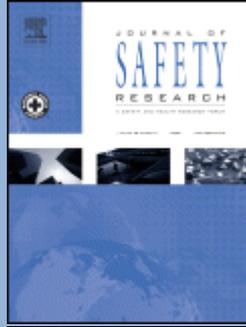


Journal of Safety Research – rok 2019, Volume 70

September 2019



Matthew A. Douglas, Stephen M. Swartz, R. Glenn Richey, Matthew D. Roberts. *Risky business: Investigating influences on large truck drivers' safety attitudes and intentions.* Pages 1-11.

Safety research in the U.S. motor carrier context remains important, as the trucking industry employs approximately 1.7 million large truck drivers. Drivers face many competing pressures in this unique high risk, high regulation, and low direct supervision context. They represent the cornerstone of safe carrier operations. Using a multi-theoretical approach, this study investigates how drivers' perceptions of carrier safety climate influence their safety-related attitudes and intentions. Responses from nearly 1500 over the road drivers provide evidence that safety climate directly influences drivers' attitudes toward safety, safety norms, and driver risk avoidance, and indirectly influences drivers' intentions to commit unsafe acts. These findings replicate previous findings and also extend the nomological network of theory in this context, adding driver risk avoidance as a central factor to the driver safety theoretical framework. Additionally, carrier managers are encouraged to reflect on the study's evidence and pursue a better understanding of their drivers' risk perceptions and tolerance, while minimizing avoidable risk through prudent safety and operational policies, procedures, and processes. Future research in this area is highly encouraged.

- **Keywords:** Motor carrier safety; Transportation safety; Safety climate; Risk avoidance; Safety management

Kwaku F. Boakye, Ruth A. Shults, Jerry D. Everett. *Nighttime seat belt use among front seat passengers: Does the driver's belt use matter?* Pages 13-17.

Introduction and Method: We explored the relationship between nighttime seat belt use of right-front passengers and their drivers using observational data from 33,310 vehicles in east Tennessee during March 2015 – May 2017. **Results:** Overall, nighttime passenger seat belt use varied by 50 percentage points from 92% when drivers were belted to 42% when drivers were not belted, suggesting that part-time seat belt users can be heavily influenced by the seat belt status of their traveling companions. When stratified by vehicle type and sex, passenger seat belt use by driver seat belt status varied as much as 74 percentage points from 96% to 22%. Passenger seat belt use was typically lower when riding with unbelted same-sex drivers than when riding with unbelted drivers of the opposite sex. **Conclusions and Practical Applications:** This finding suggests that the role of peer influence in decision-making about seat belt use

may differ depending on the sex of a vehicle driver and his or her passengers. Further research is warranted to explore this finding as well as other social and cultural influences that have not been fully examined in seat belt research.

- **Keywords:** Seat belt; Nighttime; Driver; Right-front passenger; Test of proportions

Sharon Newnam, Natassia Goode. *Communication in the workplace: Defining the conversations of supervisors.* Pages 19-23.

Background: Communications plays a central role in promoting the health and wellbeing of workers. Although much literature has shown the positive benefits of safety communication in the workplace, research has yet to explore the nature of these communication practices within supervisor-worker relationships. This study overcomes this gap in the literature through objectively monitoring communication within the daily working lives of work-group supervisors in one organization. **Aims:** The aims of the research were to: (a) categorize communication in the workplace into three categories, namely task-related communication, relationship-related communication, and safety-related communication; and (b) explore the frequency of these dialogs. **Method:** We periodically recorded brief snippets of ambient (acoustic) sounds in supervisors' workplace environment by using an Electronically Activated Recorder (EAR). The EAR was run on an Apple iPod, with an application downloaded for free on iTunes (i.e., iEAR). The EAR was programmed to record for 30s every three minutes for eight working hours a day of a five-day working week. **Results:** A total of 12.38 h of acoustic sounds from five workgroup supervisors was useable for coding. The results found examples of task-related (productivity, efficiency, workflow, and human resources) communication, as well as relationship-related (greetings, personal life discussions, workplace relations), and safety-related communication. We also found that the majority of the communication recorded was task-related communication compared with relationship-related and safety-related communication. **Practical applications:** This research provides preliminary insights into communication practices in the workplace and avenues for future research.

- **Keywords:** Communication; Occupational health and safety; Health promotion; Safety culture; Safety climate

Nandi L. Taylor, Melissa Daily. *Self-reported factors that influence rear seat belt use among adults.* Pages 25-31.

Introduction: While seat belt use among front seat occupants has significantly increased overtime a substantial usage gap still exists between front and back seat occupants. This study aims to identify factors that predict rear seat belt use among adult back seat passengers. **Methods:** We examined data from the 2016 Motor Vehicle Occupant Safety Survey, conducted by the National Highway Traffic Safety Administration, to determine the influence of front seat belt use, support of and belief of rear seat belt use laws, peer perception of seat belt use, nighttime belt use, and demographic factors on self-reported rear seat belt use. Rao-Scott chi-squared tests were used to determine significant associations between self-reported rear belt use and each predictor. Multivariate logistic regression was used to calculate adjusted odds ratios and determine the influence of significant predictors on rear seat belt use. Sampling weights were applied to produce nationally representative estimates; all statistical significance tests accounted for the complex survey design. **Results:** Among adults who reported riding in the back seat, 63% reported always using a rear seat belt. Front seat belt use, support and belief of state seat belt laws, nighttime seat belt use, age, and education were significantly associated with rear seat belt use. Multivariate regression results showed that adults who supported rear seat belt laws, reported front seat belt use and believed their state has a rear seat belt law were significantly more likely to report full-time use in the back seat. **Conclusions:** Seat belt laws and front seat belt use had

the strongest association with reporting full-time use in the back seat. **Practical Applications:** Increasing familiarity with existing laws directed towards rear seat belt use as well as increasing awareness about the benefits of seat belts in all seating positions may help improve rear seat belt use.

Grace Lee, Caitlin N. Pope, Ann Nwosu, Lara B. McKenzie, Motao Zhu. *Child passenger fatality: Child restraint system usage and contributing factors among the youngest passengers from 2011 to 2015. Pages 33-38.*

Objective: Motor-vehicle crashes (MVC) remain a leading cause of preventable injury and death for children aged 0–3 in the United States. Despite advancement in legislation and public awareness there is continued evidence of inappropriate child restraint system (CRS) use among the youngest passengers. The current study focuses on appropriate CRS use from 2011 to 2015 using data from the Fatality Analysis Reporting System (FARS) for children aged 0–3. **Methods:** Child-, driver-, vehicle-, and trip-related characteristics were investigated within a sample of 648 children from 625 crashes over 5-years in which a child aged 0–3 was fatally injured while unrestrained or wearing an identified CRS type. Multivariable log-binomial regression was used to obtain relative risk. **Results:** Only 48% of the fatally injured children were appropriately restrained in a CRS. Premature transition to a booster seat and seat belt was evident. The largest proportion of rear-facing restraint use was reported in <1 year olds (40%), with less reported in 1 (11%) and 2 year olds (2%) and no usage in 3 year olds. Younger children were more likely to be in an appropriate CRS, while Black children, driver not restrained in a lap-shoulder belt configuration, and riding in a pickup truck were less likely to be restrained appropriately. **Conclusions:** Evidence of inappropriate CRS use supports the use of more stringent legislation and parental interventions to communicate best practice recommendations and educate caregivers regarding appropriate child restraint methods. **Practical applications:** Public health campaigns focused on increasing appropriate restraint use in children are of great importance as optimally restrained children are less likely to sustain injuries, or require crash-related hospitalization compared to unrestrained children. Researchers and practitioners may find these surveillance findings essential when developing education and interventions targeting child–parent dyads at the greatest risk for a MVC-related fatality.

- **Keywords:** Child restraint system; Child safety seat; Child passenger safety; Motor vehicle crash; Fatality

Björn Sund, Carl Bonander, Niklas Jakobsson, Henrik Jaldell. *Do home fire and safety checks by on-duty firefighters decrease the number of fires? Quasi-experimental evidence from Southern Sweden. Pages 39-47.*

Introduction: Fire and rescue services Syd, in the south of Sweden, started to conduct home fire and safety checks on a large scale in 2010. The goal was to reduce the damages from residential fires. **Method:** We estimate the effects of the intervention on the incidence of residential fires and evaluate its economic effect. We use a difference-in-differences design to analyze time-varying intervention effects and conduct a cost-benefit analysis for the economic evaluation. **Results:** The results demonstrate that fires and developed fires decrease by a maximum of approximately 6% and 8% per year (assuming 100% causality) and that the intervention has positive economic effects, with the benefits estimated to be maximum 8–11 times higher than the costs. **Practical applications:** The results should be valuable as input when deciding whether to implement home fire and safety checks elsewhere.

- **Keywords:** Residential fires; Fire prevention; Smoke alarms; Public education; Cost-benefit analysis

Andrew Northmore, Eric Hildebrand. *Intersection characteristics that influence collision severity and cost. Pages 49-57.*

Introduction: Traffic engineers require robust tools to assist with their day-to-day decision making, and there is no better example of this than traffic signal warrants. North American traffic signal warrant systems are lacking in how they incorporate motor-vehicle collisions from both a severity and prediction perspective. The objective of this study was to produce reliable collision costs for the development of improved traffic signal warrants that accounted for the variations in severity that practitioners should expect based on the characteristics of the intersection being studied. **Method:** The primary data used for this analysis were from the National Automotive Sampling System (NASS) Crashworthiness Data System, with adjustments from the NASS General Estimates System and Fatality Accident Reporting System. Generalized ordered logit models were used to identify the most significant intersection characteristics, which were then used to segregate the data to determine expected the collision severity profiles and average costs of both casualty and total collisions at intersections. **Results:** The average collision at a signalized intersection was found have a lower severity than the average collision at a stop-controlled intersection. A combination of posted speed limit, urban/rural, and divided/undivided were identified as the most significant intersection characteristics in most cases and were used to delineate the data for developing collision cost estimates. **Conclusions:** Posted speed limit, rural/urban land use, and the presence of divided approaches are intersection characteristics that traffic engineers can readily determine and/or control for that have significant effects on intersection collision severity. **Practical applications:** The collision costs produced through this process give traffic engineers a reliable estimate that can provide a more substantial foundation for justifying a proposed change in intersection traffic control.

- **Keywords:** Intersection collision; Collision severity; Collision cost; Generalized ordered logit

Madelynn Stackhouse, Nick Turner. *How do organizational practices relate to perceived system safety effectiveness? Perceptions of safety climate and co-worker commitment to safety as workplace safety signals. Pages 59-69.*

Introduction: Integrating safety climate research with signaling theory, we propose that individual perceptions of safety climate signal the importance of safety in the organization. Specifically, we expect that three work-related organizational practices (training effectiveness, procedure effectiveness, and work pressure) relate to the broader risk control system in the workplace via individual perceptions of safety climate as a broad management signal. Further, we expect this broad management signal interacts with a local environmental signal (co-worker commitment to safety) to amplify or diminish perceived system safety effectiveness. **Method:** In a field study of oil and gas workers (N = 219; Study 1), we used mediation modeling to determine the relationships between work-related organizational practices, perceived safety climate, and perceived safety system effectiveness. In a field study of railway construction workers (N = 131; Study 2), we used moderated mediation modeling to explore the conditional role of co-worker commitment to safety. **Results:** We found that training effectiveness, procedure effectiveness, and work pressure predicted perceived system safety effectiveness indirectly via perceived safety climate (Studies 1 and 2) and that these indirect paths are influenced by co-worker commitment to safety (Study 2). **Conclusions:** Findings suggest that perceived safety climate is driven in part by work practices, and that perceived safety climate (from managers) and co-worker commitment to safety (from the local environment) interact to shape workplace safety system effectiveness. **Practical**

applications: The insight that training, procedures, and work pressure are meaningful predictors of perceived safety climate as a signal suggests that organizations should be cognizant of the quality of work-related practices for safety. The insight we offer on the competing versus complimentary nature of managerial safety signals (perceived safety climate) and co-worker safety signals (co-worker commitment to safety) could also be used by safety personnel to develop safety interventions directed in both areas.

- **Keywords:** Safety commitment; Safety climate; Co-workers; Railroad; Construction

Cammie Menéndez, Christina Socias-Morales, Srinivas Konda, Marilyn Ridenour. *Individual, business-related, and work environment factors associated with driving tired among taxi drivers in two metropolitan U.S. cities. Pages 71-77.*

Introduction: Violence-related events and roadway incidents are the leading causes of injury among taxi drivers. Fatigue is under-recognized and prevalent in this workforce and is associated with both injury outcomes. We describe the association of individual, business-related, and work environment factors with driving tired among taxi drivers in two very different cities. **Method:** We developed a comprehensive survey for licensed taxi drivers. We trained surveyors to administer the 30-min survey using systematic sampling among taxi drivers waiting for fares in two large U.S. cities: the Southwest (City 1) and the West (City 2). A driving tired scale of the Occupational Driver Behavior Questionnaire was the outcome. Multivariate logistic models described driving tired behavior in city-specific models using adjusted Odds Ratios (ORadj). **Results:** City 1 and City 2 had 496 and 500 participants, respectively. Each driving tired behavior was significantly more prevalent in City 2 than City 1 ($p < .05$). There were more variables and a greater diversity of variables in the models describing drowsy driving in City 1 than City 2. In City 1, variables describing negative safety climate (ORadj = 1.15), socio-demographic groups (identifying as Asian, educational attainment), passenger-related violence (ORadj = 1.79), and company tenure (ORadj = 1.15) were associated with driving tired. In City 2, high perceived safety training usefulness (ORadj = 0.48) was associated with driving tired. A risk factor for driving tired that was common to both cities was job demands (ORadj = 1.21 in City 1; 1.43 in City 2). **Conclusions:** These findings represent two diverse taxi populations driving in two geographically distinct regions that differ in safety regulation. It is important that safety measures that include fatigue awareness training are reaching all drivers. Fatigue management training should be integrated into driver safety programs regardless of location. **Practical applications:** Fatigue management strategies that recognize individual factors, business-related characteristics, and work environment are an important component of road safety and are particularly relevant for occupational drivers.

Guopeng Zhang, Yingfei Fan, Xinguo Jiang, Wenbo Fan, Teng Meng, Mengqing Xu. *Assessing the impacts of signal coordination on the crash risks of various driving cohorts. Pages 79-87.*

Introduction: Signal coordination has been widely implemented on urban arterials to improve traffic efficiency. The impacts of signal coordination on traffic safety, however, are largely overlooked, particularly on crash propensities of driver-vehicle cohorts, which will vary due to changing traffic flow patterns. **Method:** The paper aims to compare crash risks of various driving cohorts (measured by relative crash involvement ratio) on arterials with and without signal coordination with quasi-induced exposure technique, which has been well developed in estimating crash risks for driver-vehicle characteristics (i.e., driver age, gender, and vehicle type). Michigan traffic crash data (2000-2014) are retrieved for the case study. **Results:** The results indicate that: (a) when signal coordination is implemented, young, male drivers, and pickups are associated with more

crash responsibilities; (b) crash propensities vary for different disaggregated situations, e.g., young drivers may experience the rapid increase in crash risks during the peak hours; and (c) more hazardous actions (e.g., failing to stop in assured clear distance) are witnessed for the high-risk driving cohorts on the coordinated arterials than non-coordinated ones. Conclusions and **practical applications:** The findings highlight the importance of safety impact analysis of signal coordination, and serve to guide the potential improvements of safety operation and management of signal coordinated arterials.

- **Keywords:** Signal coordination; Crash propensity; Quasi-induced exposure; Relative crash involvement ratio; Driving cohorts

Xiaomeng Li, Andry Rakotonirainy, Xuedong Yan. *How do drivers avoid collisions? A driving simulator-based study.* Pages 89-96.

Introduction: Drivers' collision avoidance performance in an impending collision situation plays a decisive role for safety outcomes. This study explored drivers' collision avoidance performances in three typical collision scenarios that were right-angle collision, head-on collision, and collision with pedestrian. **Method:** A high-fidelity driving simulator was used to design the scenarios and conduct the experiment. 45 participants took part in the simulator experiment. Drivers' longitudinal/lateral collision avoidance performances and collision result were recorded. **Results:** Experimental results showed that brake only was the most common response among the three collision scenarios, followed by brake combining swerve in head-on and pedestrian collision scenarios. In right-angle collision scenario with TTC (time to collision) largest among three scenarios, no driver swerved, and meanwhile drivers who showed slow brake reaction tended to compensate the collision risk by taking a larger maximum deceleration rate within a shorter time. Swerve-toward-conflict was a prevalent phenomenon in head-on and pedestrian collision scenarios and significantly associated with collision risk. Drivers that swerved toward the conflict object had a shorter swerve reaction time than drivers that swerved away from conflict. **Conclusions:** Long brake reaction time and wrong swerve direction were the main factors leading to a high collision likelihood. The swerve-toward-conflict maneuver caused a delay in brake action and degraded subsequent braking performances. The prevalent phenomenon indicated that drivers tended to use an intuitive (heuristic) way to make decisions in critical traffic situations. **Practical applications:** The study generated a better understanding of collision development and shed lights on the design of future advanced collision avoidance systems for semi-automated vehicles. Manufactures should also engage more efforts in developing active steering assistance systems to assist drivers in collision avoidance.

- **Keywords:** Driving simulator; Collision avoidance behavior; Head-on collision; Right-angle collision; Collision with pedestrian

Sara E. Wuellner, David K. Bonauto. *Fewer workers' compensation claims and lower claim costs if employers with high injury rates achieved the rates of their safer peers.* Pages 97-103.

Introduction: Employers engaged in similar business activities demonstrate a range of workers' compensation claim rates. Workplace injuries and illnesses could be prevented if employers with high claim rates achieved the claim rates of their safer peers. Methods: We used Washington workers' compensation claims data for years 2013–2015 to calculate rates of compensable claims (eligible for disability or time loss benefits, if unable to work four days after injury) and total accepted claims (compensable plus medical-aid only claims) for each employer. We estimated the number and cost of claims to occur if employers with high claim rates reduced them to the rates of employers at the 25th percentile, adjusted for insurance risk class, employer size, and injury type. To evaluate the impact of setting more or less ambitious goals, we also estimated reductions

based on claim rates at the 10th and 50th percentiles. **Results:** Over 43% of claims and claim costs would be prevented if employers with higher claim rates lowered them to the 25th percentile using either total accepted or compensable claim rates as the benchmark outcome. The estimated claim cost savings from benchmarking to compensable claims was nearly as great as the estimate based on benchmarking to total accepted claims (\$308.5mil annually based on compensable claims vs. \$332.4mil based on total accepted claims). Restaurants and Taverns had the greatest number of potentially prevented compensable claims. Colleges and Universities and Wood Frame and Building Construction had the greatest potential reduction in compensable claim costs among larger and smaller employers, respectively. Conclusion: Substantial reductions in workers' compensation claims and costs are possible if employers achieve the injury rates experienced by their safer peers. Practical application: Evaluating the range of workplace injury rates among employers within industry groups identifies opportunities for injury prevention and offers another approach to resource allocation.

- **Keywords:** Workers' compensation; Occupational injury; Benchmarking

Matthew C. Camden, Susan A. Soccolich, Jeffrey S. Hickman, Richard J. Hanowski. *Reducing risky driving: Assessing the impacts of an automatically-assigned, targeted web-based instruction program.* Pages 105-115.

Abstract: **Introduction:** Transportation safety research has consistently shown driver behavior is the primary cause in the majority of crashes. This study evaluated the effectiveness of an automatically-assigned, targeted web-based instruction program to reduce risky driving behavior. **Method:** This quasi-experiment used a within-subjects, multiple-baseline stepwise ABC design; where "A" was the Phase I baseline, "B" was the Phase II driver awareness of program, and "C" was the Phase III WBI program. **Results:** A significant reduction in rates of risky driving behaviors coincided with the implementation of the WBI program, even for those drivers who did not receive WBI but were included in the program. More specifically, excessive speeding was significantly reduced by 73.93% from baseline to intervention across all drivers. For those drivers who received WBI, the program coincided with statistically significant reductions in speeding, hard braking, and hard cornering. The first WBI course assigned and completed was the most impactful in reducing at-risk driving behavior. **Conclusions:** These results show that the automatically-assigned, targeted WBI program was an effective method in reducing risky driving behaviors, not only for those drivers that received training, but for all drivers. The authors hypothesize the reduction in risky driving behaviors was not the result of the WBI, but instead from the implicit feedback of being assigned a training courses, the development of implicit, non-specific goals to reduce risky driving behaviors that result in a WBI course assignment, and the resulting increased driver accountability created by the WBI program. **Practical application:** Through the use of an automatically-assigned, targeted WBI program, fleets may have fewer crashes and insurance claims. This reduction in crashes and insurance claims may result in lower insurance premiums and may help to prevent injuries and save lives.

- **Keywords:** Safety; Driver monitoring; Speeding; Implicit feedback; Implicit goals

Stacey Willcox-Pidgeon, Amy E. Peden, Richard C. Franklin, Justin Scarr. *Boating-related drowning in Australia: Epidemiology, risk factors and the regulatory environment.* Pages 117-125.

Objective: Recreational boating is a popular pastime in many high income countries, and is a leading activity prior to drowning. This study reports on unintentional fatal drowning associated with boating-related incidents in Australia. **Methods:** A total population, retrospective, cross sectional design examined all boating-related

unintentional drowning deaths between July 1, 2005 and June 30, 2015. Variables examined included age, sex, location of drowning incident, vessel type, activity, presence of alcohol/drugs, and lifejacket wear. Relative risk (with a 95% confidence interval) was calculated using fatal drowning rates per 100,000 population and rates per 100,000 registered vessels. Chi square analysis and non-parametric tests for significance were applied. Statistical significance was deemed $p < .05$. **Results:** A total of 415 people drowned while boating during the study period, 91.8% male and 35.7% aged between 25 and 44 years. Men were 10 times more likely to drown when boating than females (RR = 10.64 CI:7.55–14.97). Over one-quarter (28.7%) of incidents involved alcohol, in 30.6% drugs were identified (31.3% were illegal) and 90.4% were not wearing a lifejacket. Children were more at risk of drowning on a houseboat than adults (RR = 7.13; CI:1.61–31.61). Females were more likely to drown than males when using a personal watercraft (RR = 10.53; CI:2.75–40.33). **Conclusion:** Boaters may be taking unnecessary risks by disregarding safety regulations, such as not wearing lifejackets and substance use (such as alcohol and illegal drugs). Boating in remote locations presents a high risk of drowning. While safety regulations are in place, enforcement and behavior change remain challenges. Practical application: Findings support recommendations for increased enforcement of alcohol-related regulations and introducing drug-testing for boaters. Consistency of boating safety regulations, especially around lifejacket wear, is recommended to influence behavior change. The effectiveness of current lifejacket regulations need to be critically evaluated in the context of increasing wear rates for adults and children.

- **Keywords:** Boating; Safety; Lifejackets; Drowning prevention; Alcohol

Juliet Haarbauer-Krupa, Tadesse Haileyesus, Julie Gilchrist, Karin A. Mack, Caitlin S. Law, Andrew Joseph. *Fall-related traumatic brain injury in children ages 0–4 years. Pages 127–133.*

Introduction: Falls are the leading cause of traumatic brain injury (TBI) for children in the 0–4 year age group. There is limited literature pertaining to fall-related TBIs in children age 4 and under and the circumstances surrounding these TBIs. This study provides a national estimate and describes actions and products associated with fall-related TBI in this age group. **Method:** Data analyzed were from the 2001–2013 National Electronic Injury Surveillance System–All Injury Program (NEISS–AIP), a nationally representative sample of emergency departments (ED). Case narratives were coded for actions associated with the fall, and product codes were abstracted to determine fall location and product type. All estimates were weighted. **Results:** An estimated 139,001 children younger than 5 years were treated annually in EDs for nonfatal, unintentional fall-related TBI injuries (total = 1,807,019 during 2001–2013). Overall, child actions (e.g., running) accounted for the greatest proportion of injuries and actions by others (e.g., carrying) was highest for children younger than 1 year. The majority of falls occurred in the home, and involved surfaces, fixtures, furniture, and baby products. **Conclusions:** Fall-related TBI in young children represents a significant public health burden. The majority of children seen for TBI assessment in EDs were released to home. Prevention efforts that target parent supervision practices and the home environment are indicated. **Practical applications:** Professionals in contact with parents of young children can remind them to establish a safe home and be attentive to the environment when carrying young children to prevent falls.

- **Keywords:** Traumatic brain injury; Falls; Pediatrics; Young children

Deyu Wang, Qinyi Liu, Liang Ma, Yijing Zhang, Haozhe Cong. *Road traffic accident severity analysis: A census-based study in China.* Pages 135-147.

Background: In China, despite the decrease in average road traffic fatalities per capita, the fatality rate and injury rate have been increasing until 2015. **Purpose:** This study aims to analyze the road traffic accident severity in China from a macro viewpoint and various aspects and illuminate several key causal factors. From these analyses, we propose possible countermeasures to reduce accident severity. **Method:** The severity of traffic accidents is measured by human damage (HD) and case fatality rate (CFR). Different categorizations of national road traffic census data are analyzed to evaluate the severity of different types of accidents and further to demonstrate the key factors that contribute to the increase in accident severity. Regional data from selected major municipalities and provinces are also compared with national traffic census data to verify data consistency. **Results:** From 2000 to 2016, the overall CFR and HD of road accidents in China have increased by 19.0% and 63.7%, respectively. In 2016, CFR of freight vehicles is 33.5% higher than average; late-night accidents are more fatal than those that occur at other periods. The speeding issue is severely becoming worse. In 2000, its CFR is only 5.3% higher than average, while in 2016, the number is 42.0%. **Conclusion and practical implementation:** A growing trend of accident severity was found to be contrasting to the decline of road traffic accidents. From the analysis of casual factors, it was confirmed that the release way of the impact energy and the protection worn by the victims are key variables contributing to the severity of road traffic accidents.

- **Keywords:** Road traffic safety; Accident severity; Case fatality rate

Kongzheng Liang, Ivan W.H. Fung. *The impact of macroeconomic and industrial fluctuation on fatalities of construction workers in China.* Pages 149-158.

Objective: This study explores the relationship between fluctuation in economic and industrial development and work-related fatalities of Chinese construction workers. **Methods:** The data for work-related fatalities in housing and civil engineering in China from 1996 to 2016 were tested for fluctuation and trends of both general economic and industry-specific indicators using the Engle-Granger cointegration analysis and the augmented Granger Causality test with modified Wald method. **Results:** Both the long-run equilibrium associations and short-run dynamic interactions between construction safety and macroeconomic development in China were determined. According to the estimates, fatalities in the construction industry appeared to be more significantly associated with changes in the gross output value of the industry, and the improvement in the workers' efficiency also contributed to the decline of fatalities. It initially revealed that the changes in growth rate, instead of growth itself, had a more significant influence on construction safety in China, while a marginal decreasing trend of positive effects exerted by the growth can be expected with the gradual maturity of the industry. **Significance:** The application of econometrical methods explored an untapped data source for gaining an insight into the underlying rules of occurrence of construction fatalities, thus strengthening the body of knowledge of construction safety by providing a new research perspective that some safety indicators can be treated as the macro-level socioeconomic index. **Practical applications:** The findings reminded policymakers and practitioners to be aware of potential challenges from the slowing or even declining trend facing the industry in the near future, and offered a reference to relevant authorities for establishing a more targeted and effective governance strategy.

- **Keywords:** China; Construction fatalities; Macroeconomic fluctuation; Granger causality; Cointegration analysis

Cédric Garcia, Vivian Viallon, Liacine Bouaoun, Jean-Louis Martin. *Prediction of responsibility for drivers and riders involved in injury road crashes. Pages 159-167.*

Introduction: Responsibility analysis allows the evaluation of crash risk factors from crash data only, but requires a reliable responsibility assessment. The aim of the present study is to predict expert responsibility attribution (considered as a gold-standard) from explanatory variables available in crash data routinely recorded by the police, according to a data-driven process with explicit rules. **Method:** Driver responsibility was assessed by experts using all information contained in police reports for a sample of about 5000 injury crashes that occurred in France in 2011. Three statistical methods were used to predict expert responsibility attribution: logistic regression with L1 penalty, random forests, and boosting. Potential predictors of expert attribution referred to inappropriate driver actions and to external conditions at the time of the crash. Logistic regression was chosen to construct a score to assess responsibility for drivers and riders in crashes involving one or more motor vehicles, or involving a cyclist or pedestrian. **Results:** Cross-validation showed that our tool can predict expert responsibility assessments on new data sets. In addition, responsibility analyses performed using either the expert responsibility or our predicted responsibility return similar odds ratios. Our scoring process can then be used to reliably assess responsibility based on national police report databases, provided that they include the information needed to construct the score.

- **Keywords:** Road crash; Responsibility analysis; Scoring tool; Statistical learning; Crash risk factor

Laura S. Fruhen, Mark A. Griffin, Daniela M. Andrei. *What does safety commitment mean to leaders? A multi-method investigation. Pages 169-180.*

Introduction: Perceived management safety commitment as an aspect of safety climate or culture is a key influence on safety outcomes in organizations. What is unclear is how perceptions of management commitment are created by leaders. **Method:** To address this gap in the literature, we position safety commitment as a leadership construct viewed from the perspectives of the leaders who experience and demonstrate it. In this paper, an established multidimensional commitment framework is applied to leaders' safety commitment (consisting of affective, normative, and calculative commitment). Through an exploratory sequential mixed methods design combining interviews (n = 40) and surveys (n = 89), we investigate the applicability of this theoretical conceptualization to safety commitment. **Results:** The results indicate the multiple dimensions captured leaders' safety commitment well, safety commitment can be demonstrated via a range of behaviors, and the dimensions' association with behavioral demonstrations aligned with those of other types of commitment reported in the literature. Only affective safety commitment was consistently associated with demonstrations of safety commitment. The link between high levels of affective and normative safety commitment and demonstrations was more pronounced when participants perceived their company's safety climate more positively. Adopting a focus on leaders' experience of safety commitment offers opportunities for new research into the way in which safety commitment perceptions are shaped by leaders. **Practical application:** The findings can support leaders' reflection about their personal mindset around safety and support them in fostering strong safety climates and cultures. It further encourages organizations in creating work environments that in particular foster affective and normative safety commitments in leaders.

- **Keywords:** Safety commitment; Leadership; Management; Exploratory sequential mixed methods design; Organizational safety

Kristen Jennings Black, Alec Munc, Robert R. Sinclair, Janelle H. Cheung. *Stigma at work: The psychological costs and benefits of the pressure to work safely.* Pages 181-191.

Introduction: Workplace accidents and injuries can be quite costly to both individual employees and their organizations. While safety climate (i.e., perceptions of policies and procedures related to safety that should reflect an organization's value of safety) has been established as a predictor of safety behaviors, less research has considered the possible negative pressures that could result from an environment that emphasizes safety. Though organizations may intend to create a positive safety climate, concerns about being treated differently if an employee were to be involved in a safety incident may result in unintended, but detrimental safety and health outcomes. **Method:** This study investigated the stigma associated with being involved in a safety-related incident in relation to self-reported safety behaviors and psychological health outcomes. The data were acquired through a two-wave prospective design, surveying workers from Amazon Mechanical Turk (MTurk; N=528) who indicated they were exposed to at least one physical work stressor (e.g., heavy lifting; air quality; standing for extended periods) a few times each month or more. **Results:** When controlling for safety climate, safety stigma was related to decreased safety compliance and poorer psychological health. There was a marginally significant interaction between safety stigma and safety motivation in relation to safety compliance. **Conclusions:** These findings suggest that experiencing pressure to work safely, for fear of being evaluated negatively, may actually come at the cost of employees' safety compliance and psychological health. **Practical applications:** These results may be useful in assessing and intervening to improve an organization's safety climate. Organizations should closely examine the climate for safety to ensure that positive aspects of safety are not undermined by a stigmatizing pressure associated with safety in the work environment.

- **Keywords:** Safety climate; Stigma; Safety performance; Well-being; Mental health

Robyn D. Robertson, Heather Woods-Fry, Ward G.M. Vanlaar, Marisela Mainegra Hing. *Automated vehicles and older drivers in Canada.* Pages 193-199.

Introduction: As seniors represent a growing proportion of the driving population, research about how automated vehicles can help improve older driver safety and mobility is highly relevant. This paper examines the knowledge, attitudes and perceptions of older drivers towards limited self-driving vehicles (LSDVs), and how these variables can influence the likelihood that they will rely on this technology. **Method:** The study includes data from a previous national survey (N=2662) about automated vehicle technology, with new analyses to test hypothetical models using structural equation modeling. Results of the first model were confirmed and built upon with a second more complex model that incorporated the construct "behavioral adaptation." Focus groups with older drivers were also conducted (N=38) to help reveal nuances in older drivers' knowledge, attitudes, perceptions, and behaviors regarding this technology. **Results:** Survey results demonstrated that feelings of safety and knowledge about LSDVs are positively related to perceived ease of use and adoption of the technology. The positive association between safety and perceived ease of use was further highlighted when comparing responses of older drivers to those of younger age groups, as older drivers were significantly less likely to agree that LSDVs were easy to use and were significantly less agreeable about feeling safe using them. Focus groups results confirmed that safety and knowledge of LSDVs are essential to the likelihood of adopting this technology, and revealed a high receptivity among older drivers to educational strategies and tools to increase their knowledge of LSDVs. Implications for educational strategies and safety benefits for older drivers are discussed. **Practical applications:** Results provide insight into strategies to encourage the early adoption of automated vehicles by older drivers

and facilitate a safer transition towards automated vehicles that is lead by a cohort of safety-conscious drivers.

- **Keywords:** Driver behavior; Structural equation modeling; Survey; Focus group; Semi-automated vehicles

Jenni B. Rouse, David C. Schwebel. *Supervision of young children in parking lots: Impact on child pedestrian safety.* Pages 201-206.

Introduction: Pedestrian injuries are a significant pediatric public health concern worldwide. Younger children are at particular risk for pedestrian injuries in parking lots, but there is limited research regarding children's pedestrian behaviors in parking lots. **Method:** This study examined children's behaviors and safety risks in parking lots through unobtrusive and unannounced observation of 124 children ages 2–10 years and their adult supervisors as they crossed a parking lot from their parked vehicle into a community recreation center. **Results:** Adult supervision was inadequate: over 67% of children 10 years of age and younger were unsupervised in the parking lot at some point between the vehicle parking and the child entering into the building. Approximately 90% of all children were outside of arm's length of the accompanying adult at some point while in the parking lot. Additionally, children exited the vehicle prior to the adult in over 50% of observations. Age was associated with safety risk, with older children being unsupervised more often than younger ones. **Conclusions:** Adult supervision of children in a parking lot setting was poor, creating significant safety risks. In addition, many children failed to follow basic pedestrian safety practices themselves, such as looking for moving cars. Injury prevention strategies should be implemented. **Practical applications:** As researchers gain better understanding about the safety risks for children in parking lots, interventions could target adult and child behaviors through improved supervision, altered perception of risk, and mandated behavioral guidelines for child behavior, such as how and when children exit vehicles in parking lots.

- **Keywords:** Child pedestrian; Pedestrian safety; Injury prevention; Supervision; Parking lots

Wen Hu, Jessica B. Cicchino. *Long-term crash trends at single- and double-lane roundabouts in Washington State.* Pages 207-212.

Introduction: Despite the proven safety benefits, crashes still occur at roundabouts. This study examined long-term trends in total crash counts, crash severity, and crashes involving common driver errors (failing to yield the right-of-way and speeding) in the period following the completion of single- and double-lane roundabouts in Washington state. **Method:** Crashes occurring during 2010–2016 at single- and double-lane roundabouts completed between 2009 and 2015 in Washington state were included. Poisson regression examined changes in annual total crash counts over time. Logistic regression estimated average annual changes in the odds that a crash involved an evident/incapacitating/fatal injury and that a crash involved a driver error. Regression models were estimated for single- and double-lane roundabouts separately. **Results:** Annual total crash counts declined significantly by 8.8% over time at double-lane roundabouts and increased nonsignificantly over time at single-lane roundabouts. The study estimated a significant 32.1% annual reduction in the odds that a crash involved an evident or incapacitating injury at double-lane roundabouts and a nonsignificant 18.9% reduction at single-lane roundabouts. There was a significant 10.6% annual decline in the odds that a crash was right-of-way related at double-lane roundabouts and a significant 19.1% annual decline in the odds that a crash was speeding-related at single-lane roundabouts. **Conclusions:** The current study demonstrates that safety can improve over time at double-lane roundabouts as drivers gain experience navigating them. At the same time, it is important that roundabouts include design elements that will prevent right-of-way mistakes and reduce speeds. **Practical applications:**

Communities installing double-lane roundabouts may find that their benefits will increase the longer they are in place, even if initial changes in crashes and injuries are underwhelming.

- **Keywords:** Single-lane roundabouts; Double-lane roundabouts; Crashes; Long-term trends

Subasish Das, Lisa Minjares-Kyle, Lingtao Wu, Russell H. Henk. *Understanding crash potential associated with teen driving: Survey analysis using multivariate graphical method. Pages 213-222.*

Introduction: Teen crash involvement is usually higher than other age groups, and they are typically overrepresented in car crashes. To infer teen drivers' understanding of crash potentials (factors that are associated with crash occurrence), two sources of data are generally used: retrospective data and prospective data. Retrospective data sources contain historical crash data, which have limitations in determining teen drivers' knowledge of crash potentials. Prospective data sources, like surveys, have more potential to minimize the research gap. Prior studies have shown that teen drivers are more likely to be involved in crashes during their early driving years. Thus, there is a benefit in examining how teen drivers' understanding of crash potentials change during their transition through licensing stages (i.e., no licensure to unrestricted licensure).

Method: This study used a large set of teen driver survey data (a dataset from approximately 88,000 respondents) of Texas teens to answer the research question. Researchers provided rankings of the crash potentials by gender and licensure stages using a multivariate graphical method named taxicab correspondence analysis (TCA).

Results: The findings show that driving behavior and understanding of crash potentials differ among teens based upon various licensing stages. **Practical applications:** Findings from this study can help government authorities to refine policies of teen driver licensing and implement potential countermeasures for safety improvement.

- **Keywords:** Teen driver survey; Crash potentials; Licensing; Multivariate graphical method; Taxicab correspondence analysis

Mahdi Rezapour, Shaun S. Wulff, Khaled Ksaibati. *Examination of the severity of two-lane highway traffic barrier crashes using the mixed logit model. Pages 223-232.*

Introduction: Vehicles in transport sometimes leave the travel lane and encroach onto natural or artificial objects on the roadsides. These types of crashes are called run-off the road crashes, which account for a large proportion of fatalities and severe crashes to vehicle occupants. In the United States, there are about one million such crashes, with roadside features leading to one third of all road fatalities. Traffic barriers could be installed to keep vehicles on the roadways and to prevent vehicles from colliding with obstacles such as trees, boulder, and walls. The installation of traffic barriers would be warranted if the severity of colliding with the barrier would be less severe than colliding with other fix objects on the sides of the roadway. However, injuries and fatalities do occur when vehicle collide with traffic barriers. A comprehensive analysis of traffic barrier features is lacking due to the absence of traffic barrier features data. Previous research has focused on simulation studies or only a general evaluation of traffic barriers, without accounting for different traffic barrier features. **Method:** This study is conducted using an extensive traffic barrier features database for the purpose of investigating the impact of different environmental and traffic barrier geometry on this type of crash severity. This study only included data related to two-lane undivided roadway systems, which did not involve median barrier crashes. Crash severity is modeled using a mixed binary logistic regression model in which some parameters are fixed and some are random. **Results:** The results indicated that the effects of traffic barrier height, traffic barrier offset, and shoulder width should not be separated, but rather considered as interactions that impact

crash severity. Rollover, side slope height, alcohol involvement, road surface conditions, and posted speed limit are some factors that also impact the severity of these crashes. The effects of gender, truck traffic count, and time of a day were found to be best modeled with random parameters in this study. The effects of these risk factors are discussed in this paper. **Practical applications:** Results from this study could provide new guidelines for the design of traffic barriers based upon the identified roadway and traffic barrier characteristics.

- **Keywords:** Random parameter; Traffic barrier; Guardrail; Crash severity; Interaction terms

Guilherme Olandoski, Alessandra Bianchi, Patricia Delhomme. *Brazilian adaptation of the driving anger expression inventory: testing its psychometrics properties and links between anger behavior, risky behavior, sensation seeking, and hostility in a sample of Brazilian undergraduate students. Pages 233-241.*

Introduction: In Brazil, driver aggressiveness in road traffic is a critical issue and could be an important contributing factor to the high number of traffic accidents. Because no instruments are available in Portuguese to register driving aggressiveness or driving anger in Brazil, we adapted English instruments into the Brazilian context. The aims of this study were to provide a Brazilian adaptation of the Driving Anger Expression Inventory (DAX) and to try to validate it by testing its psychometric properties and investigating its relationships with risky driving behaviors (DBQ), road accidents, driving sensation seeking, and hostility. **Method:** The Brazilian adaptations of the DAX, DBQ, the Driving Sensation Seeking Scale (DSSS) and the hostility Scale were administered to a sample of 512 undergraduate students (with a mean age of 23.7 years, 52.1% men). **Results:** Confirmatory factor analysis of the Brazilian DAX (DAX-BR) items yielded a four-factor solution with 43 items, which obtained the best goodness-of-fit to the data. Cronbach's alpha for the DAX-BR factors ranged from 0.69 to 0.88. Other results on validity were a positive correlation (range 0.39–0.59) between the factors of the DAX-BR, DSSS, and DBQ. **Conclusion:** DAX-BR as the same structure as the original and is a reliable instrument for use with young drivers. Other studies should be conducted to further validate the DAX-BR in different types of populations such as older and more experienced drivers, professional drivers, and traffic regulation offenders whose driver's license has been taken away. **Practical applications:** This Brazilian version can be recommended for the assessment of driving anger expression in Brazil among young drivers in view of helping them driver more safely, and in particular to reduce traffic violations.

- **Keywords:** DAX; DBQ; DSSS; Hostility; Driving behaviors

Boon Hong Ang, Jennifer Anne Oxley, Won Sun Chen, Khai Khun Yap, Keang Peng Song, Shaun Wen Huey Lee. *To reduce or to cease: A systematic review and meta-analysis of quantitative studies on self-regulation of driving. Pages 243-251.*

Introduction: The ability to remain safe behind the wheels can become arduous with aging, yet important for sustaining local travel needs. This review aimed to explore safe mobility issues involving older adults and gain a broad understanding of older drivers' self-regulatory driving practices and motivators behind such behavioral changes, including strategies adopted to reduce or cease driving while maintaining safe mobility. **Methods:** A systematic literature search was performed on 11 online databases for quantitative studies describing self-regulation of driving amongst older adults aged 60 years and above from database inception until December 2018. Data were described narratively and, where possible, data were pooled using random-effects meta-analysis.

Results: Of the 1556 studies identified, 54 studies met the inclusion criteria and 46 studies were included in the meta-analyses. All included studies examined car drivers only. Older adults who were single or female were found to be at higher odds of driving cessation. Physical fitness, mental health, social influence, and support systems received by older adults were important driving forces influencing mobility and adjustments made in their travel patterns. **Conclusions:** Driving self-regulation amongst older adults is a multifaceted decision, impacting mobility and mental health. Therefore, future interventions and support systems should not only create opportunities for retaining mobility for those who have ceased driving, but also promote better psychological and social well-being for regulators and for those who are transitioning from driving to non-driving status. **Practical applications:** (a) Engage and educate older adults about self-regulation, including strategies that can be adopted and non-car mobility options available. (b) Expand the research focus to explore potential interactions of factors facilitating or hindering the transition process to develop a more comprehensive framework of self-regulation. (c) Encourage ongoing research to formulate, monitor, and evaluate the effectiveness of policies and interventions implemented. (d) Expand the research horizon to explore and understand the perspectives of older adults from developing countries.

- **Keywords:** Reduction; Cessation; Factors; Safe mobility; Meta-analysis