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Nicholas Van Dyke, Mark T. Fillmore. *Acute effects of alcohol on inhibitory control and simulated driving in DUI offenders.* Pages 5.e1-11.

Introduction

The public health costs associated with alcohol-related traffic accidents have prompted considerable research aimed at identifying characteristics of individuals who drive under the influence (DUI) in order to improve treatment and prevention strategies. Survey studies consistently show that DUI offenders self-report higher levels of impulsivity compared to their nonoffending counterparts. However, little is known about how individuals with a DUI history respond under alcohol. Inhibitory control is a behavioral component of impulsivity thought to underlie risky drinking and driving behaviors.

Method

The present study examined the degree to which DUI drivers display deficits of inhibitory control in response to alcohol and the degree to which alcohol impaired their simulated driving performance. It was hypothesized that DUI offenders would display an increased sensitivity to the acute impairing effects of alcohol on simulated driving performance. Young adult drivers with a history of DUI and a demographically-comparable group of drivers with no history of DUI (controls) were tested following a 0.65 g/kg dose of alcohol and a placebo. Inhibitory control was measured by using a cued go/no-go task. Drivers then completed a driving simulation task that yielded multiple indicators of driving performance, such as within-lane deviation, steering rate, centerline crossings and road edge excursions, and drive speed.

Results

Results showed that although DUI offenders self-reported greater levels of impulsivity than did controls, no group differences were observed in the degree to which alcohol impaired inhibitory control and driving performance. The findings point to the need to identify other aspects of behavioral dysfunction underlying the self-reported impulsivity among DUI offenders, and to better understand the specific driving situations that might pose greater risk to DUI offenders.

Practical applications

The systematic study of candidate cognitive deficits in DUI offenders will provide important information on their role in risky driving behavior and decisions to drink and

drive. Such information is critical for guiding new interventions for DUI offenders that will move treatment beyond general addiction counseling.

- **Keywords:** Simulated driving; Alcohol; DUI; Impulsivity; Inhibitory control

C. Freydier, C. Berthelon, M. Bastien-Toniazzo, G. Gineyt. *Divided attention in young drivers under the influence of alcohol.* Pages 13.e1-18.

Introduction
The present research evaluates driving impairment linked to divided attention task and alcohol and determines whether it is higher for novice drivers than for experienced drivers.
Method
Novice and experienced drivers participated in three experimental sessions in which blood alcohol concentrations (BACs) were 0.0 g/L, 0.2 g/L, and 0.5 g/L. They performed a divided attention task with a main task of car-following task and an additional task of number parity identification. Driving performance, response time and accuracy on the additional task were measured.
Results
ANOVA showed a driving impairment and a decrease in additional task performance from a BAC of 0.5 g/L, particularly for novice drivers. Indeed, the latter adopt more risky behavior such as tailgating. In the divided attention task, driving impairment was found for all drivers and impairment on information processing accuracy was highlighted, notably in peripheral vision.
Practical applications
The divided attention task used here provides a relevant method for identifying the effects of alcohol on cognitive functions and could be used in psychopharmacological research.

- **Keywords:** Alcohol; Divided attention; Driving experience; Simulator; Car following

Jacques Bergeron, Martin Paquette. *Relationships between frequency of driving under the influence of cannabis, self-reported reckless driving and risk-taking behavior observed in a driving simulator.* Pages 19.e1-24.

Introduction
The role of cannabis consumption in traffic crashes is unclear and the causal link between cannabis and collisions is still to be demonstrated. While cannabis use is very likely to impair driving ability, there is as yet no overwhelming evidence that cannabis use in isolation contributes more to collisions than other characteristics inherent to cannabis users. As noted in a growing body of literature, individuals driving under the influence of cannabis (DUIC) seem to exhibit a general reckless driving style putting them at higher risk to be involved in traffic crashes.
Method
This study aims at investigating the relationship between self-reported DUIC and reckless driving by means of self-reported measures and direct observations made in a driving simulator. Participants (n = 72) were required to be between 18 and 25 years of age, to hold a valid driver's license, and to drive at least twice a week. They completed standard driving simulation tasks recreating everyday on-road trivial conditions.
Results
Results show that people admitting that they commit more real-life dangerous driving behaviors reached higher maximum speed and demonstrated more reckless driving behaviors on the driving simulation tasks. Self-reported DUIC is associated with a risky

driving style including a broad range of reckless on-road behaviors and support the problem driving behavior theory. Moreover, beyond confounding factors, both self-report DUIC and observed dangerous behaviors are associated with real-life traffic violations.
Practical applications
Since DUIC appears to be related to an overall reckless style of driving, it is proposed that public safety policies should be more holistic, simultaneously targeting multiple on-road dangerous behaviors for intervention.

- **Keywords:** Young drivers; Cannabis use; Driving simulator; Risky behaviors; Traffic violations

George Yannis, Alexandra Laiou, Panagiotis Papantoniou, Charalambos Christoforou. *Impact of texting on young drivers' behavior and safety on urban and rural roads through a simulation experiment.* Pages 25.e1-31.

Problem
This research aims to investigate the impact of texting on the behavior and safety of young drivers on urban and rural roads.
Method
A driving simulator experiment was carried out in which 34 young participants drove in different driving scenarios; specifically, driving in good weather, in raining conditions, in daylight and in night were examined. Lognormal regression methods were used to investigate the influence of texting as well as various other parameters on the mean speed and mean reaction time. Binary logistic methods were used to investigate the influence of texting use as well as various other parameters in the probability of an accident.
Results
It appears that texting leads to statistically significant decrease of the mean speed and increase of the mean reaction time in urban and rural road environment. Simultaneously, it leads to an increased accident probability due to driver distraction and delayed reaction at the moment of the incident. It appeared that drivers using mobile phones with a touch screen present different driving behavior with respect to their speed, however, they had an even higher probability of being involved in an accident.
Discussion
The analysis of the distracted driving performance of drivers who are texting while driving may allow for the identification of measures for the improvement of driving performance (e.g., restrictive measures, training and licensing, information campaigns).
Practical applications
The identification of some of the parameters that have an impact on the behavior and safety of young drivers concerning texting and the consequent results can be exploited by policy decision makers in future efforts for the improvement of road safety.

- **Keywords:** Texting; Road accidents; Speed; Reaction time; Regression

Karen Motta, Hoe Lee, Torbjorn Falkmer. Post-stroke driving: Examining the effect of executive dysfunction. Pages 33.e1-38.

Introduction
Executive dysfunction can refer to both neurocognitive deficits and behavioral symptoms that include impaired judgment, slow decision making, disorganization, impulsiveness, and risk-taking behaviors. Executive dysfunction is relatively common in the post-stroke population but is often undetected. The impact of executive dysfunction on post-stroke driving is unclear but it may pose a risk to affected drivers and other road users.
Aim
The aim of this study was to investigate the relationship between executive functioning following stroke and driving performance.

Methodology
A case–control study design was used. Purposive sampling was used to recruit stroke participants (n = 19) and healthy controls (n = 22). Participants were screened using a battery of psychometric assessments including the Montreal Cognitive Assessment and the Benton Judgment of Line Orientation. Driving performance was assessed using the STISIM driving simulator. Executive function was assessed using the Behavioural Assessment of the Dysexecutive Syndrome (BADS) and the Trail Making Test Part B.
Results
The control participants performed better than the stroke participants on the driving assessment and psychometric assessments. There was an association between the scores of the Trail Making Test Part B (Rho = 0.34, p = 0.034) and the Key Search Test of the BADS (Rho = − 0.61, p = 0.005), and the driving assessment scores. However, there was no association between the overall BADS scores and the driving assessment scores of the stroke participants.
Conclusions
The stroke participants underperformed in the driving assessment and the psychometric assessments that detected neurocognitive deficits, which included executive function. The Trail Making Test Part B and Key Search Test of the BADS were related to identify participants' deterioration in driving performance. Practical Applications: In clinical practice, the latter could be used as an indication of a post-stroke driver's performance.

- **Keywords:** Driving simulator; Executive dysfunction; Post-stroke driving

Adi Ronen, Tal Oron-Gilad, Pnina Gershon. *The combination of short rest and energy drink consumption as fatigue countermeasures during a prolonged drive of professional truck drivers.* Pages 39.e1-43.

One of the major concerns for professional drivers is fatigue. Many studies evaluated specific fatigue countermeasures, in many cases comparing the efficiency of each method separately. The present study evaluated the effectiveness of rest areas combined with consumption of energy drinks on professional truck drivers during a prolonged simulated drive. Fifteen professional truck drivers participated in three experimental sessions: control-drivers were asked to drink 500 ml of a placebo drink prior to the beginning of the drive. Energy drink-drivers were asked to drink 500 ml of an energy drink containing 160 mg of caffeine prior to the beginning of the drive, and an Energy drink + Rest session — where the drivers were asked to drink 500 ml of an energy drink prior to driving, and rest for 10 min at a designated rest area zone 100 min into the drive. For all sessions, driving duration was approximately 150 min and consisted of driving on a monotonous, two-way rural road. In addition to driving performance measures, subjective measures, and heart rate variability were obtained. Results indicated that consumption of an energy drink (in both sessions) facilitated lower lane position deviations and reduced steering wheel deviations during the first 80–100 min of the drive relative to the control sessions. Resting after 100 min of driving, in addition to the energy drink that was consumed before the drive, enabled the drivers to maintain these abilities throughout the remainder of the driving session. Practical applications: Practical applications arising from the results of this research may give indication on the possible added value of combining fatigue counter measures methods during a prolonged drive and the importance of the timing of the use for each method.

- **Keywords:** Driving; Fatigue; Rest areas; Energy drinks; Professional drivers

Francesco Bella, Alessandro Calvi, Fabrizio D'Amico. *Analysis of driver speeds under night driving conditions using a driving simulator.* Pages 45.e1-52.

Problem
Accident statistics demonstrate that there should be a greater focus on nighttime driving to improve our knowledge of driver behavior under poor lighting conditions. However, the current geometric design criteria do not take into account driving at night. Moreover, studies that propose predictive models of operating speed only consider daytime driving conditions.
Method
This study compares driver speed behavior during daytime and nighttime driving and models operating speeds and speed differentials, identifying significant factors that influence speed behavior under different lighting conditions. The research was carried out using a driving simulator for a section of an existing two-lane rural road composed of 39 tangent–curve configurations. Speed profiles were recorded for 40 drivers under simulated daytime and nighttime driving conditions.
Results
New predictive speed models, differentiated for daytime and nighttime driving, are proposed that highlight the effects of different geometric predictors under different visibility conditions. Specifically, predictive models for operating speed on curves identified the inverse of the radius and the deflection angle of the curve as predictors under both driving conditions. For speed differentials based on the 85th percentile for maximum speed reduction (85MSR), we found that the inverse of the approaching tangent length and of the curve radius significantly explained the dependent variable in both cases, with a higher dependence of nighttime 85MSR on the curve geometry than on the tangent length. Tangent length had a significant effect on operating speed for independent tangents only for the daytime model, whereas the inverse of the previous radius was confirmed as a predictor for both visibility conditions.
Practical applications
This research may influence design considerations for nighttime driving by providing evidence of the effects of nighttime conditions on driver speed choices and road safety.

- **Keywords:** Night driving; Design consistency; Operating speed; Speed differential; Driving simulator

Ghulam H. Bham, Ming C. Leu, Manoj Vallati, Durga R. Mathur. *Driving simulator validation of driver behavior with limited safe vantage points for data collection in work zones.* Pages 53.e1-60.

Introduction
This study is aimed at validating a driving simulator (DS) for the study of driver behavior in work zones. A validation study requires field data collection. For studies conducted in highway work zones, the availability of safe vantage points for data collection at critical locations can be a significant challenge. A validation framework is therefore proposed in this paper, demonstrated using a fixed-based DS that addresses the issue by using a global positioning system (GPS).
Methods
The validation of the DS was conducted using objective and subjective evaluations. The objective validation was divided into qualitative and quantitative evaluations. The DS was validated by comparing the results of simulation with the field data, which were collected using a GPS along the highway and video recordings at specific locations in a work zone. The constructed work zone scenario in the DS was subjectively evaluated with 46 participants.
Results
The objective evaluation established the absolute and relative validity of the DS. The mean speeds from the DS data showed excellent agreement with the field data. The subjective evaluation indicated realistic driving experience by the participants.
Practical applications
The use of GPS showed that continuous data collected along the highway can overcome the challenges of unavailability of safe vantage points especially at critical locations.

Further, a validated DS can be used for examining driver behavior in complex situations by replicating realistic scenarios.

- **Keywords:** Driving simulator; Safety; Global positioning systems; Vantage points; Validation

Tal Sharfi, David Shinar. *Enhancement of road delineation can reduce safety.* Pages 61.e1-68.

Background
New in-vehicle technologies often outpace the scientific support for their value. In lieu of valid and consistent scientific support, common wisdom is used, as in the assumption that enhanced roadway delineation improves driving safety.
Objective
To evaluate the effects of a Visibility Enhancement System that selectively improves lane markers' visibility on driving safety.
Method
A simulation experiment assessed the effects of an in-car lane Visibility Enhancement System (VES) that highlights the edges of the road ahead on driver's behavior and overall safety, under normal and reduced visibility conditions. Thirty drivers drove in a fix-based simulator through a winding rural road, while attempting to avoid un-enhanced and unexpected obstacles that appeared on the driving lane from time to time. The simulated VES highlighted the road edges up to a distance of 90 m with two alternative configurations: two continuous red lines or a series of red crosses. The effects of the two VES configurations on performance were measured during night and fog driving. Performance measures included speed, lane keeping behavior, eye scanning pattern, reaction time (RT) and collisions with the un-enhanced unexpected obstacles. Subjective measures included confidence and stress. Results: With the VES, drivers were more confident, less stressed, and drove faster, but had almost twice as many collisions with the unexpected obstacles. Also, steering/braking RT to the obstacles was longer with the VES than without it by nearly 44 msec.
Conclusions
The results are consistent with Lebowitz's theory (1977). While the VES enhanced spatial orientation, it fooled the drivers into assuming that the visibility of obstacles on the road was also improved, and thus actually reduced safety. Practical Applications: When visibility is an issue in nighttime crashes, the site-specific crashes should be investigated, in cases of collision with objects-on-the-road, improved delineation should be ruled out.

- **Keywords:** Driving safety; Roadway delineation; Driving simulation

David R. Large, Gary E. Burnett. *The effect of different navigation voices on trust and attention while using in-vehicle navigation systems.* Pages 69.e1-75.

Introduction
Automobiles are suffused with computers and technology designed to support drivers at all levels of the driving hierarchy. Classic secondary devices, such as in-vehicle navigation systems (IVNS), present strategic and tactical information to drivers. In order to mitigate the potential distraction and workload when interacting with these devices while driving, IVNS often employ voices to deliver navigational instructions. In contrast, voices are used during interpersonal encounters to engage the listener, provide clues about the speaker's personality and make judgments about them, for example, whether to like them and to trust them.
Method
A study conducted within a fixed-based medium-fidelity driving simulator investigated if drivers made similar 'personality' attributions to voices emanating from an IVNS and if this subsequently affected how they engaged with the device while driving. Twenty-nine

experienced drivers and IVNS users drove to a specified destination with a simulated IVNS and authentically reproduced UK road signage to support their route-finding. Either of two navigation voices were used; one considered 'high-trust' and the other 'low-trust.' Presented with a conflict scenario, where the verbal route guidance differed to the road signs, 22 drivers followed the IVNS instruction rather than the road signs. Of these, the majority were using the 'high-trust' voice.

Results

A post-drive questionnaire revealed that, despite the fact that message content and delivery remained equivalent, participants recognized different attributes ('personalities') associated with each of the navigation voices. This influenced their attitudes towards them, including how much they liked them, their preferences for use, and the level of trust that they associated with each voice.

Practical applications

While these, so-called, social responses may be invited and indeed encouraged in other contexts, in the automotive domain they are likely to conflict with the intended benefits of using a voice to deliver route guidance and therefore have implications for road safety and design.

- **Keywords:** Driving; Navigation; Trust; Attention; Distraction; Voices; Personality

Giulio Francesco Bianchi Piccinini, Carlos Manuel Rodrigues, Miguel Leitão, Anabela Simões. *Driver's behavioral adaptation to Adaptive Cruise Control (ACC): The case of speed and time headway.* Pages 77.e1-84.

Introduction

Positive safety effects of advanced driver assistance systems can only become effective if drivers accept and use these systems. Early detection of driver's intention would allow for selective system activation and therefore reduce false alarms.

Method

This driving simulator study aims at exploring early predictors of lane changes. In total, 3111 lane changes of 51 participants on a simulated highway track were analyzed.

Results

Results show that drivers stopped their engagement in a secondary task about 7 s before crossing the lane, which indicates a first planning phase of the maneuver. Subsequently, drivers start moving toward the lane, marking a mean steering wheel angle of 2.5°. Steering wheel angle as a directly measurable vehicle parameter appears as a promising early predictor of a lane change. A mathematical model of the steering wheel angle is presented, which is supposed to contribute for predicting lane change maneuvers.

Practical applications

The mathematical model will be part of a further predictor of lane changes. This predictor can be a new advanced driver assistance system able to recognize a driver's intention. With this knowledge, other systems can be activated or deactivated so drivers get no annoying and exhausting alarm signals. This is one way how we can increase the acceptance of assistance systems.

- **Keywords:** Lane change; Prediction; Mathematical model; Driving simulator; Steering wheel angle

Jeff K. Caird, Katherine A. Johnston, Chelsea R. Willness, Mark Asbridge. *The use of meta-analysis or research synthesis to combine driving simulation or naturalistic study results on driver distraction.* Pages 91.e1-96.

Three important and inter-related topics are addressed in this paper. First, the importance of meta-analysis and research synthesis methods to combine studies on

traffic safety, in general, and on driver distraction, in particular, is briefly reviewed. Second, naturalistic, epidemiologic, and driving simulation studies on driver distraction are used to illustrate convergent and divergent results that have accumulated thus far in this domain of research. In particular, mobile phone conversation, passenger presence, and text messaging naturalistic studies use meta-analyses and research syntheses to illustrate important patterns of results that are in need of more in-depth study. Third, a number of driver distraction study limitations such as poorly defined dependent variables, lack of methodological detail, and omission of statistical information prevent the integration of many studies into meta-analyses. In addition, the overall quality of road safety studies suffers from these same limitations and suggestions for improvement are made to guide researchers and reviewers. Practical Applications. The use of research synthesis and meta-analysis provide comprehensive estimates of the impact of distractions on driving performance, which can be used to guide public policy and future research.

- **Keywords:** Driver distraction; Driving simulation; Meta-analysis; Naturalistic driving; Research synthesis

Cole D. Fitzpatrick, Curt P. Harrington, Michael A. Knodler Jr., Matthew R.E. Romoser. *The influence of clear zone size and roadside vegetation on driver behavior.* Pages 97.e1-104.

Introduction
Roadside vegetation provides numerous environmental and psychological benefits to drivers. Previous studies have shown that natural landscapes can effectively lower crash rates and cause less frustration and stress to the driver. However, run-off-the-road crashes resulting in a collision with a tree are twice as likely to result in a fatality, reinforcing the need to examine the placement of vegetation within the clear zone.
Method
This study explores the relationship between the size of the clear zone and the presence of roadside vegetation on vehicle speed and lateral position. A static evaluation, distributed electronically to 100 licensed drivers, was utilized to gather speed selections for both real and virtual roads containing four combinations of clear zone sizes and roadside vegetation densities. A case study was included in the static evaluation to investigate the presence of utility poles near the edge of the road on speed selection. Validation of the static evaluation was performed by a field data collection on the same roadways shown to participants in the evaluation.
Results
The speeds observed in the field for roadways with medium clear zone/dense vegetation or large clear zone/spare vegetation correlated with the speeds chosen by static evaluation participants. Further field data were obtained on vehicle speeds and lateral positions for additional roads demonstrating the same clear zone size/vegetation density combinations.
Practical application
This study successfully demonstrates the relationship between clear zone design and driver behavior, which could improve clear zone design practices and thus roadway safety.

- **Keywords:** Roadside trees; Driving simulation; Static evaluation; Safety; Clear zone

Alexander Brown, Sean Brennan. *On the required complexity of vehicle dynamic models for use in simulation-based highway design.* Pages 105.e1-112

Introduction
This paper presents the results of a comprehensive project whose goal is to identify roadway design practices that maximize the margin of safety between the friction supply and friction demand. This study is motivated by the concern for increased accident rates on curves with steep downgrades, geometries that contain features that interact in all three dimensions — planar curves, grade, and superelevation. This complexity makes the prediction of vehicle skidding quite difficult, particularly for simple simulation models that have historically been used for road geometry design guidance.
Method
To obtain estimates of friction margin, this study considers a range of vehicle models, including: a point-mass model used by the American Association of State Highway Transportation Officials (AASHTO) design policy, a steady-state "bicycle model" formulation that considers only per-axle forces, a transient formulation of the bicycle model commonly used in vehicle stability control systems, and finally, a full multi-body simulation (CarSim and TruckSim) regularly used in the automotive industry for high-fidelity vehicle behavior prediction. The presence of skidding – the friction demand exceeding supply – was calculated for each model considering a wide range of vehicles and road situations.
Results
The results indicate that the most complicated vehicle models are generally unnecessary for predicting skidding events. However, there are specific maneuvers, namely braking events within lane changes and curves, which consistently predict the worst-case friction margins across all models. This suggests that any vehicle model used for roadway safety analysis should include the effects of combined cornering and braking.
Practical Implications
The point-mass model typically used by highway design professionals may not be appropriate to predict vehicle behavior on high-speed curves during braking in low-friction situations. However, engineers can use the results of this study to help select the appropriate vehicle dynamic model complexity to use in the highway design process.

- **Keywords:** Friction; Modeling; Simulation; Highway safety; Vehicle dynamics

Niranga Amarasingha, Sunanda Dissanayake. *Gender differences of young drivers on injury severity outcome of highway crashes.* Pages 113.e1-120

Problem
Gender differences of young drivers involved in crashes and the associated differences in risk factors have not been fully explored in the United States (U.S.). Accordingly, this study investigated the topic, where the odds ratios (ORs) were used to identify differences in crash involvements between male and female young drivers.
Method
Logistic regression models for injury severity of young male drivers and young female drivers were developed. Different driver, environmental, vehicle, and road related factors that have affected young female drivers' and young male drivers' crash involvements were identified using the models.
Results
Results indicated that some variables are significantly related to female drivers' injury risk but not male drivers' injury risk and vice versa. Variables such as driving with valid licenses, driving on weekends, avoidance or slow maneuvers at time of crash, non-collision and overturn crashes, and collision with a pedestrian were significant variables in female driver injury severity model but not in young male driver severity model. Travel on graded roadways, concrete surfaces, and wet road surfaces, collision with another vehicle, and rear-end collisions were variables that were significant in male-driver severity model but not in female-driver severity model.

Summary
Factors which increase young female drivers' injury severity and young male drivers' injury severity were identified. This study adds detailed information about gender differences and similarities in injury severity risk of young drivers.
Practical applications
It is important to note that the findings of this study show that gender differences do exists among young drivers. This sends a message to the industry that the transportation professionals and researchers, who are developing countermeasures to increase the traffic safety, may need to pay attention to the differences. This might be particularly true when developing education materials for driver training for young/inexperienced drivers.

- **Keywords:** Gender; Young drivers; Driving safety issues; Severity modeling; Crash data analysis

J.W.H. (Jan Hendrik) van Petegem, Fred Wegman. Analyzing road design risk factors for run-off-road crashes in the Netherlands with crash prediction models. Pages 121.e1-127.

Problem
About 50% of all road traffic fatalities and 30% of all traffic injuries in the Netherlands take place on rural roads with a speed limit of 80 km/h. About 50% of these crashes are run-off-road (ROR) crashes. To reduce the number of crashes on this road type, attention should be put on improving the safety of the infrastructure of this road type. With the development of a crash prediction model for ROR crashes on rural roads with a speed limit of 80 km/h, this study aims at making a start in providing the necessary new tools for a proactive road safety policy to road administrators in the Netherlands.
Method
The paper presents a basic framework of the model development, comprising a problem description, the data used, and the method for developing the model. The model is developed with the utilization of generalized linear modeling in SAS, using the Negative Binomial probability distribution. A stepwise approach is used by adding one variable at a time, which forms the basis for striving for a parsimonious model and the evaluation of the model. The likelihood ratio test and the Akaike information criterion are used to assess the model fit, and parameter estimations are compared with literature findings to check for consistency.
Results
The results comprise two important outcomes. One is a crash prediction model (CPM) to estimate the relative safety of rural roads with a speed limit of 80 km/h in a network. The other is a small set of estimated effects of traffic volume and road characteristics on ROR crash frequencies.
Practical applications
The results may lead to adjustments of the road design guidelines in the Netherlands and to further research on the quantification of risk factors with crash prediction models.

- **Keywords:** Crash prediction model; Run-off-road; Road design; Safety zone; Road safety

Alexander Maistros, William H. Schneider IV, Peter T. Savolainen. *A comparison of contributing factors between alcohol related single vehicle motorcycle and car crashes.* Pages 129.e1-135.

Introduction
Alcohol related crashes have accounted for approximately 35% of fatal crashes per year since 1994 nationwide, with approximately 30% involving impairment over the legal blood alcohol content limit of 0.08%. Educational campaigns and law enforcement efforts are two components of multi-faceted programs aimed toward reducing impaired driving.

It is crucial that further research be conducted to guide the implementation of enforcement and educational programs.
Method
This research attempts to provide such guidance by examining differences in alcohol-involved crashes involving motorcycles and passenger cars. Prior safety research has shown that motorcyclists follow a significantly different culture than the average passenger car operator. These cultural differences may be reflected by differences in the contributing factors affecting crashes and the severity of the resulting injuries sustained by the driver or motorcyclist. This research is focused on single-vehicle crashes only, in order to isolate modal effects from the contribution of additional vehicles. The crash data provided for this study are from the Ohio Department of Public Safety from 2009 through 2012.
Results
The injury severity data are analysed through the development of two mixed logit models, one for motorcyclists and one for passenger car drivers. The models quantify the effects of various factors, including horizontal curves, speeds, seatbelt use, and helmet use, which indicate that the required motor skills and balance needed for proper motorcycle operation compounded with a lack of mechanical protection make motorcyclists more prone to severe injuries, particularly on curves and in collisions with roadside objects.
Practical Applications
The findings of this study have been incorporated into combined motorcycle and sober driving educational safety campaigns. The results have shown to be favorable in supporting national campaign messages with local justification and backing.
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- Keywords: **Alcohol; Motorcycle; Crash; Mixed logit**

Brendan J. Russo, Jonathan J. Kay, Peter T. Savolainen, Timothy J. Gates. *Assessing characteristics related to the use of seatbelts and cell phones by drivers: Application of a bivariate probit model.* Pages 137.e1-142.

Introduction
The effects of cell phone use and safety belt use have been an important focus of research related to driver safety. Cell phone use has been shown to be a significant source of driver distraction contributing to substantial degradations in driver performance, while safety belts have been demonstrated to play a vital role in mitigating injuries to crash-involved occupants.
Method
This study examines the prevalence of cell phone use and safety belt non-use among the driving population through direct observation surveys. A bivariate probit model is developed to simultaneously examine the factors that affect cell phone and safety belt use among motor vehicle drivers.
Results
The results show that several factors may influence drivers' decision to use cell phones and safety belts, and that these decisions are correlated.
Practical applications
Understanding the factors that affect both cell phone use and safety belt non-use is essential to targeting policy and programs that reduce such behavior.

- **Keywords:** Cell phones; Safety belts; Driver behavior; Bivariate probit

Hong Yang, Kaan Ozbay, Kun Xie. *Assessing the risk of secondary crashes on highways.* Pages 143.e1-149.

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.

- **Keywords:** Secondary crash; Crash risk; Highway; Traffic safety; Rare event logistic regression