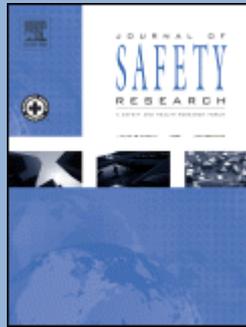


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Abhay Lidbe, Praveena Penmetsa, Teng Wang, Emmanuel Kofi Adanu, Shashi Nambisan. *Do NHTSA vehicle safety ratings affect side impact crash outcomes?* Pages 1-7.

Introduction: Side impact crash injuries tend to be severe, mainly due to the effects of the mechanism of such crashes. This study addresses the relationship between side impact crash injury severities and side impact safety ratings of the passenger cars involved in such crashes. It is motivated by the lack of research on side impact safety ratings in relation to the real-world crash outcomes. **Method:** Analysis of Crashworthiness Data System's (CDS) data show the head and thorax are the most common regions of impact of severe injuries, while the neck is the least. Irrespective of body regions, higher-rated vehicles were found to provide better occupant protection to both younger and older driver age groups. Assessment based on injury severity score (ISS) indicates that higher-rated vehicles have an overall lower average ISS compared to lower-rated vehicles. **Results:** Ultimately, this study shows that vehicles rated with National Highway Traffic Safety Administration's (NHTSA) new criteria had lower average ISS compared to vehicles rated under the old criteria. The 2011 NHTSA side impact rating criteria being relatively new, it has very few crashes to draw meaningful statistically significant conclusions. However, this paper establishes the fact that vehicles with higher star ratings (under experimental conditions) indeed offer increased occupant protection in the field conditions. **Practical applications:** Previous studies have found that safety was given priority while buying new vehicles. However, people associated vehicle safety with technologies and specific safety features rather than the vehicle's crash test results or ratings (Koppel, Charlton, Fildes, & Fitzharris, 2008). The results from this study provide a point of reference for safety advocates to educate the drivers about the importance of considering vehicle safety ratings during a vehicle purchase.

- **Keywords:** Side impact crashes; NHTSA ratings; Vehicle safety; Injury severity score; NASS CDS

Amy Li, Sijun Shen, Ann Nwosu, Kendra L. Ratnapradipa, Jennifer Cooper, Motao Zhu. *Investigating traffic fatality trends and restraint use among rear-seat passengers in the United States, 2000–2016.* Pages 9-16.

Introduction: Motor-vehicle crash is one of the leading causes of unintentional injury death in the United States. Previous studies focused on fatalities among drivers and

front-seat passengers, with a limited number of studies examining rear-seat passenger fatalities. The objectives of this study were to assess trends in rear-seat passenger motor-vehicle fatalities in the United States from 2000 to 2016 and to identify demographic factors associated with being unrestrained among fatally injured rear-seat passengers. **Methods:** Rear-seat passenger fatality data were obtained from the Fatality Analysis Reporting System (FARS) database. The fatality rate ratios for overall rear-seat passengers and for different age and sex groups were determined by comparing fatality rates in 2000 and 2016 using random effects models. Risk ratios of being unrestrained for age and sex groups were obtained using general estimating equations. **Results:** Compared to 2000, the overall rear-seat passenger fatality rate in 2016 decreased by 44% (95% confidence interval [CI]: 39–49%). In particular, the fatality rate among rear-seat passengers decreased more in males than females, and passengers aged 14–19 years experienced a larger decline than all other age groups. Fatally injured male rear-seat passengers had a higher risk of being unrestrained (adjusted risk ratio: 1.06, 95% CI: 1.04–1.07) than their female counterparts, and both youngest (≤ 13 years) and oldest (65–85 years) passengers were less likely to be unrestrained than those aged 20–64 years. **Conclusions:** Overall, fatality rates among rear-seat passengers have declined, with differential degrees of improvement by age and sex. **Practical Applications:** Continued restraint use enforcement campaigns targeted at teenagers and males would further preserve them from fatal injuries and improve traffic safety for the overall population.

- **Keywords:** Rear-seat passenger; Fatality rate; Fatality trend; Restraint use

Mohammad Abrari Vajari, Kayvan Aghabayk, Mohammad Sadeghian, Nirajan Shiwakoti. *A multinomial logit model of motorcycle crash severity at Australian intersections.* Pages 17-24.

Introduction: Motorcyclists are exposed to more fatalities and severe injuries per mile of travel as compared to other vehicle drivers. Moreover, crashes that take place at intersections are more likely to result in serious or fatal injuries as compared to those that occur at non-intersections. Therefore, the purpose of this study is to evaluate the contributing factors to motorcycle crash severity at intersections. **Method:** A data set of 7,714 motorcycle crashes at intersections in the State of Victoria, Australia was analyzed over the period of 2006–2018. The multinomial logit model was used for evaluating the motorcycle crashes. The severity of motorcycle crashes was divided into three categories: minor injury, serious injury and fatal injury. The risk factors consisted of four major categories: motorcyclist characteristics, environmental characteristics, intersection characteristics and crash characteristics. **Results:** The results of the model demonstrated that certain factors increased the probability of fatal injuries. These factors were: motorcyclists aged over 59 years, weekend crashes, midnight/early morning crashes, morning rush hours crashes, multiple vehicles involved in the crash, t-intersections, crashes in towns, crashes in rural areas, stop or give-way intersections, roundabouts, and uncontrolled intersections. By contrast, factors such as female motorcyclists, snowy or stormy or foggy weather, rainy weather, evening rush hours crashes, and unpaved roads reduced the probability of fatal injuries. **Practical Applications:** The results from our study demonstrated that certain treatment measures for t-intersections may reduce the probability of fatal injuries. An effective way for improving the safety of stop or give-way intersections and uncontrolled intersections could be to convert them to all-way stop controls. Further, it is recommended to educate the older riders that with ageing, there are physiological changes that occur within the body which can increase both crash likelihood and injury severity.

- **Keywords:** Multinomial logit model; Injury severity; Motorcycle crashes; Intersection; Risk factors

Jun Liu, Asad J. Khattak, Xiaobing Li, Qifan Nie, Ziwen Ling. *Bicyclist injury severity in traffic crashes: A spatial approach for geo-referenced crash data to uncover non-stationary correlates*. Pages 25-35.

Introduction: Bicyclists are among vulnerable road users with their safety a key concern. This study generates new knowledge about their safety by applying a spatial modeling approach to uncover non-stationary correlates of bicyclist injury severity in traffic crashes. **Method:** The approach is Geographically Weighted Ordinal Logistic Regression (GWOLR), extended from the regular Ordered Logistic Regression (OLR) by incorporating the spatial perspective of traffic crashes. The GWOLR modeling approach allows the relationships between injury severity and its contributing factors to vary across the spatial domain, to account for the spatial heterogeneity. This approach makes use of geo-referenced data. This study explored more than 7,000 geo-referenced bicycle-motor-vehicle crashes in North Carolina. **Results:** This study performed a series of non-stationarity tests to identify local relationships that vary substantially across the spatial domain. These local relationships are related to the bicyclist (bicyclist age, bicyclist behavior, bicyclist intoxication, bicycle direction, bicycle position), motorist (driver age, driver intoxication, driver behavior, vehicle speed, vehicle type) and traffic (traffic volume). **Conclusions:** Results from the regular OLR are in general consistent with previous findings. For example, an increased bicyclist injury severity is associated with older bicyclists, bicyclist being intoxicated, and higher motor-vehicle speeds. Results from the GWOLR show local (rather than global) relationships between contributing factors and bicyclist injury severity. **Practical Applications:** Researchers and practitioners may use GWOLR to prioritize cycling safety countermeasures for specific regions. For example, GWOLR modeling estimates in the study highlighted the west part (from Charlotte to Asheville) of North Carolina for increased bicyclist injury severity due to the intoxication of road users including both bicyclists and drivers. Therefore, if a countermeasure is concerned with the road user intoxication, there may be a priority for the region from Charlotte to Asheville (relative to other areas in North Carolina).

- **Keywords:** Bicycle--motor-vehicle crash; Bicyclist injury severity; Non-stationarity; Geographically weighted ordinal logistic regression

Mercedes Ayuso, Rodrigo Sánchez, Miguel Santolino. *Does longevity impact the severity of traffic crashes? A comparative study of young-older and old-older drivers*. Pages 37-46.

Introduction: This article analyzes the effect of driver's age in crash severity with a particular focus on those over the age of 65. The greater frequency and longevity of older drivers around the world suggests the need to introduce a possible segmentation within this group at risk, thus eliminating the generic interval of 65 and over as applied today in road safety data and in the automobile insurance sector. **Method:** We investigate differences in the severity of traffic crashes among two subgroups of older drivers – young-older (65–75) and old-older (75+), and findings are compared with the age interval of drivers under 65. Here, we draw on data for 2016 provided by Spanish Traffic Authority. Parametric and semi-parametric regression models are applied. **Results:** We identified the factors related to the crash, vehicle, and driver that have a significant impact on the probability of the crash being slight, serious, or fatal for the different age groups. **Conclusions:** We found that crash severity and the expected costs of crashes significantly increase when the driver is over the age of 75. **Practical Applications:** Our results have obvious implications for regulators responsible for road safety policies – most specifically as they consider there should be specific driver licensing requirements and driving training for elderly – and for the automobile insurance industry, which to date has not examined the impact that the longevity of drivers is likely to have on their balance sheets.

- **Keywords:** Older drivers; Groups at risk; Bodily injuries damages; Policy implications; Automobile insurance

Nabeel Saleem Saad Al-Bdairi. *Does time of day matter at highway work zone crashes?* Pages 47-56.

Introduction: It is widely agreed that highway work zones pose significant threats to road users because driving conditions in work zones are quite different from the normal ones, particularly when traffic volumes approach a highway capacity. Therefore, work zone safety is a critical aspect for state agencies and traffic engineers. **Method:** In the current study, a total of 10,218 crashes that occurred in highway work zones in the state of Washington for the period between 2007 and 2013 were used. Time of day is disaggregated into four subgroups: (1) Morning from 6:00 to 11:00 a.m. (2) Midday from 12:00 to 5:00 p.m. (3) Night from 6:00 to 11:00 p.m., and (4) Late night from 12:00 to 5:00 a.m. Then, four mixed logit models were estimated to account and correct for heterogeneity in the crash data by considering three injury severity levels: severe injury, minor injury, and no injury. **Results:** The estimation results reveal that most contributing factors are uniquely significant in a specific time of day period, whereas three factors affect injury severity regardless of time of day such as the indicators of not deployed airbag, one passenger vehicle involved in the crash, and rear-end collision. Further, some factors were found to affect injury severity into two or three time periods, such as female drivers that found to decrease the probability of no injury in morning and night time periods, while increasing severe injury outcome in midday time. **Conclusions:** The effect of time of day on injury severity of work-zone related crashes should be modeled separately rather than using a holistic model. **Practical applications:** As a starting point, findings of the current study can be used by transportation officials to reduce fatalities and injuries of work zone crashes by identifying factors that uniquely contribute to each time of day period.

- **Keywords:** Injury severity; Work zone related crashes; Unobserved heterogeneity; Mixed logit; Time of day

Xu Wang, Yue Cao, Peiyu Jiang, Lei Niu, Nengchao Lyu. *The safety effect of open-median management on one-side widened freeways: A driving simulation evaluation.* Pages 57-67.

Introduction: Highway expansions and upgrades are often required to increase road network capacity. The widening of one side of a highway, referred to as 'one-side widening,' is sometimes implemented in these highway expansion projects. During one-side widening, to save costs, openings can be configured on existing medians (as opposed to removing the existing medians altogether). The median openings allow vehicles in the outer lanes to enter the inner lanes, but they also raise safety concerns and may require alternate open-median management strategies for traffic authorities. There is little existing research that has evaluated the safety effect of these open-median management strategies. **Method:** To bridge this gap, this study proposes a procedure that evaluates the safety of open-median management strategies for one-side widened highways. The proposed procedure was implemented through driving simulation experiments on a section of Binlai Freeway in Shandong, China. First, the minimum location requirements for median openings were determined by calculating the short length of the weaving segment. Then, simulation tests were carried out to observe driving performance and workload measures. **Results:** The results indicate that the procedure successfully evaluates the safety effect of open-median management strategies for one-side widened freeways. It was also found that driving performance and workload are sensitive to the opening length and traffic flow. **Conclusions:** Therefore, median opening placement should be carefully selected in consideration of not only driving performance and workload but also traffic volume predictions. **Practical**

Applications: The findings in this study can guide open-median management strategies for traffic safety one-side widened highways.

- **Keywords:** Highway expansion; Open-median management; One-side widening; Driving simulation; Safety effect evaluation

Yanbo Zhang, Yangsen Huang, Yibao Wang, Tristan W. Casey. *Who uses a mobile phone while driving for food delivery? The role of personality, risk perception, and driving self-efficacy.* Pages 69-80.

Introduction: The existing literature on mobile phone use while driving (MPUWD) mainly targets the participants from general population and the young adults, however, few studies pay attention to this form of distracted driving with samples in professional contexts. The present study aims to bridge the gap by identifying the extent of and the motives behind making use of mobile phones while driving for food dispatch among deliveryman. **Method:** The snowball sampling was used to collect the data (N = 317) through a self-reported questionnaire, including demographics, personality traits, risk perception, driving self-efficacy, and mobile phone use while driving. **Results:** Descriptive analysis for the assessed MPUWD behaviors showed that 96.3% (N = 315) of food deliveryman undertook the MPUWD behaviors, though disproportionate distribution among these behaviors existed. Structural equation modeling analysis displayed that psychoticism and driving self-efficacy directly predicted the MPUWD behaviors. The mediating role of driving self-efficacy was verified with the findings that driving self-efficacy completely mediated the relationships that between risk perception and MPUWD behaviors and that between extraversion and MPUWD behaviors, as well as partially mediated the correlation between psychoticism and MPUWD behaviors. **Conclusions:** The present study confirms the prevalence of MPUWD behaviors among food deliveryman. The SEM estimates and bootstrap estimates suggest that personality traits and perceived risk perception per se display limited predicting utility to MPUWD behaviors among food deliveryman, whereas driving self-efficacy and the proposed predictors together well illustrate the assessed MPUWD behaviors among food deliveryman. **Practical Applications:** These findings imply that developing and implementing intervention efforts in a concerted way would curb these behaviors effectively.

- **Keywords:** Mobile phone use while driving; Personality traits; Risk perception; Driving self-efficacy; Structural equation modeling

Chantal P.M. Timmermans, Wael K.M. Alhajyaseen, Veerle Ross, Hideki Nakamura. *Introducing a multi-variate classification method: Risky driving acceptance among different heterogeneous driver sub-cultures.* Pages 81-91.

Introduction: Heterogeneous driving populations with many different origins are likely to have various sub-cultures that comprise of drivers with shared driver characteristics, most likely with dissimilar traffic safety cultures. An innovative methodology in traffic safety research is introduced which is beneficial for large datasets with multiple variables, making it useful for the multi-variate classification of drivers, driving attitudes and/or (risky) driving behaviours. **Method:** With the application of multidimensional scaling analysis (MDS), this study explores traffic safety culture in the State of Qatar using a questionnaire and investigates the similarity patterns between the questionnaire items, aiming to classify attitudes towards risky driving behaviours into themes. MDS is subsequently applied to classify drivers within a heterogeneous driving sample into sub-cultures with shared driver characteristics and different risky driving attitudes. **Results:** Results show that acceptance of speeding is highest among the young Arabic students and acceptance of distraction and drivers' negligence such as phone use and not wearing a seatbelt is highest among male Arab drivers. Acceptance of extreme risk-taking like

intoxicated driving and red-light running is highest among South-Asian business drivers. **Conclusion:** It is important and practical to understand risky behavioural habits among sub-cultures and thereby focussing on groups of drivers instead of individuals, because groups are easier to approach and drivers within sub-cultures are found to influence each other. By indicating which groups of drivers are most likely to perform specific risky driving themes, it is possible to target these groups and effectively emphasise certain subsets of risky driving behaviours during training or traffic safety education. **Practical Applications:** This study provides guidance for the improvement of driver education and targeted traffic safety awareness campaigns, intending to make changes to attitudes and habits within specific driver sub-cultures with the aim to improve traffic safety on the longer term.

- **Keywords:** Traffic safety culture; Risky driving behaviour; Multidimensional scaling; Heterogeneous driving population; Sub-cultures

Holger Möller, Teresa Senserrick, Kris Rogers, Chika Sakashita, Liz de Rome, Soufiane Boufous, Carine Davey, Patricia Cullen, Rebecca Ivers. *Crash risk factors for novice motorcycle riders. Pages 93-101.*

Background: Motorcycle riders have the highest injury and fatality rates among all road users. This research sought in-depth understanding of crash risk factors to help in developing targeted measures to reduce motorcycle crash injuries and fatalities. **Methods:** We used interview data from a study of 2,399 novice motorcycle riders in Victoria, Australia from 2010 to 2012 linked with their police-recorded crash and offence data. The outcome measure was self and/or police reported crash. The association between potential risk factors and crashes was explored in multivariable logistic regression models. **Results:** In the multivariable analysis, riders who reported being involved in three or more near crashes had 1.74 times (95% CI 1.11–2.74) higher odds of crashing compared to riders who reported no near-crash events, and riders who participated in a pre-learner course had 1.41 times higher odds of crashing (95% CI 1.07–1.87) compared with riders who did not attend a pre-learner course. Riders who had been involved in a crash before the study had 1.58 times (95% CI 1.14–2.19) higher odds of crashing during the study period compared with riders who were not involved in a crash. Each additional month of having held a license and learner permit decreased the odds of crashing by 2%, and each additional 1,000 km of riding before the study increased the odds of crashing by 2%. **Conclusion:** Measures of pre-learner training and riding experience were the strongest predictors of crashing in this cohort of novice motorcycle riders. At the time of the study there was no compulsory rider training to obtain a learner permit in Victoria and no on-road courses were available. It may be plausible that riders who voluntarily participated in an unregulated pre-learner course became or remained at high risk of crash after obtaining a rider license. We suggest systematically reviewing the safety benefits of voluntary versus mandatory pre-learner and learner courses and the potential need to include on-road components.

- **Keywords:** Motorcycle; Novice rider; Crash; Risk-factor; Australia

Iju Shakya, Ruth A. Shults, Mark R. Stevens, Laurie F. Beck, David A. Sleet. *State-level seat belt use in the United States, 2011–2016: Comparison of self-reported with observed use and use by fatally injured occupants. Pages 103-109.*

Introduction: Despite 49 states and the District of Columbia having seat belt laws that permit either primary or secondary enforcement, nearly half of persons who die in passenger vehicle crashes in the United States are unbelted. Monitoring seat belt use is important for measuring the effectiveness of strategies to increase belt use. **Objective:** Document self-reported seat belt use by state seat belt enforcement type and compare

2016 self-reported belt use with observed use and use among passenger vehicle occupant (PVO) fatalities. Methods: We analyzed the Behavioral Risk Factor Surveillance System (BRFSS) self-reported seat belt use data during 2011–2016. The Pearson correlation coefficient (r) was used to compare the 2016 BRFSS state estimates with observed seat belt use from state-based surveys and with unrestrained PVO fatalities from the Fatality Analysis Reporting System. **Results:** During 2011–2016, national self-reported seat belt use ranged from 86–88%. In 2016, national self-reported use (87%) lagged observed use (90%) by 3 percentage points. By state, the 2016 self-reported use ranged from 64% in South Dakota to 93% in California, Hawaii, and Oregon. Seat belt use averaged 7 percentage points higher in primary enforcement states (89%) than in secondary states (82%). Self-reported state estimates were strongly positively correlated with state observational estimates ($r=0.80$) and strongly negatively correlated with the proportion of unrestrained PVO fatalities ($r=-0.77$). Conclusion: National self-reported seat belt use remained essentially stable during 2011–2016 at around 87%, but large variations existed across states. **Practical Applications:** If seat belt use in secondary enforcement states matched use in primary enforcement states for 2016, an additional 3.98 million adults would have been belted. Renewed attention to increasing seat belt use will be needed to reduce motor-vehicle fatalities. Self-reported and observational seat belt data complement one another and can aid in designing targeted and multifaceted interventions.

- **Keywords:** Seat belts; Motor vehicles; Behavioral risk factor surveillance system; Passenger vehicle occupant; Occupant protection

Cara Hamann, Morgan Price, Corinne Peek-Asa. *Characteristics of crashes and injuries among 14 and 15 year old drivers, by rurality. Pages 111-118.*

Purpose: Motor-vehicle crashes continue to be the leading cause of death for teenagers in the United States. The United States has some of the youngest legal driving ages worldwide. The objective of this study was to determine rates and factors associated with injury crashes among 14- and 15-year-old drivers and how these varied by rurality. **Methods:** Data for this cross-sectional study of 14- and 15-year-old drivers were obtained from the Iowa Department of Transportation from 2001 to 2013. Crash and injury crash rates were calculated by rurality. The relationship between crash and driver factors and injury was assessed using logistic regression. Findings: Teen drivers, aged 14 and 15 years, had a statewide crash rate of 8 per 1,000 drivers from 2001 to 2013. The majority of crashes occurred in urban areas (51%), followed by in town (29%), remote rural areas (13%), and suburban areas (7%). Crash and injury crash rates increased as level of rurality increased. The odds of an injury crash increased more than 10-fold with the presence of multiple other teens as passengers, compared to no passengers (OR=10.7, 95% CI: 7.1–16.2). **Conclusions:** Although 14- and 15-year-old drivers in Iowa have either limited unsupervised (school permits) or supervised only driving restrictions, they are overrepresented in terms of crashes and injury crashes. Rural roads and multiple teen passengers are particularly problematic in terms of injury outcomes. **Practical applications:** Results from this study support passenger restrictions and teen driving interventions designed with a rural focus.

- **Keywords:** Teens; Young; Novice; Fatal

Lishengsa Yue, Mohamed Abdel-Aty, Yina Wu, Ou Zheng, Jinghui Yuan. *In-depth approach for identifying crash causation patterns and its implications for pedestrian crash prevention. Pages 119-132.*

Introduction: A pedestrian crash occurs due to a series of contributing factors taking effect in an antecedent-consequent order. One specific type of antecedent-consequent order is called a crash causation pattern. Understanding crash causation patterns is

important for clarifying the complicated growth of a pedestrian crash, which ultimately helps recommend corresponding countermeasures. However, previous studies lack an in-depth investigation of pedestrian crash cases, and are insufficient to propose a representative picture of causation patterns. **Method:** In this study, pedestrian crash causation patterns were discerned by using the Driving Reliability and Error Analysis Method (DREAM). One hundred and forty-two pedestrian crashes were investigated, and five pedestrian pre-crash scenarios were extracted. Then, the crash causation patterns in each pre-crash scenario were analyzed; and finally, six distinct patterns were identified. Accordingly, 17 typical situations corresponding to these causation patterns were specified as well. **Results:** Among these patterns, the pattern related to distracted driving and the pattern related to an unexpected change of pedestrian trajectory contributed to a large portion of the total crashes (i.e., 27% and 24%, respectively). Other patterns also played an important role in inducing a pedestrian crash; these patterns include the pattern related to an obstructed line of sight caused by outside objects (9%), the pattern that involves reduced visibility (13%), and the pattern related to an improper estimation of the gap distance between the vehicle and the pedestrian (10%). The results further demonstrated the inter-heterogeneity of a crash causation pattern, as well as the intra-heterogeneity of pattern features between different pedestrian pre-crash scenarios. **Conclusions and practical applications:** Essentially, a crash causation pattern might involve different contributing factors by nature or dependent on specific scenarios. Finally, this study proposed suggestions for roadway facility design, roadway safety education and pedestrian crash prevention system development.

- **Keywords:** Pedestrian crashes; Crash causation pattern; Crash contributing factors; Driving Reliability and Error Analysis Method

Cintia Isabel de Campos, Cira Souza Pitombo, Patricia Delhomme, José Alberto Quintanilha. *Comparative analysis of data reduction techniques for questionnaire validation using self-reported driver behaviors. Pages 133-142.*

Introduction: Exploratory data reduction techniques, such as Factor Analysis (FA) and Principal Component Analysis (PCA), are widely used in questionnaire validation with ordinal data, such as Likert Scale data, even though both techniques are indicated to metric measures. In this context, this study presents an e-survey, conducted to obtain self-reported behaviors between Brazilian drivers (N = 1,354, 55.2% of males) and Portuguese drivers (N = 348, 46.6% of males) based on 20 items from the Driver Behavior Questionnaire (DBQ) on a five-point Likert Scale. This paper aimed to examine DBQ validation using FA and PCA compared to Categorical Principal Component Analysis (CATPCA) which is more indicative to use with Likert Scale data. **Results:** The results from all techniques confirmed the most replicated factor structure of DBQ, distinguishing behaviors as errors, ordinary violations, and aggressive violation. However, after Varimax rotation, CATPCA explained 11% more variance compared to FA and 2% more than PCA. We identified cross-loadings among the component of the techniques. An item changed its dimension in the CATPCA results but did not change the structural interpretability. Individual scores from dimension 1 of CATPCA were significantly different from FA and PCA. Individual scores from factor 1 of CATPCA were significantly different from FA and PCA. **Practical applications:** The CATPCA seems to be more advantageous in order to represent the original data and considering data constrains. In addition to finding an interpretable factorial structure, the representation of the original data is regarded as relevant since the factor scores could be used for crash prediction in future analyses.

- **Keywords:** Factor analysis; Principal Component Analysis; Categorical Principal Component Analysis; Likert Scale; Cross-loading; Explained variance

Hans Ekbrand, Robert Ekman, Charlotta Thodelius, Michael Möller. *Fall-related injuries for three ages groups – Analysis of Swedish registry data 1999–2013. Pages 143-152.*

Introduction: The objective of this study was to analyze which factors (including factors pertaining to the individual, the household, and the local area) increase the risk of fall injuries for the three age groups with the highest risk for fall injuries in Sweden.

Method: The study combined longitudinal data covering the period 1999–2013 from several different official registries from Statistics Sweden as well as from the Swedish health care system and fitted the models to data using mixed model regressions.

Results: Three age groups had a markedly heightened risk for fall injuries: 1–3-year olds, 12–14 year olds, and the elderly (65+). The home was the most common location for fall injuries, as about 40% of all fall injuries occur in the home. Only for the elderly strong predictors for fall injuries were found, and these were: age, single household, and special housing. **Conclusions:** There is preventive potential in the special residences for the elderly and disabled. People living in these special residences make up a strongly selected group that needs extra safe environments. Our findings indicate that their needs are currently not meet. **Practical applications:** Design of special residences for the elderly and disabled should aim at reducing the consequences of falling.

- **Keywords:** Geographical differences; Fall injuries; Residence; Risk groups; Socio-economic factors

Laura E. Jones, Nimit N. Shah, Judith M. Graber, Maryanne L. Fakeh Campbell, Lauren N. Gonzalez, Koshy Koshy, Daniel C. Uhiara, Derek G. Shendell. *Injury surveillance trends in career–technical education: New Jersey 1999–2018. Pages 153-159.*

Introduction: Adolescents engaging in school-sponsored work experiences may be at risk of injury due to factors such as inexperience. This article examines trends in 20 years of reported injuries among New Jersey (NJ) adolescents engaging in school-sponsored work experiences, and compares a transition from paper to online reporting format. **Methods:** New Jersey requires reporting of injuries occurring during school-sponsored work experiences to the NJ Department of Education. Injuries reported by NJ schools from 1999 to 2018 (n = 2,119) were examined; incidence rates for 2008 to 2018 (n = 743) were calculated using publicly available NJ Department of Education enrollment data for the denominator, including for specific groups of students: career and technical education; special healthcare needs. **Results:** A downward trend in reported injuries in NJ schools was observed. However, the year online reporting became required by code (2013), an increase of nearly 50% was seen from 2012 (59–89), followed by a decline in reported incidents 2014 to 2018 (mean = 65, range 76 down to 47). Injury rate trends over time paralleled those of reported incidents. **Conclusions:** This study suggested worker safety and public health benefits of improvements from State of NJ code required training programs and online injury surveillance report form. **Practical Applications:** One potential method to address the safety and health of adolescents engaging in work experiences is the use of online reporting forms, to aid in surveillance efforts, coupled with occupational safety and health training specifically geared toward teachers and administrators who both supervise young, relatively inexperienced and vulnerable workers and who make relatively frequent worksite visits. Incorporation of specific details of the instructions on the use of a reporting form into required trainings, in addition to providing a clear, accessible guidance manual online, could further help improve youth worker safety surveillance efforts.

- **Keywords:** Career–technical education; Vocational education; Adolescent health; Surveillance; New Jersey; Injury reporting

Aowen Duan, Mingxia Zhou, Jinlong Qiu, Chengjian Feng, Zhiyong Yin, Kui Li. *A 6-year survey of road traffic accidents in Southwest China: Emphasis on traumatic brain injury.* Pages 161-169.

Background: The objective of this study is to provide an up-to-date overview of the patterns of injuries, especially traumatic brain injury (TBI) caused by RTAs and to discuss some of the public health consequences. **Methods:** A scientific team was established to collect road traffic accidents occurring between 2013 and 2018 in Chongqing, Southwest China. For each accident, the environment-, vehicle-, and person- variables were analyzed and determined. The overall injury distribution and TBI patterns of four types of road users (driver, passenger, motorcyclist and pedestrian) were compared. The environmental and time distribution of accidents with TBI were shown by bar and pie chart. The risks of severe brain injury whether motorcyclist wearing helmets or not were compared and the risk factors of severe TBI in pedestrian were determined by odds ratio analysis. **Results:** This study enrolled 2131 accidents with 2741 persons of all kind of traffic participants, 1149 of them suffered AIS1+ head injury and 1598(58%) died in 7 days. The most common cause of deaths is due to head injury with 714(85%) and 1266(79%) persons died within 2 hours. Among 423 persons suffered both skull fracture and intracranial injury, 102 (24.1%) have an intracranial injury but no skull fractures, while none of the skull fractures without intracranial injury was found. Besides, motorcyclists without a helmet were at higher risks for all the brain injury categories. The risk of pedestrian suffering severe TBI at an impact speed of more than 70 km/h is 100 times higher than that with an impact speed of less than 40 km/h. **Conclusion:** It is urgently needed to develop a more reliable brain injury evaluation criterion for better protection of the road users. We believe that strengthening the emergency care to head injury at the scene is the most effective way to reduce traffic fatality.

- **Keywords:** Traumatic brain injury; Road traffic accidents; Epidemiological survey; Injury risk

Jonathan J. Rolison, Salissou Moutari. *Combinations of factors contribute to young driver crashes.* Pages 171-177.

Introduction: Motor-vehicle crashes are a leading cause of death in adolescence and young adults. A multitude of factors, including skill level, inexperience, and risk taking behaviors are associated with young drivers' crashes. This research investigated whether combinations of factors underlie crashes involving young drivers. **Method:** A retrospective longitudinal study was conducted on population-wide one- and two-car crashes in Great Britain during years 2005–2012 per driver age (17–20, 21–29, 30–39, 40–49) and sex. Reporting officers provided their assessment of the factors contributing to crashes. Principal components analysis was conducted to identify combinations of factors underlying young drivers' crashes. Factor combinations, including challenging driving conditions, risk taking behaviors, and inexperience were implicated in young drivers' crashes. **Results:** Combinations of factors reveal new insights into underlying causes of crashes involving young drivers. One combination revealed that slippery roads due to poor weather pose greater risk to young drivers who are inexperienced and likely to exceed the appropriate speed. The findings motivate new policy recommendations, such as educating young drivers about the importance of adjusting their speed to the road conditions.

- **Keywords:** Contributing factors; Younger drivers; Road safety; Accident causation; Policymaking

Rebecca J. Guerin, Andrea H. Okun, Elizabeth Glennie. *A qualitative investigation of factors affecting school district administrators' decision to adopt a national young worker curriculum.* Pages 179-187.

Introduction: Even though the majority of youth in the U.S. work, and workers under the age of 18 are seriously injured on the job at higher rates when compared to adults, most adolescents lack instruction on workplace safety and health. **Method:** This qualitative study examines the extent to which selected U.S. school districts provide workplace safety and health instruction to students and explores the factors that influence districts' decision to adopt a free, foundational occupational safety and health (OSH) curriculum. **Results:** Results from key informant interviews conducted with a purposive sample of 34 school administrators revealed that only a third of the districts have at least 75% of their students receive some instruction on workplace safety and health, while 15% indicated they provide no instruction on this topic. District staff who indicated that they provide OSH instruction stated that it is most often taught through career and technical education (CTE; 65%) and/or health classes (26%). They believed the benefits of providing this instruction include assisting students to get jobs (38%) and helping students learn about safety (32%), while competing demands (44%) and time constraints (41%) were identified as barriers to providing OSH education to students. **Conclusions:** Given the importance of work to teens and their increased risk of work injury, interested stakeholders—including parents, teachers, employers, and the public health community—should promote the inclusion of workplace safety and health instruction in U.S. secondary schools. **Practical Applications:** This research fills a gap in current knowledge about the extent to which OSH is currently taught within U.S. secondary schools, enumerates barriers and facilitators to the inclusion of workplace safety and health instruction in schools, presents a free, foundational curriculum in workplace safety and health, and provides directions for future research on the vital role schools can play in preparing the future workforce for safe and healthy employment.

- **Keywords:** Workplace safety and health; Occupational safety and health; Secondary schools; School administrators; Teachers

Michael F. Ballesteros, Steven A. Sumner, Royal Law, Amy Wolkin, Christopher Jones. *Advancing injury and violence prevention through data science.* Pages 189-193.

Introduction: The volume of new data that is created each year relevant to injury and violence prevention continues to grow. Furthermore, the variety and complexity of the types of useful data has also progressed beyond traditional, structured data. In order to more effectively advance injury research and prevention efforts, the adoption of data science tools, methods, and techniques, such as natural language processing and machine learning, by the field of injury and violence prevention is imperative. **Method:** The Centers for Disease Control and Prevention's (CDC) National Center for Injury Prevention and Control has conducted numerous data science pilot projects and recently developed a Data Science Strategy. This strategy includes goals on expanding the availability of more timely data systems, improving rapid identification of health threats and responses, increasing access to accurate health information and preventing misinformation, improving data linkages, expanding data visualization efforts, and increasing efficiency of analytic and scientific processes for injury and violence, among others. **Results:** To achieve these goals, CDC is expanding its data science capacity in the areas of internal workforce, partnerships, and information technology infrastructure. **Practical Application:** These efforts will expand the use of data science approaches to improve how CDC and the field address ongoing injury and violence priorities and challenges.

- **Keywords:** Data science; Injury; Violence; CDC

Haiyan Hao, Yingfeng (Eric) Li, Alejandra Medina, Ronald B. Gibbons, Linbing Wang. *Understanding crashes involving roadway objects with SHRP 2 naturalistic driving study data. Pages 199-209.*

Introduction: Crashes involving roadway objects and animals can cause severe injuries and property damages and are a major concern for the traveling public, state transportation agencies, and the automotive industry. This project involved an in-depth investigation of such crashes based on the second Strategic Highway Research Program (SHRP 2) Naturalistic Driving Study (NDS) data including detailed information and videos about 2,689 events. **Methods:** The research team conducted a variety of logistic regression analyses, complemented by Support Vector Machine (SVM) analyses and detailed case studies. **Results:** The logistic regression results indicated that driver behavior/errors, involvement of secondary tasks, roadway characteristics, lighting condition, and pavement surface condition are among the factors that contributed significantly to the occurrence and/or increased severity outcomes of crashes involving roadway objects and animals. Among these factors, improper turning movements (odds ratio = 88), avoiding animal or other vehicle (odds ratio = 38), and reaching/moving object in vehicle (odds ratio = 29) particularly increased the odds of crash occurrence. Factors such as open country roadways, sign/signal violation, unfamiliar with roadway, fatigue/drowsiness, and speeding significantly increased the severity outcomes when such crashes occurred. The sensitivity analysis of the three SVM classifiers confirmed that driver behavior/errors, critical speed, struck object type, and reaction time were major factors affecting the occurrence and severity outcomes of events involving roadway objects and animals. **Practical Applications:** The study provides insights on risk factors influencing safety events involving roadway objects, including their occurrence and the severity outcomes. The findings allow researchers and traffic engineers to better understand the causes of such crashes and therefore develop more effective roadway- and vehicle- based countermeasures.

- **Keywords:** Naturalistic driving study; Logistic regression; Support vector machine; Fixed object; Animal; Crash

Jianqing Wu, Hao Xu, Yongsheng Zhang, Renjuan Sun. *An improved vehicle-pedestrian near-crash identification method with a roadside LiDAR sensor. Pages 211-224.*

Problem: Potential conflicts between pedestrians and vehicles represent a challenge to pedestrian safety. Near-crash is used as a surrogate metric for pedestrian safety evaluations when historical vehicle-pedestrian crash data are not available. One challenge of using near-crash data for pedestrian safety evaluation is the identification of near-crash events. **Method:** This paper introduces a novel method for pedestrian-vehicle near-crash identification that uses a roadside LiDAR sensor. The trajectory of each road user can be extracted from roadside LiDAR data via several data processing algorithms: background filtering, lane identification, object clustering, object classification, and object tracking. Three indicators, namely, the post encroachment time (PET), the proportion of the stopping distance (PSD), and the crash potential index (CPI) are applied for conflict risk classification. **Results:** The performance of the developed method was evaluated with field-collected data at four sites in Reno, Nevada, United States. The results of case studies demonstrate that pedestrian-vehicle near-crash events could be identified successfully via the proposed method. **Practical applications:** The proposed method is especially suitable for pedestrian-vehicle near-crash identification at individual sites. The extracted near-crash events can serve as supplementary material to naturalistic driving study (NDS) data for safety evaluation.

- **Keywords:** Near-crash identification; Pedestrian safety; Roadside LiDAR

Jordanka Kovaceva, Irene Isaksson-Hellman, Nikolce Murgovski. *Identification of aggressive driving from naturalistic data in car-following situations. Pages 225-234.*

Introduction: Aggressive driving has been associated as one of the causes for crashes, sometimes with very serious consequences. The objective of this study is to investigate the possibility of identifying aggressive driving in car-following situations on motorways by simple jerk metrics derived from naturalistic data. **Method:** We investigate two jerk metrics, one for large positive jerk and the other for large negative jerk, when drivers are operating the gas and brake pedal, respectively. **Results:** The results obtained from naturalistic data from five countries in Europe show that the drivers from different countries have a significantly different number of large positive and large negative jerks. Male drivers operate the vehicle with significantly larger number of negative jerks compared to female drivers. The validation of the jerk metrics in identifying aggressive driving is performed by tailgating (following a leading vehicle in a close proximity) and by a violator/non-violator categorization derived from self-reported questionnaires. Our study shows that the identification of aggressive driving could be reinforced by the number of large negative jerks, given that the drivers are tailgating, or by the number of large positive jerks, given that the drivers are categorized as violators. **Practical applications:** The possibility of understanding, classifying, and quantifying aggressive driving behavior and driving styles with higher risk for accidents can be used for the development of driver support and coaching programs that promote driver safety and are enabled by the vast collection of driving data from modern in-vehicle monitoring and smartphone technology.

- **Keywords:** Aggressive driving; Jerk metrics; Naturalistic driving; Car-following; Self-reported questionnaires

Tina Morgenstern, Tibor Petzoldt, Josef F. Krems, Frederik Naujoks, Andreas Keinath. *Using European naturalistic driving data to assess secondary task engagement when stopped at a red light. Pages 235-243.*

Problem: Some evidence exists that drivers choose to engage in secondary tasks when the driving demand is low (e.g., when the car is stopped). While such a behavior might generally be considered as rather safe, it could be argued that the associated diversion of attention away from the road still leads to a reduction of situational awareness, which might increase collision risk once the car regains motion. This is especially relevant for texting, which is associated with considerable eyes-off-the-road-time. Nonetheless, it seems that previous research has barely addressed the actual engagement in secondary tasks while waiting at a red light (as compared to just addressing the tasks' mere prevalence). **Objective:** The present study investigated secondary task engagement while stopped at a red light using European naturalistic driving data collected through the UDRIVE project. Attention was given to the whole engagement process, including simple prevalence and the tasks' relation (in terms of start/end) to the red light period. Moreover, given that texting is one of the most problematic forms of distraction, it was characterized in more detail regarding glance behavior. **Method:** Videos of 804 red light episodes from 159 drivers were annotated. Glance behavior was also coded for a sub-set of 75 texting events and their matched baselines. Results, conclusions and **practical applications:** Drivers engaged in at least one secondary task across almost half of the annotated red light episodes. Drivers who texted while stopped spent most of the time looking at their cell phone. Consequently, drivers might not have been prepared for potentially unexpected events once the light turned green. Further, drivers concluded texting a considerable number of times well after the red light period, which has potential implications for traffic safety.

- **Keywords:** Naturalistic driving; Distraction; Texting; Self-regulatory behavior; Red lights

Bruce G. Simons-Morton, Pnina Gershon, Fearghal O'Brien, Gary Gensler, Sheila G. Klauer, Johnathon P. Ehsani, Chunming Zhu, R.E. Gore-Langton, Thomas A. Dingus. *Crash rates over time among younger and older drivers in the SHRP 2 naturalistic driving study. Pages 245-251.*

Objective: To examine crash rates over time among 16–17-year-old drivers compared to older drivers. **Methods:** Data were from a random sample of 854 of the 3,500 study participants in SHRP 2, a U.S. national, naturalistic driving (instrumented vehicle) study. Crashes/10,000 miles by driver age group, 3-month period, and sex were examined within generalized linear mixed models. **Results:** Analyses of individual differences between age cohorts indicated higher incidence rates in the 16–17-year old cohort relative to older age groups each of the first four quarters (except the first quarter compared to 18–20 year old drivers) with incident rate ratios (IRR) ranging from 1.98 to 18.90, and for the full study period compared with drivers 18–20 (IRR = 1.69, CI = 1.00, 2.86), 21 to 25 (IRR = 2.27, CI = 1.31, 3.91), and 35 to 55 (IRR = 4.00, CI = 2.28, 7.03). Within the 16–17-year old cohort no differences were found in rates among males and females and the decline in rates over the 24-month study period was not significant. **Conclusions:** The prolonged period of elevated crash rates suggests the need to enhance novice young driver prevention approaches such as Graduated Driver's Licensing limits, parent restrictions, and post-licensure supervision and monitoring. **Practical Applications:** Increases are needed in Graduated Driver's Licensing limits, parent restrictions, and postlicensure supervision and monitoring.

- **Keywords:** Adolescents; Risk; Age; Epidemiology; GLM; Individual differences

aniel Christ. *Simulating the relative influence of tire, vehicle and driver factors on forward collision accident rates. Pages 253-262.*

Introduction: There is currently a strong focus within the automotive industry centered on traffic safety, with topics such as distracted driving, accident avoidance technologies, and autonomous vehicles. These papers tend to focus on the possible improvements from a single factor. However, there are many factors that are present in each accident, and it is important to understand the influence of each factor on the relative accident risk in order to identify the most effective approaches for improving driver safety. Rear-end accidents tend to be the most common accident type with approximately 1.8M cases, or 31% of all accidents, in 2012, according to NHTSA. Of the rear-end accident scenarios, approximately 18–23% occur on wet surfaces. **Method:** A Monte Carlo Forward Collision Simulation models the conditions of a wet rear-end accident and estimates the relative impact of various vehicle collision parameters. The model takes distributions of these parameters as inputs, and outputs a risk of collision relative to a known reference case. The parameters that can be studied include: tire grip level, road grip level, vehicle velocity, following distances, and the presence of vehicle technologies (ABS, FCW & AEB). Distributions of some of these parameters have been improved thanks to Naturalistic Driving Study data from SHRP2. **Results:** This study shows that these vehicle systems have a large impact on safety and can change the amount of influence attributed to other parameters such as tire grip levels. As the use of automated vehicle systems expands, so will the influence of tire grip performance levels on collision risks. **Practical Applications:** It is more important than ever for consumers and auto manufacturers to consider tire performance levels. Therefore, the tire industry should continue to focus on wet grip as a key performance related to safety and should strive to continue to improve tire performance.

- **Keywords:** Wet braking; Accidents; Simulations; Automated vehicles; Tire performance

Thomas Seacrist, Ethan C. Douglas, Chloe Hannan, Rachel Rogers, Aditya Belwadi, Helen Loeb. *Near crash characteristics among risky drivers using the SHRP2 naturalistic driving study. Pages 263-269.*

Problem: Previous research have focused extensively on crashes, however near crashes provide additional data on driver errors leading to critical events as well as evasive maneuvers employed to avoid crashes. The Strategic Highway Research Program 2 (SHRP2) Naturalistic Driving Study contains extensive data on real world driving and offers a reliable methodology to study near crashes. The current study utilized the SHRP2 database to compare the rate and characteristics associated with near crashes among risky drivers. **Methods:** A subset from the SHRP2 database consisting of 4,818 near crashes for teen (16–19 yrs), young adult (20–24 yrs), adult (35–54 yrs), and older (70+ yrs) drivers was used. Near crashes were classified into seven incident types: rear-end, road departure, intersection, head-on, side-swipe, pedestrian/cyclist, and animal. Near crash rates, incident type, secondary tasks, and evasive maneuvers were compared across age groups. For rear-end near crashes, near crash severity, max deceleration, and time-to-collision at braking were compared across age. **Results:** Near crash rates significantly decreased with increasing age ($p < 0.05$). Young drivers exhibited greater rear-end ($p < 0.05$) and road departure ($p < 0.05$) near crashes compared to adult and older drivers. Intersection near crashes were the most common incident type among older drivers. Evasive maneuver type did not significantly vary across age groups. Near crashes exhibited a longer time-to-collision at braking ($p < 0.01$) compared to crashes. **Summary:** These data demonstrate increased total near crash rates among young drivers relative to adult and older drivers. Prevalence of specific near crash types also differed across age groups. Timely execution of evasive maneuvers was a distinguishing factor between crashes or near crashes. **Practical Applications:** These data can be used to develop more targeted driver training programs and help OEMs optimize ADAS to address the most common errors exhibited by risky drivers.

- **Keywords:** Naturalistic driving; SHRP2; Risky drivers; Near crashes

Christian M. Richard, Joonbum Lee, Randolph Atkins, James L. Brown. *Using SHRP2 naturalistic driving data to examine driver speeding behavior. Pages 271-281.*

Problem: Speeding-related crashes continue to be a serious problem in the United States. According to the National Highway Traffic Safety Administration, 26% of all fatal crashes in 2017 had speeding as a contributing factor. **Method:** Vehicle speed data recorded during the Strategic Highway Research Program 2 (SHRP 2) Naturalistic Driving Study were analyzed to identify the frequency of speeding episodes. Up to 100 trips were sampled from 2,910 individual drivers aged 16–64. Vehicle speed data from individual trips were parsed into continuous speeding episodes (SEs) and Free-Flow Episodes (FFE), which approximated opportunities to speed. **Results & Discussion:** Driving 10 mph above the posted speed limit (PSL) was common, and 99.8% of drivers had at least one occurrence SE within their trip sample, yielding an average of 2.75 SEs per trip (623,202 SEs in total). The analysis focused on a subset of higher-speed SEs in which the vehicle reached speeds of at least 15 mph above the PSL during the SE (71,113 SEs in total). Average maximum speeds for most higher-speed SEs ranged between 12 mph to 15 mph above the PSL, and most also lasted less than 2 min. Most drivers spent less than 5% of the FFE time speeding, and only a small number of drivers spent more than 10% of the time speeding. There was also a clear trend towards the younger group having higher overall percentages of SE time relative to FFE time. **Practical Applications:** The methods and measures developed in this study provide the foundation for future analyses to determine if there are different types of speeding that vary in terms of risky characteristics, and further, if certain drivers are more likely to engage in riskier speeding behavior. Identifying higher-risk speeders is an important step

for developing countermeasures and strategies targeting drivers that are at greatest risk of speed-related crashes.

- **Keywords:** Speeding; Driver behavior; SHRP 2; Naturalistic Driving Study; Safety

Cristian Druta, Andrew Kassing, Ronald Gibbons, VA Andrew Alden. *Assessing driver behavior using shrp2 adverse weather data. Pages 283-295.*

Introduction: This study explored how drivers adapt to inclement weather in terms of driving speed, situational awareness, and visibility as road surface conditions change from dry to slippery and visibility decreases. The proposed work mined existing data from the SHRP 2 NDS for drivers who were involved in weather-related crash and near-crash events. Baseline events were also mined to create related metadata necessary for behavioral comparisons. **Methods:** Researchers attempted, to the greatest extent possible, to match non-adverse-weather driving scenarios that are similar to the crash and near-crash event for each driver. The ideal match scenario would be at a day prior to the crash during non-adverse weather conditions having the same driver, at the same time of day, with the same traffic level on the same road on which the crash or near-crash occurred. Once the matched scenarios have been identified, a detailed analysis will be performed to determine how a driver's behavior changed from normal driving to inclement-weather driving. **Results:** Data collected indicated that, irrespective of site location (i.e., state), most crashes and near-crashes occurred in rain, with only about 12% occurring in snowy conditions. Also, the number of near-crashes was almost double the number of crashes showing that many drivers were able to avoid a crash by executing an evasive maneuver such as braking or steering. **Conclusions:** Most types of near crashes were rear-end and sideswipe avoidance epochs, as the drivers may have had a difficult time merging or trying to change lanes due to low visibility or traffic. Hard braking combined with swerving were the most commonly used evasive maneuvers, occurring when drivers did not adjust their speeds accordingly for specific situations. **Practical applications:** Results from this study are expected to be utilized to educate and guide drivers toward more confident and strategic driving behavior in adverse weather.

- **Keywords:** Near-crash; Adverse weather; Crash; Slippery; Event

Jose A. Calvo, Carryl Baldwin, Brian Philips. *Effect of age and secondary task engagement on motor vehicle crashes in a naturalistic setting. Pages 297-302.*

Problem: Automobile crashes are one of the leading causes of death in the United States, especially for younger and older drivers. Additionally, distracted driving is another leading factor in the likelihood of crashes. However, there is little understanding about the interaction between age and secondary task engagement and how that impacts crash likelihood and maneuver safety. **Method:** Data from the Naturalistic Driving Study (NDS), which was part of the Second Strategic Highway Research Program (SHRP2), were used to investigate this issue. **Results:** It was found that the distribution of crashes per one million km driven during the NDS was similar to previous research, but with fewer crashes from older drivers. Additionally, it was found that older and middle-aged drivers engaged in distracted driving more frequently than was expected, and that crashes were significantly more likely if drivers of those age groups were engaged in secondary tasks. However, secondary task engagement did not predict judgment of safe/unsafe vehicle maneuvers. **Practical Applications:** More research is needed to better understand the interaction of age and distraction on crash likelihood. However, this research could aid future researchers in understanding the likelihood of future use of new in-vehicle technologies for different age groups, as well as provide insight to the engagement patterns of distraction for different age groups.

- **Keywords:** Aging and driving; Distracted driving; Naturalistic driving; SHRP2

Johnathon P. Ehsani, Karen E. Seymour, Theresa Chirles, Neale Kinnear. *Developing and testing a hazard prediction task for novice drivers: A novel application of naturalistic driving videos. Pages 303-309.*

Introduction: Novice drivers' inability to appropriately anticipate and respond to hazards has been implicated in their elevated crash risk. Our goal was to develop a driving hazard prediction task using naturalistic videos from the U.S. context that could distinguish between novice and experienced drivers. **Method:** Using the query builder from the SHRP 2 InSight Data Access Website, we identified a sample of 1034 videos for further review. Task criteria reduced these to 30 videos of near-crash events that were split into event and non-event segments and were used to develop the driving hazard prediction task (task). Participants, aged 16–20 years-old (22 novice and 19 experienced drivers) completed the task during which they watched event and non-event videos and were asked, "How likely was the driver of this car to get into a crash?" after each video. Overall ratings for hazardousness were calculated for experienced and novice drivers as well as a group difference score for hazardousness. **Results:** All participants rated event videos as more hazardous than non-event videos, but there was no main effect of group. Rather, there was a significant EventbyGroup interaction in which there were no group differences in hazard ratings for non-event videos, but experienced drivers rated event videos as more hazardous than novice drivers. Specific characteristics of the event videos, such as the hazard development period, were related to differences between novice and experienced drivers' hazardousness ratings. **Conclusion:** To the best of our knowledge, this is the first use of naturalistic driving videos from an existing database as experimental stimuli. We found that the task discriminated between novice and experienced drivers' ratings of hazardousness. This distinction suggests naturalistic driving videos may be viable stimuli for experimental studies. **Practical Applications:** The application of naturalistic driving video database for experimental research may hold promise.

- **Keywords:** Teenage driver; Hazard detection; Learning

