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Evaluating the effectiveness of the law banning handheld cellphone use while driving

Oh Hoon Kwon [a], Yoonjin Yoon [a,*], Kitae Jang [b]

[a] Department of Civil and Environmental Engineering, Korea Advanced Institute of Science and Technology (KAIST), 291 Daehak-ro, Yuseong-gu, Daejeon 305-701, South Korea
[b] Cho Chun Sik Graduate School for Green Transportation, Korea Advanced Institute of Science and Technology (KAIST), 291 Daehak-ro, Yuseong-gu, Daejeon 305-701, South Korea

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ABSTRACT

Cellphone use while driving is one of the major concerns in traffic safety, and numerous researches found that cellphone use while driving can increase traffic collision risk. With growing popularity of cellphone use, many states in the United States enacted the law banning handheld cellphone use while driving in recent years. However, there is a debate on effectiveness of the law. In this study, we analyze the six-year collision data between 2006 and 2010 in the state of California to examine the timing of a significant change in the trend of cellphone related collisions. We adopt the turning point analysis technique without imposing a prior belief on whether or when such a change has occurred. Both the frequentist and Bayesian approaches are applied to four different groups, including the all cellphone collision group and three subgroups characterized by cellphone usage. The result shows that the turning points coincides with the timing of enforcement of the handheld law in California, except for the subgroup containing hands-free related collisions only. We applied the same method to two confounding factors including driving under influence and CD/radio use, and find that the turning points do not agree with the cellphone related collisions. Although a more comprehensive set of confounding factors needs to be considered to establish a causal relationship between the handheld law and cellphone related collisions, coincidence between the handheld law and the turning point suggests that the law should be considered as one of the primary factors in cellphone related collisions reduction.

1. Introduction

Distracted driving is one of the largest contributors in traffic collision. According to National Highway Traffic Safety Administration (2010), nearly 20% of all crashes involved some level of distracted driving such as eating while driving, using audio or GPS devices, reading, and talking with passengers. In the past decade, cellphone use while driving became another contributor with increasing popularity of mobile communication. There are series of researches that suggest cellphone use while driving can produce deterioration in driving performance such as reaction time (Consiglio et al., 2003; Drews et al., 2004; Horrey and Wickens, 2006; Hosking et al., 2006; Just et al., 2008). Strayer et al. (2006) concluded that cellphone use while driving is as dangerous as driving under influence.

Reducing collision risk involving cellphone use requires both technical improvement and policy initiatives. In the United States, 10 states, the District of Columbia, and Virgin Islands started to enforce traffic safety policy to reduce collisions due to cellphone use by enacting laws banning handheld cellphone use while driving. However, there is more division than unity of opinions on the effectiveness of such policy. For example, in the state of California, which enacted the cellphone law in July 2008, we have seen conflicting reports suggesting that the cellphone law had no effect in one study (Highway Loss Data Institute, 2009) and the law was in fact was effective in another (California Office of Traffic Safety, 2012).

In this study, we analyze a large-scale traffic accident database to assess the effect of the handheld law. By investigating time-series trend of cellphone related crashes, the study aims to determine whether a statistically significant change in the cellphone related crash trend has occurred before and after the enforcement of handheld law. Adopting Bayesian approach, we impose no prior belief whether a change in the cellphone related crash trend has occurred or not over the 6-year period in the state of California between 2005 and 2010. Turning point analysis suggests that there exists

* Corresponding author. Tel.: +82 42 350 3615; fax: +82 42 350 3610.
E-mail addresses: ohunkwon@kaist.ac.kr (O.H. Kwon), yoonjin@kaist.ac.kr (Y. Yoon), kitae.jang@kaist.ac.kr (K. Jang).

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reversing trend in the number of cellphone related collisions starting from July 2008, which coincides with enforcement of California handheld law.

This paper is organized as follows. In Section 2, literature review is included on the effect of cellphone use on traffic safety and effectiveness of the handheld cellphone law. In Sections 3 and 4, we describe collision database used in our study, and explain our methodology respectively. In Sections 5 and 6, research outcome and discussion is presented. Conclusions and future research is included in the last section.

2. Literature review

As the penetration of cellphone in our daily lives grows, there have been numerous researches to unveil the relationship between cellphone use and driving safety. We categorized cellphone related researches into three main research themes: (i) impact of cellphone use on driving behavior in laboratory settings; (ii) impact of cellphone use on driving behavior in naturalistic settings; and (iii) impact of safety policy on overall cellphone related accidents based on survey and/or accident reports.

In the first category, there are numerous studies based on simulated experiments in the laboratory condition to measure the impact of speaking or texting with cellphone on driving performance. Studies find that cellphone use while driving affects drivers' situational awareness and performances negatively and increases their reaction time (Consiglio et al., 2003; Drews et al., 2004; Horrey and Wickens, 2006; Hosking et al., 2006; Just et al., 2008). Typically, laboratory studies use surrogate measures to evaluate the risk of cellphone use while driving, and correlation between driving performance and risk of collision is well documented (Guo et al., 2010).

Naturalistic driving study investigates relationship between driving behavior and traffic safety by collecting data from instrumented vehicles driven by participants for an extended period of time. Several naturalistic studies (Fitch et al., 2013; Hickman et al., 2010; Klauer et al., 2006; Olson et al., 2009) found that visually and manually complex tasks such as texting and dialing increase the risk of collision significantly. On the contrary, the studies also reported that simply talking or listening on a cellphone does not increase the risk or even decreases it in some cases. Laberge-Nadeau et al. (2003) conducted research based on three sets of survey data – driver questionnaire, cellphone activity record from cellphone companies, and driver's records and police reports – and found that increase in cellphone use also increases collision risk. Both laboratory and naturalistic driving studies agree that cellphone use while driving increases overall collision risk.

Following enactment of law prohibiting cellphone use while driving in numerous states in recent years, effectiveness of such law has been of great interest both to safety policy expert and traffic safety researchers. Foss et al. (2009) and Goodwin et al. (2012) analyzed the effect of North Carolina's ban on cellphone use of teenage drivers based on observational data over a short- and a long-term period respectively. In these subsequent studies, authors found that the ban had no effect on cellphone use behavior of teenage drivers regardless of analysis period. On the other hand, several survey-based studies in other states including Washington D.C., New York State, and Connecticut concluded that cellphone ban reduced the proportion of handheld cellphone drivers (McCartt and Geary, 2004; McCartt and Hellinga, 2007; McCartt et al., 2010).

In recent years, understanding the effect of cellphone related laws on collision frequency and severity has drawn great interest from public agencies and academic researcher alike. Highway Loss Data Institute (HLDI) (2009) conducted analysis of new monthly vehicle collision claim frequencies in Connecticut, New York, and the District of Columbia, and California, and published a result that handheld law had no significant influence on the trends of collision claim based on the analysis of monthly trends of new vehicle collision claim frequencies. On the other hand, the California Office of Traffic Safety (OTS) (2012) reported that fatalities related to handheld cellphone use had reduced since the state enacted the handheld cellphone law in July, 2008. Such conclusion is drawn from an earlier study conducted at the Safe Transportation Research and Education Center (SafeTREC) (Ragland, 2012). Using California Highway Patrol (CHP) collision database, the SafeTREC study separately assessed collisions involving handheld and hands-free cellphone to find that handheld cellphone related fatalities and injuries declined 47% and 50% respectively over the two-year period before and after the handheld law. The study also found that reduction percentages are higher than those in overall fatalities (22%) and injuries (13%).

More recently, several papers were published utilizing collision datasets with advanced statistical methods. Nikolaev et al. (2010) used yearly collision data in New York State to conduct a one-tailed t-test and found that expected values of fatal and personal injury collision rates decreased after the handheld cellphone use ban. Lim and Chi (2013) conducted panel analysis to examine the effect of state cellphone laws in the U.S. on non-alcohol related fatal collisions involving young drivers under the age of 21. The study found that although the effect of the handheld cellphone bans targeting only young driver was not evident, the bans targeting the overall drivers reduced fatal collisions. Overall, there is no single conclusion on the effectiveness of cell phone related laws from collision data perspective, and some of the earlier conclusions were based on simple descriptive statistics.

In our study, we adopt the turning point analysis technique to find the time frame that changes the trend of cellphone related crashes, if exists. By adopting both frequentist and Bayesian approaches, we impose no prior belief on whether or when such change has occurred. The intention is to infer the effect of the handheld law in California by comparing the turning point of cellphone related collisions with the timing of the handheld law.

3. Data description

In this study, we used the Statewide Integrated Traffic Records System (SWITRS) database of the state of California. SWITRS is the collection of collision report accumulated by the California Highway Patrol (CHP). In each collision record, there are two data fields that may contain cellphone use information – "inattention" and "cell". The "inattention" field which was added in January 2001 keeps track of information on several distracted driving activity such as reading, eating, smoking, electronic equipment, and cellphone use. The "cell" field which was added for cellphone use in April 2001 records cellphone usage information only. When we cross-examined cellphone related collisions before conducting our analysis, we found that values in those two fields do not always coincide with each other. Adding to the complexity, introduction of two additional attributes *handheld* and *hands-free* in both fields in July 2003 effectively created three possible ways to describe cellphone use – *handheld*, *hands-free*, and simply *cellphone use*. In Table 1, we summarized data counts in "inattention" and "cell" fields by attribute values from 2001 and 2010. One can easily see inconsistency in data; For example, among 6771 collisions recorded as *handheld* related according to "inattention" field, 5451 collisions are also recorded as *handheld* in "cell" field, while the remaining 1320 collision records show inconsistent labeling.

Fig. 1 shows five month moving average of cellphone related collision by cellphone use type. One can observe rapid decline in usage of *cellphone use* accompanied by steady increase in usage