The effectiveness of anti-alcohol PSAs in Reducing Drunk-Driving Fatalities: 1995-2010

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By

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Abstract

Alcohol abuse and awareness and drunk driving (anti-alcohol) public service announcements (PSAs) have been an important policy and public health tool to curb dangerous alcohol behaviors. Drunk driving is of particular importance because of loss of life and associated economic costs. PSAs can be a useful tool in policy efforts to curb such behavior, but little work has been done to examine their effectiveness at decreasing real-world drunk driving outcomes. The research question explored in this study is: *Whether PSAs aired in that state in past months impact drunk driving fatalities in that state during the present month*. The time period for the analysis is 1995-2010. This paper will examine the time of day when PSAs aired between 1995 and 2010. Effectiveness is measured by using OLS regression to measure the impact of PSAs aired in that state during each of the past eight months on drunk driving fatalities in that state during the present month. . I further examine the impact of PSAs airing at different times of the day (primetime, night time, and daytime). Additional analyses examine the impact of PSAs on underage drunk driving fatalities. Results indicate that a larger number of PSAs aired in a state in the past eight months is not associated with decreases in fatal accidents in the present month, but not underage s drunk driving fatalities. However, there are times of day aired that do yield effects. PSAs airing during primetime were more string associated with fatal accident reduction. Furthermore, PSAs aired closer to accidents (in the previous four months) were more predictive of larger decreases in drunk driving fatalities.

INTRODUCTION

There continues to be widespread concern among policymakers, law enforcement officers, and the general public regarding the potential detrimental effects of excessive alcohol consumption and abuse (especially by minors) and associated social problems related to alcohol, particularly drunk driving. Alcohol consumption is a leading contributor to death from injuries, which itself is one of the main causes of death for people under 21 years of age. Each year, approximately 4,700 young people die from causes related to alcohol use (Federal Trade Commission, 2014). In 2010, there were an estimated 112 million drunk driving episodes and 13,365 drunk driving-related deaths, resulting in a total cost of over $37 billion in associated costs (Chambers, Liu, & Moore, 2012). In 2012, 10,322 people were killed, 345,000 were injured due to alcohol impaired driving, and the total cost was estimated to be $132 billion.

Significant economic costs result from drunk driving, including the direct costs of health care, property damage, motor vehicle repair, emergency attendance, and premature death (World Health Organization, 2010). The social costs of drunk driving include increased law enforcement, imprisonment, compensation payments, unemployment, health and disability insurance, and loss of productivity in the workplace from injury or premature death (Centers for Disease Control and Prevention, 2008).

The United States has adopted a multipronged strategy to curb these costs, ranging from raising taxes to establishing BAC limits to reduce drunk driving. In addition to changing laws and policies, the country has launched decades of public service announcements (PSAs) and education campaigns in an attempt to curb this behavior. Many private organizations Mothers Against Drunk Driving (MADD) and Students Against Drunk Driving (SADD) have launched public service announcement (PSA) campaigns to educate the public about the hazards and consequences of irresponsible alcohol use and drunk driving. Some evidence suggests, however, that many interventions designed to discourage alcohol abuse and drunk driving have been ineffective and have done little to eliminate the health threats posed by dangerous drinking behaviors (Andsager et al., 2001; Grube & Voas, 1996; Sarkar, Andreas, & DeFaria, 2005; Valde & Fitch, 2004). To date, there have been few national level, empirical studies of the effectiveness of anti-alcohol PSAs in reducing drunk driving rates. The research question this seeks to answer is*: How effective are anti-alcohol public service announcements at reducing drunk driving fatalities?*

BACKGROUND

Policy efforts to reduce drunk driving

Drunk driving is a social problem that has a long history in the United States. Post-World War II, drunk driving became a more pressing social concern due to an increasing trend in alcohol-related fatal road accidents. As a result of this upward trend states started passing laws defining drunk driving as "driving with blood alcohol level (BAC) above a specified limit." BAC is measured by the weight of alcohol in a certain volume of blood. For example, a BAC of 0.1% means one-tenth of a percent of a person's blood is alcohol. In order to be considered a drunk driver, a driver must have a BAC above the legal limit.

By the mid-1960s, most states had enacted blood alcohol concentration laws that established an illegal BAC threshold (Williams, 2006). Laws setting limits of BAC are often referred to as "*per se*" laws– meaning that driving with a BAC above the legal limit is considered "per se" or intrinsic evidence, by fact that the driver is too intoxicated to drive responsibly. By 1997, most states had enacted a per se law setting the BAC limit to 0.1% (NHTSA, 1997). By 2004 all states had passed a 0.08% BAC law, and several states are currently considering lowering the BAC limit to 0.06%.

Drunk driving as a policy issue gained momentum in the late 70s and early 80s. By 1978, the organization Removing Intoxicated Drivers (RID) was founded by Doris Aiken after a local teenager was killed by an intoxicated driver. The 1980s further brought the issue of drunk driving to national attention (Williams, 2006). Shortly after the founding of RID, Mothers Against Drunk Drivers (MADD) was established by Candy Lightener in 1980. Lightener founded the organization after her daughter was killed by a repeat offender who only received a light punishment (Williams, 2006). Due to efforts of people like Aiken and Lightener, drinking and driving in the 1980s was transformed from a peripheral social concern to an issue of national priority.

Due to the increased public awareness of the 1980s, the Fatality Analysis Reporting System (FARS) began to track alcohol data in crash statistics (Williams, 2006). The newfound ability to track BACs of drivers involved in fatal accidents provided policy makers and advocacy organizations easier access to information needed to make strong cases against drunk driving. In the years 1980 to 1985 more than 700 new drunk driving laws were passed throughout the 50 states and Washington D.C. (Lerner, 2011). Some of these laws, such as per se, administrative license revocation, and sobriety checkpoints have been found to be effective at reducing drunk driving in various studies (Hingston, 1996; Williams, 2006; Elder, 2011). Punitive policies such as mandatory jail time or fines have been found to be less effective at consistently reducing drunk driving (Voas and Fisher, 2001; Wagenaar, 2007). Other options to reduce drunk driving include increasing alcohol taxes.

Public service announcements (PSAs) against drunk driving have been coupled with more formal drunk driving prevention policies since the early 1980s. In 1983 the Ad Council launched its first anti-drunk driving PSA. Since then, PSAs have been a constant force driving awareness of the consequences of drunk driving, and encouraging individuals to not drink and drive and/or to be an active bystander in preventing friends from drinking and driving.

Trends in drunk driving fatalities

Overall, using various metrics, since 1982 there have been dramatic reductions in alcohol-related traffic fatalities in the United States. Figures 1 provides information on total drunk driving fatalities, and drunk driving fatality rates per 100,000 state residents from 1995-2010. The total incidence of drunk driving fatal accidents slowly declined between 1995 and 2010, and even more precipitously for underage drivers.

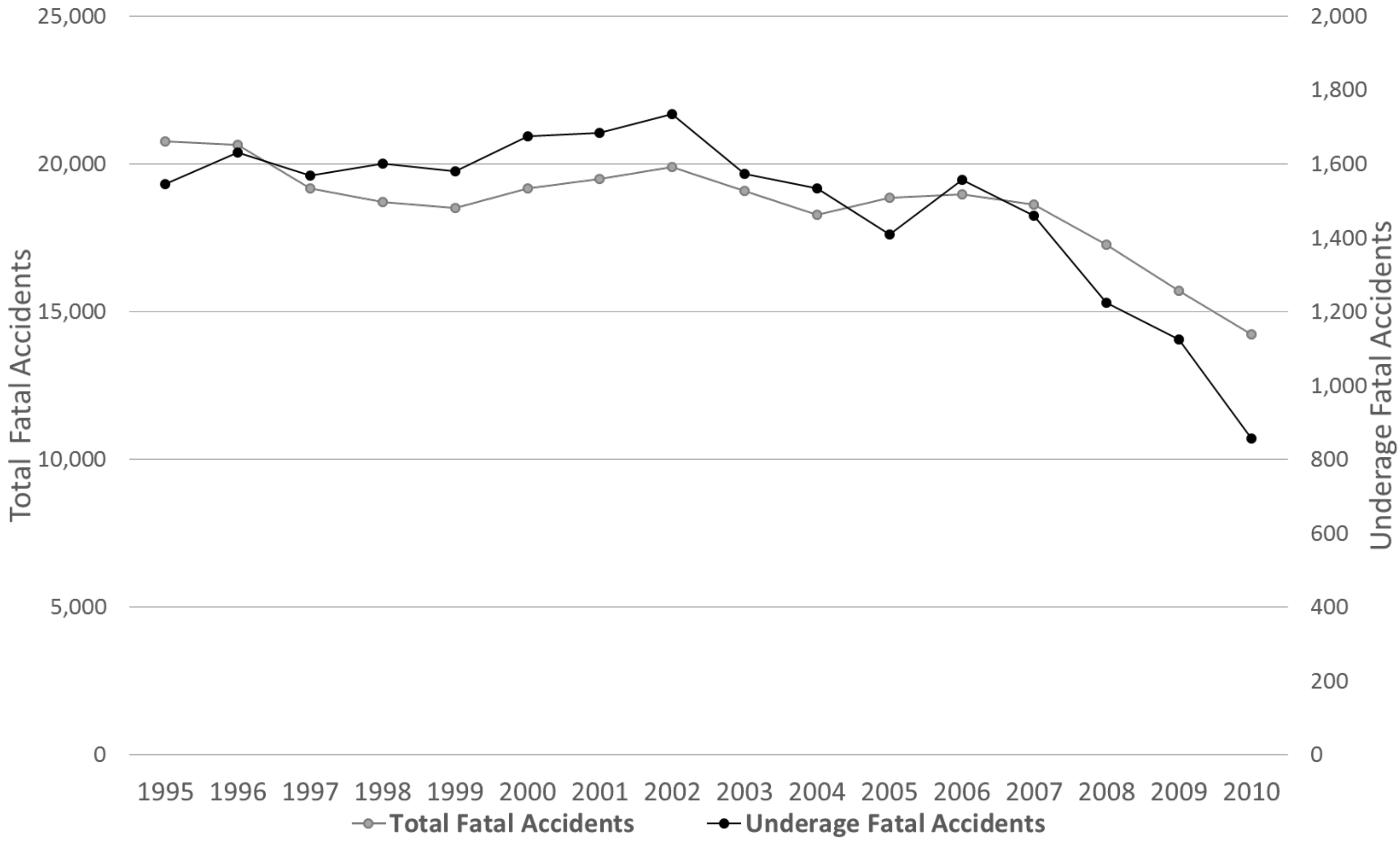

Figure 1: Fatal Accidents Caused by All Drunk Drivers and Underage Drunk Drivers per 100,000 Residents from 1995 to 2010

Anti-Alcohol PSAs

PSA campaigns have had varying degrees of success to decrease negative health behaviors or promoting positive health behaviors (Elder, 2004; Palmgreen, Donohew, Lorch, Hoyle and Stephenson, 2001; Goldman and Glance, 1998). Public service announcements campaigns to deter drunk driving have been and continue to remain a popular strategy. Between 1987 and 1992, PSAs that highlighted the use of a designated driver were the most common ad strategy (DeJong, 1998). Since the inception of the designated driver strategy in 1983, 70% of Americans have attempted to stop a person from driving while intoxicated (Anderson, 2009). Wakefield et al. in (2010) found that mass media campaigns to encourage responsible alcohol consumption and safe drinking behaviors have shown little evidence of benefits. For example, evidence for specific campaigns encouraging designated drivers is not as conclusive as other drunk driving PSA strategies, such as decreasing drunk driving with a law enforcement campaigns (Wakefield, 2010).

A campaign started in 2005, “Buzzed Driving is Drunk Driving”, highlights the legal and financial consequences of drunk driver. This campaign developed by NHTSA and the Ad Council, an entity that designs pro-social advertisements. This campaign is part of the overall Project Roadblock Campaign. Project Roadblock is the local broadcast television industry’s extension of the “Buzzed Driving is Drunk Driving” campaign. From its inception in December 2005 to December 2013, Project Roadblock has received more than $410 million in donated air time from a network of local stations. The PSAs air over the holiday week from December 26th through New Year’s Eve. The campaign typically involves over 1,300 broadcast television stations, nearly 50,000 placements of ads and reaches over 99% of US television households in 205 markets (Wireless News, 2013).

Results from the Project Roadblock series of campaigns have been captured by a national survey undertaken by the Ad Council. In 2005, 17% of adults 21 years or older said they would “always” get ride, taxi or public transport rather than drive if they felt buzzed, but 50% said they would be “extremely” or “very” likely to drive home while buzzed. In 2013, 49% adults 21 years or older said would “always” get ride, taxi or public transport rather than drive if they felt buzzed, and only 8% reported they would be “extremely” or “very” likely to drive home while buzzed (Wireless News, 2013).

Another well-known campaign – “You drink. You drive. You Lose” – has also undergone a program evaluation. The campaign took place in July in 2003, and cost an unprecedented use of paid advertising totaling $25 million. The campaign reached the targeted audience – male drivers between 18 and 34 years – and there were increases in people hearing about police checkpoints and other enforcement efforts (36% to 43.5% in the national sample). However, there was little evidence of a significant decrease in self-reported drinking and driving behavior (Levy et al, 2004).

More generally, Elder and others in 2004 reviewed of seven studies that examined high-quality and high-intensity campaigns which evaluated the role of mass media campaigns on drunk drivers across the world (Elder, 2004). The aggregate result of the campaigns was a 13% decrease in alcohol-impaired driving (Elder, 2004). This result according to guidelines in the *Guide to Community Preventative Services* is enough to provide strong evidence about the effectiveness of mass media campaigns in reducing drunk driving (Elder, 2004). This review examined the message content and the message delivery. The ads were divided into two main message content groups: PSAs that highlighted the legal consequences of drinking and driving, like losing a license, and PSAs that highlighted the social and health consequences, like hurting someone, of drinking and driving. There was no clear difference in the effectiveness of campaigns that utilized legal consequences compared to social and health consequences (Elder, 2004).

PSAs targeting parents encouraging them to prevent underage consumption and drinking and driving have also been evaluated. In a post-campaign survey of parents after an experimentally controlled distribution of PSAs about underage drinking, parents showed greater awareness of underage drinking and driving and also reported more networking with other parents, more communication with teenagers about drunk driving and partying, and more intense monitoring (Atkin and Atkin, 1986). Despite changes in parental attitudes and behaviors, there was only a slight indirect effect on teenage alcohol consumption and drunk driving rates based on self-reported surveys (Atkin, 1986).

The national level studies of drunk driving PSA campaigns that have been undertaken have a couple of limitations. One is often only one particular campaign is being evaluated (e.g. You Drink, You Drive, You Lose or Friends Don't Let Friends Drive Drunk) instead of the aggregate level of all campaigns. Furthermore, often in national level studies, the outcome variable is measured using self-reported survey data (did you see this ad, are you more or less likely to drink and drive?). While this information does provide us with knowledge of intention to drink and drive, it does not give information on the actual incidence of the behavior evidence through DUI arrests or alcohol-related fatalities. One final drawback from some of these studies is that the PSAs are rarely explicitly linked to theoretical concepts such as threat appraisal or self-efficacy. Authors make their own criteria, but often don't categorize their ads in a larger PSA or health communication theory.

FOCUS OF THE STUDY

Despite the prevalence of PSAs, there have been few rigorous empirical examinations of the effectiveness of this strategy in reducing fatal accidents. This paper aims to contribute to this debate. This study focuses on alcohol-related drunk driving fatalities at the state level for the period 1995-2010. The research question to be examined is: *Whether PSAs aired in that state in the past months impact drunk driving fatalities in that state during the present month.* The study is driven by the following hypotheses:

Hypothesis 1: The total number of anti-alcohol PSAs airing in a state in the past eight months will be significantly predict reductions in fatalities caused by adult drunk drivers in that state in the present month.

Hypothesis 2: The total number of anti-alcohol PSAs airing in a state in the past eight months will significantly predict reductions in fatalities caused by an underage drunk driver in the present month.

PSAs aired on television are often non-paid commercials, i.e., the station voluntarily airs the PSA during less "expensive" advertising time slots. PSAs airing during these times of reduced audience viewing are likely to have less of an impact on drunk driving fatalities than those aired during higher audience viewing time slots.

Hypothesis 3: PSAs aired during primetime will be more effective in reducing drink driving fatalities than PSAs aired at other times of the day (day time, night time).

The study will further examine the impact of anti-alcohol PSAs airing closer in time to the fatal accident on reducing alcohol-related fatal accidents (recency effects versus primacy effects). To examine this question we narrow down the unit of analysis from total fatal accidents in a state/year, to total fatal accidents in a state month. We then regress total PSA airing in each of the previous eight months (separately) on the state/month measured total fatal accident rate.

Hypothesis 4: Recency effects (PSA seen most recently or closer to the time of the accident) will be a stronger predictor of fatal accident rates than those appearing in earlier months (primary effects).

Data and Methods

Fatal alcohol-related accidents

Data on fatal accidents caused by a drunk driver were obtained from the *Fatality Analysis Reporting System* (FARS). FARS is a database produced by the National Highway Traffic Safety Administration. From this source drunk driving fatalities in a state/month from 1995-2010 are obtained. Drunk drivers were defined as drivers who were coded by NHTSA as “Dr_drink” or if record indicates that the driver was drinking, either through positive BAC data or police-reported alcohol involvement. Alcohol data is often missing from crash records, so this metric might undercount the actual number of drinking drivers. Other variables, such as underage drunk driving fatalities were generated by additional variables that were present in the original dataset. FARS only records accidents involving fatalities. So when there are injuries but no fatalities in an accident, the accident does not appear in the data. The data in this project therefore do not include information for every drunk-driving accident, just the accident that had fatalities. In the analysis the dependent variable is normalized as a rate, i.e., fatal alcohol-related traffic accident per 100,000 residents in the state. Table 1 provides descriptive data on the mean number of total and youth fatal accidents by year.

Table 1: Total number of state alcohol-related fatal accidents by year and age of driver.

	Total Fatal Accidents	Adult Fatal Accidents	Underage Fatal Accidents	Percent of Fatal Accidents that Were Underage
1995	20,768	19,223	1,545	7.44
1996	20,635	19,005	1,630	7.90
1997	19,182	17,614	1,568	8.17
1998	18,723	17,122	1,601	8.55
1999	18,496	16,916	1,580	8.54
2000	19,174	17,499	1,675	8.74
2001	19,478	17,794	1,684	8.65
2002	19,905	18,171	1,734	8.71
2003	19,090	17,516	1,574	8.25
2004	18,266	16,733	1,533	8.39
2005	18,842	17,434	1,408	7.47
2006	18,964	17,406	1,558	8.22
2007	18,619	17,160	1,459	7.84
2008	17,271	16,048	1,223	7.08
2009	15,720	14,595	1,125	7.16
2010	14,232	13,375	857	6.02
Total (1995-2010)	297,365	273,611	23,754	7.99

Because of our model lagging PSAs up to eight months the first year of analysis is 1996. The model needs an eight month “look back window.” The first year we have control variables is 1996, so the regression models will start in 1996. Tables that are not purely descriptive but involve manipulation (such as dividing by state-month-year population) will be from 1996 to 2010. Tables that merely describe available data include the full time frame from 1995 to 2010. Table 2 provides summary statistics on the average number of accidents caused by drunk drivers and underage drunk drivers in each state-month from 1996 to 2010.

Table 2: Number of Drunk Driving Deaths per State-Year-Month from 1996 to 2010.

	Mean	SD	Median	Min	Max
Total Accidents Caused by a Drunk Driver per 100,000 Residents	.642	.444	.554	0	4.485
Total Accidents Caused by an Adult Drunk Driver per 100,000 Residents	.588	.408	.507	0	4.057
Accidents Caused by an Underage Drunk Driver per 100,000 Residents	.054	.066	.036	0	.943

Examining the rates of drunk driving fatalities there is considerable variation across various standardized state-year-months. The rate for underage drunk driving fatalities is a small fraction of the adult rate. There is about one half of a fatal accident, which could have more than one fatality if the accident yielded multiple deaths, per 100,000 residents in each state-year-month. One thing to consider is the number of fatalities is divided by the total population, not the adult driver and the underage driver (ages 15-20) population.

Anti-alcohol PSAs

This analysis makes use of a census of alcohol abuse awareness and drunk driving PSAs, collectively referred to as anti-alcohol PSAs in this paper, appearing on national network and local cable television stations in the U.S. from January 1995 through December 2010 (15 years) in the 210 largest Designated Marketing Areas (DMAs) in the U.S. We obtained these data from TNS Kantar Media. The data files include a set of graphic images (or full-video in later years) of the PSA content as well as the time, date, and station on which the PSA aired. The data include both national and state anti-alcohol and drunk driving PSAs. The data include N=11,187 unique PSAs that aired a total of N=18,530,141 times during the time frame. From 1996 to 2010 there were 17,675,111 airings. Another thing to note about the PSA data is dataset included all PSAs aired regardless of if the channel was broadcast or cable. Both types of viewership are captured along with locally aired verses nationally aired PSAs.

We assigned each PSA airing to a U.S. state according to the DMA in which the PSA aired. For PSAs appearing in DMAs that crossed state boundaries, we assigned the PSA to both overlapping states. For example, DMAs for large cities on state borders (e.g., Washington, D.C. and New York City, N.Y.)

cross two or more states. Ninety-five out of the 210 DMAs included multiple states. We assigned national ads to every DMA in which the ad cleared locally.

I examined PSAs aired by month and PSAs aired by the day of week to gain a better understanding of when PSAs aired. The results are found in Figure 2, which also tracks total drunk driver fatalities, and Table 3.

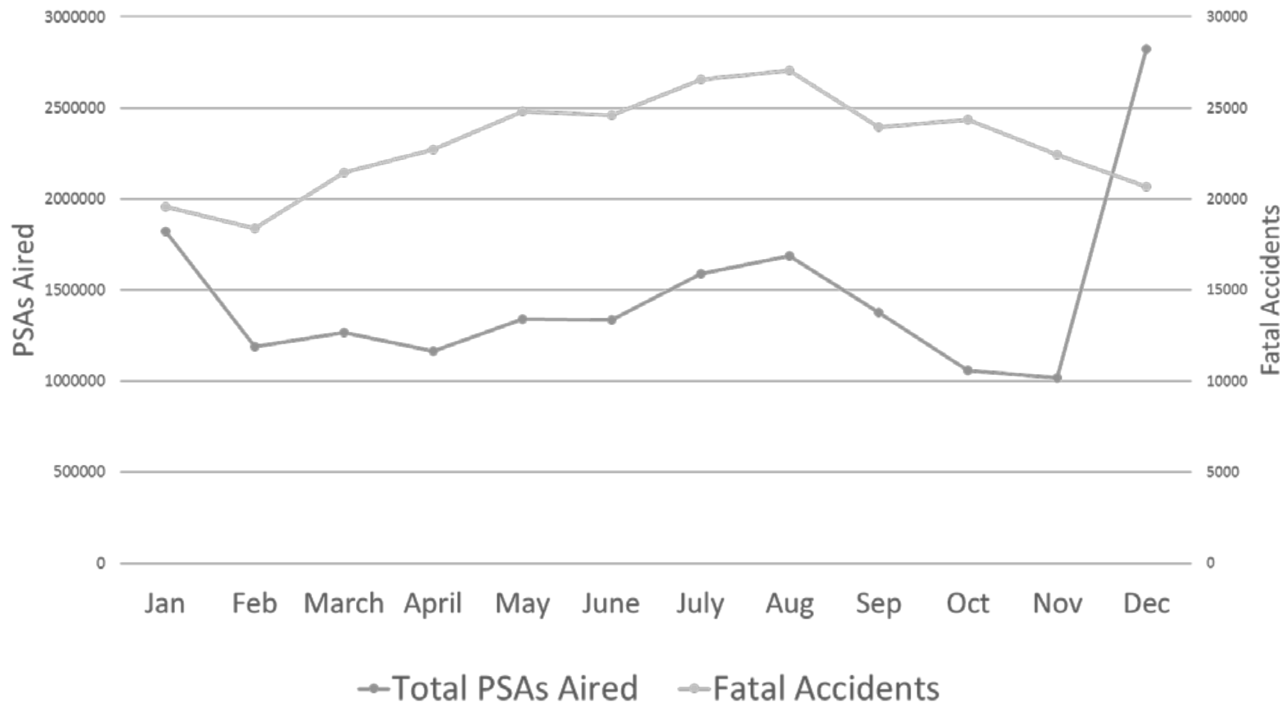

Figure 2: Number of PSA Airings and Fatalities per Month

Examining the monthly airings data, the months with the most PSAS were December and January, around the holiday seasons of Christmas and New Year's. This reflects the pattern of fatalities and drunk driving which spike around the end of the year. Other concentrations of PSA airings were during the summer months of July and August, which are also where there are more fatalities. For the most part, there are similar trends in number of accidents and number of PSAs aired. This can be partially explained by many campaigns and news stations concentrate around late December.

Table 3: Number of PSAs Airings by Day of Week: 1995-2010

	Number of PSAs	Percentage of Total
Monday	2,594,813	14.0
Tuesday	2,630,288	14.2
Wednesday	2,726,784	14.7
Thursday	2,696,660	14.6
Friday	2,793,261	15.1
Saturday	2,619,640	14.1
Sunday	2,468,695	13.3
Total	18,530,141	100.0

PSAs aired by day of week remain constant with Friday airing slightly more PSAs than the rest of the week.

In order to examine differential effects of PSAs on drink driving fatalities by time of day PSAs aired, PSA airing totals were estimated for the following time periods: Primetime (7:00PM - 10:59PM), Daytime (7:00AM – 6:59PM), and nighttime (11:00PM- 6:59AM). Table 4 shows the total number of PSAs aired in each day part as well as provides summary statistics for each state-month from 1996 to 2010. Figure 3 breaks down which specific times of day has the most PSAS aired. Finally, Figure 4 illustrates how the PSAs aired in aggregate day part (Primetime, Night Time, and Day Time) varied throughout the timeframe of 1996-2010.

Table 4: PSA Totals by Time of Day and Summary Statistics per State-Month 1996 - 2010

	Total	Mean # PSAs	Standard Deviation	Median # PSAs	Minimum # PSAs	Maximum # PSAs
Total PSA Airings	17,675,111	1,925.4	1,733.7	1,476	4	18,265
Primetime (7:00PM - 10:59PM) Percent of Total	2,273,027 (12.8%)	247.6	263.7	172	0	2,962
Daytime (7:00AM – 6:59PM) Percent of Total	7,534,524 (42.6%)	820.8	846.5	571.5	1	9,367
Night Time (11:00PM- 6:59AM) Percent of Total	7,866,785 (44.6%)	856.9	730.8	680	0	7,642

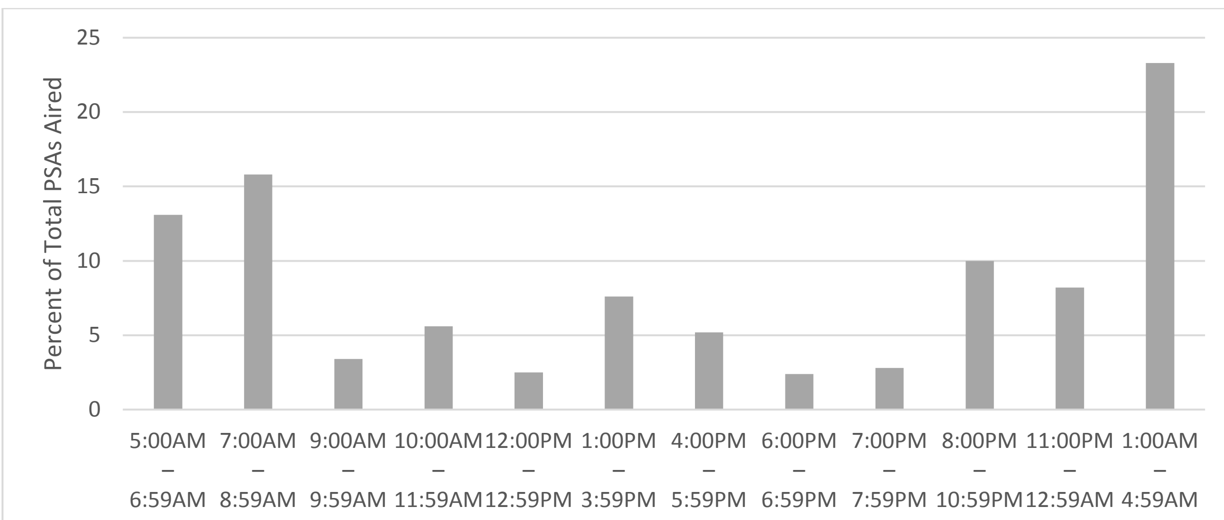

Figure 3: Percent of Total PSAs Aired by Time of Day 1995-2010

Table 4 and Figure 3 illustrate that the vast majority of PSAs are aired during the day or at night when people are not watching TV.

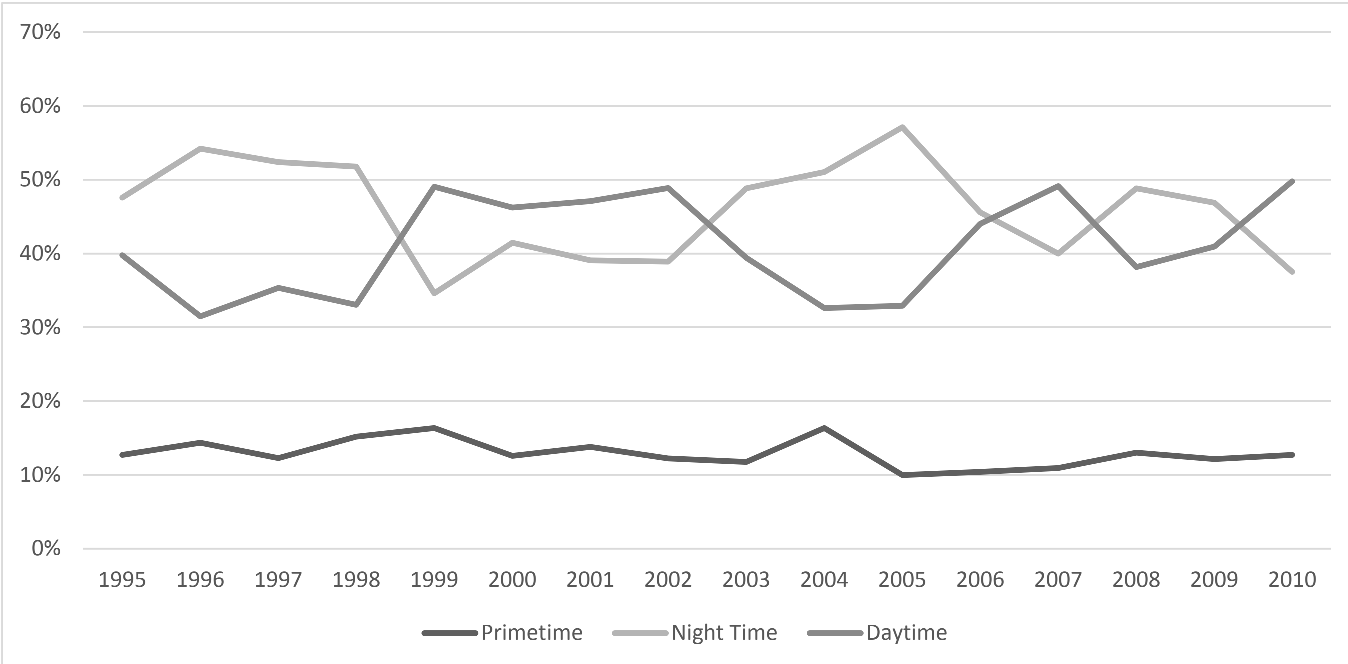

Figure 4: Percent of PSAs Aired by Time of Day by Year 1995-2010

Figure 4 illustrates the fluctuations of when PSAS are aired. Daytime and Night time aired PSAs fluctuate for popular timeslot aired. Primetime is consistently below the other two slots, and has been consistent.

One final characteristic of the PSAs we examine was the sponsor of the PSA. PSAs can be sponsored by government, businesses or even alcohol companies. The results of our analysis are reported in Table 5. Federal government agencies along with other business sponsors (most often local news stations) were the most common sponsors. This an important result because the federal government created PSAs often rely on donated media time, and might not be aired at a time where there are viewers watching. The significance of having other business sponsors be high is that news stations often donate media time or sponsor the PSAs, potentially through national level campaigns like Project Roadblock. This might indicate that PSAs are being aired during more desirable spts.

Table 5: Number of PSAs Airings by Sponsors from 1995-2010

Sponsor	Number	Percent of Total
Mothers Against Drunk Driving (MADD)	780,804	4.2
Recording Artists, Actors and Athletes Against Drunk Driving (RADD)	1,323,830	7.1
Students Against Drunk Driving (SADD)	7,559	0.0
Alcoholics Anonymous	1,325,036	7.2
Al-Anon	18,594	.1
Alcohol Company	303,856	1.6
Federal Governmental Agency	11,742,398	63.4
State/Local Agency	751,307	4.1
Other Business Sponsor	3,541,548	19.1
No Sponsor	3,149,463	17.0

Control Variables

Public service announcements are only one policy tool that states can use. Often states use a multipronged prevention strategy that is comprised of policies and laws. State policies and laws can reduce drunk driving by having strict definitions of drunk driving (per se or high BAC laws), outlining penalties (administrative license revocation or mandatory fines), controlling the sale of alcohol (server training and taxes on alcohol) or setting a liability climate around alcohol (dram shop and sobriety checkpoints). The model needs to control for these other factors that might decrease drunk driving.

A large number of state policy variables were available in the data collected for this study. Some variables did not have pervious empirical evidence supporting their inclusion in the model and were dropped from further analyses. In order to determine a parsimonious set of control variable to use in the model, preliminary regressions were run using fatal accident rates as the dependent variable and the set of law and policy variables supported by previous empirical studies as predictors. Each variable run in the preliminary regressions was checked for significance in predicting fatal accident rates. If a variable was not significant, it was dropped from the model. For variables that were counted twice in the offense definition and punishment category - like test refusal and test refusal penalties – only one variable was included.

Many control variables used, especially state policies and laws, were collected from 1996 to 2010. This is in part why the regression analysis, discussed below, uses the shortened 1996 to 2010 time frame.

State policies and laws: These variables include state anti-alcohol laws and policies (offense classification, punishment and sanctions, social liability and alcohol control climate); tax alcohol tax policies; and, state demographic characteristics (Table 6). Data for the state-control dataset were collected from the following national databases: National Institute on Alcohol Abuse and Alcoholism, and the Governors' Office of Highway Safety. Legal databases such as Lexis Nexus were also searched to find state laws regarding drunk driving definition and persecutions in state statutes.

State Background Characteristics*:* In addition to specific policies, other factors influence a state's drunk driving rate. For example, vehicle miles traveled documents how many miles residents actually drive. Finally, there are demographic characteristics such as the unemployment rate, percentage of minorities or youth, or law enforcement. The demographic variables were obtained from the US Census Bureau's American Community Survey.

Table 6 provides definitions and descriptive statistics on control variables included in the analysis. Most law and policy variables were entered into the model as dummy variables, and most variables had within state variation throughout the timeframe/

Control variables used in regressions examining underage drunk driving fatalities

Different models will be used for underage fatal accidents. Some policies like social hosting or license revocation are specifically targeted towards youth. For the youth specific models that use drunk driving fatalities caused by drivers under 21, the adult variables will be swapped for the youth targeted variables. An example of this is the per se law, targeted towards adults, versus zero tolerance laws, which are exclusively for minors. This allows the model to address both the general and minor populations with different policy tools that states have tried. For each iteration of the basic model, all the state background characteristics and demographic variables were included. This included vehicle miles traveled, percent

Hispanic, percent black, percent youth (under 21), percent unemployed and law enforcement officers per 100,000 people. Additionally, taxes for beer, wine, and liquor were also included in each model as well.

Table 6. Control Variables Used in the Model

Variable Name	Variable Definition	Regression Used
State Laws and Policies:		
Per Se Laws	Whether the state-year has a .08 Per Se Law	Total Accidents
Zero Tolerance Law	Whether the state-year have a zero tolerance law	Underage Accidents
Vehicular Homicide	Whether the state-year have a vehicular homicide law	Both
High BAC Laws	Measures the state-year’s cut off for high BAC and “aggravated offenses”	Both
Ignition Interlock	Measure strength of the state-year’s ignition interlock laws	Both
Administrative License Revocation	Information on the state-year’s administrative license action laws	Total Accidents
Administrative License Revocation Minor Specific	Whether the state-year has a minor specific administrative license action law	Underage Accidents
Mandatory Jail Time	Whether the state-year have mandatory jail time for a DUI conviction	Total Accidents
Mandatory Jail Time Minor Specific	Whether the state-year have a minor specific mandatory jail time for a DUI conviction	Underage Accidents
Sobriety Checkpoints	Whether the state-year allow sobriety checkpoints	Both
Dram Shop Law	Whether the state-year have a specific dram shop law	Total Accidents
Minor Specific Dram Shop Law	Whether the state-year have a minor specific dram shop law	Underage Accidents
Mandatory BAC Test Laws	Whether the state-year require mandatory BAC testing for drivers who survive a crash	Both
Open Container Law	Whether the state-year has an open container law	Both
State alcohol taxes:		
Beer Tax	The $/gallon excise tax rate for beer	Both
Wine Tax	The $/gallon excise tax rate for wine	Both
Spirit Tax	The $/gallon excise tax rate for spirits	Both
State demographic characteristics:		
Vehicle Miles Traveled	Vehicle miles traveled per state-year per 100,000 residents	Both
Percent Hispanic	The percentage of people in that state-year that reported being Hispanic	Both
Percent Black	The percentage of people in that state-year that reported being black	Both
Percent Youth	The percentage of people in that state-year that reported being youth. Youth is defined as under 20 from 2000-2010 and under 19 from 1995-1999	Both
Percent Unemployed	The percentage of people in that state-year that reported being unemployed	Both
Law Enforcement	The state-year’s law enforcement officers per 100,000 residents	Both

Empirical Model Specification

Ordinary Least Squared (OLS) models are estimated, regressing total alcohol-related fatal accidents in a state month, on PSAs airing in the state in the previous eight months. Control variables in the model include state alcohol-related laws and policies in the current year and month, state alcohol taxes in the current year and month, and state demographic characteristics in the current year. PSA data and fatality data is available at the state-month level. However, the control variables are only available at the state-year level, so each month within a state-year will have the same data values for these variables. For year estimates that were totals, liable to change from month to month, like vehicle miles traveled the total number was divided by 12 and assigned to each state-year-month.

Furthermore, control variables were collected from 1996-2010, so regression analysis will take place between those years. As a result of the need for a year “look back” in number of PSAs aired, the regression result timeframe is a year than the descriptive time frame and results. All models include year fixed effects.

Figure 5 illustrates the lagged nature of PSAs. The regression analysis starts in 1996 because that is the first year we have all the necessary data (control variables, dependent variables, and lagged PSAs data. The first state year month there are accident numbers for is September 1996. We use the previous eight months back to January, 1996 to capture the full spectrum of lagged PSAs.

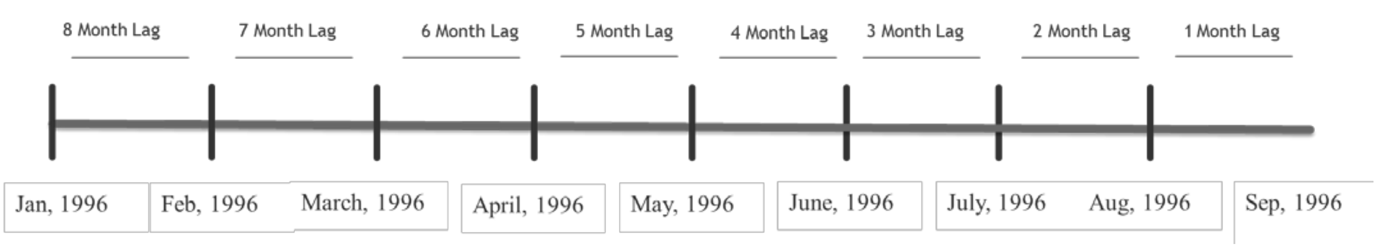

Figure 5: Illustration of Timeline of Lagged PSAs

To test **Hypothesis 1** the following model will be estimated:

$$FDDA_{sm} = \beta_0 + \beta_1 TPSA_{sm-1}.\ B_8 TPSA_{sm—8} + \beta_9\ SALP_{sm} + \beta_{10}\ SDC_{sm} + \beta_{11}\ YEAR + \varepsilon \ \ldots\ldots(1)$$

Where:

FDDA = Fatal drunk driving accidents caused by adult drunk drivers in state year month ($_{SM}$)

TPSA = Total PSAs airing in previous state year month ($_{SM}$)

SALP = State alcohol laws and policies in state year month ($_{SM}$)

SDC = State demographic characteristics in state year month ($_{SM}$)

YEAR = Set of year dummy controls

ε = Error term

To test **Hypothesis 2** the following model will be estimated:

$UAFDDA_{sm} = \beta_0 + \beta_1 TPSA_{sm-1}.\ B_8 TPSA_{sm-8} + \beta_9\ SALP_{sm} + \beta_{10}\ SDC_{sm} + \beta_{11}\ YEAR + \varepsilon$ …...(2)

Where:

UAFDDA = Fatal drunk driving accidents caused by an underage driver in state month ($_{SM}$)

To test **Hypothesis 3** the following two model will be estimated:

$FDDA_{sm} = \beta_0 + \beta_1 TPSAPT_{sm-1\ldots.}\ B_8 TPSAPT_{sm-1} + \beta_9\ SALP_{sm} + \beta_{10}\ SDC_{sm} + \beta_{11}\ YEAR + \varepsilon$ …………(3)

$FDDA_{sm} = \beta_0 + \beta_1 TPSADT_{sm-1\ldots.}\ B_8 TPSADT_{sm-1} + \beta_9\ SALP_{sm} + \beta_{10}\ SDC_{sm} + \beta_{11}\ YEAR + \varepsilon$ ……..…..(4)

$FDDA_{sm} = \beta_0 + \beta_1 TPSANT_{sm-1\ldots.}\ B_8 TPSANT_{sm-1} + \beta_9\ SALP_{sm} + \beta_{10}\ SDC_{sm} + \beta_{11}\ YEAR + \varepsilon$..…………(5)

Where:

TPSAPT = Total PSA airing during prime time in state year month ($_{SM}$)

TPSADT = Total PSAs airing during day time in state year month ($_{SM}$)

TPSANT = Total PSAs airing during night time in state year month ($_{SM}$)

To test **Hypothesis 4**, the coefficients on the lagged variables will be evaluated for sign and significance in predicting alcohol-related fatal accidents. Regressions 3-5 will be re-estimated using $UAFDDA_{sm}$ as the dependent variable.

RESULTS

Results on the impact of total PSA airings in the past state month on adult fatal accidents in that state in the present month are presented in Table 7. Table 8 present estimates on underage drunk drivers. Both Table 7 and Table 8 present estimates for the impact of PSAs airings in the past eight months by time of day they aired. PSAs are measured in 10,000, so the coefficients indicate the reduction in total number of fatal accidents per 100,000 residents in the state resulting from an additional 10,000 PSAs aired. At the bottom of each column there is a “Total Over Eight Months” coefficient. Because PSAs are tracked having an effect for eight months after they initially aired, coefficients are added together to get a total effect across the lagged timeframe.

Models that used state-fixed effects (Appendix Tables A and B) are included in the appendix as well as full regressions that include the full set of control variables. The year-fixed regression coefficients with the control variables are included in Appendix Tables C and D.

Table 7: Regression Results on PSAs by Time of Day Aired and Lagged Month on Fatal Accidents Caused by Adult Drunk Drivers

Type of Time Lag	Dependent Variable (per 100,000 residents)	Total aired PSAs	Daytime aired PSAs	Primetime aired PSAs	Night Time aired PSAs
One Month Lag	Adult Fatal Accidents	-0.055 (0.033)	-0.107 (0.065)	-0.406** (0.181)	-0.140 (0.087)
Two Month Lag	Adult Fatal Accidents	-0.051 (0.037)	-0.098 (0.069)	-0.500*** (0.189)	-0.067 (0.104)
Three Month Lag	Adult Fatal Accidents	-0.020 (0.037)	-0.027 (0.070)	-0.376** (0.190)	-0.067 (0.106)
Four Month Lag	Adult Fatal Accidents	-0.051 (0.037)	-0.107 (0.070)	-0.470** (0.190)	-0.051 (0.106)
Five Month Lag	Adult Fatal Accidents	-0.009 (0.040)	-0.013 (0.080)	-0.115 (0.206)	-0.062 (0.107)
Six Month Lag	Adult Fatal Accidents	-0.075 (0.040)	-0.164** (0.079)	-0.360* (0.206)	-0.132 (0.106)
Seven Month Lag	Adult Fatal Accidents	0.039 (0.040)	0.081 (0.079)	0.223 (0.206)	0.039 (0.105)
Eight Month Lag	Adult Fatal Accidents	-0.025 (0.037)	-0.071 (0.075)	0.094 (0.197)	-0.080 (0.089)
Total Over 8 Months	Adult Fatal Accidents	-0.25	-0.51	-1.91	-0.56

** Significant at the 95 Level, *** Significant at the 99 Level
Standard errors in (parentheses)
All control variables used in these regressions are defined in Table 6.

Table 8: Regression Results on PSAs by Time of Day Aired and Lagged Month on Fatal Accidents Caused by Underage Drunk Drivers

Type of Time Lag	Dependent Variable (per 100,000 residents)	Total aired PSAs	Daytime aired PSAs	Primetime aired PSAs	Night Time aired PSAs
One Month Lag	Underage Fatal Accidents	-0.010 (0.006)	-0.018 (0.012)	-0.068** (0.033)	-0.023 (0.016)
Two Month Lag	Underage Fatal Accidents	-0.011 (0.007)	-0.019 (0.013)	-0.083** (0.035)	-0.023 (0.019)
Three Month Lag	Underage Fatal Accidents	-0.003 (0.007)	-0.008 (0.013)	-0.037 (0.035)	-0.006 (0.019)
Four Month Lag	Underage Fatal Accidents	-0.008 (0.007)	-0.013 (0.013)	-0.082** (0.035)	-0.010 (0.019)
Five Month Lag	Underage Fatal Accidents	0.003 (0.007)	0.011 (0.015)	-0.004 (0.038)	-0.002 (0.020)
Six Month Lag	Underage Fatal Accidents	0.002 (0.007)	0.003 (0.014)	0.023 (0.038)	-0.002 (0.019)
Seven Month Lag	Underage Fatal Accidents	0.001 (0.007)	-0.006 (0.014)	-0.003 (0.038)	0.012 (0.019)
Eight Month Lag	Underage Fatal Accidents	-0.011 (0.007)	-0.025 (0.014)	-0.037 (0.036)	-0.031 (0.016)
Total Over 8 Months	Underage Fatal Accidents	-0.04	-0.08	-0.29	-0.09

** Significant at the 95 Level, *** Significant at the 99 Level

Standard errors in (parentheses)

Total PSAs aired on all fatal accidents (H1 and H4)

Hypothesis 1, that the total number of anti-alcohol PSAs aired in a state in the previous eight months significantly predicts reductions in fatalities caused by adult drunk drivers, was not supported. To interpret a coefficient, the regression coefficient for Total PSAs lagged by one month on fatal total accidents caused by a drunk driver is -0.055 but it is not statistically significant. Results indicate that for every 10,000 increase in PSAs aired in the previous month, there is an associated decrease of 0.066 fatal accidents per 100,000 residents in the state in that month. The effect is small and is weakly significant. The other significant result for total PSAs reducing drunk driving fatalities caused by adults occurred in the six month lag, or the PSAs that were aired six months previously. This coefficient was -.075 and was not significant. All of the added coefficients across the different time periods were all negative, suggesting that PSAs led to a net decrease in fatalities, even if it was not significant.

Total PSAs aired on all fatal accidents (H2 and H4)

Hypothesis 2 was not supported by the data. No effects were found for PSAs aired in the prior1-7 months on total underage fatal drunk driving accidents. All the added coefficients were all negative.

Impact by time of PSA airing (H3 and H4)

Results indicate support for Hypothesis 3 and 4. PSAs aired during primetime were found to be significantly more effective in reducing drink driving fatalities than PSAs aired in other times of the day (day time, night time). For Primetime aired PSAs and examining adult fatalities, the first four months of PSAs yielded negative and statistically significant results ranging from -.376 to -.500. For Primetime aired PSAs on their effects on underage drunk driving accidents three out of four coefficients from the first four months had negative and significant results ranging from -.068 to -.083.

Regarding PSAs aired in other parts of the day for the adult fatality measure, there were no significant results at the six-month lag for daytime, primetime and total PSAs. The primetime effect was smaller than the previous effects and it was the only significant effect for Daytime aired PSAs. Comparing the added coefficients, primetime was the largest (-1.91), followed by nigh ttime and daytime.

Primacy versus Recency effects (H4)

PSAs airing closer to the month in which accidents were measured were found to have stronger effects (recency effects) that those airing in more lagged months (primacy effects). Hypothesis 4 was supported in the data, but only for PSAs airing in prime time. Table 9 summarized these effects.

Table 9: Summary of Regression Coefficients for Primetime PSA Airings.

Primetime PSA airings: Adult accidents	Primetime PSA airings: Underage accidents
1st month lag = -0.406** 2nd month lag = -0.500*** 3rd month lag = -0.376** 4th month lag = -0.470** 5th month lag = -0.115 6th month lag = -0.360 7th month lag= 0.223 8th month lag = 0.094 Total = -1.91	1st month lag = -0.068** 2nd month lag = -0.083** 3rd month lag = -0.037 4th month lag = -0.082** 5th month lag = -0.004 6th month lag = 0.023 7th month lag= -0.003 8th month lag = -0.037 Total = -.29

** Significant at the 95 Level, *** Significant at the 99 Level
Standard errors in (parentheses)

The effects of PSAs airing during primetime in reducing total fatal drunk driving accidents, and underage fatal drunk driving accidents, are strongly evident in the four months prior to fatal accident measures, but all effects seem to disappear in airings prior to that time.

Effects are significantly stronger for the impact on total accidents, but smaller and still significant for underage total accidents during these months. Figure 6 graphs the size of the effects of various PSAs depending on how lagged the PSAs were. The figure illustrates how the more lagged, or the farther in the past the PSAs were aired from the accident the weaker the effect, indicated by the closer coefficients are to zero.

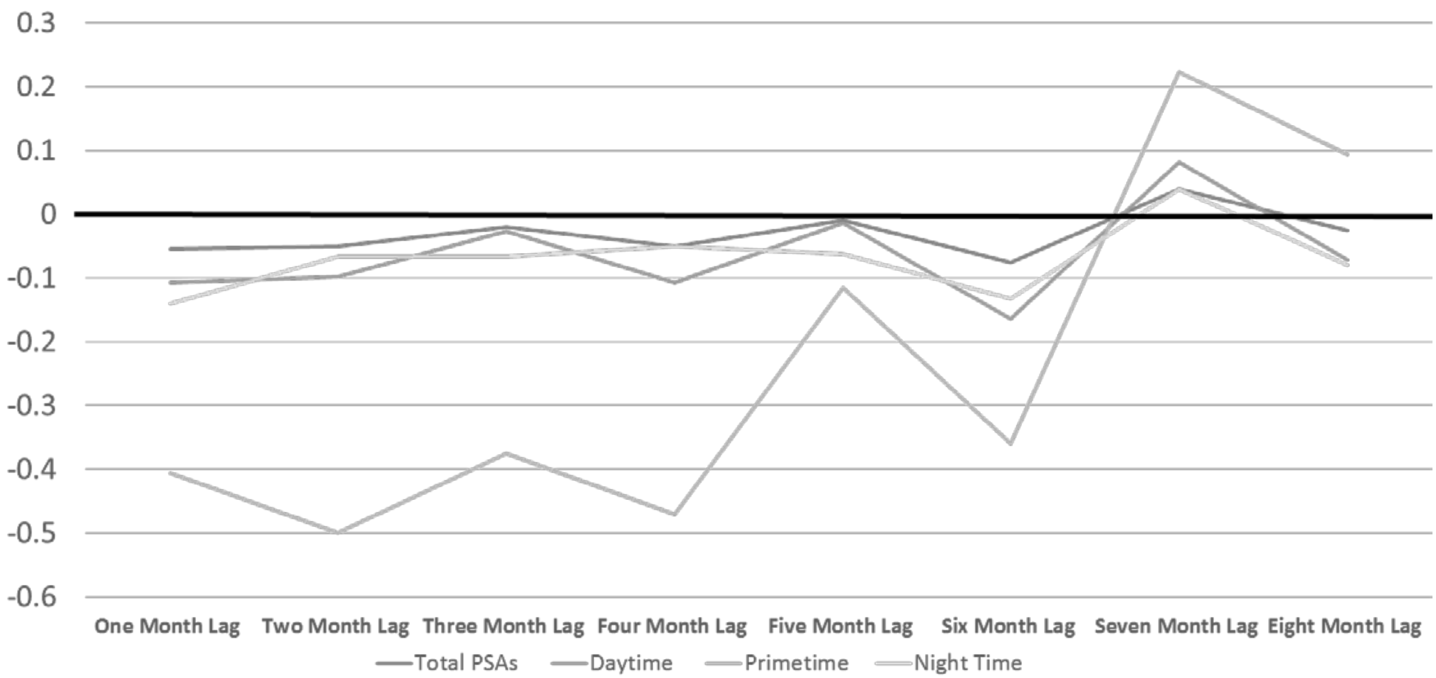

Figure 6: Size and Direction of Regression Coefficients across Eight Months

Summary of Results

PSAs can be effective at reducing drunk driving. All significant coefficients for both adults and underage drivers were negative. However, time aired both in terms of time of day and the rececny viewed are important predictors of effectiveness. Primetime PSAs produce the largest, significant, and consistent effects for both adult and underage drunk drivers. Furthermore, as PSAs got farther away from the time they were aired, evidenced by longer lags, the effects often shrunk and got closer to zero, no effect. This is especially apparent around four month lags and for the PSAs aired in primetime.

Discussion

Overall, all PSAs with a one month lag, had weak effectiveness on decreasing drunk driving accidents. However, PSAs aired in primetime yielded larger effects and more statistically significant effects. These effects existed for both total accidents as well as underage accidents for the first two lagged months. This suggests that PSAs need to be reaching an audience to be effective, and that simply airing PSAs whenever it is convenient is not enough. However, the challenge to airing PSAs in primetime is that it is also the most popular time for advertisers, so stations might not be willing to give up donated media time and instead sponsors of PSAs might need to buy PSAs.

Although there is support that some airings of PSAs do have associated decreases in drunk driving fatalities, the magnitude of the effects also needs to be considered. The mean number of fatal accidents caused by an adult drunk driver per state, year, month unit of analysis was .588. Considering the coefficients for the first four months lagged ranged -376.to -.500, PSAs do seem to have a substantial impact in decreasing drunk driving fatalities. There is a similar story for underage drunk driving fatalities because the mean number of fatalities in a given state, year, month was .054 and the range of coefficients for the first four lagged months is -.037 to -.083. An increase of 10,000 primetime PSAs would decrease fatal accidents caused by an underage drunk driver by over 100 percent. When examining the added coefficients, the effects do get larger. Individual PSAs aired in each state-year-month might not have a large effect, but taken in the aggregate, the PSAs have a more noteworthy effect.

However, despite the large nature of the coefficients, when put into the policy feasibility context, the effectiveness of PSAs diminish. The mean number of PSAs aired overall per each state month was 1,925, a small fraction of the 10,000 unit increase. Furthermore, the number of PSAs aired in primetime, the most consistently effective time slot, was 247.6 PSAs. The number of PSAs aired in primetime would have to be increased by over a factor of 40 to reach 10,000 PSAs in each state-year-month.

The support for Hypothesis 4, recency effects, also highlights the important nature of having consistently aired PSAs. PSAs must continue to saturate the media waves if they are to remain effective otherwise the effect begins to decay.

There are several main takeaways for policy makers. Policy makers of all levels from federal to local might need to spend more money on having PSAs being aired during the primetime slots. Although primetime is the most expensive place to air ads of any kind, they are also the slots where the message reaches the best audience. Leaders of media campaigns who want to maximize effects of PSAs should devote efforts to having more messaging in peak viewing hours. Furthermore, PSAs potentially need to be aired with more volume. The effects outlined in the regression results were drastic; however, very few state-year-months aired over 10,000 PSAs initially. An increase in 10,000 PSAs aired per state-year-month might be infeasible both money wise and time wise. However, incremental increases would likely boost the effectiveness of PSAs. More PSAs in general and specifically in primetime have the potential to yield great results.

A similar result points to the trend for PSAs effectiveness to fade around four months. This suggests that policy makers need to keep airing PSAs to keep public health messaging fresh and not have viewers get complacent. This is particularly important around time of years, such as the end of year holidays and the summer, when fatal accidents are high. More research is needed in balancing the magnitude of these effects: time of day aired, month lagged, and volume.

Limitations and Areas of Future Research

The current census of PSAs analyzed comprised of two main topics: anti-drunk driving PSAs and alcohol abuse and awareness PSAs. While the majority of PSAs are directly related to reducing drunk driving, there are PSAs that are only tangentially related to reducing drunk driving, for example PSAs that encourage enrolment in Alcoholics Anonymous or urging parents to talk to their kids about the dangerous of alcohol use. It is possible that the inclusion of these PSAs muddle the effect of PSAs strictly related to curbing drunk driving. A future area of research would be to examine the two types of PSAs on drunk driving outcomes separately instead of together.

The units of the PSAs variables is very large, 10,000. Very few state-year-months aired that much volume of PSAs. It is possible that a huge increase in PSAs, especially if they are the same, will desensitize the audiences. Market saturation and airwave domination might appear to have big decreases, but in reality it could yield to diminishing marginal returns. Future studies should examine what might be an appropriate increase of PSAs to expect from states and also which volume produces the greatest results.

The study is also limited by the type of data available. The dependent variables were normalized for population in each state year month by dividing by 100,000 residents. However the 100,000 residents in each state year is a noisy denominator for our analysis. The denominator of total population, each 100,000 resident, includes people who are below driving age. An area of future research would be to divide adult drunk driving fatal accidents per 100,000 adults, 21 and up in each state year. For underage drunk driving fatal accidents, the rate could be the

100,000 15-20 year old drivers. Unfortunately, the US Census where the population estimates were collected only has appropriate age brackets from 2006 onwards. The paper did run the same regressions using these more precise dependent variables from 2006-2010. The results are presented in the Appendix in Tables E and F. We found similar trends as previously reported, but the coefficients were larger in magnitude. However, there were some interesting significantly positive coefficients which warrant further investigation.

Furthermore, the dependent variable, drunk driving fatal accidents, only captures an extreme outcome. There are other outcomes that are serious, like non-fatal injuries, that are also harmful to and could be studied, but there is a lack of data. Also, there is a variety of outcomes such as DUI arrests or license suspensions that might capture the number of episodes of drunk driving more accurately. Also, because this study examines the effectiveness of PSAs at state, year, month there is a lack of individual decision making processes and drunk driving behaviors. Currently, there is no way to link whether or not a person saw a PSA and whether or not they drove drunk or stopped someone from driving drunk. Despite this limitation, the paper does provided needed evidence on an aggregate level of drunk driving outcomes, something that remains a gap in the literature.

A future avenue of exploration is to examine content of the PSAs in addition to time aired. Throughout the process of assembling the PSA dataset, researchers contented coded every unique PSA on wide variety of characteristics. It would be possible to organize these characteristics around psychologically driven cognitive processes that have been experimentally examined to be effective at encouraging behavior change. Future research could examine what type of content and what themes of PSAs are the most effective in reducing drunk driving.

This analysis is historic and examines PSAs aired from 1996-2010; however, work in this field will face new challenges as people shift away from watching television. Primetime in the 2010s might have lost its high viewership as people turn to streaming services and watch television at their own convenience. This profound shift in viewing behavior presents new puzzles for advertisers and PSA makers alike. There will likely need to be new and innovative ways to reach an audience and to establish effectiveness.

Conclusion

PSAs have been and will likely continue to be an important tool in policy makers and community leaders' arsenal to decrease drunk driving and other negative health outcomes. However, PSAs should not be a catch all policy solution. PSAs are most effective when aired during primetime between 7:00PM and 11:00PM when most people are watching television. This finding is important because it shows how important timing and having a captive audience is to communicating health messaging. Although airing PSAs in this timeslot might be more expensive, it might be worth it in terms of overall decreases in fatalities.

Furthermore, media campaigns need to be constantly on and updated. PSAs lost their effectiveness the farther out they aired. To prevent this decay, PSAs should be aired throughout the year so viewers do not lose message salience and are exposed to consistent messaging.

The results from this study indicate that PSAs can be effective, they would just need to be heavily invested in and campaigns cannot be haphazardly thrown together. PSAs should be aired in primetime and consistently throughout the year for effects to really reach their potential. State leaders would need to ramp up the number of PSAs, especially in primetime, from their current levels. However, this shift might be warranted and save lives one primetime-aired PSA at a time.

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Appendix

Table A: Regression Results on PSAs by Time of Day Aired and Lagged Month on Fatal Accidents Caused by Adult Drunk Drivers (State-Fixed Effects)

Type of Time Lag	Dependent Variable (per 100,000 residents)	Total PSAs	Daytime aired PSAs	Primetime aired PSAs	Night Time aired PSAs
One Month Lag	Adult Fatal Accidents	-0.039 (0.031)	-0.069 (0.060)	-0.295 (0.168)	-0.097 (0.081)
Two Month Lag	Adult Fatal Accidents	-0.039 (0.034)	-0.073 (0.064)	-0.422** (0.175)	-0.025 (0.096)
Three Month Lag	Adult Fatal Accidents	-0.007 (0.034)	-0.003 (0.064)	-0.290 (0.175)	-0.033 (0.097)
Four Month Lag	Adult Fatal Accidents	-0.040 (0.034)	-0.089 (0.065)	-0.374** (0.175)	-0.009 (0.097)
Five Month Lag	Adult Fatal Accidents	0.015 (0.037)	0.041 (0.073)	0.018 (0.190)	-0.015 (0.098)
Six Month Lag	Adult Fatal Accidents	-0.055 (0.037)	-0.111 (0.072)	0.018 (0.190)	-0.087 (0.098)
Seven Month Lag	Adult Fatal Accidents	0.057 (0.037)	0.136 (0.072)	0.301 (0.190)	0.074 (0.097)
Eight Month Lag	Adult Fatal Accidents	0.005 (0.033)	-0.004 (0.068)	0.262 (0.182)	-0.006 (0.082)

** Significant at the 95 Level, *** Significant at the 99 Level
Standard errors in (parentheses)
All control variables used in these regressions are defined in Table 6.

Table B: Regression Results on PSAs by Time of Day Aired and Lagged Month on Fatal Accidents Caused by Underage Drunk Drivers (State-Fixed Effects)

Type of Time Lag	Dependent Variable (per 100,000 residents)	Total PSAs	Daytime aired PSAs	Primetime aired PSAs	Night Time aired PSAs
One Month Lag	Underage Fatal Accidents	-0.008 (0.006)	-0.012 (0.012)	-0.060 (0.033)	-0.022 (0.016)
Two Month Lag	Underage Fatal Accidents	-0.010 (0.007)	-0.016 (0.012)	-0.079** (0.034)	-0.022 (0.019)
Three Month Lag	Underage Fatal Accidents	-0.002 (0.007)	-0.004 (0.012)	-0.032 (0.034)	-0.006 (0.019)
Four Month Lag	Underage Fatal Accidents	-0.008 (0.007)	-0.013 (0.013)	-0.075** (0.034)	-0.008 (0.019)
Five Month Lag	Underage Fatal Accidents	0.005 (0.007)	0.017 (0.014)	0.016 (0.037)	-0.000 (0.019)
Six Month Lag	Underage Fatal Accidents	0.004 (0.007)	0.009 (0.014)	0.037 (0.037)	0.004 (0.019)
Seven Month Lag	Underage Fatal Accidents	0.003 (0.007)	0.000 (0.014)	0.009 (0.037)	0.014 (0.019)
Eight Month Lag	Underage Fatal Accidents	-0.008 (0.006)	-0.018 (0.013)	-0.016 (0.035)	-0.022 (0.016)

** Significant at the 95 Level, *** Significant at the 99 Level
Standard errors in (parentheses)
All control variables used in these regressions are defined in Table 6.

Table C: Regression Results on PSAs by Time of Day Aired and Lagged Month on Fatal Accidents Caused by Adult Drunk Drivers (Year-Fixed Effects) with Controls

Control Variable	Total	Daytime	Primetime	Night Time
One Month Lag	-0.055*	-0.107	-0.406**	-0.140
Two Month Lag	-0.051	-0.098	-0.500***	-0.067
Three Month Lag	-0.020	-0.027	-0.376**	-0.067
Four Month Lag	-0.051	-0.107	-0.470**	-0.051
Five Month Lag	-0.009	-0.013	-0.115	-0.062
Six Month Lag	-0.075*	-0.164**	-0.360*	-0.132
Seven Month Lag	0.039	0.081	0.223	0.039
Eight Month Lag	-0.025	-0.071	0.094	-0.080
Per Se Laws	-0.028**	-0.029**	-0.029**	-0.028**
Vehicular Homicide	-0.053***	-0.052***	-0.055***	-0.053***
High BAC Laws	0.003	0.003	0.003	0.003
Ignition Interlock	0.051***	0.052***	0.052***	0.051***
Administrative License Revocation	-0.038***	-0.037***	-0.037***	-0.038***
Mandatory Jail Time	0.074***	0.073***	0.075***	0.073***
Sobriety Checkpoints	0.050***	0.047***	0.048***	0.050***
Dram Shop Law	-0.033***	-0.033***	-0.033***	-0.033***
Mandatory BAC Test Laws	0.036***	0.035***	0.037***	0.036***
Open Container Law	-0.184***	-0.187***	-0.185***	-0.182***
Beer Tax	-0.005***	-0.005***	-0.005***	-0.005***
Wine Tax	0.01	0.008	0.01	0.01
Spirit Tax	0.236***	0.244***	0.239***	0.234***
Vehicle Miles Traveled	0.012***	0.012***	0.012***	0.012***
Percent Hispanic	-0.003***	-0.003***	-0.003***	-0.003***
Percent Black	-0.006***	-0.006***	-0.006***	-0.006***

Percent Youth	0.036***	0.035***	0.035***	0.036***
Percent Unemployed	-0.010***	-0.010***	-0.010***	-0.010**
Law Enforcement	0.001***	0.001***	0.001***	0.001***

Table D: Regression Results on PSAs by Time of Day Aired and Lagged Month on Fatal Accidents Caused by Underage Drunk Drivers (Year-Fixed Effects) with Controls

Control Variable (and PSA variables)	Total	Daytime	Primetime	Night Time
One Month Lag	-0.010	-0.018	-0.068**	-0.023
Two Month Lag	-0.011	-0.019	-0.083**	-0.023
Three Month Lag	-0.003	-0.008	-0.037	-0.006
Four Month Lag	-0.008	-0.013	-0.082**	-0.010
Five Month Lag	0.003	0.011	-0.004	-0.002
Six Month Lag	0.002	0.003	0.023	-0.002
Seven Month Lag	0.001	-0.006	-0.003	0.012
Eight Month Lag	-0.011*	-0.025*	-0.037	-0.031*
Zero Tolerance Laws	-0.003	-0.003	-0.003	-0.003
Vehicular Homicide	-0.009***	-0.009***	-0.009***	-0.009***
High BAC Laws	0	0	0	0
Ignition Interlock	0.007***	0.007***	0.007***	0.007***
Minor Administrative License Revocation	-0.002	-0.002	-0.002	-0.002
Minor Mandatory Jail Time	-0.010***	-0.009***	-0.009***	-0.010***
Sobriety Checkpoints	0.008***	0.007***	0.008***	0.008***
Dram Shop Law	-0.006***	-0.006***	-0.006***	-0.006***
Mandatory BAC Test Laws	0.004*	0.004*	0.004**	0.004**
Open Container Law	-0.015***	-0.015***	-0.015***	-0.015***
Beer Tax	0	0	0	0
Wine Tax	-0.003	-0.003	-0.003	-0.003
Spirit Tax	0.026***	0.028***	0.027***	0.026***
Vehicle Miles Traveled	0.001***	0.001***	0.001***	0.001***
Percent Hispanic	-0.000***	-0.000***	-0.000***	-0.000***
Percent Black	-0.001***	-0.001***	-0.001***	-0.001***
Percent Youth	0.004***	0.004***	0.004***	0.004***
Percent Unemployed	-0.003***	-0.003***	-0.003***	-0.003***

Law Enforcement	0.000***	0.000***	0.000***	0.000***

Table E: Regression Results (2006-2010) on an increase of 1,000 PSAs by Time of Day Aired and Lagged Month on Fatal Accidents Caused by Adult Drunk Drivers

Type of Time Lag	Dependent Variable (per 100,000 residents aged 21 and up)	Total PSAs	Daytime aired PSAs	Primetime aired PSAs	Night Time aired PSAs
One Month Lag	Adult Fatal Accidents	-0.180*** (0.052)	-0.325*** (0.102)	-1.164*** (0.330)	-0.533*** (0.147)
Two Month Lag	Adult Fatal Accidents	-0.220*** (0.057)	-0.468*** (0.112)	-1.509*** (0.349)	-0.455*** (0.156)
Three Month Lag	Adult Fatal Accidents	0.092 (0.058)	0.205* (0.115)	0.435 (0.355)	0.222 (0.155)
Four Month Lag	Adult Fatal Accidents	0.096 (0.059)	0.159 (0.116)	0.490 (0.352)	0.296* (0.156)
Five Month Lag	Adult Fatal Accidents	-0.039 (0.059)	-0.099 (0.117)	-0.280 (0.352)	-0.053 (0.157)
Six Month Lag	Adult Fatal Accidents	0.075 (0.058)	0.172 (0.114)	0.290 (0.349)	0.120 (0.153)
Seven Month Lag	Adult Fatal Accidents	-0.055 (0.057)	-0.109 (0.111)	-0.351 (0.340)	-0.097 (0.156)
Eight Month Lag	Adult Fatal Accidents	0.057 (0.052)	0.065 (0.100)	0.311 (0.323)	0.186 (0.144)

* Significant at the 90 Level, ** Significant at the 95 Level, *** Significant at the 99 Level
Standard errors in (parentheses)

All control variables used in these regressions are defined in Table 6.

Table F: Regression Results (2006-2010) on an increase of 1,000 PSAs by Time of Day Aired and Lagged Month on Fatal Accidents Caused by Underage Drunk Drivers

Type of Time Lag	**Dependent Variable (per 100,000 residents ages (15-20)**	**Total PSAs**	**Daytime aired PSAs**	**Primetime aired PSAs**	**Night Time aired PSAs**
One Month Lag	Underage Fatal Accidents	-0.009 (0.007)	-0.014 (0.013)	-0.067 (0.041)	-0.030 (0.018)
Two Month Lag	Underage Fatal Accidents	-0.012 (0.007)	-0.027* (0.014)	-0.095** (0.043)	-0.016 (0.019)
Three Month Lag	Underage Fatal Accidents	-0.002 (0.007)	0.001 (0.014)	-0.014 (0.044)	-0.007 (0.019)
Four Month Lag	Underage Fatal Accidents	0.011 (0.007)	0.017 (0.014)	0.057 (0.044)	0.037* (0.019)
Five Month Lag	Underage Fatal Accidents	-0.004 (0.007)	-0.008 (0.014)	-0.025 (0.044)	-0.005 (0.019)
Six Month Lag	Underage Fatal Accidents	0.015** (0.007)	0.034** (0.014)	0.083* (0.043)	0.022 (0.019)
Seven Month Lag	Underage Fatal Accidents	-0.011 (0.007)	-0.022 (0.014)	-0.071* (0.042)	-0.020 (0.019)
Eight Month Lag	Underage Fatal Accidents	-0.001 (0.006)	0.001 (0.012)	0.005 (0.040)	-0.013 (0.018)

* Significant at the 90 Level, ** Significant at the 95 Level, *** Significant at the 99 Level
Standard errors in (parentheses)

All control variables used in these regressions are defined in Table 6.