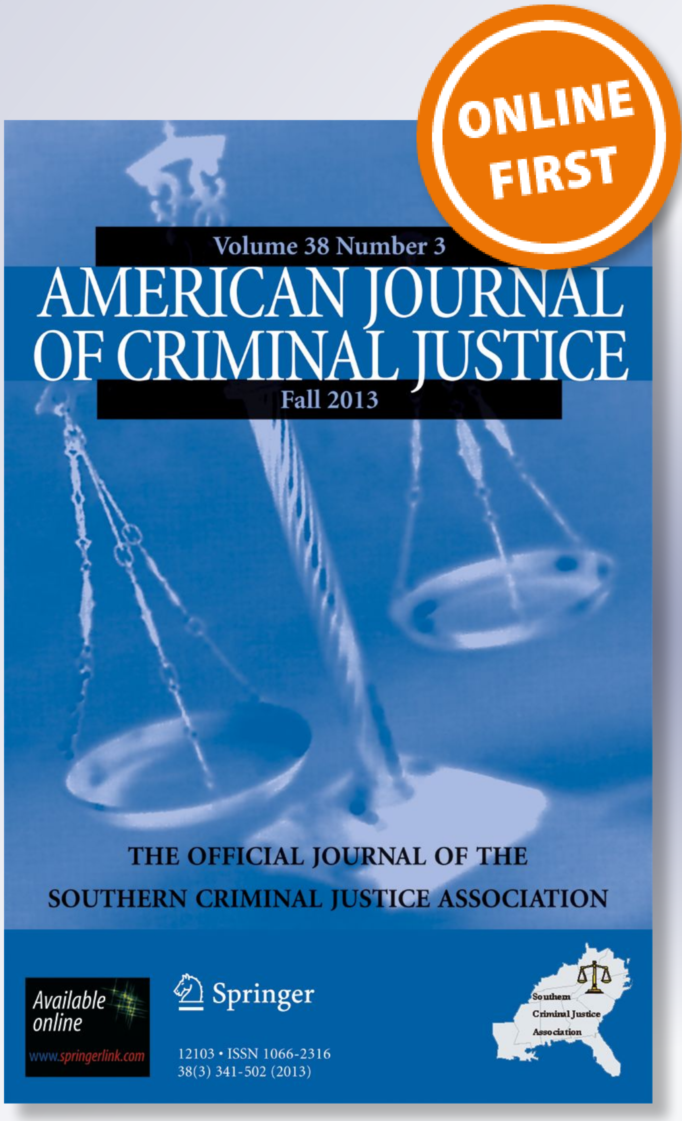
Policing The Drunk Driving Problem: A Longitudinal Examination of DUI Enforcement and Alcohol Related Crashes in the U.S. (1985–2015)

Richard J. Stringer

American Journal of Criminal Justice
The Journal of the Southern Criminal Justice Association

ISSN 1066-2316

Am J Crim Just
DOI 10.1007/s12103-018-9464-4



Springer

American Journal of Criminal Justice
https://doi.org/10.1007/s12103-018-9464-4

Policing The Drunk Driving Problem: A Longitudinal Examination of DUI Enforcement and Alcohol Related Crashes in the U.S. (1985–2015)

Richard J. Stringer[1]

Received: 21 August 2018 / Accepted: 12 November 2018/Published online: 24 November 2018

Abstract
This project examines the relationship between police enforcement of driving under the influence (DUI) and fatal alcohol related crashes. This article merged data from several sources to fit several 3-level growth curve models that assess the relationship between DUI arrests and fatal alcohol related crashes in U.S. counties from 1985 to 2015. The findings indicate that increases in DUI arrests are related to decreased fatal alcohol related crashes during the period. However, the two are not linearly related and the relationship varies across states. The non-linearity indicates there is a point of diminished returns where increased arrests are no longer related to reductions in fatalities. These findings suggest that policy makers should explore alternative methods of reducing crashes to supplement enforcement efforts such as addressing problems of alcoholism and traffic safety.

Keywords Policing · Drunk driving · DUI · Fatal crashes · Deterrence

Beginning in the 1980s, substantial criminal justice resources have been devoted to reducing driving under the influence of alcohol (DUI) and the harms associated with it. Still, approximately 20 % of the U.S. population continues to engage in this risky behavior (Drew, 2010) which is related to increased risk of automobile crashes which can result in property damage, bodily injuries, and fatalities. Police also play an important role in the criminal justice effort to reduce DUI and related crashes since "[t]he Achilles' heel of deterrent policies aimed at drunk driving….is the probability of apprehension" (Ross, 1992, p. 68). However, little research has examined the effectiveness of DUI enforcement at reducing alcohol related crashes, and this project aims to fill this void.

✉ Richard J. Stringer
Richard.stringer@kennesaw.edu

1 Department of Sociology & Criminal Justice, Kennesaw State University, 402 Bartow Ave MB#2204, Kennesaw, GA 30144, USA

Although DUI and related crashes have been occurring since the invention of the automobile, it was not until the 1980s that a major social movement against DUI began (Lerner, 2011). The cornerstone for this movement was the focus on the "killer-drunk" and the plethora alcohol related fatal crashes in the U.S. (Gusfield, 1981, p. 151; Reinarman, 1988). In an effort to reduce DUI and the resulting fatalities, the movement implemented several reforms such as tougher legislation, increased fines and jail time, license suspensions and an increased expectation of DUI enforcement (Mastrofski & Ritti, 1992). The rationale for the tougher DUI laws revolved largely around deterrence and incapacitation, which rely on high DUI arrests to be successful (Mastrofski & Ritti, 1992; Ross, 1992). As the gatekeepers to the criminal justice system, police officers bring offenders into the system and control the flow of DUI cases (Lundman, 1998). Therefore, police DUI enforcement is crucial to efforts to reduce drunk driving and crashes.

DUI offenses rarely come to the attention of police through citizen complaints, accidents or calls for service like other crimes (Snortum, Riva, Berger, & Mangione, 1990). In fact, generally offenders are located through the officer's own observations of erratic driving or during ordinary traffic stops for other offenses. Thus, police officers must be proactive and put effort into locating DUI offenders to make arrests. However, prior to the anti-DUI movement of the 1980s, police officers and administrators generally considered DUI enforcement a very low priority and generally tried to avoid it (see Lundman, 1998; Mastrofski, Ritti, & Hoffmaster, 1987; Mastrofski & Ritti, 1992, 1996). Additionally, when officers did encounter DUI suspects informal methods were often also used to stop the person from driving without making an arrest (e.g. walking home) (Mastrofski & Ritti, 1992; Lundman, 1998). As a result, although DUI was technically a crime in many states, enforcement was very low prior to the anti-DUI movement of the 1980s. However, the 1980s represents a turning point for DUI enforcement and many departments began to consider DUI enforcement a higher priority and made efforts to increase the probability of apprehension (e.g. using DUI checkpoints and setting up specialized DUI units) (Jacobs, 1989).

Correspondingly, the heightened priority of DUI enforcement and the resulting efforts to increase the probability of apprehension lead to significant increases in DUI arrests in the U.S. (Lundman, 1998). In fact, although the DUI arrest rate varies widely across the country (Erickson et al., 2015), it is among the highest of all offense types. Specifically, an estimated 1,017,808 DUI arrests were made in 2016, exceeded only by larcenies (1,050,058) and drug abuse offenses combined (1,572,579) (UCR, 2017). Fatalities resulting from DUI automobile crashes have also significantly declined since the 1980s (Williams, 2006), however DUI continues to result in over 10,000 fatal crashes every year (NHTSA, 2016a). While the trend in DUI arrests and crashes over time is consistent with the deterrence hypothesis, the evidence is inconclusive (Ross, 1992). Therefore, this project explores the relationship between DUI arrests and fatal alcohol related crashes in the U.S. from 1985 through 2015.

Prior Literature

Although DUI has been understudied within the criminological literature, some studies have explored the deterrence of drunk driving propensities at the individual level (Lanza-Kaduce, 1988; Nagin & Pogarsky, 2001; Piquero & Pogarsky, 2002; Pogarsky & Piquero, 2003; Yao, Johnson, & Tippetts, 2016). Additionally, a few traffic safety studies have examined the relationship between DUI enforcement and alcohol related crashes (Dula, Dwyer, & LeVerne, 2007; Fell et al., 2014; Yao et al., 2016), however, they have mixed results that are mostly cross-sectional and unable to explain changes over time. Therefore, the extant literature from neither field can provide a conclusive answer to the research questions outlined herein. This void in the literature across both fields may be a result of the rarity of criminologists and traffic safety scholar's consideration of one another's research (DeMichele, Lowe, & Payne, 2014). Furthermore, the prior studies from both fields have largely focused on micro (individual or crash level analysis) or macro (state level analysis) units of analysis. Thus, this project fills a void in the literature by assessing the relationship between DUI arrests and crashes across counties over time.

Criminological scholars have examined the relationship between individual perceptions of certainty of punishment and self-reported drunk driving. Specifically, prior studies indicate that college students have decreased intentions to drink and drive when the perceived certainty of arrest and punishment is greater (Nagin & Pogarsky, 2001; Piquero & Pogarsky, 2002; Pogarsky & Piquero, 2003; Yao et al., 2016). However, Lanza-Kaduce (1988) found that the perceived certainty of punishment has no effect on DUI for college students. While most of the prior studies utilized college student samples, Piquero and Paternoster (1998a, b) found that perceived certainty of punishment decreased projections to engage in DUI with a national probability sample. Thus, it appears the perceived certainty of punishment is generally related to decreases in the propensity to drive drunk.

Interestingly, several of these prior studies have discovered that being punished for DUI decreases an offender's perceived certainty of receiving future punishment (Bouffard, Niebuhr, & Exum, 2016; Piquero & Paternoster, 1998a, b; Piquero & Pogarsky, 2002; Pogarsky & Piquero, 2003). Thus, those that have been previously punished also have an increase in the intention to drink and drive in the future (Bouffard et al., 2016; Piquero & Pogarsky, 2002; Pogarsky & Piquero, 2003). Pogarsky and Piquero (2003) found support for the contention that the experience of being caught and punished for DUI can have a "resetting effect" on an individual's perceived certainty of being punished (p. 96). Thus, the experience of punishment can increase an offender's propensity to drink and drive since they may believe it will be a while before they will be caught and punished again (Piquero & Pogarsky, 2002; Pogarsky & Piquero, 2003). However, others suggest this unusual relationship may also be explained by labeling, defiance, weakened prosocial bonds, or an underlying construct such as low self-control or an alcohol disorder (Bouffard et al., 2016).

The prior research has noteworthy implications for the ability of deterrence-based punishments to reduce drunk driving among recidivists. Recidivism is particularly important because DUI recidivists have a higher risk of fatal crash involvement than other drivers (Fell, 2014). While the prior studies suggest that personal experiences with punishment may not reduce DUI, it appears that recidivists are not heavily influenced by the vicarious experience of others through general deterrence either (Freeman & Watson, 2006). Additionally, recidivist drunk drivers often have issues with alcohol addiction which can prevent them from making rational choices about DUI relative to perceptions of punishment (Yu, Evans, & Clark, 2006), and deterrence based polices are least effective at reducing recidivism among those with alcohol problems (Goodfellow & Kilgore, 2013). Thus, deterrence-based interventions may be less effective for recidivist drunk drivers who are most likely to cause fatal crashes.

Although the criminological literature provides some insight into perceptions of deterrence and recidivism, this literature does not assess how deterrence is related to DUI crashes. However, since the criminal justice response to drunk driving is aimed at reducing fatalities associated with alcohol related crashes, this is an important issue to address. The traffic safety field has conducted some exploration of this phenomenon, although it has employed limited analytical techniques, has been largely cross-sectional, and has produced mixed results. For example, Dula et al. (2007) were unable to establish a significant relationship between DUI arrests and DUI crashes for each of the 95 counties in Tennessee. Conversely, Fell and Colleagues (Fell et al., 2014) indicated that increases in per capita arrest rates were related to a decline in the ratio of alcohol related crashes to non-alcohol related crashes in a national sample of 71 communities and police agencies, however this effect was only meaningful after statistical significance was redefined ($P < .10$).

One longitudinal study examined DUI arrests and fatal alcohol related crashes at the state level from 1996 to 2006 (Yao et al., 2016). This project conducted a state level analysis of 30 states that were selected by using t-tests to determine which states had the most change in DUI crashes "in order to be cost efficient" (Yao et al., 2016, p. 449). The findings indicated that increases in the per-capita DUI arrest rate in each of these states predicted a decrease in the ratio of alcohol related fatal crashes to non-alcohol related fatal crashes. Thus, the Yao and Colleagues (Yao et al., 2016) project is the sole study to find a significant relationship ($P < .05$) between DUI arrests and crashes.

While Yao and Colleagues (Yao et al., 2016) is also the only project that utilized longitudinal data, the use of t-tests as an analytical method has substantial limitations and is not conducive to a substantial multivariate longitudinal analysis. Additionally, the use of the ratio of alcohol related crashes to non-alcohol related crashes is questionable because the model can become sensitive to change in the denominator: non-alcohol related crashes. The use of this ratio is especially problematic for a bivariate analysis which cannot control for changes in other factors over time. Furthermore, evidence suggests that there was a 16,000 increase in non-alcohol related crashes between 2001 and 2007 (Wilson & Stimpson, 2010) and that the crash risk for sober drivers doubled between 1996 and 2007, which may be due to increases in "texting or cell phone use" (Voas, Torres, Romano, & Lacey, 2012, p. 348).

In sum, while the prior literature suggests increases in the certainty of punishment for DUI may lead to decreases in DUI at the individual level, the research on macro level enforcement of DUI and fatal alcohol related crashes remains largely inconclusive. As such, this project is one of few to integrate research from both the criminological and traffic safety literature on DUI to substantially contribute to both. While the criminological literature provides theoretical grounding in the perceptions of deterrence at the individual level, it overlooks aggregate level differences in perceptions of deterrence that may vary across place with DUI enforcement. Additionally, the criminological literature has failed to assess the relationship between deterrence and the harm that occurs because of DUI (crashes). This is particularly problematic since reducing crashes is the main goal of DUI enforcement and Sherman (2013) argues that researchers should assess the harm from crime when evaluating police effectiveness rather than crime rates or counts, which can be misleading. While the traffic safety literature has conducted some limited exploration of the relationship between DUI arrests and alcohol related crashes these results are inconclusive. As such, this project aims to fill this void in the literature of both fields by examining DUI enforcement and fatal alcohol related crashes at the county level from 1985 to 2015.

Theoretical Framework

Police DUI enforcement is theoretically related to alcohol related fatal crashes in two ways: incapacitation and deterrence. Incapacitation is the physical restraint of an offender to prevent them from committing future crimes (Zimring & Hawkins, 1995). Classic examples of incapacitation involve incarceration of an offender which can occur both before and after trial, depending on the offender's ability to post bond and the sentence they receive for their offense.

Furthermore, most states have also enacted legislation designed to incapacitate offenders that are not incarcerated such as administrative license suspensions, impounding vehicles, seizing license plates, ignition interlock devices, and drivers license suspensions and revocations (see Ross, 1992).

Although DUI arrests can lead to various types of incapacitation that prevent future DUI offenses, they can also prevent the occurrence of future crashes. Specifically, if an offender's ability to engage in future DUI after being arrested is incapacitated, then so is that offender's ability to cause future alcohol related crashes. Additionally, while we generally think of incapacitation as preventing future offenses and future harms from them, the incapacitative effects of the arrest can even prevent the harm from the current offense since the offense and the harm do not occur contemporaneously. For example, every time an officer makes an arrest prior to a crash occurring they are interrupting the DUI process which often leads to crashes. Therefore, the incapacitation of offenders by the officer has prevented a crash by removing that offender from the roadway before the harms occurs. Since not every DUI trip results in a crash this is not likely the case for all arrests at the crash level, but discernable effects may be present in the aggregate.

Police DUI enforcement may also indirectly influence alcohol related fatal crashes by affecting aggregate levels of perceived certainty of punishment. Classical deterrence theory posits that the rational actor will not engage in a behavior if punishment for that behavior is swift, certain, and severe (Beccaria, 2009; Pratt, Cullen, Blevins, Daigle, & Madensen, 2006). While deterrence is a micro level theory of individual behavior, the theoretical logic can be applied to aggregate shifts and geographic differences across time and place. Additionally, the theory assumes that individuals will learn about certainty, severity, and swiftness of punishment through both personal and vicarious experiences (Stafford & Warr, 1993). As such, these perceptions will be greatly influenced by the social environment or community to which a person is exposed, including the level of police DUI enforcement in that community. In fact, Laughran and Colleagues (Loughran, Pogarsky, Piquero, & Paternoster, 2012) purport that the macro and micro levels are related, and perceptions of deterrence are influenced by aggregate level functions (see also Zimring & Hawkins, 1973).

It is important to note that it would be erroneous to assume that aggregate level differences in DUI enforcement in a community will influence each individual in a community's perceptions of certainty of punishment equally or even similarly. However, aggregate differences in enforcement would be related to aggregate level differences in perceptions across time and place. For example, when police avoided DUI detection and handled it informally when discovered (Lundman, 1998), aggregate levels of perceived certainty and severity of punishment was likely much lower when compared to the current era of policing. Since DUI enforcement varies greatly across the country (Erickson et al., 2015) differences in perceptions may also be present across place. For example, in counties with high levels of DUI enforcement, offenders are more likely to experience personal and/or vicarious experiences with punishment and low levels low punishment avoidance. Thus, offenders in such a community will be less likely to drink and drive which will lead to decreases in alcohol related fatal crashes.

Increasing quality and quantity of enforcement should theoretically raise the objective certainty of punishment and the perceived risk of punishment (Ross, 1992). While there are several ways to increase the certainty of apprehension for DUI (e.g. increases in patrols around bars, conducting sobriety checkpoints, etc.), these methods all have the same result when handled formally – arrest. Since vicarious experiences are important to perceptions of deterrence, one need not be arrested themselves or view a DUI stop or roadblock themselves, but they need only learn about it from some other source (e.g. a friend or the local news). Thus, arrests make a good measure of enforcement and the certainty of being punished (Decker & Kohfeld, 1985; Sampson & Cohen, 1988). As such, the research hypothesis is as follows:

> H1: Because increases in DUI arrests incapacitate DUI offenders and lead to increased certainty of punishment for DUI this project hypothesizes that increases in DUI arrests are related to decreases in alcohol related fatal crashes in the U.S.

Method

This project aggregated and merged data from several sources to test the aforementioned hypothesis. Appropriate harmonization of these data was monitored throughout to ensure these data were properly integrated into one harmonious dataset. These data were merged together using county and state level FIPS codes which were present in each dataset. Data was collected on counties across 49 states and the District of Columbia from 1985 through 2015. State level data was also collected for the same sample. The sample excludes both Florida and Illinois due to unreliable reporting of arrests (see FBI, 2014). This study utilized data from the Fatality Analysis Reporting System (FARS) to measure fatal crashes in the U.S. (NHTSA, 2016). These data are compiled and maintained by the National Highway Traffic Safety Administration (NHTSA, 2016b), and reflect automobile crashes that occur on public roadways and result in at least one fatality of a motorist or non-motorist within 30 days of a crash (NHTSA, 2016). These data were aggregated to the county level to facilitate analysis.

Data was also acquired from the Uniform Crime Reports (UCR) to measure DUI arrests and crime rates within U.S. counties. The County-Level Detailed Arrest and Offense Data files for 1994 through 2014 were downloaded directly from ICPSR (FBI, 2014). However, due to changes in the imputation procedures for non-reporting across counties and originating agencies in 1994, the county level data prior to 1994 is not comparable with data from 1994 and beyond[1]. Therefore, county UCR files prior to 1994 were not used.

To facilitate this longitudinal analysis, the 1985–1993 data from the Arrests by Age, Sex, and Race file was used (FBI, 1993). Because these data are aggregates by age, sex, and race, they were first summed to provide total estimates for each reporting agency. Subsequently, procedures were implemented to create county level data by mirroring the procedures utilized for the post 1993 county files.[1] Specifically, agencies that reported 12 months of data were kept as is, those that reported between three and 11 months were weighted by the months reported, and those reporting zero to 2 months were imputed. The formula for the calculations for the weight of the agencies reporting three to 11 months was:

$$F_{ar} = a + \left(\frac{a}{m}\right) * (12 - m)$$

with F_{ar} = Frequency of arrests reported per agency and year, a = arrests reported, m = months reported.

Multiple imputation[2] was utilized to estimate total DUI arrests and part I offenses known for the agencies reporting zero to 2 months out of the year.[3] These files were then aggregated to the county level and merged with the post 1993 county level UCR files. Each dataset was analyzed separately, and parameter estimates, standard errors, and other information were pooled using "Rubin's Rules" of imputation analysis (see Rubin, 1987). These pooled results are presented in the tables herein.

Data from the Economic Research Service was obtained to measure rurality (Butler & Beale, 1990). These data, known as "Beale codes" measure the rurality or urbanism of a county on a continuum rather than a simple dichotomous measure of rural vs. urban making it superior to other methods. While this was originally developed in 1974, it has been updated every 10 years (1983, 1993, 2003, and 2013). Due to the

[1] Specifically, prior to 1994, any originating agency that reported less than 6 months of data were excluded, and those that reported six to 11 months were increased and weighted by 12/months reported (FBI, 2014). To increase the quality of data, a new imputation procedure was implemented in 1994 to provide more accurate estimates of arrests. Specifically, while agencies reporting three to 11 months were increased by a weight of 12/months reported, and agencies reporting zero to 2 months were set as missing and imputed (FBI, 2014).

[2] The percentage of reporting agencies with missing information was 4% for DUI arrests and violent crime, and 24% for self-report DUI. The missing value analysis indicates that the missing data are missing at random (MAR), and thus there is no systematic error in the missing values and the missingness is ignorable (see Rubin, 1987). As such, these data are appropriate for multiple imputation. The imputation algorithm was also constrained to return a value within the range of the original data for each of the 10 imputations. The sensitivity analysis indicates the missing data have been properly imputed and the imputed mean values do not significantly vary from the original data.

[3] Prior to imputation both DUI arrests and part I offenses were logarithmically transformed so they would meet the assumption of normality for predictions. After imputation the logarithmic measures were exponentiated and returned to their original form before the values for each reporting agency were aggregated to the county level. The predictors used for the imputation algorithm mirrored those used for the post 1993 data including state, arrest rates, and geographic stratum. Specifically, dichotomous variables controlled for state with Texas as the referent, also year was controlled with dichotomous measures with 1985 as the reference category, arrest rates were calculated per 100,000 population, and counties and cities by population range.

infrequent construction of these data, the linear interpolation at each missing point in time was utilized to fill missing years between updates. The formula for these interpolations is presented below:

$$T_{ct} = t_1 + \left((t_2 - t_1)/10_{(1-9)}\right)$$

Census data was also utilized to control for socio-demographic differences among counties. Additionally, data from the National Alcohol Beverage Control Association (2014) was used to create dichotomous measures of dry counties, which are counties that outlaw the sale of alcohol.

State level data was also integrated from several sources to control for state level policies and other factors. This is especially important for the analysis here because state laws related to DUI and traffic safety vary across time and state (Voas, Tippetts, & Fell, 2000). Therefore, information on state alcohol and DUI legislation was obtained from the Alcohol Policy Information System (APIS) (National Institute on Alcohol Abuse and Alcoholism [NIAAA], 2016). Additionally, per-capita alcohol consumption was obtained from the National Institute on Alcohol Abuse and Alcoholism (LaVallee, Kim, & Yi, 2014). Estimates of total vehicle miles traveled were also procured from the Federal Highway Administration (2015). Finally, data from the Behavioral Risk Factor Surveillance system estimated self-reported drunk driving.

Measures

Table 1 presents descriptive statistics for county and state level measures utilized for this project. The dependent variable is a continuous measure of the total frequency of alcohol related fatal crashes in each county per year. This measure was operationalized as fatal crashes where the police report indicates alcohol was involved or played a role in the crash. Due to skewness, kurtosis, and zero values, this measure was logarithmically transformed prior to analysis (log +1). The independent variable of theoretical interest is a continuous measure of the total DUI arrests within a county each year.[4] This measure was also logarithmically transformed prior to analysis. Table 1 presents descriptive statistics for the original and transformed versions of these variables.

[4] While some have used measures such as police force size, police per capita, and police expenditures to measure certainty of punishment, a meta-analysis by Pratt and Colleagues (Pratt et al., 2006) suggests that the arrest ratio (arrests/offenses known) has a stronger effect size in relation to crime than these measures. However, some argue the arrest ratio introduces an artefactual statistical relationship where none is present originally (Jacob & Rich, 1980), and that it creates tautological results when assessing trends in crime and arrest rates (Chilton, 1982). Thus, scholars purport that the frequency of arrests should be utilized instead of the arrest ratio (Decker & Kohfeld, 1985; Sampson & Cohen, 1988). In fact, Decker and Kohfeld (1985) contend that criminals will not be knowledgeable about complex ratios and probabilities of arrest and are more likely to know about the number of arrests taking place in their neighborhoods which is more likely to affect their perceptions of the certainty of arrest. Moreover, although the public only has an ambiguous knowledge about the probability of arrest for serious index crimes, police interventions for driving violations are much more visible to the public and lead to increased perceptions of apprehension (Sampson & Cohen, 1988). The use of the arrest ratio is also particularly problematic when assessing DUI offenses due to high correlation between arrests and offenses known because DUI offenses generally come to the attention of the police through their own observations, rather than reports from citizen reports like other offenses (Snortum et al., 1990). Thus, a ratio calculated by dividing arrests by offenses known would be severely biased toward one with very little variance.

Table 1 Descriptive statistics ($n = 89,423$)

	Mean	Standard Deviation	Min.	Max.
DUI Arrests	448.51	1626	0	113,401
DUI Arrests (log)	4.81	1.69	0	11.64
DUI Related Crashes	3.79	3.79	0	445
DUI Related Crashes (log)	1.08	0.88	0	6
Non-DUI Fatal Crashes	7.14	16.64	0	728
Repeat Offender Crashes	0.65	1.84	0	110
Part I Violent Offenses Known	181.85	1024	0	64,718
Total Population	84,518	274,094	52	9,938,312
% African-American	8.77	14.69	0	87.00
% Hispanic	6.31	12.36	0	98
% Caucasian	84.73	16.7	1.90	100
% Population Age 18–24	7.22	3.28	0	57.94
% Population 25–34	12.97	2.57	0	32.97
% Bachelor's Degree or More	16.64	8.25	0	80
% Below the Poverty Level	13.1	6.87	0	63
Male/Female Ratio	101.24	11.87	0	383
Beale Code (Urban - Rural)	5.82	2.55	1	9
Moist County	0.13	0.33	0	1
Dry County	0.03	0.18	0	1
.08 Per-Se Law	0.47	0.50	0	1
Administrative License Suspension Law	0.68	0.45	0	1
% Drinking and Driving in Past Year	0.04	0.02	0	0.14
Per Capita Alcohol Consumption (Gallons)	2.39	0.37	1.20	5.05
Vehicle Miles Traveled (Millions)	67,749	61,542	3223	329,534

Because crime levels within the community can influence enforcement of traffic violations such as DUI (see Klinger, 1997) the frequency of Part I violent UCR offenses known to police was logarithmically transformed and utilized to control for the crime in each county. Since rural drivers have greater crash risks and are more likely to engage in risk-taking behaviors (Rakauskas, Ward, & Gerberich, 2009), this project utilizes "Beale Codes" to control for an ordinal continuum from rural to urban (Butler & Beale, 1990). Furthermore, since not all alcohol related crashes are caused by the intoxicated driver (see e.g. Stringer, 2016), this project also controls for other factors within each county that may cause crashes by including a continuous measure of the frequency of non-alcohol related crashes in each county per year (see Morrison, Ponicki, Gruenewald, Wiebe, & Smith, 2016). The frequency of crashes involving a driver with a prior DUI conviction is also measured to control for DUI recidivism since it is also associated with alcohol related crashes (see Fell, 2014). Both measures were also logarithmically transformed prior to analysis.

Additionally, several measures to control for the demographic composition of the community were included at the county level. The population size of each county was measured as the log of the total population. As young people have an increased propensity to drink and drive (Drew, 2010) and are increasingly involved in alcohol related crashes (Peck, Gebers, Voas, & Romano, 2008), two continuous measures represent the percent of the population 18–24 and 25–34. As well, because men are more likely to drive after drinking (Hoyle, Miller, Stogner, Posick, & Blackwell, 2017; Zador et al., 2000), the ratio of men to women was measured as the number of men per 100 women. Three variables also controlled for the percent of the population that is Caucasian, African-American, and Hispanic since racial and ethnic diversity are related to alcohol use and abuse (Holmila, Mustonen, Österberg, & Raitasalo, 2009). The percent of the population below the poverty level and with a bachelor's degree or more are controlled due to increased alcohol problems in deprived neighborhoods (Fone, Farewell, White, Lyons, & Dunstan, 2013) and among the working class (Gusfield, 1996; Hemmingsson, Lundberg, Diderichsen, & Allebeck, 1998). Moreover, because alcohol availability may be related to alcohol related crashes (see Morrison et al., 2016; Ponicki, Gruenewald, & Remer, 2013), two binary variables account for dry and moist counties with completed wet counties as the referent.

This project also controlled for several other state level factors identified as predictors of alcohol related crashes by prior research (see Tippetts, Voas, Fell, & Nichols, 2005; Voas et al., 2000). The estimated total vehicle miles traveled, and total per-capita alcohol consumption were operationalized as continuous variables. The estimated total vehicle miles traveled was normalized with a logarithmic transformation. Additionally, administrative license suspension and .08 per-se BAC legislation were operationalized as dichotomous measures which compare the presence of the law to no law as the reference category. Finally, the prevalence of DUI was measured as the percent of the population that reported driving under the influence in the past year[2].

Data Analysis

Multilevel latent growth curve modeling was utilized for the analysis of these longitudinal data. Growth curve modeling has become increasingly popular as a parsimonious alternative to time-series analysis for longitudinal data (see Hox & Roberts, 2011). While classical growth curve models nest repeated observations over time within a unit such as an individual, these models can also be extended with the addition of a third level to nest level 1 and 2 units within some higher order structure (see Raudenbush & Bryk, 2002). The implementation of this type of strategy facilitates the estimation of the growth curve model at level 1 while also accounting for the multilevel structure at levels 2 and 3. This strategy allows for the counties to be examined as they naturally exist in society: nested within states.

Therefore, these data are structured like a classic growth curve model with repeated county observations ($n = 89{,}423$) at level 1, which were nested within each county ($n = 2986$) at level 2 to account for change over time. However, because counties within the same state may be correlated, the county level was also nested within a third level which represents the state ($n = 49$) to ensure an unbiased estimation of standard errors. This strategy also facilitates one of the best advantages of multilevel modeling: the ability to estimate random effects models that account for the interaction of covariates with unmeasured factors at higher levels (Snijders & Bosker, 2012).

The analysis of data over a significant period of time such as this (30 years) raised doubt on the assumption that the change in alcohol related fatal crashes over time was linear, and that such a model was appropriate. Therefore, to test this assumption, a quadratic growth model was fit that indicated non-linearity in the change in alcohol related fatal crashes over time. Furthering this logic, cubic and quartic polynomials were also examined. Although the quartic model did not fit these data, the cubic model did, and was retained. The parameter estimates for the unconditional 3-level cubic polynomial growth model measuring time and alcohol related fatal crashes are presented in Table 2.

The exponentiated coefficients, which are perhaps more intuitive, were also calculated and presented. Additionally, an a priori centering constant (t = Year – 1985) was applied to the measure of time to make the first-year of the sampling frame at time t^0 (1985) equal to zero, and successive increases in time by one-unit increase (1986 = 1, 1987 = 2, etc.) (see Raudenbush & Bryk, 2002). These estimates indicate the initial mean value for DUI fatal crashes at time zero is approximately 4.35 for each county, and there has been non-linear deceleration in fatal alcohol related crashes over the period of study. While the parameter estimates may appear trivial, the importance in controlling for change over time cannot be underscored with time-series data, and the changes over time are illustrated in Fig. 1 below.

The cubic growth model was utilized to model this non-linear change over time in the subsequent analysis. Thus, the unconditional three-level cubic growth curve model was estimated as the following:

$$Y_{tij} = \pi_{0ij} + \pi_{1ij}(t) + \pi_{2ij}(t)^2 + \pi_{3ij}(t)^3 + e_{tij}$$
$$\pi_{0ij} = \beta_{00j} + r_{0ij}$$
$$\beta_{00j} = \gamma_{000} + u_{00j}$$

Additionally, a 1-year lag time was implemented between independent and dependent variables to control for temporal order. This strategy is designed to circumvent the shortcomings of the non-recursive model, because a reciprocal relationship may exist between DUI arrests and alcohol related fatal crashes. In fact, Decker and Kohfeld (1985) found that arrests do not affect crime but increases in arrests are preceded by increases in crime (see also Makowsky & Stratmann, 2011; DeAngelo & Hansen, 2014). Thus, DUI arrests at t-1 (e.g. 2014) were used to predict alcohol related crashes at time t (e.g. 2015).

Table 2 Unconditional model of DUI fatal crashes and time

	Coefficient	Standard Error	*p* value	Exp(B)
Year	−0.038	0.009	<0.001	0.96
Year^2	0.003	0.001	<0.001	1.003
Year^3	−0.001	0.000	<0.001	0.99
Intercept	1.470	0.077	<0.001	4.35

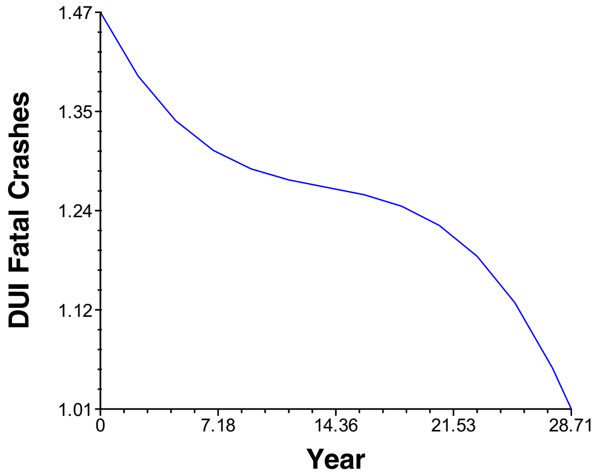


Fig. 1 Cubic estimates of alcohol related fatal crashes and time

The models presented are mixed effects models. Thus, some measures are allowed to randomly vary across states and others are fixed.[5] Initial determination of random effects was based on statistically significant *p* values and reliability estimates (Raudenbush & Bryk, 2002). However, because random effects may not fit within a predefined statistical distribution (Heagerty & Zeger, 2000), which can lead to assumption violations and issues with the validity of the *p* value, confidence intervals and normality plots were also used to determine if random effects were appropriate for each measure. Therefore, measures that had a significant p value, appeared normally distributed, were reliable, and had a 95% confidence interval above zero were allowed to vary randomly across states[5].

The analysis of repeated measures time-series data such as this raises questions about the error structure of the model used to analyze these data due to the possibility of serial autocorrelation between measures and nearby observations. Therefore, while Models 1 and 2 present parameter estimates based on a simple error structure that assumes independence and constant variance, Model 3 provides estimates derived from a more complex autoregressive error structure. The partial autocorrelation function (PACF) plot indicates there is no significant autocorrelation beyond the first lag. Thus, an AR(1) process is specified where the error of each time point depends on the error at the prior point t-1.

The unconditional model in Table 2 indicates there is significant clustering effects within both counties and states, and therefore multilevel analysis is appropriate for these data.[6] All predictors, with the exception of year noted earlier, were grand mean

[5] Random effects across states were estimated for the following measures: DUI Arrests, DUI arrests^2, crashes involving a driver with a prior DUI conviction, non-alcohol related crashes, violent crime, bachelor's degree, White, Black, Hispanic, sex ratio, poverty, Beale Code, age 18–24, and 25–34.

[6] The assumptions of multilevel modeling were all assessed and have been met. Multicollinearity was assessed with variance inflation factors (VIF), and no factors were collinear (VIF < 2). Correlations matrices were inspected at level 2 and 3 to check for highly correlated variables, and standard errors were monitored throughout to check for cross-level collinearity. Finally, residual scatterplots and Q-Q plots indicate that assumptions of linearity and homogeneity of the variance have been met.

centered since there is no reason to believe that group mean centering is appropriate for these data (Enders & Tofighi, 2007). Polynomial models also assessed non-linearity between DUI arrests and alcohol related crashes, which is both theoretically and empirically important when assessing certainty of punishment and crime (Loughran et al., 2012).

The reliability estimates (.944, and .939) indicate that approximately 94 % of the variance in alcohol related fatal crashes is explainable with these data and approximately 6 % is related to random sampling error and is therefore unexplainable. The intra-class correlation coefficient (ICC) indicates that approximately 26% (ICC = .26) of the variance in alcohol related fatal crashes are explainable over time at level 1. Forty-three percent (ICC = .43) of the variance is explainable at the county level, and 31 % (ICC = .31) is explainable across states. Finally, the proportion of variance explained at each level was estimated through the calculation of an r-squared by comparing change in the variance components between the unrestricted and restricted models.

Findings

Figure 2 illustrates the bivariate relationship between DUI arrests and alcohol related fatal crashes per 100,000 of the population in the United States from 1985 to 2015. These data indicate that both DUI arrests and crashes have generally declined during the period of study. Although, the estimates presented were standardized by population size, the frequency counts also show a very similar trend over time. There are clearly visible signs of change in time for both DUI crashes and arrests. It should also be noted the trend is approximate to the estimates from Fig. 1.

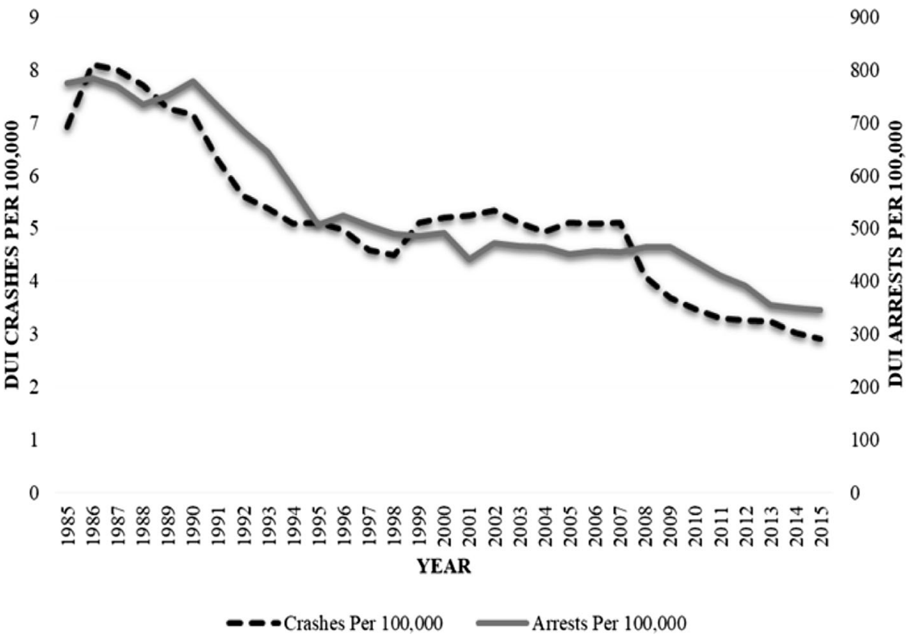


Fig. 2 DUI arrests and alcohol related fatal crashes per 100,000 population

Table 3 presents findings from the multilevel latent growth curve models predicting alcohol related fatal crash rate with a 1-year time lag in the United States from 1985 to 2015. The r-squared estimates indicate that approximately 7 % of the explainable variance in alcohol related fatal crashes has been explained over time. Approximately 92% of the explainable variance is also explained across counties and states.[7] Model 1 presents the linear relationship between DUI arrests and fatal alcohol related crashes. The parameter estimates for the linear equation illustrate a small and insignificant decrease (.3%) in alcohol related crashes is related to increases in DUI arrests. However, tests for non-linearity of the DUI arrest and fatal crash relationship indicate that a non-linear parabolic relationship was present.

Therefore, Model 2 presents the results from the estimation of a quadratic polynomial equation for DUI arrests. While the linear component predicts that each percentage increase in DUI arrests is related to a decrease (about 11%) in the percentage of alcohol related fatal crashes in the following year, the quadratic component indicates some acceleration in the relationship (1% for each percent increase in DUI arrests). Thus, each percent increase in DUI arrests predicts an initial decrease in alcohol related fatal crashes of about 11 % followed by a change to predict an increase (.013%) in alcohol related fatal crashes. This relationship is illustrated in Fig. 3 where the measure is grand mean centered, and zero represents the mean.

DUI arrests were also found to vary randomly across states in their relationship with alcohol related fatal crashes. The estimates of these random effects are presented in Table 4. These estimates indicate that the relationship between DUI arrests and alcohol related crashes significantly ($p < .001$) varies across states.

A one-way ANOVA was also estimated which compared a model with fixed effects for DUI arrests to a model with random effects. The results, presented in Table 5, indicate the model is significantly improved by including the random parameters. Thus, all the above tests lead to a satisfactory conclusion that the DUI arrest/fatal crash relationship varies across states. Model 3 presents the estimates with the autoregressive error structure. The AIC and BIC values for this model suggest that model fit is improved with this model and a one-way ANOVA, similar to that presented in Table 5 also indicates that model fit it significantly improved (106.76***). Thus, this model provides a superior fit to these data than the restricted error structure in Model 2. However, other than reducing the standard error for several measures, the substantive findings do not significantly differ from Model 2.

Several of the control variables also produced some noteworthy results. Specifically, Repeat DUI offender (recidivist) crashes were positively related to fatal alcohol related crashes in all models. The frequency of non-alcohol related crashes and violent crime rate were also important predictors of alcohol related crashes in each county. Although the change in the per-se BAC limit was related to a decrease in DUI crashes, administrative license suspension legislation is positively correlated with crashes. The significance of alcohol sales restrictions seems also to fluctuate between models.

[7] While the variance explained by these models may appear odd, it is important to consider it in light of the ICC. As such, these models explain about 92 % of the forty-three and 31 % of the explainable variance at level two and three, respectively. Furthermore, the interaction of unmeasured variables through random effects is also likely playing a role in these explained variances (see Snijders & Bosker, 2012). Any unresolved serial autocorrelation would also exist at level one, rather than levels two and three which examine heterogeneity across place, which may explain the lower explained variance over time at level one.

Table 3 Mixed effects 3 level growth curve models predicting DUI fatal crashes with 1 year lag (1985–2015)

	Model 1	Model 2	Model 3
DUI Arrests	−.003 (.005)	−.113*** (.016)	−.113*** (.017)
DUI Arrests^2	–	.013*** (.002)	.013*** (.002)
Non-DUI Fatal Crashes (log)	.060*** (.008)	.058*** (.007)	.048*** (.004)
Repeat DUI Offender Crashes (log)	.039*** (.006)	.036*** (.005)	.017*** (.004)
P1 Violent Crime (log)	.016*** (.004)	.016*** (.004)	.006* (.003)
Beale Code (Urban - Rural)	.002 (.003)	.002 (.003)	.001 (.002)
% Bachelors Degree or More	−.009*** (.001)	−.009*** (.001)	−.009*** (.001)
% Below the Poverty Level	−.008*** (.002)	−.006*** (.001)	−.005*** (.001)
% African-American	−.001 (.002)	−.003 (.002)	−.003*** (.001)
% Hispanic	−.008*** (.002)	−.007*** (.001)	−.003*** (.001)
% Caucasian	−.007*** (.002)	−.007*** (.002)	−.006*** (.001)
% Population 18–24	−.002 (.003)	−.003 (.002)	−.001 (.001)
% Population 25–34	.003 (.003)	.002 (.002)	.001 (.002)
Male/Female Ratio	−.001 (.001)	−.001 (.001)	−.001** (.000)
Total Population (log)	.428*** (.006)	.409*** (.006)	.422*** (.006)
Dry County	−.044 (.026)	−.056* (.024)	−.049 (.025)
Moist County	.044* (.021)	.036 (.019)	.017 (.021)
.08 BAC Law	−.015* (.007)	−.014* (.007)	−.016* (.007)
Administrative License Suspension	.017* (.010)	.021* (.010)	.037*** (.007)
Mean Self-Report DUI	.299 (.160)	.288 (.157)	.125 (.089)
Total Vehicle Miles Traveled (log)	.068*** (.019)	.068*** (.018)	.082*** (.022)
Total Per-Capita Alcohol Consumption	.335*** (.018)	.324*** (.018)	.370*** (.015)
Year	−.024*** (.002)	−.024*** (.002)	−.021*** (.002)
Year^2	.001*** (.000)	.001*** (.000)	.001*** (.000)
Year^3	−.001*** (.000)	−.001*** (.000)	−.001*** (.000)
Intercept	1.259*** (.030)	1.264*** (.030)	1.297*** (.037)
AIC	122,509	122,103	121,584
BIC	122,772	122,413	121,904
L1 R-Squared	0.07	0.07	0.07
L2 R-Squared	0.90	0.92	0.92
L3 R-Squared	0.92	0.92	0.92

*$p < .05$, **$p < .01$, ***$p < .001$

However, the strongest predictors of alcohol related fatal crashes were per-capita alcohol consumption and total population size. The estimated total vehicle miles traveled was also important. Interestingly, while mean percentage of persons who indicated they had driven drunk in the past year approached significance ($P < .10$), the analysis failed to reveal a meaningful relationship between this measure and fatal DUI crashes.

In sum, increases in the frequency of DUI arrests in a community should lead to increased perceptions of certainty of punishment which should reduce the frequency of

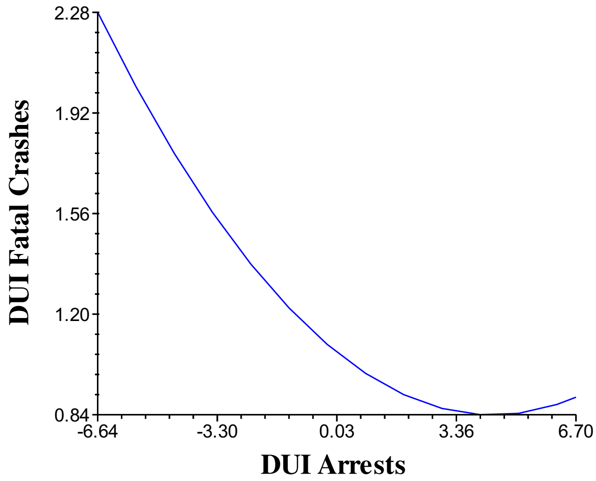


Fig. 3 Quadratic estimates for dui arrests and alcohol related crashes

DUI and DUI related crashes. Overall, the analysis presented herein supports this hypothesis. In fact, despite controlling for other factors and temporal ordering, increases in DUI arrests appear to be largely related to decreases in alcohol related fatal crashes in the United States. However, the relationship appears to be more nuanced than originally hypothesized due to non-linearity and random effects. As such, the hypothesis that increases in DUI arrests are related to decreases in fatal alcohol related crashes was substantiated by this project.

Discussion

This project is the first nationwide, longitudinal project designed to assess the relationship between DUI enforcement (arrests) and DUI related harm (alcohol related fatal crashes) in the United States. Since DUI arrests are the principle source of DUI intervention (Mastrofski & Ritti, 1992; Ross, 1992) and evaluating the harm from crime is the best criteria for assessing police effectiveness (Sherman, 2013), this project is delivers crucial information for criminal justice policy and the overarching goal of

Table 4 Random effects estimates for DUI arrests

	Standard Deviation	Lower C.I.	Upper C.I.	*P* value
State				
DUI Arrests	0.069	0.051	0.099	0.001
DUI Arrests^2	0.007	0.006	0.011	0.001
Intercept	0.219	0.169	0.265	0.001
County				
Intercept	0.205	0.198	0.212	0.001

C.I. = 95% Confidence Interval

Table 5 1-Way anova comparing fixed effects DUI arrests to random effects

	df	AIC	BIC	Log Link	Chi^2
DUI Arrests Fixed	28	63,206.03	63,450.32	−31,575.02	
DUI Arrests Random	33	63,023.27	63,311.18	−31,379.72	192.76***

* $p < .05$, ** $p < .01$, *** $p < .001$

preventing DUI to reduce alcohol related fatal crashes and save lives. As such, the findings of this study create an important addition to the extant traffic safety and criminological literature, theory, and social policy on drunk driving. As hypothesized, the results suggest that formal police enforcement of the DUI code has a negative effect on alcohol related crashes in the United States. Therefore, these results are consistent with both the incapacitation (Zimring & Hawkins, 1995) and deterrence hypotheses (Beccaria, 2009; Pratt et al., 2006).

Police DUI enforcement may facilitate incapacitative effects which prevent offenders from driving drunk. While the direct effect of the arrest may immediately prevent an alcohol related crash by removing the drunk driver from the roadway to the jail, such an effect is not likely the case in these models because DUI arrests predicted alcohol related fatal crashes in the following year due to the time lag. However, it is not impossible for an arrest to have a substantial lasting incapacitative effect for arrested offenders lasting into the following year and beyond. Since most offenders that are arrested for DUI are convicted (see Jones, Wiliszowski, & Lacey, 1999), it is likely that offenders will be further incapacitated after arrest since the principle mechanism of preventing appears to incapacitation (Ross, 1992). While beyond the scope of this article, examples of further incapacitation include jail or prison sentences, license restrictions, suspensions and revocations, ignition interlocks, etc. (Jacobs, 1989; Ross, 1992). However, state laws vary on incapacitative measures taken to prevent further drunk driving after an arrest has been made, and this may account for some of the random variance in the relationship between DUI arrests and crashes across states.

The findings are congruent with much of the existing literature that has examined DUI arrests and alcohol related crashes (see Dula et al., 2007; Fell et al., 2014; Yao et al., 2016). However, the findings suggest the relationship between these phenomena are more complex than originally hypothesized. Specifically, there was a significant non-linear relationship between DUI arrests and fatal alcohol related crashes that also varied across states. Therefore, while the linear results presented in Model 1 are consistent with the insignificant relationship reported in Tennessee (Dula et al., 2007), the overall findings are to the contrary. Such an inconsistency could result from a lack of generalizability of the findings in Tennessee to the rest of the country or failure to account for non-linearity.

The issue of non-linearity is particularly interesting in light of the relationship depicted in Fig. 3. Specifically, the negative relationship between DUI arrests and crashes appears to reach a point around the 75th percentile of the distribution where it is no longer significantly different from zero, and then starts to go up again. Thus, at some point increasing DUI enforcement may be a futile effort to reduce fatal alcohol related crashes and may actually contribute to them. This non-linear relationship suggests the marginal returns illustrated at higher levels of DUI enforcement may be due to a saturation effect (see Loughran et al., 2012). Specifically, once the upper level of saturation for certainty of punishment is reached, increases in certainty of punishment will have little effect on crime (Logan, 1972; Erickson, Gibbs, & Jensen, 1977).

Although the increase in alcohol related crashes shown in Fig. 3 was not significantly different from zero, this nuance is worthy of some discussion since it may appear counterintuitive. Although the individual level processes are difficult to apply to a macro-level analysis, this may be a product of punishment encouraging future offending. This can occur because punishment for DUI actually decreases the perceived certainty of future punishment and increases future DUI offending (see Bouffard et al., 2016; Piquero & Pogarsky, 2002; Pogarsky & Piquero, 2003). However, being mindful of the ecological fallacy, such an assertion is beyond the scope of the macro level analysis here.

The results for crashes involving recidivist drunk drivers also suggest that recidivism does contribute to overall alcohol related fatal crashes. This is also consistent with other studies which indicate that recidivists have a higher risk of involvement in fatal crashes than non-recidivists (Fell, 2014), and are not influenced by the vicarious experiences of others to the same extent as the rest of the population (Freeman & Watson, 2006). It is important to separate the effects from those that are less deterrable from those that are (see Pogarsky, 2002; Zimring & Hawkins, 1968). Thus, controlling for recidivist crashes may have contributed to the robustness of the effects for DUI enforcement as well as the insignificance of the positive effects of enforcement found near the upper boundary.

The variance in the relationship between DUI arrests and fatal crashes across states is particularly intriguing. These random effects indicate that DUI arrests are interacting with some other unknown and/or unmeasured factor at the state level (see Snijders & Bosker, 2012). While attempts were made to explain these random effects with several cross-level interactions between the state level measures and DUI arrests, these interactions were not significant. Thus, the causes of the variance in the relationship across states remains unknown. Since DUI arrests initiate criminal justice processing for offenders, the diversity in the effects of arrests may be related to variance in DUI processing and or punishment across states. For example, there may be differences in rehabilitative versus punitive and/or formal versus informal approaches that may influence DUI propensities (Taxman & Piquero, 1998). Although some find that the type of sanctions imposed have little influence on recidivism (Ahlin, Zador, Rauch, Howard, & Duncan, 2011), others find that some sanctions are effective (see Hansen, 2015; Sloan, Eldred, & Xu, 2014; Sloan, Eldred, McCutchan, & Platt, 2016).

While the variance in the DUI arrest/crash relationship may be due to diversity in post arrest policies, it may also result from policing strategies across states since DUI enforcement varies greatly across the country (Erickson et al., 2015). For example, although research suggests that DUI checkpoints are effective enforcement strategies many states prohibit or choose not to use them (see James, 2013). Additionally, the increase in alcohol related crashes predicted by increased violent crime is consistent with Klinger's (Klinger, 1997) theory that police may focus on traffic enforcement less in high crime areas. Since arrests are a formal way of handling DUI offenders, differences in policing styles across place may also play a role (see Wilson, 1978).

Several of the state level factors were important predictors of alcohol related fatalities. Theoretically, alcohol consumption and vehicular travel are both necessary elements to DUI, and Ross (1992) argues the DUI problem is the result of an interaction between two broader social problems of alcohol abuse and traffic safety. Therefore, the strong relationships between vehicle miles traveled and per capita alcohol consumption with alcohol related fatal crashes is not surprising, and consistent with prior research (see e.g. Chamlin & Sanders, 2017; Tippetts et al., 2005; Voas et al., 2000). Controlling for per-capita alcohol consumption is particularly important because it declined considerably from 1982 through 1995 (LaVallee et al., 2014) when there were also significant decreases in alcohol related crashes (see Fig. 2). Moreover, some scholars argue it accounts for at least some of the decline in alcohol related crashes (see Fell & Voas, 2006). While no research has conclusively explained the change in per-capita alcohol consumption, Williams (2006) argues it "occurred as a part of a change in social norms" (p. 129) which can also influence alcohol related crashes (see Stringer, 2018).

Interestingly, the percent of the population that indicated they had driven drunk in the past 12 months was not a significant predictor of alcohol related fatal crashes. Although it approached statistical significance ($P < .10$), the insignificance was likely a product of the limitations the secondary data which measured the percent of the population who drove drunk in the past year at the state level over time, rather than the frequency of DUI in each county. Although this project attempted to account for this "dark figure" of drunk driving, the actual rate is largely unknown and "probably unknowable" because even self-report data relies on a respondent's ability to know if they are above the limit and have committed the offense (Jacobs, 1989, p. 43). However, recent estimates indicate there is 1 arrest for every 1000 DUI trips in the U.S. (Zaloshnja, Miller, & Blincoe, 2013). Therefore, the vast majority of DUI offenders avoid punishment which can do more to encourage offending than punishment does to deter it (Stafford & Warr, 1993), and also has a negative impact on the perceived certainty of punishment for drunk drivers (see Freeman & Watson, 2006; Piquero & Paternoster, 1998a, b; Piquero & Pogarsky, 2002).

Although this project presents a macro level analysis which does not proclaim to assess individual level processes such as personal and vicarious punishment and punishment avoidance (see Stafford & Warr, 1993), the findings are consistent with much of the deterrence literature indicating that increased perceived certainty of DUI arrest is related to a decreased intention to drink and drive (Nagin & Pogarsky, 2001; Piquero & Paternoster, 1998a, b; Piquero & Pogarsky). It is difficult to apply macro level research to the micro level, and one must keep in mind the ecological fallacy of making inferences about individuals from aggregates. However, "…micro and macro deterrence processes may be related since perceived sanction threats are influenced in some measure by what goes on at the aggregate level" (Loughran et al., 2012, p.729; see also Zimring & Hawkins, 1973). Thus, although this will likely vary across individuals within a community, aggregate increases in DUI arrests within a community may be related to aggregate increases in personal and vicarious experiences with punishment and decreased arrests are more likely related to punishment avoidance within communities.

While it is probable that aggregate personal and vicarious experience with DUI arrests will have a direct effect on perceptions of certainty of punishment, the frequency of DUI arrests is also indicative of the DUI enforcement intensity in a community since officers generally discover DUI through their own proactive observations rather than calls for service (Snortum et al., 1990). Therefore, DUI arrests may also provide some measure of the level of overall DUI enforcement in a community since most of these practices will lead to arrests. For example, communities with increased DUI arrests are likely to be involved in other highly visible enforcement activities that will influence perceptions of certainty of punishment such as traffic stops which are highly visible to drivers (Fell et al., 2015), DUI checkpoints, saturation patrols, etc., (Sanem et al., 2015). Since all of these enforcement practices are highly visible, they are also likely to influence aggregate level perceptions of apprehension in a community (see Decker & Kohfeld, 1985; Sampson & Cohen, 1988).

In sum, this project illustrates that DUI enforcement is related to decreases in fatal alcohol related crashes since the movement against drunk driving began in the 1980s. However, this project illustrated that the relationship is more complicated, non-linear with considerable variation across states, than originally hypothesized. This aids in the reconciliation of the mixed results from the limited prior research and illustrates the need for more criminologists to investigate this important issue.

While this inquiry presents a rigorous longitudinal examination of DUI arrests and alcohol related fatal crashes in the United States, it is not without its limitations. For example, some of the control measures such as self-reported DUI, alcohol consumption, and vehicle miles traveled were only available at the state level. The ability to discern incapacitative effects of DUI enforcement from those related to deterrence are also limited and future research should attempt to disentangle these two phenomena. It should also be noted that DUI arrests are a proxy for DUI enforcement and therefore subject to some degree of measurement error. Despite these limitations, this project provided a substantial addition to the criminological and traffic safety literature. However, further research is required to understand the diversified effects of DUI enforcement across states to develop policies that can optimize the efforts to reduce fatal crashes.

Policy Implications

The results of this project suggest the DUI enforcement does lead to reductions in fatal alcohol related crashes in the United States. However, at some point enforcement is no longer effective. Therefore, in the era of evidence-based policing, these findings are particularly useful for police to determine "what works" and "helps assure that police neither increase crime nor waste money" (Sherman, 2013, p. 1). As such, policy makers should consider supplementing enforcement efforts with alternative methods to reducing these fatalities, for as DeMichele and Payne (2013) contend: "If I had a hammer, I would not use it to control drunk driving" (p. 213). Although the public largely supports the punitive approach to DUI (Applegate, Cullen, Link, Richards, & Lanza-Kaduce, 1996), it may be helpful to step back from the focus on deterrence of the individual drunk driver and reconsider the idea that the DUI problem results from the interaction of two broader social problems of alcohol abuse and traffic safety (Ross, 1992).

The neoliberalization of society has meaningfully reduced access to public health services for many with substance abuse issues such as alcoholism, which has left the criminal justice system responsible for controlling many public health issues (see e.g. Garland, 2001; Wacquant, 2009). In fact, the most recent data indicate there are approximately 15.1 million adults in the U.S. with alcohol abuse disorders (many of which drive), although only 6.7% have received treatment (Substance Abuse and Mental Health Services Administration [SAMHSA], 2015). As a result, about 88,000 people die each year due to alcohol-related causes, and alcohol abuse remains the third leading cause of preventable death, after tobacco and poor exercise and diet (Center for Disease Control and Prevention [CDC], 2010). Thus, since alcoholism is such a widespread problem and those with the disorder are among the least likely to be deterrable (see Goodfellow & Kilgore, 2013; Yu et al., 2006), the exploration of increasing access to public health services for alcoholics may be helpful in reducing alcohol related crashes and alcoholism in general.

Policy makers should also consider that the DUI problem is really a part of a much larger issue of traffic fatalities. For example, in 2016, there were a total of 34,439 fatal crashes, however 10,497 of these crashes, about one third, were alcohol related (NHTSA, 2016a). Moreover, the measure of non-alcohol related crashes was among the strongest predictors of alcohol related crashes. Thus, it is important to remember that crashes are complex sequences of events with multiple causal agents that come together to make the crash possible (Gusfield, 1985), these include the driver, vehicle, and other environmental factors such as road, weather, and other vehicles or objects (Haddon Jr, 1972). As such, not all alcohol related crashes are caused by the drinking driver (Stringer, 2016), and the sole focus on the alcohol use of individual drivers may be a large oversimplification of a broader and more complex social issue of traffic fatalities (Zylman, 1968). Thus, policy makers should explore other methods of addressing the traffic safety problem in general by exploring other contributing factors to crashes such as distractions, speeding, traffic and vehicle engineering to make automotive travel safer overall (see also Ross, 1992).

Funding This work was supported by the U.S. Department of Justice [grant number 2016-R2-CX-0027].

References

Ahlin, E. M., Zador, P. L., Rauch, W. J., Howard, J. M., & Duncan, G. D. (2011). First-time DWI offenders are at risk of recidivating regardless of sanctions imposed. *Journal of Criminal Justice, 39*(2), 137–142.

Applegate, B. K., Cullen, F. T., Link, B. G., Richards, P. J., & Lanza-Kaduce, L. (1996). Determinants of public punitiveness toward drunk driving: A factorial survey approach. *Justice Quarterly, 13*(1), 57–79.

Beccaria, C. (2009 [1764]). *On crimes and punishments and other writings* (R. Davies, trans. R. Bellamy Ed.). New York: Cambridge University Press.

Bouffard, J. A., Niebuhr, N., & Exum, M. L. (2016). Examining specific deterrence effects on DWI among serious offenders. *Crime & Delinquency, 0011128716675359*.

Butler, M. A., & Beale, C. L. (1990). *Rural-urban continuum codes for metro and nonmetro counties*. US Department of Agriculture, Economic Research Service.

Centers for Disease Control and Prevention (CDC). 2010. Alcohol and public health: Alcohol-related disease impact (ARDI). Average for United States 2006–2010 alcohol-attributable deaths due to excessive alcohol use.

Chamlin, M. B., & Sanders, B. A. (2017). Social policy and crash fatalities: A multivariate time series analysis. *Journal of Crime and Justice*, 1–12.

Chilton, R. (1982). Analyzing urban crime data: Deterrence and the limitations of arrests per offense ratios. *Criminology, 19*(4), 590–607.
DeAngelo, G., & Hansen, B. (2014). Life and death in the fast lane: Police enforcement and traffic fatalities. *American Economic Journal: Economic Policy, 6*(2), 231–257.
Decker, S. H., & Kohfeld, C. W. (1985). Crimes, crime rates, arrests, and arrest ratios: Implications for deterrence theory. *Criminology, 23*(3), 437–450.
DeMichele, M., Lowe, N. C., & Payne, B. K. (2014). A criminological approach to explain chronic drunk driving. *American Journal of Criminal Justice, 39*(2), 292–314.
DeMichele, M., & Payne, B. (2013). If I had a hammer, I would not use it to control drunk driving. *Criminology & Public Policy, 12*(2), 213–225.
Drew, L. (2010). *National survey of drinking and driving attitudes and behaviors: 2008*. US Department of Transportation, National Highway Traffic Safety Administration.
Dula, C. S., Dwyer, W. O., & LeVerne, G. (2007). Policing the drunk driver: Measuring law enforcement involvement in reducing alcohol-impaired driving. *Journal of Safety Research, 38*(3), 267–272.
Enders, C. K., & Tofighi, D. (2007). Centering predictor variables in cross-sectional multilevel models: A new look at an old issue. *Psychological Methods, 12*(2), 121–138.
Erickson, D. J., Farbakhsh, K., Toomey, T. L., Lenk, K. M., Jones-Webb, R., & Nelson, T. F. (2015). Enforcement of alcohol-impaired driving laws in the United States: A national survey of state and local agencies. *Traffic Injury Prevention, 16*(6), 533–539.
Erickson, M. L., Gibbs, J. P., & Jensen, G. F. (1977). The deterrence doctrine and the perceived certainty of legal punishments. *American Sociological Review, 42*, 305–317.
Federal Bureau of Investigation. (1993). *Uniform Crime Reporting Program Data [United States]: Arrests by Age, Sex, and Race. ICPSR23346-v1*. Ann Arbor: Inter-university consortium for political and social research [distributor], 2009-03-06.
Federal Bureau of Investigation. (2014). *Uniform Crime Reporting Program Data: County-Level Detailed Arrest and Offense Data, 2011*. United States Department of Justice. Office of Justice Programs. Retrieved from: https://doi.org/10.3886/ICPSR34582.v2
Federal Highway Administration. (2015). Highway Statistics Series 1986–2014. U.S. Department of Transportation Office of Highway Policy Information. Retrieved Novemeber 1, 2015 from: https://www.fhwa.dot.gov/policyinformation/statistics.cfm
Fell, J. C. (2014). Update: Repeat DWI offenders involvement in fatal crashes in 2010. *Traffic Injury Prevention, 15*(5), 431–433.
Fell, J. C., & Voas, R. B. (2006). Mothers against drunk driving (MADD): The first 25 years. *Traffic Injury Prevention, 7*(3), 195–212.
Fell, J. C., Waehrer, G., Voas, R. B., Auld-Owens, A., Carr, K., & Pell, K. (2014). Effects of enforcement intensity on alcohol impaired driving crashes. *Accident Analysis & Prevention, 73*, 181–186.
Fell, J. C., Waehrer, G., Voas, R. B., Auld-Owens, A., Carr, K., & Pell, K. (2015). Relationship of impaired-driving enforcement intensity to drinking and driving on the roads. *Alcoholism: Clinical and Experimental Research, 39*(1), 84–92.
Fone, D. L., Farewell, D. M., White, J., Lyons, R. A., & Dunstan, F. D. (2013). Socioeconomic patterning of excess alcohol consumption and binge drinking: A cross-sectional study of multilevel associations with neighbourhood deprivation. *BMJ Open, 3*(4), e002337.
Freeman, J., & Watson, B. (2006). An application of Stafford and Warr's reconceptualisation of deterrence to a group of recidivist drink drivers. *Accident Analysis & Prevention, 38*(3), 462–471.
Garland, D. (2001). *The culture of control* (Vol. 367). Oxford: Oxford University Press.
Goodfellow, M., & Kilgore, C. (2013). DUI offenders' beliefs about DUI statutes and DUI law enforcement: Implications for deterrence. *Journal of Drug Issues, 44*(3), 269–280.
Gusfield, J. R. (1981). *The culture of public problems: Drinking-driving and the symbolic order*. Chicago: University of Chicago Press.
Gusfield, J. R. (1985). Social and cultural contexts of the drinking-driving event. *Journal of Studies on Alcohol and Drugs, 10*, 70.
Gusfield, J. R. (1996). *Contested meanings: The construction of alcohol problems*. Madison: University of Wisconsin Press.
Haddon Jr., W. (1972). A logical framework for categorizing highway safety phenomena and activity. *Journal of Trauma and Acute Care Surgery, 12*(3), 193–207.
Hansen, B. (2015). Punishment and deterrence: Evidence from drunk driving. *American Economic Review, 105*(4), 1581–1617.
Heagerty, P. J., & Zeger, S. L. (2000). Marginalized multilevel models and likelihood inference (with comments and a rejoinder by the authors). *Statistical Science, 15*(1), 1–26.

Hemmingsson, T., Lundberg, I., Diderichsen, F., & Allebeck, P. (1998). Explanations of social class differences in alcoholism among young men. *Social Science & Medicine, 47*(10), 1399–1405.
Holmila, M., Mustonen, H., Österberg, E., & Raitasalo, K. (2009). Public opinion and community-based prevention of alcohol-related harms. *Addiction Research & Theory, 17*(4), 360–371.
Hox, J., & Roberts, J. K. (Eds.). (2011). *Handbook of advanced multilevel analysis*. Psychology Press.
Hoyle, J., Miller, B. L., Stogner, J. M., Posick, C., & Blackwell, B. S. (2017). Analyzing predictors of drinking and driving among gender cohorts within a college sample. *American Journal of Criminal Justice*, 1–14.
Jacob, H., & Rich, M. J. (1980). Effects of the police on crime: A second look. *Law & Society Review, 15*, 109.
Jacobs, J. B. (1989). *Drunk driving: An American dilemma*. University of Chicago Press.
James, V. (2013). The end of a smashing night: Deconstructing the effectiveness of sobriety checkpoint. *ACJS Today, 38*(2), 4–11.
Jones, R. K., Wiliszowski, C. H. & Lacey J. H. (1999). Examination of DWI Conviction Rate Procedures. U.S. Department of Transportation. Natonal Highway Traffic Safety Administration. Report No. DOT HS 808 970.
Klinger, D. A. (1997). Negotiating order in patrol work: An ecological theory of police response to deviance. *Criminology, 35*, 277–306.
Lanza-Kaduce, L. (1988). Perceptual deterrence and drinking and driving among college students. *Criminology, 26*(2), 321–341.
LaVallee, R. A., Kim, T., & Yi, H. Y. (2014). *Apparent per Capita Alcohol Consumption: National, State, and Regional Trends, 1977–2012*. U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health.
Lerner, B. H. (2011). *One for the road: Drunk driving since 1900*. JHU press.
Logan, C. H. (1972). General deterrent effects of imprisonment. *Social Forces, 51*, 64–73.
Loughran, T. A., Pogarsky, G., Piquero, A. R., & Paternoster, R. (2012). Re-examining the functional form of the certainty effect in deterrence theory. *Justice Quarterly, 29*(5), 712–741.
Lundman, R. J. (1998). City police and drunk driving: Baseline data. *Justice Quarterly, 15*(3), 527–546.
Makowsky, M. D., & Stratmann, T. (2011). More tickets, fewer accidents: How cash-strapped towns make for safer roads. *The Journal of Law and Economics, 54*(4), 863–888.
Mastrofski, S. D., & Ritti, R. R. (1992). You can lead a horse to water: A case study of a police department's response to stricter drunk-driving laws. *Justice Quarterly, 9*(3), 465–491.
Mastrofski, S. D., & Ritti, R. R. (1996). Police training and the effects of organization on drunk driving enforcement. *Justice Quarterly, 13*(2), 291–320.
Mastrofski, S. D., Ritti, R. R., & Hoffmaster, D. (1987). Organizational determinants of police discretion: The case of drinking-driving. *Journal of Criminal Justice, 15*(5), 387–402.
Morrison, C., Ponicki, W. R., Gruenewald, P. J., Wiebe, D. J., & Smith, K. (2016). Spatial relationships between alcohol-related road crashes and retail alcohol availability. *Drug and Alcohol Dependence, 162*, 241–244.
Nagin, D. S., & Pogarsky, G. (2001). Integrating celerity, impulsivity, and extralegal sanction threats into a model of general deterrence: Theory and evidence. *Criminology, 39*(4), 865–892.
National Alcohol Beverage Control Association. (2014). *Wet and Dry Counties*. Retreived online from: http://www.nabca.org/assets/Docs/Research/White%20Papers/WetDry%20March%202014.pdf. Accessed 21 April 2007.
National Highway Traffic Safety Administration (NHTSA). (2016a). Traffic Safety Facts: Alcohol-Impaired Driving (2016 Data). Technical Report Number DOT HS 812 450. Washington; Department of Transportation Retrieved from: https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812450
National Highway Traffic Safety Administration (NHTSA). (2016b). *Fatality Analysis Reporing System (FARS)*. United States Department of Transportation.
National Institute on Alcohol Abuse & Alcoholism (NIAAA). 2016. Alcohol policy information system (APIS). Retrieved on October 1, 2015 from: https://alcoholpolicy.niaaa.nih.gov/
Peck, R. C., Gebers, M. A., Voas, R. B., & Romano, E. (2008). The relationship between blood alcohol concentration (BAC), age, and crash risk. *Journal of Safety Research, 39*(3), 311–319.
Piquero, A., & Paternoster, R. (1998a). An application of Stafford and Warr's reconceptualization of deterrence to drinking and driving. *Journal of Research in Crime and Delinquency, 35*(1), 3–39.
Piquero, A., & Paternoster, R. (1998b). An application of Stafford and Warr's reconceptualization of deterrence to drinking and driving. *Journal of Research in Crime & Delinquency, 35*(1), 3–40.
Piquero, A. R., & Pogarsky, G. (2002). Beyond Stafford and Warr's reconceptualization of deterrence: Personal and vicarious experiences, impulsivity, and offending behavior. *Journal of Research in Crime and Delinquency, 39*(2), 153–186.

Pogarsky, G. (2002). Identifying "deterrable" offenders: Implications for research on deterrence. *Justice Quarterly, 19*(3), 431–452.
Pogarsky, G., & Piquero, A. R. (2003). Can punishment encourage offending? Investigating the "resetting" effect. *Journal of Research in Crime and Delinquency, 40*(1), 95–120.
Ponicki, W. R., Gruenewald, P. J., & Remer, L. G. (2013). Spatial panel analyses of alcohol outlets and motor vehicle crashes in California: 1999–2008. *Accident Analysis & Prevention, 55*, 135–143.
Pratt, T. C., Cullen, F. T., Blevins, K. R., Daigle, L. E., & Madensen, T. D. (2006). The empirical status of deterrence theory: A meta-analysis. In *Taking stock: The status of criminological theory* (Vol. 15, pp. 367–396).
Rakauskas, M. E., Ward, N. J., & Gerberich, S. G. (2009). Identification of differences between rural and urban safety cultures. *Accident Analysis & Prevention, 41*(5), 931–937.
Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (Vol. 1). Sage.
Reinarman, C. (1988). The social construction of an alcohol problem. *Theory and Society, 17*(1), 91–120.
Ross, H. L. (1992). *Confronting drunk driving: Social policy for saving lives*. Yale University Press.
Rubin, D. (1987). *Multiple Imputation for Nonresponse in Surveys*. New York: J. Wiley and Sons.
Sampson, R. J., & Cohen, J. (1988). Deterrent effects of the police on crime: A replication and theoretical extension. *Law and Society Review, 22*, 163–189.
Sanem, J. R., Erickson, D. J., Rutledge, P. C., Lenk, K. M., Nelson, T. F., Jones-Webb, R., & Toomey, T. L. (2015). Association between alcohol-impaired driving enforcement-related strategies and alcohol-impaired driving. *Accident Analysis & Prevention, 78*, 104–109.
Sherman, L. W. (2013). The rise of evidence-based policing: Targeting, testing, and tracking. *Crime and justice, 42*(1), 377–451.
Sloan, F., Eldred, L., McCutchan, S., & Platt, A. (2016). Deterring rearrests for drinking and driving. *Southern Economic Journal, 83*(2), 416–436.
Sloan, F. A., Eldred, L. M., & Xu, Y. (2014). The behavioral economics of drunk driving. *Journal of Health Economics, 35*, 64–81.
Snijders, T. A., & Bosker, R. J. (2012). *Multilevel analysis: An introduction to basic and advanced multilevel modeling* (2nd ed.). Thousand Oaks: SAGE.
Snortum, J. R., Riva, P. R., Berger, D. E., & Mangione, T. W. (1990). Police documentation of drunk-driving arrests: Jury verdicts and guilty pleas as a function of quantity and quality of evidence. *Journal of Criminal Justice, 18*(2), 99–116.
Stafford, M. C., & Warr, M. (1993). A reconceptualization of general and specific deterrence. *Journal of Research in Crime and Delinquency, 30*(2), 123–135.
Stringer, R. J. (2016). Are buzzed drivers really the problem a quasi-experimental multilevel assessment of the involvement of drivers with low blood alcohol levels in fatal crashes. *Criminal Justice Policy Review, 29*(5), 464–488.
Stringer, R. J. (2018). Exploring traffic safety culture and drunk driving: An examination of the community and DUI related fatal crashes in the US (1993–2015). *Transportation Research Part F: Traffic Psychology and Behaviour, 56*, 371–380.
Substance Abuse and Mental Health Services Administration (SAMHSA). 2015. *Results from the 2015* National Survey on drug use and health (NSDUH): Detailed tables. Retreived from: https://www.samhsa.gov/data/sites/default/files/NSDUH-DetTabs-2015/NSDUH-DetTabs-2015/NSDUH-DetTabs-2015.htm#tab5-6a.
Taxman, F. S., & Piquero, A. (1998). On preventing drunk driving recidivism: An examination of rehabilitation and punishment approaches. *Journal of Criminal Justice, 26*(2), 129–143.
Tippetts, A. S., Voas, R. B., Fell, J. C., & Nichols, J. L. (2005). A meta-analysis of. 08 BAC laws in 19 jurisdictions in the United States. *Accident Analysis & Prevention, 37*(1), 149–161.
Uniform Crime Reports. (2017). Crime in the United States. U.S. Department of Justice, Federal Bureau of Investigation. Retrieved from https://ucr.fbi.gov/crime-in-the-u.s/2016/crime-in-the-u.s.-2016/topic-pages/tables/table-18.
Voas, R. B., Tippetts, A. S., & Fell, J. (2000). The relationship of alcohol safety laws to drinking drivers in fatal crashes. *Accident Analysis & Prevention, 32*(4), 483–492.
Voas, R. B., Torres, P., Romano, E., & Lacey, J. H. (2012). Alcohol-related risk of driver fatalities: An update using 2007 data. *Journal of Studies on Alcohol and Drugs, 73*(3), 341–350.
Wacquant, L. (2009). *Punishing the poor: The neoliberal government of social insecurity*. Duke University Press.
Williams, A. F. (2006). Alcohol-impaired driving and its consequences in the United States: The past 25 years. *Journal of Safety Research, 37*(2), 123–138.

Wilson, F. A., & Stimpson, J. P. (2010). Trends in fatalities from distracted driving in the United States, 1999 to 2008. *American Journal of Public Health, 100*(11), 2213–2219.

Wilson, J. Q. (1978). *Varieties of police behavior: The Management of law and Order in eight communities, with a new preface by the author*. Harvard University press.

Yao, J., Johnson, M. B., & Tippetts, S. (2016). Enforcement uniquely predicts reductions in alcohol-impaired crash fatalities. *Addiction, 111*(3), 448–453.

Yu, J., Evans, P. C., & Clark, L. P. (2006). Alcohol addiction and perceived sanction risks: Deterring drinking drivers. *Journal of Criminal Justice, 34*(2), 165–174.

Zador, P. L., Krawchuk, S. A., & Voas, R. B. (2000). Alcohol-related relative risk of driver fatalities and driver involvement in fatal crashes in relation to driver age and gender: an update using 1996 data. *Journal of Studies on Alcohol and Drugs, 61*(3), 387.

Zaloshnja, E., Miller, T. R., & Blincoe, L. J. (2013). Costs of alcohol-involved crashes, United States, 2010. *Annals of Advances In Automotive Medicine, 57*, 3.

Zimring, F. E., & Hawkins, G. (1995). *Incapacitation: Penal confinement and the restrain*. New York: Oxford University Press.

Zimring, F. E., & Hawkins, G. J. (1968). Deterrence and marginal groups. *Journal of Research in Crime and Delinquency, 5*, 100–114.

Zimring, F. E., & Hawkins, G. J. (1973). *Deterrence: The legal threat in crime control*. Chicago, IL: University of Chicago Press.

Zylman, R. (1968). Accidents, alcohol and single-cause explanations. Lesions from the Grand Rapids study. *Quarterly Journal of Studies on Alcohol*, (Supp. no. 4), 212–33.

Richard J. Stringer Ph.D. is an Assistant Professor at Kennesaw State University. His research interests include drug and alcohol policy, policing, and advanced quantitative methods. His prior research has been funding by the Department of Justice (DOJ) and has appeared in outlets such as the Journal of Crime and Justice, Journal of Drug Issues, and Criminal Justice Policy Review.