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Factors contributing to driver choice after hitting a pedestrian in Japan

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ABSTRACT

In Japan, where pedestrian deaths account for a third of road traffic fatalities, 7.4% of victims die from hit-and-run accidents. To identify determinants for drivers considering leaving an accident scene after hitting a pedestrian, environment-related, driver-related, and pedestrian-related factors were examined using Japanese national police data. Results generally confirmed the conceptual framework of previous studies, which examined hit-and-run behavior based on a classic economic cost–benefit approach. However, results suggest that effects of road-related factors and harsher legal punishments have limited influence for reducing hit-and-run likelihood after a driver hits a pedestrian. Measures to prevent hit-and-run accidents are presented herein.

1. Introduction

In Japan, accidental injury of pedestrians is an important road traffic safety issue. In 2012, 1634 pedestrians were fatally injured, accounting for one-third of road traffic deaths (National Police Agency, 2013). The higher fatality risk for pedestrians is attributable to pedestrian–vehicle conflict arising from dense population in a country with numerous vehicles. Japan has a population density of 343 people per square kilometer (Statistics Bureau, Ministry of Internal Affairs and Communication, 2011), which is 10 times greater than that of the United States. Moreover, Japan has 0.6 vehicles per capita (Japan Automobile Manufacturers Association, 2013). Although road traffic accident fatalities in Japan have decreased during the last decade, the share of pedestrian fatalities among all road traffic accident fatalities has increased (National Police Agency, 2013).

Among pedestrian accidents of different types, hit-and-run accidents are of interest to researchers in various areas. For instance, hit-and-run accidents are a concern of the judicial system not only because hit-and-run behavior is a crime but because the victim might be forced to cover the costs of an accident on their own if the hit-and-run driver is not apprehended. Furthermore, police need evidence to provide a link between a suspect driver and the victim. Forensic science studies of techniques have been conducted to elucidate the nature and sequence of crashes and to identify the vehicle involved. Moreover, hit-and-run accidents are a concern of emergency medicine studies because leaving the victim at the accident scene delays accident notification and medical assistance, thereby increasing fatality risks (e.g., Cales, 1984).

Using analysis of hit-and-run and non-hit-and-run cases obtained from statistical databases, studies have been conducted to identify factors associated with hit-and-run behavior. However, little research has been conducted to examine pedestrian-involved hit-and-run accidents (Aidoo et al., 2013; MacLeod et al., 2012; Solnick and Hemenway, 1994, 1995). Moreover, earlier studies of pedestrian-involved hit-and-run accidents examined few factors using limited data. MacLeod et al. (2012) and Solnick and Hemenway (1994, 1995) conducted studies of pedestrian hit-and-run accidents using FARS (Fatality Analysis Reporting System) data that include only fatal accidents in the United States. Furthermore, with the exception of a paper presented by Aidoo et al. (2013), no report in the relevant literature has described an investigation of the factors of pedestrian-involved hit-and-run accidents empirically using data obtained outside of the United States.

Factors affecting a driver's choice of hit-and-run are particularly important because hit-and-run behavior is subject to a driver's decisions made after hitting a pedestrian. Previous studies have examined conceptual frameworks to clarify hit-and-run behavior at a crash scene (Solnick and Hemenway, 1994; Tay et al., 2008). The framework, based on a classic economic cost–benefit approach, has much in common with rational choice theories of criminal behavior (e.g., Nagin and Paternoster, 1993). The main determinants compelling a driver to stay at a crash scene are the expected costs associated with reporting the crash, which include legal punishment for the accident. The main determinants compelling a driver to flee are the likelihood of apprehension, the expected benefit

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of avoiding prosecution, and the expected costs of being apprehended (Tay et al., 2008). For instance, drivers are more likely to leave an accident scene when the traffic volume is low. Thereby drivers infer a lower probability of being observed and associated with the accident.

In addition, driver-related factors are important because they are associated with a driver's choice of behaviors at the accident scene. Previous studies have revealed that drunk drivers and those who have no valid license are more likely to have hit-and-run accidents (Kim et al., 2008; MacLeod et al., 2012; Solnick and Hemenway, 1994, 1995). Additionally, results show that younger drivers are more likely to have hit-and-run accidents (MacLeod et al., 2012; Solnick and Hemenway, 1994). These findings are consistent with studies showing that young drivers and drivers with a history of violations tend to be impulsive (Dahlen et al., 2005; Ryb et al., 2006), risk-taking (see review Turner et al., 2004), and shortsighted (Castellà and Pérez, 2004; Machin and Shankey, 2008; Møller and Gregersen, 2008; Ryb et al., 2006). However, results of hit-and-run likelihood for older drivers are mixed (Tay et al., 2008; Solnick and Hemenway, 1994, 1995; MacLeod et al., 2012).

Recent studies have investigated measures to prevent hit-and-run accidents on environment-related factors based on the conceptual framework on a driver's choice of hit-and-run. However, they do not include driver-related factors (e.g., Tay et al., 2009; Aidoo et al., 2013). To identify factors affecting hit-and-run choices of drivers after hitting a pedestrian at an accident scene, environment-related, driver-related, and pedestrian-related factors are examined simultaneously because these factors are associated with hit-and-run related choices. Moreover, these factors are often mutually correlated. MacLeod et al. (2012) reported that driver-related predictors are more reliable than environmental factors. However, no report in the literature describes a study that has examined pedestrian hit-and-run accidents to identify factors affecting driver choices of hit-and-run considering multiple factors and using injury cases.

This study was undertaken to identify determinants for a driver who is considering leaving the scene after hitting a pedestrian, and to advance discussions of measures to prevent hit-and-run likelihood with emphasis on driver decision making at the accident scene. Therefore, we examined environment-related, driver-related, and pedestrian-related factors of Japanese hit-and-run pedestrian accidents by constructing logistic regression models using cases in which pedestrians suffered minor, severe, and fatal injuries.

2. Method

2.1. Data

For this study, cases were obtained from Traffic Accident Statistics (TAS) maintained by the National Police Agency (NPA). TAS includes information related to case reports of road traffic accidents from 47 Prefectural Police Headquarters located throughout Japan. Environment-related, driver-related and pedestrian-related information related to accident cases in TAS are regarded as reliable because Japanese police are responsible not only for the investigation of hit-and-run cases. They are also responsible for road traffic control and driver's license administration. Moreover, trained traffic police officers compile accident data all over Japan using the same instruction manual. The compiled data are checked by TAS administrators of prefectural police headquarters and by those of the NPA. TAS includes information related to all injury accident cases in Japan organized into three categories of injury severity: fatal, severe, and minor. In the data, fatality refers to the immediate death or subsequent death from injury within 24 h of an accident. Severe injury refers to the estimated treatment period of one month or longer. Minor injury refers to an estimated treatment period of less than one month. The injury level is determined based on certificates issued by a medical doctor. For these reasons, scientific analysis is possible using TAS. Previous studies of accident prevention have used the TAS database (e.g., Okamura et al., 2010; Shimamura et al., 2005).

The TAS database includes 34,897 hit-and-run cases and 738,795 non-hit-and-run cases, in which pedestrian victims suffered minor, severe, or fatal injuries. Therefore, the share of hit-and-run accidents is 4.5% among injury pedestrian accidents. Regarding fatal pedestrian accidents, TAS includes 1484 hit-and-run cases and 18,629 non-hit-and-run cases: The share of hit-and-run accidents is 7.4% among fatal pedestrian accidents. It is noteworthy that the hit-and-run rate in Japan is lower than that of the United States: MacLeod et al. (2012) reported that 18.1% fatal pedestrian accidents were hit-and-run during 1998 and 2007 in the United States.

To ascertain factors contributing to hit-and-run driver choices at accident scenes more precisely, cases that were included in this study were those meeting several criteria. First, accidents involving privately owned four-wheeled vehicles were included, but accidents related to motorcycles, buses, taxis, or commercial trucks were excluded. Second, only drivers 18 years or older were included because people can obtain a driver's license at 18 years or older in Japan. Finally, we included only those cases in which the vehicle was slightly damaged or undamaged and the driver suffered minor or no injury. This criterion was set because we especially intended to explore determinants related to psychological processes of hit-and-run choice at the accident scene (e.g., determinants of motivation). It is also noteworthy that cases with severe vehicle damaged accounted for a small portion of the hit-and-run pedestrian accidents (4%). No driver was severely or fatally injured in the hit-and-run pedestrian accidents in our data. Consequently, this study analyzed 7059 cases of hit-and-run pedestrian accidents and 562,342 cases of non-hit-and-run pedestrian accidents.

In this study, all eligible cases of non-hit-and-run accidents were included, but for hit-and-run cases, only cases in which hit-and-run drivers were identified were included to identify driver factors. Identified drivers might be different from those who were never identified. As in previous studies, the present study has an important limitation. The comparison of descriptive statistics between cleared cases and non-cleared cases is explained later in Section 3.

2.2. Statistical model

Most previous studies have used a multivariate logistic regression model, which is widely used in various fields of medicine and in safety research, to identify qualitative and quantitative factor variables that predict a dichotomous outcome. The formula of logistic regression is $\text{Logit}\,(Y) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots + \beta_i X_i$, where X_i denotes an independent variable, with β_i as the corresponding coefficient; i is the number of independent variables. The definition of Logit is that $\text{Logit}(Y) = \log\,(p(X)/1 - p(X))$, where X denotes a vector of independent variables $X = (X_1, X_2, \ldots, X_3)$. In this study, the dependent variable is whether the case is a hit-and-run case or not. Therefore, $p(X)$ is the probability of a hit-and-run case.

In this study, independent variables include environment-related, driver-related, and pedestrian-related factors: all factors are dichotomous (present = 1, absent = 0). Table 1 presents the number of hit-and-run cases and non-hit-and-run cases for each factor. Environment-related factors include the year in which an accident occurred, season, day of the week, time of day, weather,