.14	[1.02,	1.26]
Some college/trade school	1.10	[0.98,	1.24]	1.11	[0.98,	1.25]
College graduate	1.19	[1.05,	1.35]	1.31***	[1.16,	1.49]
Married	0.93	[0.85,	1.02]	0.97	[0.88,	1.06]
Divorced	1.08	[0.97,	1.20]	1.26***	[1.13,	1.39]
Separated/Widowed	1.19	[1.02,	1.38]	1.14	[0.97,	1.33]
Accident in arrest	1.19***	[1.09,	1.30]	0.95	[0.87,	1.04]
Previous at-fault accident	0.88	[0.81,	0.96]	0.83***	[0.76,	0.90]
Previous moving violations	0.90	[0.84,	0.96]	0.93	[0.87,	1.00]
Previous misdemeanor arrest	0.88	[0.81,	0.96]	1.11	[1.01,	1.21]
Previous felony arrest	0.64***	[0.57,	0.71]	0.87	[0.78,	0.97]
Previous alcohol-related arrest	1.01	[0.90,	1.13]	1.22***	[1.08,	1.36]
Previous drug-related arrest	0.45***	[0.40,	0.51]	0.60***	[0.54,	0.67]
Alcohol risk medium	1.79***	[1.63,	1.97]	1.40***	[1.28,	1.54]
Alcohol risk problem	2.87***	[2.53,	3.25]	1.97***	[1.74,	2.23]
Alcohol risk severe	5.20***	[4.51,	5.99]	3.27***	[2.83,	3.78]
Drug risk medium	0.63***	[0.57,	0.69]	0.71***	[0.65,	0.79]
Drug risk problem	0.45***	[0.40,	0.50]	0.53***	[0.47,	0.60]
Drug risk severe	0.21***	[0.19,	0.24]	0.31***	[0.27,	0.35]
Driver risk medium	0.91	[0.83,	0.99]	0.90	[0.82,	0.98]
Driver risk problem	0.76***	[0.68,	0.84]	0.81***	[0.73,	0.91]
Driver risk severe	0.73***	[0.65,	0.82]	0.83	[0.73,	0.93]
Stress risk medium	1.20***	[1.10,	1.30]	1.31***	[1.20,	1.43]
Stress risk problem	1.36***	[1.22,	1.51]	1.46***	[1.32,	1.63]
Stress risk severe	1.47***	[1.25,	1.73]	1.78***	[1.51,	2.10]
DSM-IV Substance abuse	1.31***	[1.21,	1.41]	1.09	[1.01,	1.18]
DSM-IV Substance dependency	1.04	[0.93,	1.16]	0.83	[0.74,	0.93]

Notes: $N = 56{,}190$. Model 1 = low BAC (.00 - .07%, reference) vs. severe BAC (≥ .15%); Model 2 = low BAC (.00 - .07%, reference) vs. refused BAC test; *** $p < .001$.