LETTER FROM THE GUEST EDITORS

Driving Behavior and Traffic Safety in Traffic Engineering

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INTRODUCTION

Road safety has been internationally recognized as a primary strategic goal in many societies and involves road user, vehicle and environment elements in a systematic manner. The element of road users represents all aspects of human factors, such as user age, gender, health condition, personality, alcohol use, distraction, driving experience, etc. The vehicle element includes vehicle type, size, weight, design, capability, technology, etc while the element of environment involves roadway factors (traffic volume, road type, pavement/terrain surface condition, signage, traffic control device, sight distance, number of lane, speed limit, traffic volume, etc) and natural environment factors (such as weather and lighting conditions). The complex interactions among these factors reflect the complex driving behaviors on the roads.

Clearly, better driving behaviors will result in the better traffic safety. While traffic safety is measured by numbers of accidents, injuries, or damages, it is not as observable as driving behaviors. Therefore, the theme of this special issue emphasizes that improving traffic safety requires a better understanding of the driving behaviors on roads and the interaction between driver, vehicle, and environment. Through this special issue, we aim to collect multi-method research outcomes in addressing driving behavior and safety issues. This special issue selects seven papers submitted from three countries: USA, Canada, and China. They represent diverse perspectives in exploring the relationships between traffic safety and driving behaviors. These studies embody the efforts of the traffic safety engineers and researchers on improving transportation safety and quality.

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CONTRIBUTIONS

In-service road safety reviews are currently the most practical program that aims at reducing traffic crashes and injuries. It is a formal examination of the safety performance of an existing road by an independent expert or a multidisciplinary team, with special attention given to the interactions between roadway elements and driver behavior. In this issue, Tay and Mishra examined whether the reviews would contribute to any expected reduction in collisions on roads. They conducted a three year before-after study with comparison group analysis and Empirical Bayes method, using 1999-2005 collision data for 22 treatment and 37 comparison locations. They found that the expected effect of conducting in-service road safety reviews was quite positive in terms of improving road safety but the expected reductions in collision were highly sensitive to the evaluation methodology used. It was recommended that in-service safety reviews should be conducted at any high crash locations, especially at locations with high severity crashes.

The formation and dissipation of congestion would create greater variations in speed which would potentially increase the likelihood of crash occurrence on freeways [1,2]. Hence, it would be important to examine traffic congestion in relation to traffic safety and three papers in this issue dealt with different perspectives related to congestion measurement, congestion mitigation, and traffic shock waves. In one paper, Yu *et al*. analyzed the ordinal characteristics of congestion intensity and introduced the cumulative logistic regression into the congestion intensity models for different types of road (expressways, major arterials, minor arterials, and collectors) using data collected in Beijing, China. More than 4,000 data records related to congestion intensity were collected during a two-day on-road test. Five independent variables related to driving behaviors in the road network were used to reflect real-world traffic operating conditions. They included travel speed, delay ratio, stop time, the number of stops, and the density of the expressways' entrances/exits or the major and minor

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arterials' signalized intersections. The proposed model fitted the data very well, with a pseudo R-square of 0.77 and a prediction accuracy of 73.4%. Therefore, the proposed model could be effectively applied to determine the traffic congestion intensity on different road classes. The regression analysis also revealed that travel speed had the highest contribution and thus the proposed model would be a useful tool for engineers in managing traffic congestion, speed and safety.

Another area of congestion and safety concerns would the highway work zone [3-5]. In the second paper, Wei *et al*. proposed a method to integrate Dynamic Late Merge (DLM) with merge metering at the downstream taper area of a work zone. With Dynamic Merge Metering Traffic Control System for work zones (DMM-Tracs), the merge metering control would be activated depending on the volume and/or speed detected at an upstream location of the work zone. If the thresholds of control parameters were met, a merge metering signal installed at the taper area would be activated and approaching vehicles would be instructed in the advance areas of the work zone. With DMM-Tracs, the delay penalty would be distributed equally in all lanes, which potentially increased the efficiency when discharging traffic into the open lane inside the work zone. DMM-Tracs had an added advantage over other work zone traffic control strategies due to its capability in switching various control options in response to varied traffic conditions. In this paper, the microscopic simulation software VISSIM was used to determine the volume threshold values and evaluate the performance of DMM-Tracs in terms of delay and travel times. The simulation results indicated that DMM-Tracs discharged queues at a faster rate than the Late Merge strategy, thus producing shorter delays. The ability to control the orderly merging of traffic and reduce delays would contribute significantly to improving safety around the work zones on highways.

In the third paper on congestion and safety, Lee and Volpatti examined how the formation and dissipation of a queue indicated by shock waves affected the likelihood of crash occurrence on freeways. The authors collected traffic flow data from loop detectors on a section of the westbound Gardiner Expressway in Toronto, Canada, as well as the corresponding crashes that occurred on this road section during weekdays of a 13-month period from January 1998 to January 1999. The shock waves were compared between the crash and non-crash cases to evaluate the association of shock waves with crash likelihood. It was found that typical shock wave types varied in different time periods during the day and lower forward shock wave speed increased crash likelihood. Based on the findings, authors recommended that time-varying volume and density be monitored in real time to detect high crash-prone traffic conditions. In practice, when these conditions are detected, safety and messages and warnings could be displayed using variable message signs [6-8] to modify driver behaviors and reduce the likelihood of a crash.

Besides work zones, intersections would also be considered as hazardous locations on the roads [9-12]. In this issue, Yan and Richards conducted a pilot field observation study at four signalized intersections at Knoxville, Tennessee -two with restricted right-turn sight distances and two with sufficient sight distances - to investigate if restricted right-turn sight distances had a significant impact on Right-Turn-On-Red (RTOR) behaviors. Using data collected by a video camera, the study found that restricted sight distances could: cause drivers to seriously encroach into pedestrian crossings in order to maximize available sight distances at the intersections; lead to a higher non-stop RTOR violation rate; cause drivers to accept smaller gaps; and increase the possibility of conflicts with pedestrians. Due to these significantly negative effects on RTOR behaviors, the right-turn sight distance would be a significant safety issue at signalized intersections. Besides improving the sight distance, one way to mitigate this safety issue would be to provide better pavement marking.

In a related paper in this issue, Noor *et al*. examined the effectiveness of a proposed pavement marking as a red light running countermeasure. The pavement marking "SIGNAL AHEAD" was painted at the stop sight distance from the intersection stop-bar to assist drivers in making a proper stop/go decision without running a red light or making an abrupt stop. In the study, red light running behaviors were recorded at a test intersection (with marking) and a control intersection (without marking) in Orlando, Florida. A reduction in the red light running rate was observed after the marking was applied at the test intersection, while the red light running rate did not change significantly at the control intersection, leading to the conclusion that the marking has a good potential as to improve driving behaviors at signalized intersections.

Deer-Vehicle Collisions (DVCs) posed a significant road safety problem in North America. For example, there were approximately 305,000 such crashes in 2006 in the United States of America, resulting in an estimated $1.6 billion lost to the economy [13]. In this issue, Shao *et al*. studied DVCs by examining roadway geometric and roadside characteristics in northeast Ohio, USA. A total of 1,208 non-intersection crashes in rural highways were investigated for three years (2001-2003), covering 173.5 miles of two-lane highways, on which 46 % of the crashes were DVCs. Field surveys were conducted to collect necessary geometric and roadside information for the researched highway sections. Statistical analyses indicated that the distance between the wooded areas to the roadway, the percentage of the ditches, and the number of vertical curves were the most important factors associated with DVCs. The DVC probability in farm areas was three times higher than non-farm areas. However, there was no significant association between DVC and run-off-road (ROR) crashes in the study areas.

SUMMARY

Traffic safety is a major concern of many governments, institutes, and individuals in both developed and developing countries. Reducing traffic crashes, injuries, and deaths require comprehensive and integrated solutions to improve driving behaviors on roadways. This special issue presents a collection of papers from researchers in different countries to provide a better understanding of some of the key road safety issues and to suggest potential measures to improve traffic safety and reduce the huge social cost associated with traffic collisions. To this end, we would like to express our appreciation of the efforts by all the authors in contributing

to this special issue. We also like to thank the reviewers for their contributions in making this issue a success. We hope that more efforts in this area of research will continue in the future.

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