An Evaluation of the Impact of City of Austin's Hands-Free Ordinance on the Number of Reported Collisions

By

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Abstract

Purpose. Scholars have generally accepted that using a hand-held device such as a cell phone while driving is a distraction and dangerous. Distracted driving has become a public safety concern, which is evident by the passage of a number of city and state laws banning the use of cell phones while driving. There is no consensus on the effectiveness of legislation that bans the use of hand-held devices while driving. The purpose of this research is to evaluate the impact of the 2015 City of Austin, Texas ordinance prohibiting the use of all portable (hand-held) electronic devices while operating a vehicle or bicycle on the number of reported collisions. ***Method.*** The research design for this analysis is an interrupted time series with a comparison group. This study utilizes daily aggregated traffic accident data as the dependent variable and controls for precipitation and temperature. Data was gathered and analyzed 60 days before and after the implementation of the hands-free ordinance, while removing the 30 days immediately prior and after the ordinance to remove sensitivity. ***Results.*** The regression analysis results indicate there is not a statistically significant relationship or correlation between the City of Austin's Hands-Free ordinance and reported collisions during the analyzed time period. In contrast, the results show a slight increase in the number of reported collisions shortly following the implementation of the ordinance. ***Conclusions.*** The City of Austin's Hands-Free ordinance implemented 1/1/2015 did not have the desired impact of lowering the number of reported collisions during the time period analyzed. This suggests that either drivers are not abiding by the new law or that operating a cell phone hands-free is just as dangerous as hand-held.

Introduction

Cell phone use has grown exponentially over the past few decades. As of 2014, the Cellular Telecommunications and Internet Association (CTIA) reported the number of cell phone subscribers in the US was approximately 355.4 million. The number of wireless subscribers in 2014 was more than three times the reported 100 million subscribers in 2000 (CTIA, 2015). With the combination of affordability and increased social dependency on cell phones, their usage has become a normal facet in many people's daily activities. The constant need for social connectivity has caused many people to use cell phones while operating a vehicle. The use of cell phones is no longer limited to texting and phone calls, but also includes the interaction with social media applications like Facebook, Instagram, and Twitter. Studies have found that the risk of car accidents may increase with driver distractions such as talking or texting on a cell phone (Redelmeier & Tibshirani, 1997; Strayer, Drews, & Crouch, 2006).

The evidence that cell phone use while driving leads to increases in the number of vehicle accidents and fatalities has led to public concern (Wilson & Stimpson, 2010; Lee, Champagne, & Francscutti, 2013; Centers for Disease Control and Prevention (CDC), 2013). To combat the ill effects of distracted driving, many states and local jurisdictions have enacted laws prohibiting the full or marginal use of hand-held devices. The enactment of laws prohibiting cell phone use while driving and their effectiveness is of great interest to both the public and elected officials (Ibrahim, Anderson, Burris, & Wagenaar, 2011; Governors Highway Safety Association (GHSA), 2013). As of January 2015, forty-four states, the District of Columbia, Guam, and the Virgin Islands have enacted laws that ban text messaging for all drivers (Pickrell & KC, 2015). Of those forty-four states and U.S. territories, sixteen also have laws banning hand-held cell

phone use while driving. With public officials trying to address public concern and opposition to proposals on cell phone bans, the effectiveness of such bans in reducing collisions is central to policy debate (Nikolaev, Robbins, & Jacobson, 2010;Kwoon, Yoon, & Jang, 2014; Lim & Chi, 2013). Several studies on the effectiveness of such policies have produced mixed results (Kwoon et al., 2014; McCartt, Hellinga, & Bratiman, 2006). Hence, there is no consistent concrete evidence that laws prohibiting cell phone use while driving are effective at reducing collisions. Within the studies completed, there has been limited focus at the city or county level in Texas.

On January 1, 2015, the City of Austin, Texas implemented city ordinance no. 20140828-041 which amended a prior driving ordinance to include the offense of the use of portable electronic devices while operating a motor vehicle or bicycle. The initiative of the ban aimed to increase safety by decreasing distracted driving in Austin (City of Austin, 2014). The City of Austin defines distracted driving as any activity that could divert a person's attention away from the primary task of driving. Examples of distracted driving defined by the City of Austin include: texting, using a cell phone for any reason, eating and drinking, talking to passengers, grooming, reading, using a navigation system, watching a video, and adjusting a music player (City of Austin, 2014).

The purpose of this research is to evaluate the impact of the 2015 City of Austin, Texas ordinance prohibiting the use of all portable (hand-held) electronic devices while operating a vehicle or bicycle on the number of reported collisions.

Literature Review

Laws prohibiting the use of cell phones while driving are motivated by concern for public safety. The main goal for implementing cell phone bans is to prevent distracted driving that cause collisions and fatalities.

Distracted driving is risky behavior. It diverts the driver's attention from the primary task of driving and poses a threat to road safety. It is often generalized to include activities such as eating, putting on makeup, using a navigation systems talking to passengers, and cell phone use to name but a few (City of Austin, 2014b; GHSA, 2011; NHTSA, 2015b). The act of making a phone call or text on a hand-held phone often involves visual, auditory, manual, and cognitive recognition all of which are considered distractions while driving (GHSA, 2011). With the proliferation of the public's demand for wireless communication, the use of smartphones has become increasingly common. A survey conducted in 2013 by the Pew Research Center found that 91% of American adults are cell phone owners, out of which 56% say they own a smartphone (Duggan & Smith, 2013; Smith, 2103). The multifaceted use of smartphones has increased the accessibility to the internet. Approximately 93% of the smartphone owners use their phone to access the internet (Duggan & Smith, 2013).

In a research note, Pickrell and KC (2015) of the National Center for Statistics and Analysis analyzed data from the National Occupant Protection Use Survey, which provides observed data on driver electronic device use in the United States. They found that the visible manipulation of hand-held devices steadily increased from 0.2% in 2005 to 2.2% in 2014.

The popularity and mobility of cell phones has led to the inclusion of legislation to ban the use of electronic devices while operating a vehicle. Bans often cover a broad spectrum of devices such as smartphones, MP3 players, electronic reading devices, laptop computers, and navigation systems (City of Austin, 2014a; McCartt, Kidd, & Teoh, 2014).

Several surveys have been conducted on behavior, knowledge of laws, and patterns of driver cell phone use (hands-free and hand-held). The surveys have produced similar findings about the prevalence of cell phone use while driving at the international, national, state, and local levels. The CDC (2013) conducted an international survey and found that U.S. drivers reported a higher frequency of talking and texting on their cell phones than the other countries surveyed. The prevalence of talking on a cell phone ranged from 21% in the United Kingdom to 69% in the United States (CDC, 2013). In a national survey, Braitman and McCartt (2010) found that 40% of respondents reported talking on the phone while driving a few times per week and was higher for males than females. At the state level, a survey conducted across Texas found that 76% of respondents reported talking on a cell phone while driving at least once in the past month and males were more likely than females to text (Womack, 2013). In unison with the above mentioned survey studies, Engelberg, Hill, Rybar, and Styer (2015) found similar results at the county level with 56% of respondents claiming they spend their overall driving time talking on a hand-held phone. It is evident that cell phone use while driving is a prevalent behavior.

Clearly cell phones have the potential to compromise driver safety. There are a number of studies that attempt to determine the risks associated with distracted driving. One often cited experimental study by Strayer et al., (2006), characterized cell phone use through a comparison with driving while intoxicated. They found that when controlling for driving difficultly and time on task, cell-phone drivers exhibited greater impairment (i.e., more accidents and less responsive

driving behavior) than intoxicated drivers (Strayer et al., 2006). Evidence from driving simulators show slower reaction time and longer time to recover the speed lost in braking in both modes of hands-free or hand-held. Research found no significant differences in the impairments to driving caused by either mode of cell phone communication. These findings call into question policy-motivated regulations that encourage the prohibition of hand-held cell phones, yet permit hands-free cell phones (Strayer et al., 2006; Redelmeier & Tibshirani, 1997). Other case-crossover design studies used estimates to determine the effect of cell phone use on accident rates. Redelmeier & Tibshirani (1997) suggested that using a cell phone increased the associated risk of having a car accident fourfold. In sync with Redelmeier & Tibshirani, Cohen and Graham (2003) argued that eliminating the use of cell phones while driving reduces the number of car accidents by approximately 6%. In an empirical study capturing trends in fatalities from distracted driving, Wilson and Stimpson (2010) concluded distracted driving fatalities would increase 75.6% on average for every one million additional text messages sent per month. Nevertheless, distracted driving and the increased risk of road accidents is a public health issue. (Wilson & Stimpson, 2010).

Several types of studies have been conducted to determine the effectiveness of legislation that bans cell phone use. Reduction in cell phone use while driving is one way to measure the effectiveness of anti-cell phone laws. Observational studies can produce varied results because it can be difficult for the observer to see the visible manipulation of a device by a driver. In addition, the awareness of cell phone bans can also cause a driver to change their behavior to hide their cell phone use from view (Goodwin, O'Brien, & Foss, 2012; Highway Data Loss Institute (HLDI), 2010). Goodwin et al (2012) found that two years after implementation of North Carolina's ban on teenage driver cell phone use showed no significant decrease. However,

their survey results revealed that 74% of responding teenagers were aware of the restriction (Goodwin et al., 2012). McCartt and Geary (2004) observed cell phone use pre- and post-implementation of a state-wide hand-held ban in New York using Connecticut as a control state. Their study found no long term reduction in cell phone use among drivers.

Several empirical studies evaluated the impact of legislation banning the use of cell phones while operating a vehicle and found significant results. All of the reviewed empirical studies had a common theme of using collision or injury data as their dependent variable. Three studies used a form of time-series regression models to analyze their data. One study utilized crash-related hospitalizations as their dependent variable to examine the changes after the enactment of a texting ban relative to those states without (Ferdinand, Menachemi, Blackburn, Sen, Nelson, & Morrisey, 2015). Results indicated that texting bans were associated with seven % reduction in crash-related hospitalizations among all age groups (Ferdinand et al., 2015). Kwon et al., (2014) used cell phone-related collision data gathered from the State of California and showed similar results. There was a 33% decline in accidents after the ban implementation. In comparison to McCartt and Geary's (2004) observational study of New York's (NY) hand-held ban, Nikolaev, Robbins, and Jacobson (2010) used fatal car accidents at the NY county level as its measure pre- and post-law. Nikolaev et al. (2010) found 46 out of 62 counties experienced lower fatal accident rates, at statistically significant levels.

Many empirical studies using crash data have found legislation banning hand-held devices to be non-effective (HLDI, 2009; HLDI, 2010, HLDI, 2013; Burger, Kaffine, & Yu, 2014). Three studies by HLDI (2013, 2010, 2009) found no significant decline in crash risk. All studies used time series regression models and used control cities or states to compensate for unknown factors. However, their dependent variable, insurance claims, could skew the results

because the claims were only for private vehicles. Burger et al., (2014) found similar results using crash data collected from the State of California's Performance Management System. This study controlled for precipitation, gasoline price, holidays, and road hazards. Burger et al., (2014) study is unique because it included lag time to determine if their results were sensitive to the number collisions around the ban date, which could impact behavior because drivers anticipated the ban or delayed their response to it.

Studies which examine the impact of legislation on crashes focus on many determinants and consequences. Some studies show an initial reduction in crashes only to have accident levels rebound to normal rates in the long run (Abouk & Adam, 2013; McCartt & Geary, 2004). Effectiveness of legislation can be also discriminatory based on age (Lim & Chi, 2013a; Lim & Chi, 2013b). Cell phone bans had the most pronounced effect among drivers between 18-34 years of age in contrast to ages 55 and older (Lim & Chi, 2013b). Population density plays an important factor in hand-held ban effectiveness (Jacobson, King, Ryan, & Robbins, 2012). Jacobson et al., (2012) used a regression model of four groups of varying population density levels that were analyzed. They found the New York hand-held ban reduced accidents in all but the very rural counties.

Common themes emerge with the existing literature on cell phone bans. It is generally understood and accepted that using a hand-held device such as a cell phone while driving is dangerous and considered a public concern. There is no consensus, however, on the effectiveness of legislation that bans the use of hand-held devices while driving. The methods used to evaluate the effectiveness cell phone ban laws range from gathering observational data, aggregate collision or claim data, and survey data. Several empirical studies use collision or accident rates as a dependent variable. The other common link is the time variable.

All modes of evaluation have an important impact on the perspective of the effectiveness of City of Austin's Hands-Free ordinance**.** The literature supports the reasonable expectation that collision rates will be reduced with an implementation of a cell phone ban. The following hypothesis is suggested:

H1: The City of Austin's ordinance prohibiting the use of all portable (hand-held) electronic devices while operating a vehicle or bicycle will have a negative effect on the number of reported collisions in Austin, Texas.

Table 1: Conceptual Framework Supported by Literature

Title:	An Evaluation of the Hands-Free Ordinance on the Number of Collisions in Austin, Texas.
Purpose:	The purpose of the research is to evaluate the impact of the 2015 City of Austin ordinance prohibiting the use of all portable (hand-held) electronic devices while operating a vehicle or bicycle on the number of reported collisions.
Formal Hypothesis	**Sources Used to Support the Hypothesis**
H1: The City of Austin's ordinance prohibiting the use of all portable (hand-held) electronic devices while operating a vehicle or bicycle will have a negative effect on the number of reported collisions.	Braitman & McCartt, 2010; Jacobson et al., 2012; Kwon et al., 2014; Lim & Chi, 2013; McCartt & Geary, 2004; Nikolaev et al., 2010; Redelmeier & Tibshirani, 1997; Strayer et al., 2006; Wilson & Stimpson, 2010

Methods

The research design for this evaluation is an interrupted time series with a comparison group serving as a quasi-experiment. This design is used to assess the impact of the City of Austin's Hands-Free ordinance on the number of reported collisions. "Analysis of the time series quasi-experiment is a statistical comparison of the pre-and post-intervention time series

segments" (McDowall, McLeay, Me dinger, & Hay, 1980, p. 12). Time series analysis is an appropriate approach to determine the effect of a new policy or to evaluate a new program on some outcome of interest when there are multiple data points before and after the implementation (Pickup, 2015; Johnson, 2014). Furthermore, it is considered a useful tool for evaluating the effects or consequences of political and social policies when the focus is on change (Pickup, 2015). Alejandra Pena (2015), in her applied research project, used an interrupted time series analysis to determine if cities hosting the Super Bowl experienced an increase in crime rates. Incorporating a comparison group into the analysis strengthens the design as it eliminates resulting bias when one observation is made (Hernandez, 2015).

This study utilizes daily aggregated traffic accident data as the dependent variable. The decision to use crash data was motivated primarily by the City of Austin's Hands-Free ordinance concern over road safety and reduction in the number of accidents related to cell phone use while driving. Other empirical studies have used fatal accidents as their dependent variables (Lim & Chi, 2013; Abouk & Adam, 2013; Wilson & Stimpson, 2010). In contrast to studies that limit the analysis to only fatal accidents, this research design considers all accidents (fatal and non-fatal). HLDI (2009, 2010, 2013) used collision insurance claims from data gathered by its member companies, however, it only accounted for 80 percent of the private passenger insurance market. Ultimately, their analysis excluded commercial vehicles, approximately 20% of the private market, and all accidents for which claims were not filed (Abouk & Adam, 2013).

To control for other mitigating factors that might influence car accidents, several studies included control variables to rule out alternative hypotheses. Weather, such as precipitation and temperature, were controlled for in Wilson & Stimpson's (2010) linear multivariate regression

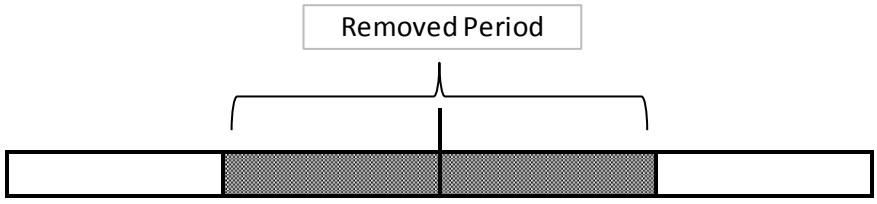
analysis to estimate the relationship between state-level distracted driving fatalities and texting volumes.

As with similar studies, this study takes into account other variables that may be cause for alternative hypotheses. City-level data was collected for the amount of daily precipitation and temperature from the National Oceanic Atmospheric Association (NOAA) to be used as control variables for both the treatment and comparison groups. Climate is an important factor that increases the likelihood of driving and having a collision (Wilson & Stimpson, 2010). Precipitation is measured by the amount of daily precipitation by inches. Temperature is measured by the average daily temperature in tenths of a degree in Fahrenheit.

The crash data for this analysis is aggregated into the number of reported daily accidents in Austin, Texas. The Texas Department of Transportation (TXDOT) is responsible for the collection and analysis of crash data submitted by law enforcement on the Texas Peace Officer's Crash Report form. TXDOT provides an automated process for obtaining crash data files through the Crash Records Information System (CRIS). To control for unobserved time-varying effects, the study narrowed the time window of analysis. Crash data was collected from CRIS for the location of Austin, Texas for the time periods of 60 days before and after January 1, 2015 and January 1, 2014. Given the hands-free ordinance went into effect January 1, 2015, which is particularly heavily traveled period due to holidays, 30 days immediately prior to the ban and 30 days after the ban were removed from this study. It is anticipated that observations around the ordinance date will be sensitive due to heavily traveled holidays, drivers anticipating the cell phone ban, or delaying their response due to expected lack of enforcement (Burger, 2014). Figure 1 represents the time frame of study with the removed period centered on the implementation of the ordinance. The time period between Jan 31 to March 1, 2015 represents

the treatment group. The comparison group is Austin's prior year's crash data before and after January 1, 2014.

Figure 1: Time Frame with Removed Period



Austin 2014-2015:	11/2/14	12/2/14	1/1/15	1/31/15	3/1/15
Austin 2013-2014:	11/2/13	12/2/13	1/1/14	1/31/14	3/1/14

The interrupted time series is aimed to provide an estimate of the impact of Austin's Hands-Free ordinance on the number of report accidents after controlling for normal growth in accidents. Testing the correlation using time or natural ordering will determine if there is relationship and the direction of the relationship between car accidents and the City of Austin's Hands-Free ordinance. Depicted below in Figure 2 is the research design used for this study (Tajalli, 2014).

Figure 2: Research Design for Reported Collisions

Austin 2014-2015: $O_1\ O_2\ O_3 \ldots O_t\ X\ O_{t+1}\ O_{t+2}\ O_{t+3} \ldots O_{t+n}$

Austin 2013-2014: $O_1\ O_2\ O_3 \ldots O_t\ \quad O_{t+1}\ O_{t+2}\ O_{t+3} \ldots O_{t+n}$

Table 2: Operationalization of the Hypothesis

Title:	An Evaluation of the Hands-Free Ordinance on the Number of Collisions in Austin, Texas.
Purpose:	The purpose of the research is to evaluate the impact of the 2015 City of Austin ordinance prohibiting the use of all portable (hand-held) electronic devices while operating a vehicle or bicycle on the number of reported collisions.

Variables	**Unit of Measurement**	**Data Source**
Dependent Variable		
Collisions	Number of daily crashes	Texas Department of Transportation - Motor Vehicle Traffic Crash Data; 2013-2015
Independent Variables		
A. Day (Time Counter)	A counter 1-60 representing the 60 days of data on collisions	Manually Coded
B. Change of trends	0 = Nov. 2 thru Dec. 1 1, 2, 3 . . . = Jan. 31 thru Mar. 1	Manually Coded
C. Austin 2014-2015/ Austin 2013-2014	0 = 11/2/14-12/1/14; 1/31/15-3/1/15 (Intervention Group) 1 = 11/2/13-12/1/13; 1/31/14-3/1/14 (Comparison Group)	Manually Coded
D. Difference in Trends Before Ordinance	Nov. 2, 2013 – Dec. 1, 2013 vs. Nov. 2, 2014 – Dec. 1, 2014	Manually Coded
E. Difference in Ordinance Impact	C*B	Manually Coded
Control Variables		
F. Temperature	Degrees in Fahrenheit	National Oceanic and Atmospheric Administration (http://www.ncdc.noaa.gov)
G. Precipitation	Inches	National Oceanic and Atmospheric Administration (http://www.ncdc.noaa.gov)

Results

To improve linearity of our regression and improve the model fit, the dependent variable of the study was transformed by taking its natural logarithm. Our first round of analysis indicated presence of autocorrelation. The Prais-Winsten method was used to remove the autocorrelation. The third iteration for correcting the autocorrelation provided an almost-perfect Durbin-Watson value of 1.99; which indicated presence of no serial correlation in our time series analysis.

Table 3 summarizes the findings of this study. When controlling for precipitation and temperature, the findings show that the coefficients of interest are not statistically significant. The regression analysis results suggest there is not a statistically significant relationship or correlation between the City of Austin's Hands-Free ordinance and reported collisions.

Table 3: The Impact of Hands-Free Electronics on Collisions

	Unstandardized Coefficients†
A. Time	-0.001
B. Change in Trend	0.003
C. 2014/2015 vs. 2013/2014	0.065
D. Diff. in Trends before the Ordinance	-0.003
E. Net Ordinance impact	0.005
F. Temperature	0.002
G. Precipitation	0.095*
Constant	3.576**
R^2	0.09
F	3.23**
Durbin-Watson	1.99
Autocorrelation Rho (AR1)	0.15

Dependent Variable = Natural log of daily reported collisions
† Corrected for Autocorrelation. The Prais-Winsten method is used.
** Significant at α< .05*
*** Significant at α< .05*

The variable of concern of this study is the Net Ordinance Impact (Variable E). The coefficient represents the difference-in-differences in trends for the two groups (Tajalli, 2014). The Net Ordinance Impact (Variable E) was not statistically significant, indicating the regression analysis did not detect an effect of the hands-free ordinance on the number of reported collisions.

The findings do not support the hypothesis of this study. Therefore, the City of Austin's Hands-Free ordinance did not have a statistically significant impact on the reported collisions during this time period.

Conclusion

The purpose of this research was to evaluate the impact of the 2015 City of Austin ordinance prohibiting the use of all portable (hand-held) electronic devices while operating a vehicle or bicycle on the number of reported collisions in Austin, Texas. This study utilized an interrupted time series regression analysis with a comparison group using data gathered from TXDOT and NOAA. The study sought to examine the relationship between the hands-free ordinance and the number of reported collisions to determine their directional impact. In contrast with other studies, the methodology of this analysis focuses on city public policy and uses a comparison group of the same city, but of a prior year.

Except for the control variable, Precipitation, the overall regression model did not achieve significance results. The findings did not reveal a significant relationship between the number of reported collisions and the implementation of the hands-free ordinance in Austin, Texas.

It is worth noting that this study's results are consistent with the HLDI (2009, 2010, 2013), which found no reduction in insurance collision claims due to hands-free bans in several

states. The results also mirror those of Jacobson et al., (2012) whose findings showed an immediate increase in its accident rate after enacting a hand-held ban, but after seven years saw a lower crash rate. Jacobson et al., (2012) suggest these types of regression analyses help to show the evolution of accident rate trends with the initially erratic compliance rate reflected in a higher accident rates.

There is still no consensus on the effectiveness of cell phone-related laws on collisions. Banning texting or hand-held cell phones may results in drivers defaulting to new forms of distraction such as lowering the phone from view. Deterrents like heavier fines or stronger enforcement should be considered in producing a more effective hands-free ordinance. Evidence indicates that drivers operating a hand-held or hands-free cell phone increase their crash risk (Strayer et al., 2006), therefore, it would not be outlandish to consider banning both behaviors.

There are avenues for further study that included analysis at the city level, short term vs long term, and use of a different data source for the dependent variable. Further study focusing only on collisions with contributing factors of cell phone use is limited due to the available crash data from TXDOT-CRIS. Prior to 1/1/2015, the Texas Peace Officer's Crash Report form included only one cell/mobile device use as a selection criteria for contributing factors to a crash. After 1/1/2015, the form was updated to include four other contributing collision factors such as cell/mobile device use–talking, cell/mobile device use-texting, cell/mobile device use-other, and cell/mobile device use unknown.

The number of reported collisions due to distraction caused by cell phone use skyrocketed after 1/1/2015. It can only be suspected that law enforcement in Austin, with the newly implemented hands-free ordinance, were aware of the new contributing factor selections

and properly investigated the collision to accurately determine cause. To solely focus on reported collisions due to cell phone distraction would be difficult due to these newly added selections. Furthermore, it is difficult to judge whether drivers involved in collisions used their cell phones while driving in collisions (Kwoon et al, 2014). It could be easy to imagine that the number of reported collisions due to cell phone use is actually quite higher due to false statements of drivers or witnesses.

This analysis can help policymakers determine the potential effect of a city-wide hand-held ban on reported collisions with the ultimate effort to better inform public policy decisions. This analysis highlights the need for more research on the effects of hands-free ordinances.

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