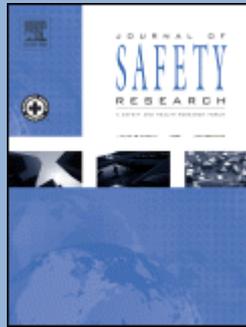


## **Journal of Safety Research – rok 2017, Volume 62**

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### **Majid Khalilikhah, Kevin Heaslip. *Improvement of the performance of animal crossing warning signs.* Pages 1-12.**

**Introduction:** Animal-vehicle collisions (AVCs) can result in serious injury and death to drivers, animals' death, and significant economic costs. However, the cost effectiveness of the majority of AVC mitigation measures is a significant issue. **Method:** A mobile-based data collection effort was deployed to measure signs under the Utah Department of Transportation's (UDOT) jurisdiction. The crash data were obtained from the UDOT risk management database. ArcGIS was employed to link these two data sets and extract animal-related crashes and signs. An algorithm was developed to process the data and identify AVCs that occurred within sign recognition distance. Kernel density estimation (KDE) technique was applied to identify potential crash hotspots. **Results:** Only 2% of AVCs occurred within the recognition distance of animal crossing signs. Almost 58% of animal-related crashes took place on the Interstate and U.S. highways, wherein only 30% of animal crossing signs were installed. State routes with a higher average number of signs experienced a lower number of AVCs per mile. The differences between AVCs that occurred within versus outside of sign recognition distance were not statistically significant regarding crash severity, time of crash, weather condition, driver age, vehicle speed, and type of animal. It is more likely that drivers become accustomed to deer crossing signs than cow signs. **Conclusions:** Based on the historical crash data and landscape structure, with attention given to the low cost safety improvement methods, a combination of different types of AVC mitigation measures can be developed to reduce the number of animal-related crashes. After an in-depth analysis of AVC data, warning traffic signs, coupled with other low cost mitigation countermeasures can be successfully placed in areas with higher priority or in critical areas. **Practical applications:** The findings of this study assist transportation agencies in developing more efficient mitigation measures against AVCs.

- **Keywords:** Animal vehicle collision (AVC) Traffic sign Kernel density estimation (KDE) Mitigation measures Crash data analysis

### **Eric R. Teoh, Daniel L. Carter, Sarah Smith, Anne T. McCartt. *Crash risk factors for interstate large trucks in North Carolina.* Pages 13-21.**

**Introduction:** Provide an updated examination of risk factors for large truck involvements in crashes resulting in injury or death. **Methods:** A matched case-control study was conducted in North Carolina of large trucks operated by interstate carriers. Cases were defined as trucks involved in crashes resulting in fatal or non-fatal injury, and

one control truck was matched on the basis of location, weekday, time of day, and truck type. The matched-pair odds ratio provided an estimate of the effect of various driver, vehicle, or carrier factors. **Results:** Out-of-service (OOS) brake violations tripled the risk of crashing; any OOS vehicle defect increased crash risk by 362%. Higher historical crash rates (fatal, injury, or all crashes) of the carrier were associated with increased risk of crashing. Operating on a short-haul exemption increased crash risk by 383%. Antilock braking systems reduced crash risk by 65%. All of these results were statistically significant at the 95% confidence level. Other safety technologies also showed estimated benefits, although not statistically significant. **Conclusions:** With the exception of the finding that short-haul exemption is associated with increased crash risk, results largely bolster what is currently known about large truck crash risk and reinforce current enforcement practices. Results also suggest vehicle safety technologies can be important in lowering crash risk. This means that as safety technology continues to penetrate the fleet, whether from voluntary usage or government mandates, reductions in large truck crashes may be achieved. **Practical application:** Results imply that increased enforcement and use of crash avoidance technologies can improve the large truck crash problem.

- **Keywords:** Large trucks Tractor-trailers Crash risk Vehicle defects Crash avoidance technology

**Saeed Givchchi, Ehsan Hemmativaghef, Hassan Hoveidi. *Association between safety leading indicators and safety climate levels. Pages 23-32.***

**Objectives:** The aim of this study was to evaluate the association of leading indicators for occupational health and safety, particularly safety inspections and non-compliances, with safety climate levels. **Methods:** Nordic Occupational Safety Climate Assessment Questionnaire was employed to evaluate safety climate in cross-sectional design. The geographically diverse population of the inspection body made it possible to conduct the survey across 10 provinces in Iran. 89 completed questionnaires were obtained with a response rate of 47%. Except for management safety justice, the internal consistency of other six dimensions was found to be acceptable ( $\alpha \geq 0.7$ ). **Results:** Mean scores of dimensions ranged from 3.50 in trust in the efficacy of safety systems (SD = 0.38) to 2.98 in workers' safety priority and risk non-acceptance (SD = 0.47). Tukey HSD tests indicated a statistically significant difference of mean scores among groups undergoing different number of safety inspections and those receiving different number of non-compliances ( $p < 0.05$ ), with no significant differences based on safety training man-hours and sessions ( $p > 0.05$ ). Spearman's rank-order correlation showed no relationship between work experience and number of non-compliances (correlation coefficient =  $-0.04$ ,  $p > 0.05$ ) and between safety training man-hours and number of non-compliances (correlation coefficient =  $-0.15$ ,  $p > 0.05$ ). **Conclusions:** Our results indicate that safety climate levels are influenced by number of safety inspections and the resultant non-compliances. **Practical applications:** Findings suggest that safety non-compliances detected as a result of conducting safety inspections could be used to monitor the safety climate state. Establishing plans to conduct scheduled safety inspections and recording findings in the form of safety non-compliance and monitoring their trend could be used to monitor levels of safety climate.

- **Keywords:** Active failures Just culture Latent failures Non-compliance Safety inspection

**Tina Schneiderei, Tibor Petzoldt, Andreas Keinath, Josef F. Krems. *Using SHRP 2 naturalistic driving data to assess drivers' speed choice while being engaged in different secondary tasks. Pages 33-42.***

**Introduction:** The engagement in secondary tasks while driving has been found to result in considerable impairments of driving performance. Texting has especially been suspected to be associated with an increased crash risk. At the same time, there is evidence that drivers use various self-regulating strategies to compensate for the increased demands caused by secondary task engagement. One of the findings reported from multiple studies is a reduction in driving speed. However, most of these studies are of experimental nature and do not let the drivers decide for themselves to (not) engage in the secondary task, and therefore, eliminate other strategies of self-regulation (e.g., postponing the task). The goal of the present analysis was to investigate if secondary task engagement results in speed adjustment also under naturalistic conditions. **Method:** Our analysis relied on data of the SHRP 2 naturalistic driving study. To minimize the influence of potentially confounding factors on drivers' speed choice, we focused on episodes of free flow driving on interstates/highways. Driving speed was analyzed before, during, and after texting, smoking, eating, and adjusting/monitoring radio or climate control; in a total of 403 episodes. **Results:** Data show some indication for speed adjustment for texting, especially when driving with high speed. However, the effect sizes were small and behavioral patterns varied considerably between drivers. The engagement in the other tasks did not influence drivers' speed behavior significantly. **Conclusions and practical applications:** While drivers might indeed reduce speed slightly to accommodate for secondary task engagement, other forms of adaptation (e.g., strategic decisions) might play a more important role in a natural driving environment. The use of naturalistic driving data to study drivers' self-regulatory behavior at an operational level has proven to be promising. Still, in order to obtain a comprehensive understanding about drivers' self-regulatory behavior, a mixed-method approach is required.

- Keywords: Naturalistic driving, Distraction, Self-regulatory behavior, Speed adjustment, Interstate/highway

**Onyumbwe Enembe B. Lukongo. *Economic and statistical perspectives on traffic safety in Louisiana, 2005–2015. Pages 43-51.***

**Introduction:** This study examine and applies recent empirical evidence from Mississippi and Alabama on fatal crashes and its relationship with gasoline prices and alcohol consumptions using the Louisiana Crash Data Reports between January 2005 and December 2015. **Method:** The negative binomial models is the preferred specification for the Louisiana Crash Data. The marginal effects and related elasticities were calculated to facilitate the interpretation of the results. **Results:** Findings suggest that higher gasoline prices reduce fatalities among young drivers. A fewer number of young drivers on the roads are believed to reduce the likelihood of fatal crashes. Underage drinking is still prominent in Louisiana. Extreme temperatures are positively associated with youth and other types of fatal crashes. **Practical Applications:** This study highlights a huge toll on society in terms of social and economic costs, wealth destruction, and unfulfilled potential of the deceased or incapacitated.

- **Keywords:** Traffic safety, Economic analysis, Louisiana, Motor vehicle, Negative binomial model

**Fernanda Cruz Rios, Wai K. Chong, David Grau. *The need for detailed gender-specific occupational safety analysis. Pages 53-62.***

**Introduction:** The female work in population is growing in the United States, therefore the occupational health and safety entities must start to analyze gender-specific data

related to every industry, especially to nontraditional occupations. Women working in nontraditional jobs are often exposed to extreme workplace hazards. These women have their safety and health threatened because there are no adequate policies to mitigate gender-specific risks such as discrimination and harassment. Employers tend to aggravate this situation because they often fail to provide proper reporting infrastructure and support. According to past studies, women suffered from workplace injuries and illnesses that were less prominent among men. Statistics also confirmed that men and women faced different levels of risks in distinct work environments. For example, the rates of workplace violence and murders by personal acquaintances were significantly higher among women. **Methods:** In this paper, the authors analyze prior public data on fatal and nonfatal injuries to understand why we need to differentiate genders when analyzing occupational safety and health issues. **Results:** The analyses confirmed that women dealt with unique workplace hazards compared to men. **Conclusions:** It is urgent that public agencies, such as the U.S. Department of Labor, record gender-specific data in details and by occupations and industries. **Practical application:** The reader will become aware of the current lack – and need – of data and knowledge about injuries and illnesses separated by gender and industry. Finally, safety and health researchers are encouraged to investigate the gender-specific data in all industries and occupations, as soon as they become available.

- **Keywords:** Gender equality, Safety, Occupational health, Women, Construction

**Dinesh Mohan, Shrikant I. Bangdiwala, Andres Villaveces. *Urban street structure and traffic safety. Pages 63-71.***

**Introduction:** This paper reports the influence of road type and junction density on road traffic fatality rates in U.S. cities. **Method:** The Fatality Analysis Reporting System (FARS) files were used to obtain fatality rates for all cities for the years 2005–2010. A stratified random sample of 16 U.S. cities was taken, and cities with high and low road traffic fatality rates were compared on their road layout details (TIGER maps were used). Statistical analysis was done to determine the effect of junction density and road type on road traffic fatality rates. **Results:** The analysis of road network and road traffic crash fatality rates in these randomly selected U.S. cities shows that, (a) higher number of junctions per road length was significantly associated with a lower motor-vehicle crash and pedestrian mortality rates, and, (b) increased number of kilometers of roads of any kind was associated with higher fatality rates, but an additional kilometer of main arterial road was associated with a significantly higher increase in total fatalities. When compared to non-arterial roads, the higher the ratio of highways and main arterial roads, there was an association with higher fatality rates. **Conclusions:** These results have important implications for road safety professionals. They suggest that once the road and street structure is put in place, that will influence whether a city has low or high traffic fatality rates. A city with higher proportion of wider roads and large city blocks will tend to have higher traffic fatality rates, and therefore in turn require much more efforts in police enforcement and other road safety measures. **Practical applications:** Urban planners need to know that smaller block size with relatively less wide roads will result in lower traffic fatality rates and this needs to be incorporated at the planning stage.

- **Keywords:** Traffic safety Urban planning Urban safety Street structure Block size

**Alejandra Medina-Flintsch, Jeffrey S. Hickman, Feng Guo, Matthew C. Camden, Richard J. Hanowski, Quon Kwan. *Benefit-cost analysis of lane departure warning and roll stability control in commercial vehicles. Pages 73-80.***

**Introduction:** This paper presents the cost benefits of two different onboard safety systems (OSS) installed on trucks as they operated during normal revenue deliveries. Using a formal economic analysis approach, the study quantified the costs and benefits

associated with lane departure warning (LDW) systems and roll stability control (RSC) systems. **Methods:** The study used data collected from participating carriers (many of these crashes were not reported to state or Federal agencies), and the research team also reviewed each crash file to determine if the specific OSS would have mitigated or prevented the crash. The deployment of each OSS was anticipated to increase the safety of all road users, but impact different sectors of society in different ways. Benefits that were inherent in each group (e.g., industry, society) were considered, and different benefit–cost analyses (BCAs) were performed. **Results:** This paper presents two BCAs: a BCA focused on the costs and benefits in the carrier industry by implementing each OSS, and a BCA that measured the societal benefits of each OSS. In addition, a BCA for a theoretical mandatory deployment option for each OSS is presented. **Conclusions:** BCA results for LDW and RSC clearly showed their benefits outweighed their costs for the carrier and society. **Practical applications:** Cost information is a crucial factor in purchasing decisions in carriers; similarly, regulators must consider the cost burden prior to mandating technologies. The results in this study provide carrier decision makers and regulators with information necessary to make an informed decision regarding RSC and LDW.

- **Keywords:** Lane departure warning; Roll stability control; Commercial vehicle; Benefit–cost analysis; Crash

**Naghmeh Niroomand, Glenn P. Jenkins. *Estimating the value of life and injury for pedestrians using a stated preference Framework. Pages 81-87.***

**Introduction:** The incidence of pedestrian death over the period 2010 to 2014 per 1000,000 in North Cyprus is about 2.5 times that of the EU, with 10.5 times more pedestrian road injuries than deaths. With the prospect of North Cyprus entering the EU, many investments need to be undertaken to improve road safety in order to reach EU benchmarks. **Method:** We conducted a stated choice experiment to identify the preferences and tradeoffs of pedestrians in North Cyprus for improved walking times, pedestrian costs, and safety. The choice of route was examined using mixed logit models to obtain the marginal utilities associated with each attribute of the routes that consumers chose. These were used to estimate the individuals' willingness to pay (WTP) to save walking time and to avoid pedestrian fatalities and injuries. We then used the results to obtain community-wide estimates of the value of a statistical life (VSL) saved, the value of an injury (VI) prevented, and the value per hour of walking time saved. **Results:** The estimate of the VSL was €699,434 and the estimate of VI was €20,077. These values are consistent, after adjusting for differences in incomes, with the median results of similar studies done for EU countries. The estimated value of time to pedestrians is €7.20 per person hour. **Conclusions:** The ratio of deaths to injuries is much higher for pedestrians than for road accidents, and this is completely consistent with the higher estimated WTP to avoid a pedestrian accident than to avoid a car accident. The value of time of €7.20 is quite high relative to the wages earned. **Practical applications:** Findings provide a set of information on the VRR for fatalities and injuries and the value of pedestrian time that is critical for conducting ex ante appraisals of investments to improve pedestrian safety.

- **Keywords:** Willingness to pay; Choice experiment; Value of a statistical life; Value of an injury; Pedestrian time

**Anders Jonsson, Carl Bonander, Finn Nilson, Fredrik Huss. *The state of the residential fire fatality problem in Sweden: Epidemiology, risk factors, and event typologies. Pages 89-100.***

**Introduction:** Residential fires represent the largest category of fatal fires in Sweden. The purpose of this study was to describe the epidemiology of fatal residential fires in

Sweden and to identify clusters of events. **Method:** Data was collected from a database that combines information on fatal fires with data from forensic examinations and the Swedish Cause of Death-register. Mortality rates were calculated for different strata using population statistics and rescue service turnout reports. Cluster analysis was performed using multiple correspondence analysis with agglomerative hierarchical clustering. **Results:** Male sex, old age, smoking, and alcohol were identified as risk factors, and the most common primary injury diagnosis was exposure to toxic gases. Compared to non-fatal fires, fatal residential fires more often originated in the bedroom, were more often caused by smoking, and were more likely to occur at night. Six clusters were identified. The first two clusters were both smoking-related, but were separated into (1) fatalities that often involved elderly people, usually female, whose clothes were ignited (17% of the sample), (2) middle-aged (45–64 years old), (often) intoxicated men, where the fire usually originated in furniture (30%). Other clusters that were identified in the analysis were related to (3) fires caused by technical fault, started in electrical installations in single houses (13%), (4) cooking appliances left on (8%), (5) events with unknown cause, room and object of origin (25%), and (6) deliberately set fires (7%). **Conclusions:** Fatal residential fires were unevenly distributed in the Swedish population. To further reduce the incidence of fire mortality, specialized prevention efforts that focus on the different needs of each cluster are required. **Practical applications:** Cooperation between various societal functions, e.g. rescue services, elderly care, psychiatric clinics and other social services, with an application of both human and technological interventions, should reduce residential fire mortality in Sweden.

- **Keywords:** Residential fire-related mortality; Fatal fires; Fire deaths; Record linkage; Cluster analysis

**Katherine E. Schofield, Bruce H. Alexander, Susan G. Gerberich, Richard F. MacLehose. *Workers' compensation loss prevention representative contact and risk of lost-time injury in construction policyholders. Pages 101-105.***

**Introduction:** Insurance loss prevention (LP) representatives have access and contact with businesses and employees to provide targeted safety and health resources. Construction firms, especially those smaller in size, are a high-risk population. This research evaluated the association between LP rep contact and risk for lost-time injuries in construction policyholders. **Methods:** Workers' compensation data were utilized to track LP rep contact with policyholders and incidence of lost-time injury over time. Survival analysis with repeated events modeling calculated hazard ratios (HR) and 95% confidence intervals (CI). **Results:** Compared no LP contact, one contact was associated with a 27% reduction of risk (HR = 0.73, CI = 0.65–0.82), two with a 41% (HR = 0.59, CI = 0.51–0.68), and three or more contacts with a 28% reduction of risk (HR = 0.72, CI = 0.65–0.81). **Conclusions:** LP reps appear to be a valuable partner in efforts to reduce injury burden. Their presence or contact with policyholders is consistent with reduction in overall incidence of lost-time injuries. **Practical applications:** Reduction in lost-time injuries, resulting in reduced workers' compensation costs for policyholders and insurance companies, builds a business-case for safety and injury prevention. LP reps are often a low or no-cost benefit for insurance policyholders and may be an important injury prevention resource for small firms and/or those with lack of safety resources and staff.

- **Keywords:** Workers' compensation; Injury; Survival analysis; Business-case; Safety

**David M. DeJoy, Todd D. Smith, Mari-Amanda Dyal. *Safety climate and firefighting: Focus group results.* Pages 107-116.**

**Background:** Firefighting is a hazardous occupation and there have been numerous calls for fundamental changes in how fire service organizations approach safety and balance safety with other operational priorities. These calls, however, have yielded little systematic research. **Methods:** As part of a larger project to develop and test a model of safety climate for the fire service, focus groups were used to identify potentially important dimensions of safety climate pertinent to firefighting. **Results:** Analyses revealed nine overarching themes. Competency/professionalism, physical/psychological readiness, and that positive traits sometimes produce negative consequences were themes at the individual level; cohesion and supervisor leadership/support at the workgroup level; and politics/bureaucracy, resources, leadership, and hiring/promotion at the organizational level. A multi-level perspective seems appropriate for examining safety climate in firefighting. **Conclusions:** Safety climate in firefighting appears to be multi-dimensional and some dimensions prominent in the general safety climate literature also seem relevant to firefighting. These results also suggest that the fire service may be undergoing transitions encompassing mission, personnel, and its fundamental approach to safety and risk. **Practical applications:** These results help point the way to the development of safety climate measures specific to firefighting and to interventions for improving safety performance.

- **Keywords:** Firefighters; Safety climate; Occupational safety; Injury prevention; Qualitative research

**Myunghoon Ko, Srinivas Reddy Geedipally, Troy Duane Walden, Robert Carl Wunderlich. *Effects of red light running camera systems installation and then deactivation on intersection safety.* Pages 117-126.**

**Introduction:** The primary objective of this paper is to evaluate the safety impacts of red-light running camera (RLC) system installation and then deactivation at 48 intersections in Houston, Texas. The second objective is to evaluate the spillover effect at nearby non-treated intersections in Houston after the deactivation. **Methods:** To accomplish study objectives, an Empirical Bayes (EB) before-after analysis was used. **Results:** The results indicate statistically significant collision reductions on all red-light running (RLR) crash types (37 percent) as well as right-angle RLR crashes (47 percent) at the treated intersections after RLC activation. By way of comparison, the RLC deactivation analysis indicated that crashes increased by 20 percent for all RLR crash types and by 23 percent in right-angle RLR crashes at the formerly treated intersections. After deactivation, all severity RLR crashes increased more than expected at nearby non-treated intersections, which indicates the possibility of an adverse spillover effect. However, fatal/injury crashes associated with rear-end decreased after deactivation at both formerly treated and non-treated intersections, although those rear-end crashes account for smaller proportions when compared to all crash types/right-angle crashes. **Practical applications:** Overall, removing RLC treatments results in a negative reaction to the safety benefits that the treatment provides when it is in place and actively working and to the nearby intersections where the treatment has not been implemented. This study helps define the effects that RLCs have on safety at signalized intersections after installation and deactivation.

- **Keywords:** Intersection safety; Red-light running cameras; Enforcement; Cameras deactivation

**Pieter A. Cornelissen, Joris J. Van Hoof, Menno D.T. De Jong. *Determinants of safety outcomes and performance: A systematic literature review of research in four high-risk industries. Pages 127-141.***

**Introduction:** In spite of increasing governmental and organizational efforts, organizations still struggle to improve the safety of their employees as evidenced by the yearly 2.3 million work-related deaths worldwide. Occupational safety research is scattered and inaccessible, especially for practitioners. Through systematically reviewing the safety literature, this study aims to provide a comprehensive overview of behavioral and circumstantial factors that endanger or support employee safety. **Method:** A broad search on occupational safety literature using four online bibliographical databases yielded 27.527 articles. Through a systematic reviewing process 176 online articles were identified that met the inclusion criteria (e.g., original peer-reviewed research; conducted in selected high-risk industries; published between 1980-2016). Variables and the nature of their interrelationships (i.e., positive, negative, or nonsignificant) were extracted, and then grouped and classified through a process of bottom-up coding. **Results:** The results indicate that safety outcomes and performance prevail as dependent research areas, dependent on variables related to management & colleagues, work(place) characteristics & circumstances, employee demographics, climate & culture, and external factors. Consensus was found for five variables related to safety outcomes and seven variables related to performance, while there is debate about 31 other relationships. Last, 21 variables related to safety outcomes and performance appear understudied. **Conclusions:** The majority of safety research has focused on addressing negative safety outcomes and performance through variables related to others within the organization, the work(place) itself, employee demographics, and—to a lesser extent—climate & culture and external factors. **Practical applications:** This systematic literature review provides both scientists and safety practitioners an overview of the (under)studied behavioral and circumstantial factors related to occupational safety behavior. Scientists could use this overview to study gaps, and validate or falsify relationships. Safety practitioners could use the insights to evaluate organizational safety policies, and to further development of safety interventions.

- **Keywords:** Occupational safety; Workplace circumstances; Employees; Demographics; Safety performance

**Giulio Bianchi Piccinini, Johan Engström, Jonas Bårgman, Xuesong Wang. *Factors contributing to commercial vehicle rear-end conflicts in China: A study using on-board event data recorders. Pages 143-153.***

**Introduction:** In the last 30 years, China has undergone a dramatic increase in vehicle ownership and a resulting escalation in the number of road crashes. Although crash figures are decreasing today, they remain high; it is therefore important to investigate crash causation mechanisms to further improve road safety in China. **Method:** To shed more light on the topic, naturalistic driving data was collected in Shanghai as part of the evaluation of a behavior-based safety service. The data collection included instrumenting 47 vehicles belonging to a commercial fleet with data acquisition systems. From the overall sample, 91 rear-end crash or near-crash (CNC) events, triggered by 24 drivers, were used in the analysis. The CNC were annotated by three researchers, through an expert assessment methodology based on videos and kinematic variables. **Results:** The results show that the main factor behind the rear-end CNC was the adoption of very small safety margins. In contrast to results from previous studies in the US, the following vehicles' drivers typically had their eyes on the road and reacted quickly in response to the evolving conflict in most events. When delayed reactions occurred, they were mainly due to driving-related visual scanning mismatches (e.g., mirror checks) rather than visual distraction. Finally, the study identified four main conflict scenarios that represent the typical development of rear-end conflicts in this data. **Conclusions:** The findings of this study have several practical applications, such as informing the specifications of in-

vehicle safety measures and automated driving and providing input into the design of coaching/training procedures to improve the driving habits of drivers.

- **Keywords:** Naturalistic driving data; Truck drivers; Human factors; Traffic safety; Active safety systems

**Ahmed Farid, Mohamed Abdel-Aty, Jaeyoung Lee, Naveen Eluru. *Application of Bayesian informative priors to enhance the transferability of safety performance functions. Pages 155-161.***

**Introduction:** Safety performance functions (SPFs) are essential tools for highway agencies to predict crashes, identify hotspots and assess safety countermeasures. In the Highway Safety Manual (HSM), a variety of SPFs are provided for different types of roadway facilities, crash types and severity levels. Agencies, lacking the necessary resources to develop own localized SPFs, may opt to apply the HSM's SPFs for their jurisdictions. Yet, municipalities that want to develop and maintain their regional SPFs might encounter the issue of the small sample bias. Bayesian inference is being conducted to address this issue by combining the current data with prior information to achieve reliable results. It follows that the essence of Bayesian statistics is the application of informative priors, obtained from other SPFs or experts' experiences.

**Method:** In this study, we investigate the applicability of informative priors for Bayesian negative binomial SPFs for rural divided multilane highway segments in Florida and California. An SPF with non-informative priors is developed for each state and its parameters' distributions are assigned to the other state's SPF as informative priors. The performances of SPFs are evaluated by applying each state's SPFs to the other state. The analysis is conducted for both total (KABCO) and severe (KAB) crashes. **Results, conclusions and practical applications:** As per the results, applying one state's SPF with informative priors, which are the other state's SPF independent variable estimates, to the latter state's conditions yields better goodness of fit (GOF) values than applying the former state's SPF with non-informative priors to the conditions of the latter state. This is for both total and severe crash SPFs. Hence, for localities where it is not preferred to develop own localized SPFs and adopt SPFs from elsewhere to cut down on resources, application of informative priors is shown to facilitate the process.

- **Keywords:** Bayesian informative priors; Negative binomial models; Markov chain Monte Carlo simulations; Highway safety Manual; Transferability

**Bryan Wimer, Christopher Pan, Tim Lutz, Mat Hause, Chris Warren, Ren Dong, Sherry Xu. *Evaluating the stability of a freestanding Mast Climbing Work Platform. Pages 163-172.***

Mast Climbing Work Platforms (MCWPs) are becoming more common at construction sites and are being used as an alternative to traditional scaffolding. Although their use is increasing, little to no published information exists on the potential safety hazards they could pose for workers. As a last line of defense, a personal fall-arrest system can be used to save a worker in a fall incident from the platform. There has been no published information on whether it is safe to use such a personal fall-arrest system with MCWPs. In this study, the issues of concern for occupational safety included: (a) the overall stability of the freestanding mast climber during a fall-arrest condition and (b) whether that fall-arrest system could potentially present safety hazards to other workers on the platform during a fall-arrest condition. This research project investigated those safety concerns with respect to the mast climber stability and the workers using it by creating fall-arrest impact forces that are transmitted to the equipment and by subsequently observing the movement of the mast climber and the working deck used by the workers. This study found that when the equipment was erected and used according to the manufacturer's recommendations during a fall-arrest condition, destabilizing forces were very small and there were no signs of potential of MCWP collapse. However, potential fall

hazards could be presented to other workers on the platform during a fall arrest. Workers near an open platform are advised to wear a personal fall-arrest system to reduce the risk of being ejected. Due to the increasing use of MCWPs at construction sites, there is a corresponding need for evidence and science-based safety guidelines or regulations and further research should be conducted to continue to fill the knowledge gap with MCWP equipment.

- **Keywords:** Mast Climbing Work Platform; Mast climbers; Fall exposure; Fall-arrest; Fall hazard

**Anthony W. Parker, Megan J. Tones, Gabrielle E. Ritchie. *Development of a multilevel health and safety climate survey tool within a mining setting.* Pages 173-180.**

**Introduction:** This study aimed to design, implement and evaluate the reliability and validity of a multifactorial and multilevel health and safety climate survey (HSCS) tool with utility in the Australian mining setting. **Methods:** An 84-item questionnaire was developed and pilot tested on a sample of 302 Australian miners across two open cut sites. **Results:** A 67-item, 10 factor solution was obtained via exploratory factor analysis (EFA) representing prioritization and attitudes to health and safety across multiple domains and organizational levels. Each factor demonstrated a high level of internal reliability, and a series of ANOVAs determined a high level of consistency in responses across the workforce, and generally irrespective of age, experience or job category. Participants tended to hold favorable views of occupational health and safety (OH&S) climate at the management, supervisor, workgroup and individual level. **Conclusion:** The survey tool demonstrated reliability and validity for use within an open cut Australian mining setting and supports a multilevel, industry specific approach to OH&S climate. Findings suggested a need for mining companies to maintain high OH&S standards to minimize risks to employee health and safety. Future research is required to determine the ability of this measure to predict OH&S outcomes and its utility within other mine settings. **Practical applications:** As this tool integrates health and safety, it may have benefits for assessment, monitoring and evaluation in the industry, and improving the understanding of how health and safety climate interact at multiple levels to influence OH&S outcomes.

- **Keywords:** Mining; Occupational health; Safety attitudes questionnaire; Safety climate; Scale development and validity

**Ruth A. Shults, Allan F. Williams. *Trends in teen driver licensure, driving patterns and crash involvement in the United States, 2006–2015.* Pages 181-184.**

**Introduction:** The Monitoring the Future (MTF) survey provides nationally-representative annual estimates of licensure and driving patterns among U.S. teens. A previous study using MTF data reported substantial declines in the proportion of high school seniors that were licensed to drive and increases in the proportion of nondrivers following the recent U.S. economic recession. **Method:** To explore whether licensure and driving patterns among U.S. high school seniors have rebounded in the post-recession years, we analyzed MTF licensure and driving data for the decade of 2006–2015. We also examined trends in teen driver involvement in fatal and nonfatal injury crashes for that decade using data from the Fatality Analysis Reporting System and National Automotive Sampling System General Estimates System, respectively. **Results:** During 2006–2015, the proportion of high school seniors that reported having a driver's license declined by 9 percentage points (11%) from 81% to 72% and the proportion that did not drive during an average week increased by 8 percentage points (44%) from 18% to 26%. The annual proportion of black seniors that did not drive was consistently greater than twice the proportion of nondriving white seniors. Overall during the decade, 17- and 18-year-old

drivers experienced large declines in fatal and nonfatal injury crashes, although crashes increased in both 2014 and 2015. **Conclusions:** The MTF data indicate that licensure and driving patterns among U.S. high school seniors have not rebounded since the economic recession. The recession had marked negative effects on teen employment opportunities, which likely influenced teen driving patterns. Possible explanations for the apparent discrepancies between the MTF data and the 2014 and 2015 increases in crashes are explored. **Practical applications:** MTF will continue to be an important resource for clarifying teen driving trends in relation to crash trends and informing strategies to improve teen driver safety.

- **Keywords:** Adolescent; Teenagers; Licensure; Automobile driving; Motor vehicle crashes

**Francisco J. Forteza, Jose M. Carretero-Gómez, Albert Sesé. *Effects of organizational complexity and resources on construction site risk. Pages 185-198.***

**Introduction:** Our research is aimed at studying the relationship between risk level and organizational complexity and resources on construction sites. Our general hypothesis is that site complexity increases risk, whereas more resources of the structure decrease risk. A Structural Equation Model (SEM) approach was adopted to validate our theoretical model. **Method:** To develop our study, 957 building sites in Spain were visited and assessed in 2003–2009. All needed data were obtained using a specific tool developed by the authors to assess site risk, structure and resources (Construction Sites Risk Assessment Tool, or CONSRAT). This tool operationalizes the variables to fit our model, specifically, via a site risk index (SRI) and 10 organizational variables. Our random sample is composed largely of small building sites with general high levels of risk, moderate complexity, and low resources on site. **Conclusions:** The model obtained adequate fit, and results showed empirical evidence that the factors of complexity and resources can be considered predictors of site risk level. **Practical Applications:** Consequently, these results can help companies, managers of construction and regulators to identify which organizational aspects should be improved to prevent risks on sites and consequently accidents.

- **Keywords:** Risk site; Construction; Organization; Complexity; Resources

**Caroline K. Smith, Naomi J. Anderson. *Work-related injuries among commercial janitors in Washington State, comparisons by gender. Pages 199-207.***

**Introduction:** We analyzed workers' compensation (WC) data to identify characteristics related to workers' compensation claim outcomes among janitorial service workers in Washington State. **Method:** We analyzed WC data from the Washington State Department of Labor & Industries (L&I) State Fund (SF) from January 1, 2003 through December 31, 2013, for janitorial service workers employed in the National Occupational Research Agenda (NORA) Services Sector. We constructed multivariable models to identify factors associated with higher medical costs and increased time lost from work. **Results:** There were 2,390 janitorial service compensable claims available for analysis. There were significant differences in injury type and other factors by gender, age, and language preference. Linguistic minority status was associated with longer time loss and higher median medical costs. Women were estimated to account for 35% of janitorial service workers but made up 55% of the compensable claims in this study. **Conclusions:** Janitorial service workers comprise a large vulnerable occupational group in the U.S. workforce. Identifying differences by injury type and potential inequitable outcomes by gender and language is important to ensuring equal treatment in the workers' compensation process. **Practical applications:** There were significant differences in injury and individual characteristics between men and women in this study.

Women had twice the estimated rate of injury to men, and were more likely to require Spanish language materials. Improving communication for training and knowledge about the workers' compensation system appear to be high priorities in this population of injured janitorial service workers.

- **Keywords:** Workers' compensation; Occupational injuries; Health disparities; Spanish language; Low Wage

**Thajudeen Hassan, M.N. Vinodkumar, Neethu Vinod. *Role of sensation seeking and attitudes as mediators between age of driver and risky driving of Powered Two Wheelers. Pages 209-215.***

**Introduction:** This study examines the effect of age of driver on risky driving of Powered Two-Wheelers (PTW) employing sensation seeking and safety attitudes as mediators. **Methods:** A survey was conducted with 1299 PTW drivers (1089 males and 210 females) within the age of 18 and 63 years, living in the state of Kerala, India. The questionnaire consisted of 31 items to measure sensation seeking, safety attitude, and risky driving of the drivers. **Results:** Mediation models were examined using sensation seeking as mediator and secondly safety attitudes as mediators. The relationship between the driver's age and risky driving was fully mediated by all the three variables. **Practical applications:** Results of this study suggest that safety strategies should be employed to reduce risky driving tendencies that could be achieved by shaping or adapting the mediators (reducing sensation seeking and enhancing safety attitudes). This goal could be reached by starting to educate children about this at an early stage when they are at school as well as by social learning and safety awareness campaigns.

- **Keywords:** Driver age; Sensation seeking; Safety attitude; Risky driving; Mediation analysis; Powered Two-Wheelers (PTW)

**Xiuwen Sue Dong, Julie A. Largay, Xuanwen Wang, Chris Trahan Cain, Nancy Romano. *The construction FACE database – Codifying the NIOSH FACE reports. Pages 217-225.***

**Introduction:** The National Institute for Occupational Safety and Health (NIOSH) has published reports detailing the results of investigations on selected work-related fatalities through the Fatality Assessment and Control Evaluation (FACE) program since 1982. **Method:** Information from construction-related FACE reports was coded into the Construction FACE Database (CFD). Use of the CFD was illustrated by analyzing major CFD variables. **Results:** A total of 768 construction fatalities were included in the CFD. Information on decedents, safety training, use of PPE, and FACE recommendations were coded. Analysis shows that one in five decedents in the CFD died within the first two months on the job; 75% and 43% of reports recommended having safety training or installing protection equipment, respectively. **Conclusion:** Comprehensive research using FACE reports may improve understanding of work-related fatalities and provide much-needed information on injury prevention. **Practical Application:** The CFD allows researchers to analyze the FACE reports quantitatively and efficiently.

- **Keywords:** Construction industry; Fatality assessment and control evaluation; Injury prevention and intervention; Occupational fatality; Workplace safety

**Paul Schepers, Berry den Brinker, Rob Methorst, Marco Helbich. *Pedestrian falls: A review of the literature and future research directions. Pages 227-234.***

**Introduction:** Pedestrian falls (PFs) – falls in public spaces without collisions with other road users – are a significant cause of serious transport-related injuries, amounting to

three-quarters of all pedestrians admitted to hospital. **Methods:** This scoping review examined peer-reviewed research on PFs published between 1995 and 2015. Electronic databases (Scopus, SafetyLit, and PubMed) were used to find studies identifying PFs or outdoor falls (the latter also including falls in gardens). **Results:** We identified only 28 studies reporting relevant information on PFs (i.e., 15 prospective, 10 retrospective, and 3 intervention studies). The results show that more walking is related to a lower risk of PFs. Older people, especially older women, have a higher risk of (injurious) PFs. Outdoor fall victims have equally good or better health characteristics and scores on balance tests compared to those who have not experienced such falls. Road factors such as uneven surfaces, busy junctions, stairs, and slippery surfaces seem to play an important role in PFs, but much of the research on these factors is of a qualitative nature. **Conclusions:** PF victims are generally in good health (apart from normal age-related problems) but at risk due to road factors. **Practical applications:** We recommend to adopt a human factors approach. The road system should be adapted to human capabilities and limitations including those of pedestrians. Measures such as preventing uneven surfaces and good winter maintenance seem to be effective. However, we advise more quantitative research on road factors to inform design guidelines and standards for public space authorities given the qualitative nature of current research on road factors.

- **Keywords:** Outdoor falls; Pedestrian accidents; Walking; Road factors; Road safety

**David C. Schwebel, M. Alison Tillman, Marie Crew, Matthew Muller, Anna Johnston. *Using interactive virtual presence to support accurate installation of child restraints: Efficacy and parental perceptions.* Pages 235-243.**

**Introduction:** Child restraint systems (car seats) reduce injury risk for young children involved in motor-vehicle crashes, but parents experience significant difficulty installing child restraints correctly. Installation by certified child passenger safety (CPS) technicians yields more accurate installation, but is impractical for broad distribution. A potential solution is use of interactive virtual presence via smartphone application (app), which permits “hands on” teaching through simultaneous and remote joint exposure to 3-dimensional images. **Method:** In two studies, we examined the efficacy of remote communication via interactive virtual presence to help parents install child restraints. Study 1 was conducted at existing car seat checkpoints and Study 2 at preschools/daycare centers. In both cases, existing installations were assessed by certified CPS technicians using an objective coding scheme. Participants then communicated with remotely-located certified CPS technicians via a smartphone app offering interactive virtual presence. Technicians instructed participants to install child restraints and then the installation was inspected by on-site technicians. Both before and after the remote interaction, participants completed questionnaires concerning perception of child restraints and child restraint installation, self-efficacy to install child restraints, and perceived risk of injury to children if they were in a crash. **Results:** In both studies, accuracy of child restraint installations improved following the remote interaction between participants and certified CPS technicians. Together, the two samples achieved a weighted average of 90% correct installations across a multi-point inspection. Both samples reported increased self-efficacy to install child restraints and altered perceptions about the accuracy of the child restraint installations in their vehicles. **Conclusions:** Findings support use of interactive virtual presence as a strategy to realize accurate installation of child restraints. **Practical applications:** Interactive virtual presence between certified CPS technicians and the public via smartphone app has potential to improve proper child restraint installations broadly, including to vulnerable and underserved rural populations.

- **Keywords:** Smartphone app; M-health; Motor vehicle safety; Child restraint systems, child passenger safety

**Laurie F. Beck, Daniel D. Nguyen. *School transportation mode, by distance between home and school, United States, Consumer Styles 2012. Pages 245-251.***

**Introduction:** Motor-vehicle crashes are a leading cause of death among children in the United States, and almost one-fourth of all trips by school-aged children are trips to and from school. This study sought to determine how children (5–18 years) travel to and from school and, among those living  $\leq 1$  mile of school, to explore the role of school bus service eligibility on school travel mode. **Methods:** We used national 2012 survey data to determine prevalence of usual school travel mode, stratified by distance from school. For those living  $\leq 1$  mile of school, multivariable regression was conducted to assess the association between bus service eligibility and walking or bicycling. **Results:** Almost half (46.6%) of all children rode in passenger vehicles (PV) to school and 41.8% did so for the trip home. Results were similar among those living  $\leq 1$  mile (48.1%, PV to school; 41.3%, PV to home). Among those living  $\leq 1$  mile, 21.9% and 28.4% of children walked or bicycled to and from school, respectively. Ineligibility for school bus service was strongly associated with walking or bicycling to school [adjusted prevalence ratio (aPR: 5.36;  $p < 0.001$ )] and from school (aPR: 5.36;  $p < 0.001$ ). **Conclusions:** Regardless of distance from school, passenger vehicles were a common mode of travel. For children who live close to school, the role that school bus service eligibility plays in walking or bicycling deserves further consideration. **Practical applications:** Given the large proportion of children who use passenger vehicles for school travel, effective interventions can be adopted to increase proper child restraint and seat belt use and reduce crash risks among teen drivers. Better understanding of conditions under which bus service is offered to children who live close to school could inform efforts to improve pedestrian and bicyclist safety for school travel.

- **Keywords:** Motor vehicle; Child passenger safety; Children; Pedestrians; Bicyclists

**Jeneita M. Bell, Matthew J. Breiding, Lara DePadilla. *CDC's efforts to improve traumatic brain injury surveillance. Pages 253-256.***

**Introduction:** Youth sports concussion has become a prominent public health issue due to growing concern about the risk of long-term health effects. **Method:** A broad spectrum of stakeholders has convened to propose solutions, including a committee of the National Academy of Sciences (NAS) who systematically examined the issue and, in a 2014 report, made a series of recommendations to better address this public health problem. **Results:** Among these recommendations, the NAS committee called for CDC to develop a plan for a comprehensive surveillance system to better quantify the incidence and outcomes of youth sports concussion among children 5 to 21 years of age. Since the release of the NAS report, CDC has taken action to address this recommendation and, in the process, develop strategies to improve traumatic brain injury (TBI) surveillance more broadly. The challenges outlined by the NAS committee with respect to producing comprehensive incidence estimates of youth sports concussion are not exclusive to youth sports concussion, but also apply to TBI surveillance overall. In this commentary, we will discuss these challenges, the process CDC has undertaken to address them and describe our plan for improving TBI and youth sports concussion surveillance.

- **Keywords:** Traumatic; Brain; Injury; Sports; Survey