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Editorial

Letter from the Editors

The *Journal of Safety Research* is pleased to publish in this special issue the proceedings of several papers presented at the 4th International Conference on Road Safety and Simulation convened at Roma Tre University in Rome, Italy, October 2013. This conference serves as an interdisciplinary forum for the exchange of ideas, methodologies, research, and applications aimed at improving road safety globally.

Conference proceedings provide the opportunity for research in its formative stages to be shared, allowing our readers to gain early insights in the type of work currently being conducted and for the researchers to receive valuable feedback to help inform ongoing activities. This conference in particular offers an array of research topics not often covered by this journal from researchers practicing in over 11 countries. As is common with publishing conference proceedings, the papers published in this issue did not go through the normal *JSR* review process. Each paper included in this issue did meet the Road Safety and Simulation conference review requirements. They reflect varying degrees of scientific rigor, methodological design, and groundbreaking application.

The proceedings published in this special issue of *JSR* draw from the following road safety research sectors represented at the conference: driving simulation, crash causality, naturalistic driving, and new research methods.

It is our hope that the publication of these important proceedings will stimulate vigorous dialogue, rigorous research, and continuing innovative initiatives and applications, leading, ultimately, to fewer traffic fatalities, injuries, and crashes.

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Assessing the risk of secondary crashes on highways

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ABSTRACT

Introduction: The occurrence of "secondary crashes" is one of the critical yet understudied highway safety issues. Induced by the primary crashes, the occurrence of secondary crashes does not only increase traffic delays but also the risk of inducing additional incidents. Many highway agencies are highly interested in the implementation of safety countermeasures to reduce this type of crashes. However, due to the limited understanding of the key contributing factors, they face a great challenge for determining the most appropriate countermeasures.*Method:* To bridge this gap, this study makes important contributions to the existing literature of secondary incidents by developing a novel methodology to assess the risk of having secondary crashes on highways. The proposed methodology consists of two major components, namely: (a) accurate identification of secondary crashes and (b) statistically robust assessment of causal effects of contributing factors. The first component is concerned with the development of an improved identification approach for secondary accidents that relies on the rich traffic information obtained from traffic sensors. The second component of the proposed methodology is aimed at understanding the key mechanisms that are hypothesized to cause secondary crashes through the use of a modified logistic regression model that can efficiently deal with relatively rare events such as secondary incidents. The feasibility and improved performance of using the proposed methodology are tested using real-world crash and traffic flow data. *Results:* The risk of inducing secondary crashes after the occurrence of individual primary crashes under different circumstances is studied by employing the estimated regression model. Marginal effect of each factor on the risk of secondary crashes is also quantified and important contributing factors are highlighted and discussed. *Practical applications:* Massive sensor data can be used to support the identification of secondary crashes. The occurrence mechanism of these secondary crashes can be investigate by the proposed model. Understanding the mechanism helps deploy appropriate countermeasures to mitigate or prevent the secondary crashes.

1. Introduction

The presence of traffic incidents such as crashes, disabled vehicles, and debris on the road is a major contributing factor that reduces capacity and service quality of transportation systems. These incidents account for approximately one-fourth of all traffic delays (FHWA, 2007). More severely, these incidents will induce secondary crashes that put motorists and responder lives at risk. As shown by Tedesco, Alexiadis, Loudon, Margiotta, and Skinner (1994), the crash risk will increase more than six times in case a prior crash occurred. Similarly, an additional minute increase in the clearance time increases the likelihood of secondary crashes by 2.8% (Karlaftis, Latoski, Richards, Nadine, & Sinha, 1999). It is estimated that secondary crashes alone account for 20% of all crashes and 18% of all fatalities on freeways (O'laughlin & Smith, 2002; Owens et al., 2010). In addition, secondary crashes induce additional traffic congestions and delays to road users. Therefore, the prevention of secondary crash has been placed in a high priority in traffic incident management (O'laughlin & Smith, 2002).

In order to develop appropriate countermeasures to mitigate secondary crashes, it is necessary to understand the mechanism of its occurrence. Despite earlier efforts on investigating these crashes, there are still very limited studies focusing on mining the casual relationship between secondary crashes and possible explanatory variables. Most existing work has focused on identifying secondary crashes (Chou & Miller-Hooks, 2010; Green, Pigman, Walton, & McCormack, 2012; Moore, Giuliano, & Cho, 2004; Raub, 1997a,b; Sun & Chilukuri, 2010; Yang, Bartin, & Ozbay, 2013; Yang, Morgul, Bartin, & Ozbay, 2014s; Zhan, Gan, & Hadi, 2009) and analyzing their corresponding characteristics (Hirunyanitiwattana & Mattingly, 2006; Yang, Bartin, & Ozbay, 2013a; Zhan, Shen, Hadi, & Gan, 2008; Zhang & Khattak, 2010b). Therefore, the objective of this paper is to examine the mechanism of secondary crash occurrence. The relationship between

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