

Journal of Safety Research – rok 2023, Volume 84

February 2023



Robert Andrew Yockey, Cristina S. Barroso. *Drugged driving among U.S. adolescents, 2016–2019, USA. Pages 1-6.*

Introduction: Drugged driving, the operation of a vehicle under the influence of any illegal drugs and alcohol, is a growing problem, but remains understudied among adolescents. The purpose of this article is to estimate past-year driving under the influence of alcohol, marijuana, and other drugs among a large sample of U.S. adolescents and potential associations (e.g., age, race, metropolitan status, sex). Design: A cross-sectional secondary data analysis of the 2016–2019 National Survey on Drug Use and Health among 17,520 adolescents ages 16–17-years old was conducted. Weighted logistic regression models were built to determine potential associations to drugged driving. Results: An estimated 2.00% of adolescents drove under the influence of alcohol in the past year, 5.65% drove under the influence of marijuana in the past year, and an estimated 0.48% drove under the influence of other drugs other than marijuana in the past year. Differences were based on race, past-year drug use, and county status. Conclusions: Drugged driving is a growing problem among adolescents and interventions are greatly needed to mitigate these behaviors among youth.

- **Keywords:** Drugged driving; Adolescence; Health behavior

Muhammad Tahmidul Haq, Vincent-Michael Kwesi Ampadu, Khaled Ksaibati. *An investigation of brake failure related crashes and injury severity on mountainous roadways in Wyoming. Pages 7-17.*

Introduction: Although the braking system plays a key role in a safe and smooth vehicular operation, it has not been given proper attention and hence brake failures are still underrepresented in traffic safety. The current body of literature on brake failure-related crashes is very limited. Moreover, no previous study was found to extensively investigate the factors associated with brake failures and the corresponding injury severity. This study aims to fill this knowledge gap by examining brake failure-related crashes and assessing the factors associated with the corresponding occupant injury severity. Method: The study first performed a Chi-square analysis to examine the relationship among brake failure, vehicle age, vehicle type, and grade type. Three

hypotheses were formulated to investigate the associations between the variables. Based on the hypotheses, vehicles aged more than 15 years, trucks, and downhill grade segments seemed to be highly associated with brake failure occurrences. The study also applied the Bayesian binary logit model to quantify the significant impacts of brake failures on occupant injury severity and identified various vehicle, occupants, crash, and roadway characteristics. Conclusions and Practical Applications: Based on the findings, several recommendations regarding enhancing statewide vehicle inspection regulation were outlined.

- **Keywords:** Traffic safety; Brake failure; Injury severity; Occupant protection; Bayesian binary logit model

Daniel Kielminski, Elise Atkinson, Diane Peters, Seann Willson, Theresa Atkinson. *Crash characteristics for classic/historic vehicles and comparisons to newer vehicles. Pages 18-23.*

Introduction: Older vehicles, commonly referred to as “classic,” “vintage,” or “historic” vehicles (CVH), share the roadways with newer vehicles. Older vehicles lacking safety systems likely come with an increased risk of fatality, however there is no study examining the typical conditions for crashes involving CVH. Method: This study utilized information from crashes occurring in 2012 to 2019 to estimate fatal crash rates for vehicles grouped by model year deciles. Data from crashes documented in the National Highway Traffic Safety Administration’s (NHTSA) FARS and GES/CRSS data sets were utilized to examine roadway, temporal, and crash types for passenger vehicles produced in 1970 or earlier (CVH). Results: These data show CVH crashes are rare (<1% of crashes), but carry a relative risk of fatality from 6.70 (95th CI: 5.44–8.26) for impacts with other vehicles, which was the most common crash, to 9.53 (7.28–12.47) for rollovers. Most crashes occurred in dry weather, typically during summer, in rural areas, most frequently on two lane roads, and in areas with speed limits between 30 and 55 mph. Factors associated with fatality for occupants in CVH included alcohol use, lack of seat belt use, and older age. Conclusions and Practical Applications: Crashes involving a CVH are a rare event but have catastrophic consequences when they do occur. Regulations that limit driving to daylight hours may lower the risk of crash involvement, and safety messaging to promote belt use and sober driving may also help. Additionally, as new “smart” vehicles are developed, engineers should keep in mind that older vehicles remain on the roadway. New driving technologies will need to safely interact with these older, less safe vehicles.

- **Keywords:** Fatality; Classic car; Model year; Crash; Driver

Marco Dozza, Tianyou Li, Lucas Billstein, Christoffer Svernlöv, Alexander Rasch. *How do different micro-mobility vehicles affect longitudinal control? Results from a field experiment. Pages 24-32.*

Introduction: While micromobility vehicles offer new transport opportunities and may decrease fuel emissions, the extent to which these benefits outweigh the safety costs is still uncertain. For instance, e-scooterists have been reported to experience a tenfold crash risk compared to ordinary cyclists. Today, we still do not know whether the real safety problem is the vehicle, the human, or the infrastructure. In other words, the new vehicles may not necessarily be unsafe; the behavior of their riders, in combination with an infrastructure that was not designed to accommodate micromobility, may be the real issue. Method: In this paper, we compared e-scooters and Segways with bicycles in field trials to determine whether these new vehicles create different constraints for longitudinal control (e.g., in braking avoidance maneuvers). Results: The results show that acceleration and deceleration performance changes across vehicles; specifically, e-scooters and Segways that we tested cannot brake as efficiently as bicycles. Further, bicycles are experienced as more stable, maneuverable, and safe than Segways and e-

scooters. We also derived kinematic models for acceleration and braking that can be used to predict rider trajectories in active safety systems. Practical Applications: The results from this study suggest that, while new micromobility solutions may not be intrinsically unsafe, they may require some behavior and/or infrastructure adaptations to improve their safety. We also discuss how policy making, safety system design, and traffic education may use our results to support the safe integration of micromobility into the transport system.

- **Keywords:** E-scooters; Segways; Cycling safety; Bicycle dynamics; Active safety

Bodhi Weaver, Andrea Kirk-Brown, Denise Goodwin, Jennie Oxley. *Psychosocial safety behavior: A scoping review of behavior-based approaches to workplace psychosocial safety. Pages 33-40.*

Introduction: In an era of workplace safety where psychosocial risks are widely recognized as occupational hazards, emerging research has sought to clarify the impact of these risks and the requisite interventions for improving psychosocial safety climate and reducing psychological injury risk. Method: The construct of psychosocial safety behavior (PSB) provides a novel framework for emerging research that seeks to apply a behavior-based safety approach to workplace psychosocial risks across several high-risk industries. This scoping review aims to provide a synthesis of existing literature on PSB, including its development as a construct and application in workplace safety interventions to date. Results: Although a limited number of studies of PSB were identified, the findings of this review provide evidence for growing cross-sector applications of behaviorally-focused approaches to improving workplace psychosocial safety. In addition, the identification of a broad spectrum of terminology surrounding the construct of PSB provides evidence of key theoretical and empirical gaps, with implications for future intervention-based research to address emerging areas of focus.

- **Keywords:** Psychosocial safety behavior; PSB; Workplace mental health; Psychosocial hazards; Enacted psychosocial safety

Eva Michelaraki, Marios Sekadakis, Christos Katrakazas, Apostolos Ziakopoulos, George Yannis. *One year of COVID-19: Impacts on safe driving behavior and policy recommendations. Pages 41-60.*

Introduction: In the unprecedented year of 2020, the rapid spread of COVID-19 disrupted everyday activities worldwide, leading the majority of countries to impose lockdowns and confine citizens in order to minimize the exponential increase in cases and casualties. To date, very few studies have been concerned with the effect of the pandemic on driving behavior and road safety, and usually explore data from a limited time span. Method: This study presents a descriptive overview of several driving behavior indicators as well as road crash data in correlation with the strictness of response measures in Greece and the Kingdom of Saudi Arabia (KSA). A k-means clustering approach was also employed to detect meaningful patterns. Results: Results indicated that during the lockdown periods, speeds were increased by up to 6%, while harsh events were increased by about 35% in the two countries, compared to the period after the confinement. However, the imposition of another lockdown did not cause radical changes in Greek driving behavior during the late months of 2020. Finally, the clustering algorithm identified a "baseline," a "restrictions," and a "lockdown" driving behavior cluster, and it was shown that harsh braking frequency was the most distinctive factor. Policy recommendations: Based on these findings, policymakers should focus on the reduction and enforcement of speed limits, especially within urban areas, as well as the incorporation of active travelers in the current transport infrastructure.

- **Keywords:** COVID-19; Response measures; Driving behavior; Road crashes; k-Means clustering

Elizabeth Karpinski, Ellie Bayles, Lisa Daigle, Dan Mantine. *Comparison of motor-vehicle involved e-scooter fatalities with other traffic fatalities.* Pages 61-73.

Introduction: Shared e-scooters are an emerging mode of transportation with many features that make their physical properties, behavior, and travel patterns unique. Safety concerns have been raised concerning their usage, but it is difficult to understand effective interventions with so little data available. Methods: Using media and police reports, a crash dataset was developed of rented dockless e-scooter fatalities in crashes involving motor vehicles that occurred in the United States in 2018–2019 (n = 17) and the corresponding records from the National Highway Traffic Safety Administration data were identified. The dataset was used to perform a comparative analysis with other traffic fatalities during the same time period. Results: Compared to fatalities from other modes of transportation, e-scooter fatality victims are younger and more likely male. More e-scooter fatalities occur at night than any other mode, except pedestrians. E-scooter users are comparatively as likely as other unmotorized vulnerable road users to be killed in a hit-and-run crash. While e-scooter fatalities had the highest proportion of alcohol involvement of any mode, this was not significantly higher than the rate seen in pedestrian and motorcyclist fatalities. E-scooter fatalities were more likely than pedestrian fatalities to be intersection-related, and to involve crosswalks or traffic signals. Conclusions: E-scooter users share a mix of the same vulnerabilities as both pedestrians and cyclists. Although e-scooter fatalities are demographically most similar to motorcycle fatalities, crash circumstances share more similarities with pedestrian or cyclist fatalities. Other characteristics of e-scooter fatalities are notably distinct from other modes. Practical Applications: E-scooter use must be understood by users and policymakers to be a distinct mode of transportation. This research highlights the similarities and differences between similar modes, like walking and cycling. By using this information on comparative risk, e-scooter riders and policymakers can take strategic action to minimize the number of fatal crashes.

- **Keywords:** E-scooters; Micromobility; Transportation fatalities; Transportation safety

Chengying Hua, Wei (David) Fan. *Injury severity analysis of time-of-day fluctuations and temporal volatility in reverse sideswipe collisions: A random parameter model with heterogeneous means and heteroscedastic variances.* Pages 74-85.

Problem: Sideswipe collisions in the opposite direction often result in more severe injuries than the typical same-direction crashes, especially when light trucks are involved. This study investigates the time-of-day fluctuations and temporal volatility of potential factors that affect the injury severity of reverse sideswipe collisions. Methods: A series of random parameters logit models with heterogeneous means and heteroscedastic variances are developed and utilized to explore unobserved heterogeneity inherent in variables and preclude biased parameter estimation. The segmentation of estimated results is also examined through temporal instability tests. Results: Based on crash data in North Carolina, a number of contributing factors are identified that have profound associations with obvious and moderate injuries. Meanwhile, significant temporal volatility is observed in the marginal effects of several factors such as driver restraint, alcohol or drugs impact, Sport Utility Vehicle (SUV) at fault, and adverse road surface across three different periods. Fluctuations in the time of day indicate that restraint with belts is more effective in mitigating the obvious injury in the nighttime, and high-class roadway sustains a higher probability of resulting in more serious injury compared to the daytime. Practical Applications: The findings of this study could help further guide the implementation of safety countermeasures related to atypical sideswipe collisions.

- **Keywords:** Crash injury severity; Sideswipe collisions; Temporal instability; Time of day; Random parameter

Danica Pollard, John Duncan Grewar. *Cars dent, horse riders break: Analysis of police-recorded injury incidents involving ridden horses on public roads in Great Britain. Pages 86-98.*

Introduction: Police-recorded road injury data are frequently used to approximate injury risk for different road user groups but a detailed analysis of incidents involving ridden horses has not previously been conducted. This study aims to describe human injuries resulting from interactions between ridden horses and other road users on public roads in Great Britain and identify factors associated with severe to fatal injuries. Method: Police-recorded road incident data involving ridden horses (2010–2019) were extracted from the Department for Transport (DfT) database and described. Multivariable mixed-effects logistic regression modeling was used to identify factors associated with severe/fatal injury outcomes. Results: A total of 1,031 injury incidents involving ridden horses were reported by police forces, involving 2,243 road users. Out of 1,187 road users injured, 81.4% were female, 84.1% were horse riders, and 25.2% ($n = 293/1,161$) were in the 0–20 year age category. Horse riders represented 238/267 serious injuries and 17/18 fatalities. Vehicle types involved in incidents where horse riders were seriously/fatally injured were mostly cars (53.4%, $n = 141/264$) and vans/light goods vehicles (9.8%, $n = 26$). Horse riders, cyclists, and motorcyclists had higher odds of severe/fatal injury compared to car occupants ($p < 0.001$). Severe/fatal injuries were more likely on roads with 60–70 mph speed limits versus 20–30 mph roads, while odds of severe/fatal injury increased with increasing road user age ($p < 0.001$). Conclusions: Improved equestrian road safety will largely impact females and young people as well as reducing risk of severe/fatal injuries in older road users and those using modes of transport such as pedal-cycles and motorcycles. Our findings support existing evidence that reductions in speed limits on rural roads would help reduce the risk of serious/fatal injuries. Practical applications: More robust equestrian incident data would better inform evidence-based initiatives to improve road safety for all road users. We suggest how this can be done.

- **Keywords:** Equestrian road safety; Casualties; Injury risk; Risk reduction; Near-miss

Douglas D. Boyd. *Use of flight tracking data to inform safety deficiencies for general aviation cross-country operations in challenging flying environments. Pages 99-107.*

Background: Air carriers, but not general aviation, have long employed in-flight data to identify risks/implement corrective measures for improved safety. Herein, using in-flight data, aircraft (in non-instrument-rated private pilots (PPLs) ownership) operations in two potentially hazardous environments (mountains, degraded visibility) were researched for safety practice deficiencies. Four questions were posed, the first two related to mountainous terrain operations: were aircraft (a) flown with hazardous ridge-level winds, (b) within gliding distance of level terrain? Regarding degraded visibility, did aviators (c) depart with low cloud ceilings ($\leq 3,000$ ft.), (d) fly at night away from urban lighting? Methods: The study cohort comprised: (a) single engine aircraft in sole PPL proprietorship (b) registered in Automatic Dependent Surveillance-Broadcast (ADS-B-Out) equipage-required locations prone to low cloud ceilings in three mountainous states. ADS-B-Out data for cross-country flights (>200 nm) were collected. Results: 250 flights (50 airplanes) were tracked (spring/summer 2021). For aircraft transiting areas subject to mountain winds influences, 65% completed one/multiple flights with potentially hazardous ridge-level winds. Two thirds of airplanes traversing mountainous topography would have, for at least one flight, been unable to glide to level terrain with a powerplant failure. Encouragingly, flight departures for 82% of the aircraft were with $>3,000$ ft. cloud ceilings. Likewise, flights for $>86\%$ of the study cohort were undertaken during

daylight. Employing a risk scale, operations for 68% of the study cohort did not exceed low-risk (i.e., ≤ 1 unsafe practice) and high-risk flight(s) (three concurrent unsafe practices) were rare (4% of airplanes). In log-linear analysis, no interactions were evident between the four unsafe practices ($p = 0.602$). Discussion: Hazardous winds and inadequate engine failure planning were identified as safety deficiencies for general aviation mountain operations. Practical Application: This study advocates for the expanded use of ADS-B-Out in-flight data to inform safety deficiencies/implement corrective measures toward improving general aviation safety.

- **Keywords:** Aviation safety; General aviation; Mountain flights; Aviation hazards; Risk factors

Carla L. MacLean, Itiel E. Dror. *Measuring base-rate bias error in workplace safety investigators.* Pages 108-116.

Introduction: This study explored the magnitude of professional industrial investigators' bias to attribute cause to a person more readily than to situational factors (i.e., human error bias). Such biased opinions may relieve companies from responsibilities and liability, as well as compromise efficacy of suggested preventative measures. Method: Professional investigators and undergraduate participants were given a summary of a workplace event and asked to allocate cause to the factors they found causal for the event. The summary was crafted to be objectively balanced in its implication of cause equally between two factors: a worker and a tire. Participants then rated their confidence and the objectivity of their judgment. We then conducted an effect size analysis, which supplemented the findings from our experiment with two previously published research studies that used the same event summary. Results: Professionals exhibited a human error bias, but nevertheless believed that they were objective and confident in their conclusions. The lay control group also showed this human error bias. These data, along with previous research data, revealed that, given the equivalent investigative circumstances, this bias was significantly larger with the professional investigators, with an effect size of $d_{unb} = 0.97$, than the control group with an effect size of only $d_{unb} = 0.32$. Conclusions: The direction and strength of the human error bias can be quantified, and is shown to be larger in professional investigators compared to lay people. Practical Applications: Understanding the strength and direction of bias is a crucial step in mitigating the effects of the bias. The results of the current research demonstrate that mitigation strategies such as proper investigator training, a strong investigation culture, and standardized techniques, are potentially promising interventions to mitigate human error bias.

- **Keywords:** Cognitive bias; Workplace Investigation; Human error bias; Context effects; Expert decision making

Chandrakantan Subramaniam, Johanim Johari, Munir Shehu Mashi, Rohaizah Mohamad. *The influence of safety leadership on nurses' safety behavior: The mediating role of safety knowledge and motivation.* Pages 117-128.

Introduction: This paper investigates the relationships among safety leadership, safety motivation, safety knowledge, and safety behavior in the setting of a tertiary hospital in Klang Valley, Malaysia. Method: Underpinned by the self-efficacy theory, we argue that high-quality safety leadership enhances nurses' safety knowledge and motivation and subsequently, improves their safety behavior (safety compliance and safety participation). A total of 332 questionnaire responses were gathered and analyzed using SmartPLS Version 3.2.9, revealing the direct effect of safety leadership on both safety knowledge and safety motivation. Results: Safety knowledge and safety motivation were found to directly and significantly predict nurses' safety behavior. Notably, safety knowledge and safety motivation were established as important mediators in the

relationship between safety leadership and nurses' safety compliance and participation. Practical Applications: The findings of this study offer key guidance for safety researchers and hospital practitioners in identifying mechanisms to enhance safety behavior among nurses.

- **Keywords:** Safety behavior; Safety leadership; Safety knowledge; Safety motivation; Malaysia

Kazuyuki Neki, Sudeshna Mitra, William Majani Wambulwa, Raymond Franklin Soames Job. *Profile of low and middle-income countries with increases versus decreases in road crash fatality population rates and necessity of motorcycle safety. Pages 129-137.*

Introduction: Road crash fatalities have increased significantly in Low- and Middle-Income Countries (LMICs) between 2006 and 2016. This study presents how road safety characteristics have changed in LMICs by comparing data over time and relationships between the road crash fatality increase and a wide range of data from LMICs. Parametric and nonparametric methods are used to test significance. Method: There were 35 countries in the Latin America and Caribbean region, the Sub-Saharan Africa region, the East Asia and Pacific region, and the South Asia region, where the population rate of road crash fatalities consistently increased as per country reports, World Health Organization and Global Burden of Disease estimates. In these countries, the proportion of fatalities involving motorcycles (including powered two or three-wheelers) substantially increased (44%) over the same time (statistically significant). In these countries, the helmet-wearing rate was only 46% for all passengers. These patterns were not observed in LMICs with decreasing population fatality rates. Results: Motorcycle helmet usage rates strongly correlate with decreasing fatalities per 10,000 motorcycles in Low-Income Countries (LICs) and LMICs. Effective interventions (including increasing helmet usage) are urgently needed for motorcycle crash trauma in LMICs, especially where the economy and motorization rapidly grow. National strategies for motorcycle safety, conforming to the Safe System principles, are recommended. Conclusions: For evidence-based policy formulation, there is a need to continue strengthening data collection, sharing, and use.

- **Keywords:** Road safety; LMIC; Road crash fatalities; Motorcycles; Safe system; Helmets

Ziyu Jin, John Gambatese, Ali Karakhan, Chukwuma Nnaji. *Analysis of prevention through design studies in construction: A subject review. Pages 138-154.*

Introduction: The concept of addressing and minimizing construction site safety risks in the early phase of a project has generated research interest, especially since the National Institute for Occupational Safety and Health (NIOSH) launched its national Prevention through Design (PtD) initiative in July 2007. In the last decade, several studies on PtD with differing goals and methods have been published in construction journals. To date, few systematic examinations of the development and trends associated with PtD research have been conducted in the discipline. Method: This paper presents a study of the latest PtD research trends in construction safety management through analysis of publications in prominent construction journals from 2008 to 2020. Both descriptive and content analyses were conducted based on the number of papers published annually and clusters of topics covered in the papers. Results: The study shows an increasing interest in PtD research in recent years. Research topics covered mainly focus on the perspectives of PtD stakeholders, PtD resources/tools/procedures, and technology applications to facilitate PtD implementation in practice. This review study provides an improved understanding of the state-of-the-art of PtD research in terms of accomplishments and

research gaps. The study also compares the findings from journal articles with industry best practices related to PtD to guide future research in this domain. Practical Application: This review study is of significant value to researchers to overcome the limitations of the current PtD studies, and to extend the scope of PtD research, and can be used by industry professionals when considering and selecting appropriate PtD resources/tools in practice.

- **Keywords:** Prevention through Design (PtD); Construction safety; Construction technologies; Design for safety; Occupational health and safety

David Rodwell, Lyndel Bates, Grégoire S. Larue, Barry Watson, Narelle Haworth. *The prototype willingness model: An application to adolescent driver speeding.* Pages 155-166.

Introduction: Many young drivers are involved in crashes due to speeding. Some studies have used the Prototype Willingness Model (PWM) to explain the risky driving behavior of young people. However, many have measured PWM constructs in a manner inconsistent with its formulation. The PWM asserts that the social reaction pathway is underpinned by a heuristic comparison of oneself with a cognitive prototype of someone who engages in a risky behavior. This proposition has not been comprehensively examined and few PWM studies specifically examine social comparison. The current study investigates intentions, expectations, and willingness to speed by teen drivers using operationalizations of PWM constructs more aligned with their original conceptualizations. Additionally, the influence of dispositional social comparison tendency on the social reaction pathway is examined to further test the original propositions underpinning the PWM. Method: Two hundred and eleven independently driving adolescents completed an online survey including items measuring PWM constructs and social comparison tendency. Hierarchical multiple regression was used to investigate the influence of perceived vulnerability, descriptive and injunctive norms, and prototypes on speeding intentions, expectations, and willingness. A moderation analysis examined the effect of social comparison tendency on the association between prototype perceptions and willingness. Results: The regression models explained substantial amounts of variance in intentions (39%), expectations (49%), and willingness (30%) to speed. There was no evidence that social comparison tendency influences the relationship between prototypes and willingness. Conclusions: The PWM is useful for predicting teenage risky driving. More studies should confirm that social comparison tendency does not moderate the social reaction pathway. However, there may be need for further theoretical development of the PWM. Practical applications: The study suggests that it may be possible to develop interventions to reduce adolescent driver speeding based on manipulation of PWM constructs such as speeding driver prototypes.

- **Keywords:** Teen driver; Novice driver; Risk-taking; Social comparison; Intentions

M. Ashifur Rahman, Subasish Das, Xiaoduan Sun. *Understanding the drowsy driving crash patterns from correspondence regression analysis.* Pages 167-181.

Drowsy driving-related crashes have been a key concern in transportation safety. In Louisiana, 14% (1,758 out of 12,512) of police-reported drowsy driving-related crashes during 2015–2019 resulted in injury (fatal, severe, or moderate). Amid the calls for action against drowsy driving by national agencies, it is of paramount importance to explore the key reportable attributes of drowsy driving behaviors and their potential association with crash severity. Method: This study used 5-years (2015–2019) of crash data and utilized the correspondence regression analysis method to identify the key collective associations of attributes in drowsy driving-related crashes and interpretable patterns based on injury levels. Results: Several drowsy driving-related crash patterns were identified through crash clusters – afternoon fatigue crashes by middle-aged female

drivers on urban multilane curves, crossover crashes by young drivers on low-speed roadways, crashes by male drivers during dark rainy conditions, pickup truck crashes in manufacturing/industrial areas, late-night crashes in business and residential districts, and heavy truck crashes on elevated curves. Several attributes – scattered residential areas indicating rural areas, multiple passengers, and older drivers (aged more than 65 years) – showed a strong association with fatal and severe injury crashes. Practical Applications: The findings of this study are expected to help researchers, planners, and policymakers in understanding and developing strategic mitigation measures to prevent drowsy driving.

- **Keywords:** Drowsy driving; Fatigue; Correspondence regression; Sleepy drivers; Driver behavior

Florent Varet, Thémis Apostolidis, Marie-Axelle Granié. *Social value, normative features and gender differences associated with speeding and compliance with speed limits. Pages 182-191.*

Introduction: Among risky driving behaviors, speeding is a main causal and aggravating factor of road crashes and is more frequent among males than females. Research suggests that this gender gap could be explained by gender social norms that lead males to assign more social value to speeding than females. However, few studies have proposed directly investigating gendered prescriptive norms associated with speeding. We propose to address this gap through two studies based on the socio-cognitive approach to social norms of judgment. Methods: Study 1 (N = 128, within-subject design) investigated the extent to which speeding is subject to social valuation among males, compared to females, through a self-presentation task. Study 2 (N = 885, between-subject design) aimed to identify the dimension of social value (i.e., social desirability, social utility) that both genders associate with speeding, based on a judgment task. Results and conclusion: Although results of study 1 indicate that both genders devalue speeding and value speed limits compliance, we found that males do so to a lesser extent than females. Results of study 2 further suggest that males less value speed limit compliance than females on the social desirability dimension, while no gender difference were found in valuation of speeding on both dimensions of social value. Regardless of gender, results also indicate that speeding is valued more on the social utility than on the social desirability dimension, while speed limit compliance is valued similarly on both dimensions. Practical applications: Road safety campaigns toward males could benefit to focus more on enhancing the representations of speed compliant drivers, in terms of social desirability, than devaluing the representation of speeding drivers.

- **Keywords:** Speeding; Gender differences; Social norms; Social value; Socio-cognitive approach

Kaitlin Wingate, Elizabeth Dalsey, Deborah Poling Scott. *A review of occupational safety and health research for American Indians and Alaska Natives. Pages 204-211.*

Introduction: To better understand what is known about issues affecting American Indian and Alaska Native (AI/AN) workers, authors conducted a literature review of publications specific to AI/AN and occupational safety and health. Methods: Search criteria included: (a) American Indian tribes and Alaska Native villages in the United States; (b) First Nations and aboriginals in Canada; and (c) occupational safety and health. Results: Results of two identical searches in 2017 and 2019 identified 119 articles and 26 articles respectively, with references to AI/AN people and occupation. Of the 145 total articles, only 11 articles met the search criteria for addressing occupational safety and health research among AI/AN workers. Information from each article was abstracted and categorized according to National Occupational Research Agenda (NORA) sector, resulting in: four articles related to agriculture, forestry, and fishing; three related to mining; one

related to manufacturing; and one related to services. Two articles reported on AI/AN people and occupational well-being in general. Conclusions: The review was limited by the small number and age of relevant articles, reflecting the likelihood that findings could be out of date. General themes across the reviewed articles point to the need for increased overall awareness and education regarding injury prevention and risks associated with occupational injuries and fatalities among AI/AN workers. Similarly, increased use of personal protective equipment (PPE) is recommended for the agriculture, forestry, and fishing industries, as well as for workers exposed to metals dust. Practical Applications: The lack of research in most NORA sectors indicates the need for heightened research efforts directed toward AI/AN workers.

- **Keywords:** AI; AN; Occupational safety and health; Worker safety

Rune Elvik. *Effects on accidents of technical inspections of heavy goods vehicles in Norway: A re-analysis and a replication.* Pages 212-217.

Introduction: This paper presents a re-analysis of a previous study of the effects on accidents of technical inspections of heavy vehicles in Norway and a replication of the study using more recent data. Method: Increasing the number of technical inspections is associated with a reduction in the number of accidents. Reducing the number of inspections is associated with an increase in the number of accidents. The relationship between changes in the number of inspections and changes in the number of accidents is well described by means of logarithmic dose-response curves. Results: These curves show that inspections had a larger effect on accidents in the recent period (2008–2020) than in the first period (1985–1997). Based on recent data, a 20% increase in the number of inspections is associated with a 4–6% reduction in the number of accidents. A 20% reduction of the number of inspections is associated with a 5–8% increase in the number of accidents.

- **Keywords:** Heavy goods vehicle; Technical inspections; Accidents; Evaluation study

Saba Doulabi, Hany M. Hassan, Bin Li. *Senior Americans' perceptions, attitudes, and safety concerns toward Autonomous Vehicles (AVs).* Pages 218-231.

Introduction: Autonomous vehicles (AVs) are considered a promising solution to improve seniors' safety and mobility. However, to transition to fully automated transportation, especially among seniors, it is vital to assess their perception and attitude toward AVs. This paper investigates seniors' perceptions and attitudes to a wide range of AV options from the perspective of pedestrians and users in general, as well as during and after the COVID-19 pandemic. Underlying this objective is to examine older pedestrians' safety perceptions and behaviors at crosswalks in the presence of AVs. Method: A national survey collected data from a sample of 1,000 senior Americans. Using Principal Component Analysis (PCA) and Cluster Analysis, three clusters of seniors were identified with different demographic characteristics, perceptions, and attitudes toward AVs. Results: PCA findings revealed that "risky pedestrian crossing behavior," "cautious pedestrian crossing behavior in the presence of AVs," "positive perception and attitude toward shared AVs," and "demographic characteristics" were the main components explaining most of the variation within the data, respectively. The PCA factor scores were used in the cluster analysis, which resulted in the identification of three distinctive groups of seniors. Cluster one included individuals with lower demographic scores and a negative perception and attitude toward AVs from the perspective of users and pedestrians. Clusters two and three included individuals with higher demographic scores. Cluster two included individuals with a positive perception toward shared AVs from the user perspective, but a negative attitude toward pedestrian-AV interaction. Cluster three included those with a negative perception toward shared AVs but a somewhat positive

attitude toward pedestrian-AV interaction. The findings of this study provide valuable insights to transportation authorities, AV manufacturers, and researchers regarding older American's perception and attitude toward AVs as well as their willingness to pay and use Advanced Vehicle Technologies.

- **Keywords:** Older adults; Perception and attitude; Pedestrian-AV interaction; Semi-automated vehicles; Fully automated vehicles; COVID-19 pandemic

Abdulkarim Almukdad, Deepti Muley, Radwan Alfahel, Firas Alkadour, Reem Ismail, Wael K.M. Alhajyaseen. *Assessment of different pedestrian communication strategies for improving driver behavior at marked crosswalks on free channelized right turns. Pages 232-242.*

Introduction: Previous studies have indicated low driver yielding rates to pedestrians in various countries. This study analyzed four different strategies to improve driver yielding rates at marked crosswalks on channelized right turn lanes at signalized intersections. Method: A sample of 5,419 drivers was collected for four gestures using field experiments for males and females in the State of Qatar. The experiments were conducted in daytime and nighttime on weekends at three different locations; two sites are located in an urban area and the third is located in non-urban area. The effect of pedestrians' and drivers' demographic characteristics, gestures, approach speed, time of the day, location of the intersection, car type, and driver distractions on yielding behavior is investigated using logistic regression analysis. Results: It was found that for the base gesture, only 2.00% of drivers yielded to the pedestrians, while for hand, attempt, and vest-attempt gestures the yielding percentages were considerably higher, 12.81%, 19.59%, and 24.60%, respectively. The results also showed that females received significantly higher yielding rates compared to males. In addition, the probability of a driver yielding increased 2.8 times when drivers approached at slower speed compared to a higher speed. Further, drivers' age group, accompanied, and distractions were not significant in determining drivers' probability of yielding.

- **Keywords:** Driver behavior; Yielding behavior; Pedestrian safety; Unsignalized crossings; Logistic regression

Stuart Ballingall, Majid Sarvi, Peter Sweatman. *Safety assurance for automated driving systems that can adapt using machine learning: A qualitative interview study. Pages 243-250.*

Introduction: Automated Driving Systems (ADSs) present significant unresolved challenges for traditional safety assurance frameworks. These frameworks did not envisage, nor readily support, automated driving without the active involvement of a human driver, or support safety-critical systems using Machine Learning (ML) to modify their driving functionality during in-service operation. Method: An in-depth qualitative interview study was conducted as part of a broader research project on safety assurance of ADSs that can adapt using ML. The objective was to capture and analyze feedback from leading global experts, from both regulatory and industry stakeholders, with the key objectives of identifying themes that could assist with the development of a safety assurance framework for ADSs, and providing a sense of the level of support and feasibility for various safety assurance concepts relevant to ADSs. Results: Ten themes were identified from an analysis of the interview data. Several themes support a whole-of-life safety assurance approach for ADSs, with strong support for ADS developers to be required to produce a Safety Case, and for ADS operators to maintain a Safety Management Plan throughout an ADSs operational life. There was also strong support for in-service ML-enabled changes to be allowed within pre-approved system boundaries, although there were mixed views on whether human oversight of such changes should be required. Across all themes identified, there was support for progressing reform within

current regulatory frameworks, without requiring wholesale changes to current frameworks. The feasibility of some themes was identified as presenting challenges, particularly with the ability for regulators to develop and maintain an appropriate level of knowledge, capability and capacity, and with the ability to effectively articulate and pre-approve boundaries within which in-service changes can occur without additional regulatory approval. Conclusions: Further research on the individual themes and findings would be beneficial to support more informed reform decisions.

- **Keywords:** Automated driving systems; Safety assurance; Machine learning; Adaptive system; Safety case

Norris Novat, Emmanuel Kidando, Boniphace Kutela, Angela E. Kitali. *A comparative study of collision types between automated and conventional vehicles using Bayesian probabilistic inferences. Pages 251-260.*

Introduction: Automated vehicle (AV) technology is a promising technology for improving the efficiency of traffic operations and reducing emissions. This technology has the potential to eliminate human error and significantly improve highway safety. However, little is known about AV safety issues due to limited crash data and relatively fewer AVs on the roadways. This study provides a comparative analysis between AVs and conventional vehicles on the factors leading to different types of collisions. Method: A Bayesian Network (BN) fitted using the Markov Chain Monte Carlo (MCMC) was used to achieve the study objective. Four years (2017–2020) of AV and conventional vehicle crash data on California roads were used. The AV crash dataset was acquired from the California Department of Motor Vehicles, while conventional vehicle crashes were obtained from the Transportation Injury Mapping System database. A buffer of 50 feet was used to associate each AV crash and conventional vehicle crash; a total of 127 AV crashes and 865 conventional vehicle crashes were used for analysis. Results: Our comparative analysis of the associated features suggests that AVs are 43% more likely to be involved in rear-end crashes. Further, AVs are 16% and 27% less likely to be involved in sideswipe/broadside and other types of collisions (head-on, hitting an object, etc.), respectively, when compared to conventional vehicles. The variables associated with the increased likelihood of rear-end collisions for AVs include signalized intersections and lanes with less than 45 mph speed limit. Conclusions: Although AVs are found to improve safety on the road in most types of collisions by limiting human error leading to vehicle crashes, the current state of the technology shows that safety aspects still need improvement.

- **Keywords:** Automated vehicles; Traffic crashes severity; Bayesian networks

Leila Omid, Khadijeh Mostafae Dolatabad, Colin Pilbeam. *Differences in perception of the importance of process safety indicators between experts in Iran and the West. Pages 261-272.*

Introduction: The importance of safety in high-risk industries such as oil and gas facilities has been reported previously. Process safety performance indicators can provide insight into improving the safety of process industries. This paper aims to rank the process safety indicators (metrics) by Fuzzy Best-Worst Method (FBWM) using the data gathered through a survey. Method: The study uses a structured approach considering the UK Health and Safety Executive (HSE), the Center for Chemical Process Safety (CCPS), and the IOGP (International Association of Oil and Gas Producers) recommendations and guidelines to generate an aggregate set of indicators. It calculates the level of importance of each indicator based on the opinions of experts from Iran and some Western countries. Results: The findings of the study demonstrate that some lagging indicators such as the number of times processes do not proceed as planned due to

insufficient staff competence and the number of unexpected disruptions of the process due to failure in instrumentation and alarms are important in process industries in both Iran and Western countries. Western experts identified process safety incident severity rate as an important lagging indicator, whereas Iranian experts considered this as relatively unimportant. In addition, leading indicators such as sufficient process safety training and competency, the desired function of instrumentation and alarms, and proper management of fatigue risk play an important role in enhancing the safety performance of process industries. Experts in Iran viewed permit to work as an important leading indicator, while experts in the West focused on fatigue risk management. Practical Applications: The methodology used in the current study gives a good view to managers and safety professionals in regard to the most important indicators of process safety and allows them to focus more on important process safety indicators.

- **Keywords:** Process safety; Lagging indicators; Leading indicators; Process industries; Fuzzy best worst method

Marco H. Benedetti, Bo Lu, Neale Kinnear, Li Li, M. Kit Delgado, Motao Zhu. *The impact of Illinois' comprehensive handheld phone ban on talking on handheld and handsfree cellphones while driving. Pages 273-279.*

Introduction: Distracted driving has been linked to multiple driving decrements and is responsible for thousands of motor-vehicle fatalities annually. Most U.S. states have enacted restrictions on cellphone use while driving, the strictest of which prohibit any manual operation of a cellphone while driving. Illinois enacted such a law in 2014. To better understand how this law affected cellphone behaviors while driving, associations between Illinois' handheld phone ban and self-reported talking on handheld, handsfree, and any cellphone (handheld or handsfree) while driving were estimated. Methods: Data from annual administrations of the Traffic Safety Culture Index from 2012–2017 in Illinois and a set of control states were leveraged. The data were cast into a difference-in-differences (DID) modeling framework, which compared Illinois to control states in terms of pre- to post-intervention changes in the proportion of drivers who self-reported the three outcomes. Separate models for each outcome were fit, and additional models were fit to the subset of drivers who talk on cellphones while driving. Results: In Illinois, the pre- to post-intervention decrease in the drivers' probability of self-reporting talking on a handheld phone was significantly more extreme than that of drivers in control states (DID estimate -0.22 ; 95% CI $-0.31, -0.13$). Among drivers who talk on cellphones while driving, those in Illinois exhibited a more extreme increase in the probability of talking on a handsfree phone while driving than those control states (DID estimate 0.13 ; 95% CI $0.03, 0.23$). Conclusions: These results suggest that Illinois' handheld phone ban reduced talking on handheld phones while driving among study participants. They also corroborate the hypothesis that the ban promoted substitution from handheld to handsfree phones among drivers who talk on the phone while driving. Practical Applications: These findings should encourage other states to enact comprehensive handheld phone bans to improve traffic safety.

- **Keywords:** Distracted driving; Handheld and handsfree phone use while driving; Handheld phone policies; Traffic safety; Quasi-experimental analysis

He Zou, Shunying Zhu, Ruoxi Jiang, Qiucheng Chen, Jingan Wu, Pan Wang, Chengliang Diao. *Traffic conflicts in the lane-switching sections at highway reconstruction zones. Pages 280-289.*

Introduction: There are designated sections for lane-shifting in several highway reconstruction and expansion zones. Similar to the bottleneck sections of highways, these sections are characterized by poor pavement surface conditions, disorderly traffic

flow, and high safety risk. This study examined the continuous track data of 1,297 vehicles collected using an area tracking radar. Method: The data from the lane shifting sections were analyzed in contrast with the regular section data. Further, the single-vehicle attributes, traffic flow factors, and the respective road characteristics in the lane-shifting sections were also taken into account. In addition, the Bayesian network model was established to analyze the uncertain interaction between the various other influencing factors. The K-Fold cross validation method was used to evaluate the model. Results: The results showed that the model has a high reliability. The analysis of the model revealed that the significant influencing factors in decreasing order of their influence on the traffic conflict are: the curve radius, cumulative turning angle per unit length, standard deviation of the single-vehicle speed, vehicle type, average speed, and the standard deviation of the traffic flow speed. The probability of traffic conflicts is estimated to be 44.05% when large vehicles pass through the lane-shifting section while it is 30.85% for small vehicles. The probabilities of traffic conflict are 19.95%, 34.88%, and 54.79% when the turning angles per unit length are 0.20 °/m, 0.37 °/m, and 0.63 °/m, respectively. Practical Applications: The results support the view that the highway authorities help reduce traffic risks on lane change sections by diverting large vehicles, implementing speed limits on road sections, and increasing the turning angle per unit length of vehicles.

- **Keywords:** Lane-shifting section; Collision risk; Traffic conflict; Bayesian network; Traffic risk assessment

Nejc Sedlar, Amy Irwin, Douglas Martin, Ruby Roberts. *A qualitative systematic review on the application of the normalization of deviance phenomenon within high-risk industries.* Pages 290-305.

Introduction: The concept of normalization of deviance describes the gradual acceptance of deviant observations and practices. It is founded upon the gradual desensitization to risk experienced by individuals or groups who recurrently deviate from standard operating procedures without encountering negative consequences. Since its inception, normalization of deviance has seen extensive, but segmented, application across numerous high-risk industrial contexts. The current paper describes a systematic review of the existing literature on the topic of normalization of deviance within high-risk industrial settings. Method: Four major databases were searched in order to identify relevant academic literature, with 33 academic papers meeting all inclusion criteria. Directed content analysis was used to analyze the texts. Results: Based on the review, an initial conceptual framework was developed to encapsulate identified themes and their interactions; key themes linked to the normalization of deviance included risk normalization, production pressure, culture, and a lack of negative consequences. Conclusions: While preliminary, the present framework offers relevant insights into the phenomenon that may help guide future analysis using primary data sources and aid in the development of intervention methods. Practical Applications: Normalization of deviance is an insidious phenomenon that has been noted in several high-profile disasters across a variety of industrial settings. A number of organizational factors allow for and/or propagate this process, and as such, the phenomenon should be considered as an aspect of safety evaluations and interventions.

- **Keywords:** Normalization of deviance; Risk normalization; Systematic review; High-risk industry; Safety

Alainie Sawtelle, Mohammadali Shirazi, Per Erik Garder, Jonathan Rubin. *Driver, roadway, and weather factors on severity of lane departure crashes in Maine.* Pages 306-315.

Introduction: In Maine, lane departure crashes account for over 70% of roadway fatalities. The majority of roadways in Maine are rural. Moreover, Maine has aging

infrastructure, houses the oldest population in the United States, and experiences the third coldest weather in the United States. Methods: This study analyzes the impact of roadway, driver, and weather factors on the severity of single-vehicle lane departure crashes occurring from 2017 to 2019 on rural roadways in Maine. Rather than using police reported weather, weather station data were utilized. Four facility types: Interstates, minor arterials, major collectors, and minor collectors were considered for analysis. The Multinomial Logistic Regression model was used for the analysis. The property damage only (PDO) outcome was considered as the reference (or base) category. Results: The modeling results show that the odds of a crash leading to major injury or fatality (KA outcome) increases by 330%, 150%, 243%, and 266% for older drivers (65 or above) compared to young drivers (29 or less) on Interstates, minor arterials, major collectors, and minor collectors, respectively. During the winter period (October to April), the odds of KA severity outcome (with respect to the PDO) decreases by 65%, 65%, 65%, and 48% on Interstates, minor arterials, major collectors, and minor collectors, respectively, presumably due to reduced speeds during winter weather events. Conclusion: In Maine, factors such as older drivers, operating under the influence, speeding, precipitation, and not wearing a seatbelt showed higher odds of leading to injury. Practical Applications: This study provides safety analysts and practitioners in Maine a comprehensive study of factors that influence the severity of crashes in Maine at different facilities to improve maintenance strategies, enhance safety using proper safety countermeasures, or increase awareness across the state.

- **Keywords:** Crash data; Crash severity; Lane departure; Statistical analysis; Multinomial logit

Blawal Hussain, Tomio Miwa, Hitomi Sato, Takayuki Morikawa. *Subjective evaluations of self and others' driving behaviors: A comparative study involving data from drivers in Japan, China, and Vietnam. Pages 316-329.*

Introduction: This study explored the influence of personal attributes on subjectively-reported aggressive driving behaviors, with an emphasis on the inter-influences between subjectively-reported aggressive driving behaviors between self and other individuals. To determine this, a survey was conducted comprising participants' socio-demographic data, information on their history with automotive accidents, and subjective scales to report on the driving behaviors between self and others. More specifically, a four-factor shortened version of the Manchester Driver Behavior Questionnaire was used to collect data on the aberrant driving behaviors of "self" and "others." Method: Participants were recruited from three countries, namely, Japan (1,250 responses), China (1,250), and Vietnam (1,000). This study only considered the "aggressive violations' factor," which was referred to as self-aggressive driving behaviors (SADB) and others' aggressive driving behaviors (OADB). After collecting the data, univariate and bivariate multiple regression models were employed to better understand the response patterns from both scales. Results: This study found that accident experience had the strongest influence on the reporting of aggressive driving behaviors (followed by education level). However, variation in countries was also found between both the rate of engagement in aggressive driving behavior and its recognition. In this study, highly educated Japanese drivers tended to evaluate others as safe, whereas highly educated Chinese drivers tended to evaluate others as aggressive. This discrepancy can likely be attributed to cultural norms and values. Meanwhile, evaluations from Vietnamese drivers seemed to differ depending on whether they drove cars or bikes, with additional influences as a result of the driving frequency. Furthermore, this study found that it was most difficult to explain the driving behaviors on the "other" scale reported by Japanese drivers. Practical Applications: These findings can aid policymakers and planners to develop road safety measures that reflect the behaviors of drivers in their respective countries.

- **Keywords:** Driver Behavior Questionnaire (DBQ); Self-reported driving behaviors; Aggressive road violations; Road safety; Driving aggression

Md Eaysir Arafat, Grégoire S. Larue, Sepehr Ghasemi Dehkordi. *Effectiveness of interventions for mobile phone distracted pedestrians: A systematic review. Pages 330-346.*

Introduction: Mobile phones are used universally due to their versatility and easy-to-use features; this includes when users are walking and when crossing streets. At intersections, using a mobile phone is a secondary task that can distract from the primary task of scanning the road environment and ensuring it is safe to traverse. Such a distraction has been shown to increase risky pedestrian behavior compared to non-distracted behavior. Developing an intervention to make distracted pedestrians aware of imminent danger is a promising approach to refocus pedestrians on their primary task and avoid incidents. Interventions have already been developed in different parts of the world, such as in-ground flashing lights, painted crosswalks, and mobile phone app-based warning systems. Method: A systematic review of 42 articles was performed to determine the effectiveness of such interventions. This review found that three types of interventions are currently developed, with differing evaluations. Interventions based on infrastructure tend to be evaluated based on behavioral change. Mobile phone-based apps tend to be evaluated on their ability to detect obstacles. Legislative changes and education campaigns are not currently evaluated. Further, technological development often occurs independently of pedestrians' needs, reducing the likely safety benefits of such interventions. The interventions related to infrastructure mainly focus on warning pedestrians without considering pedestrian mobile phone use, potentially leading to numerous irrelevant warnings and reduced user acceptance. The lack of a comprehensive and systematic approach to evaluating these interventions is also an issue requiring consideration. Practical Applications: This review demonstrates that despite significant recent progress surrounding pedestrian distraction, more work is required to identify the most effective interventions to implement. Future studies with a well-designed experimental framework are necessary to compare the different approaches, and warning messages, and ensure the best guidance for road safety agencies.

- **Keywords:** Mobile phone; Distraction; Vulnerable road users; Countermeasures; Behavior

Ittai Shichman, Or Shaked, Shai Factor, Itay Ashkenazi, Etay Elbaz, Reut Aviv Mordechai, Amal Houry. *The association between electric scooter riding position and injury characteristics. Pages 347-352.*

Background: The popularity of electric scooters (e-scooters) and the shared e-scooter services as new means of transportation worldwide led to high numbers of injuries requiring emergency department (ED) visits. Private and rental e-scooters have different sizes and capabilities, offering several possible riding positions. While the rising use of e-scooters and their associated injuries have been reported, little is known about the influence of riding position on injury characteristics. The purpose of this study was to characterize e-scooter riding positions and their related injuries. Methods: E-scooters related ED admissions were retrospectively collected between June 2020 and October 2020, in a level-I trauma center. Demographics, ED presentation data, injury information, e-scooter design, and clinical course were collected and compared according to e-scooter riding position ("foot-behind-foot" vs "side-by-side"). Results: During the study period, 158 patients were admitted to the ED with e-scooter related injuries. The majority of riders used the foot-behind-foot position (n = 112, 71.3%) compared to the side-by-side position (n = 45, 28.7%). Orthopedic fractures were the most common injuries (n = 78, 49.7%). "Foot-behind-foot" group had a significantly higher fracture rate compared to "side-by-side" group (54.4% vs 37.8% within group, respectively; p = 0.03). Conclusions: Riding position is associated with different injury types, with

orthopedic fracture rates significantly higher in the more commonly used “foot-behind-foot” riding position. Practical Application: These study findings suggest that the common e-scooter narrow-based design is considerably more dangerous, calling for further research to introduce safer e-scooter designs and update recommendations for safer riding positions.

- **Keywords:** Electric scooter; E-scooter; Rental scooter; Riding position; Emergency medicine

Guilherme De Moura Araujo, Farzaneh Khorsandi Kouhanestani, Fadi A. Fathallah. *Ability of youth operators to reach agricultural all-terrain vehicles controls.* Pages 353-363.

Problem: Utility All-Terrain Vehicles (ATVs) are one major cause of youth injuries and fatalities on farms. Utility ATVs have heavy weights and fast speeds that require complex maneuvering. Youth’s physical capabilities may not be sufficient to perform those complex maneuvers correctly. Therefore, it is hypothesized that most youth engage in ATV-related incidents because they ride vehicles unfit for them. There is a need to assess ATV-youth fit based on youth anthropometry. Method: This study focused on evaluating potential inconsistencies between the operational requirements of utility ATVs and the anthropometric measures of youth through virtual simulations. Virtual simulations were performed to assess 11 youth-ATV fit guidelines proposed by several ATV safety advocacy organizations (National 4-H council, CPSC, IPCH, and FReSH). In total, 17 utility ATVs along with male-and-female-youth of nine ages (8 to 16 years old) and three height percentiles (5th, 50th, and 95th) were evaluated. Results: The results demonstrated a physical mismatch between ATVs’ operational requirements and youth’s anthropometry. For example, male-youth aged 16 of the 95th height percentile failed to pass at least 1 out of the 11 fit guidelines for 35% of all vehicles evaluated. The results were even more concerning for females. Female youth 10 years old and younger (from all height percentiles) failed to pass at least one fit guideline for all ATVs evaluated. Discussion: Youth are not recommended to ride utility ATVs. Practical Applications: This study provides quantitative and systematic evidence to modify current ATV safety guidelines. Furthermore, youth occupational health professionals could use the present findings to prevent ATV-related incidents in agricultural settings.

- **Keywords:** Anthropometry; ATV; Children; Farm; Quadbike

Chun-Yip Hon, Jaskaren Randhawa, Norman Lun, Craig Fairclough, Linda Rothman. *Comparison of management and workers’ perception, attitudes and beliefs toward health and safety in the Ontario manufacturing sector.* Pages 364-370.

Introduction: The Ontario manufacturing sector is over-represented when it comes to workers’ compensation claims in the province. A previous study suggested that this may be the result of compliance gaps with respect to the province’s occupational health and safety (OHS) legislation. These gaps may be, in part, due to differences in perceptions, attitudes, and beliefs toward OHS between workers and management. This is noteworthy as these two cohorts, when working well together, can foster a healthy and safe work environment. Therefore, this study sought to ascertain the perceptions, attitudes, and beliefs of workers and management with respect to OHS in the Ontario manufacturing sector and to identify differences between the groups, if any. Methods: A survey was created and disseminated online to get the widest reach across the province as possible. Descriptive statistics were used to present the data and chi-square analyses were performed to determine if there were any statistically significant differences in responses between workers and managers. Results: In total, 3,963 surveys were included in the analysis, which consisted of 2,401 (60.6%) workers and 1,562 (39.4%) managers.

Overall, workers were more likely to state that their workplace was 'a bit unsafe' relative to managers and this difference was statistically significant. There were also statistically significant differences between the two cohorts with respect to health and safety communication matters, the perception of safety as a high priority, whether people work safely when unsupervised, and whether control measures are adequate. Conclusions: In summary, there were differences in perception, attitudes, and beliefs toward OHS between workers and managers in Ontario manufacturing and these differences must be addressed in order to improve the sector's health and safety performance. Practical Applications: Manufacturing workplaces can improve their health and safety performance by strengthening labor-management relationships, including having routine health and safety communication.

- **Keywords:** Perceptions, attitudes, and beliefs; Occupational health and safety; Workers; Managers; Manufacturing

Alexandra S. Mueller, Jessica B. Cicchino, Joseph V. Calvanelli Jr. *Consumer demand for partial driving automation and hands-free driving capability. Pages 371-383.*

Introduction: It is often assumed that consumers want partial driving automation in their vehicles, yet there has been little research on the topic. Also unclear is what the public's appetite is for hands-free driving capability, automated (auto)-lane-change functionality, and driver monitoring that helps reinforce proper use of these features. Method: Through an internet-based survey of a nationally representative sample of 1,010 U.S. adult drivers, this study explored consumer demand for different aspects of partial driving automation. Results: Eighty percent of drivers want to use lane centering, but more prefer versions with a hands-on-wheel requirement (36%) than hands-free (27%). More than half of drivers are comfortable with different driver monitoring strategies, but comfort level is related to perceptions of feeling safer with it given its role in helping drivers use the technology properly. People who prefer hands-free lane centering are the most accepting of other vehicle technologies, including driver monitoring, but some also indicate an intent to misuse these features. The public is somewhat more reluctant to accept auto lane change, with 73% saying they would use it, and more often prefer it to be driver-initiated (45%) than vehicle-initiated (14%). More than three quarters of drivers want auto lane change to have a hands-on-wheel requirement. Conclusion: Consumers are interested in partial driving automation, but there is resistance to more sophisticated functionality, especially vehicle-initiated auto lane change, in a vehicle that cannot technically drive itself. Practical applications: This study confirms the public's appetite for partial driving automation and possible intention for misuse. It is imperative that the technology be designed in ways that deter such misuse. The data suggest that consumer information, including marketing, has a role to play to communicate the purpose and safety value of driver monitoring and other user-centric design safeguards to promote their implementation, acceptance, and safe adoption.

- **Keywords:** Public opinion; Lane centering; Level 2; Driver monitoring; Auto lane change

Jane M. Fry. *Mobile phone penalties and road crashes: Are changes in sanctions effective? Pages 384-392.*

Introduction: Road crashes are a major, preventable cause of death and serious injury. Being distracted by a mobile phone while driving can increase the risk of a crash by three to four times and increase crash severity. To reduce distracted driving, on 1 March 2017 the penalty for using a hand-held mobile phone while driving in Britain doubled to £200 and six penalty points. Method: We examine the effects of this increased penalty on numbers of serious or fatal crashes over 6 weeks either side of the intervention using Regression Discontinuity in Time. Results: We find no effect of the intervention,

suggesting the increased penalty is not effective in reducing the more serious road crashes. Conclusions: We rule out an information problem and an enforcement effect, concluding the increase in fines was insufficient to change behaviour. With very low detection rates of mobile phone use, our result could occur if the perceived certainty of punishment remained very low after the intervention. Practical application: Future technology will increase the ability to detect mobile phone usage, and there may be fewer road crashes if the solution is to raise awareness of such technology and publicise numbers of offenders caught. Alternatively, a mobile phone blocking application could avert the problem.

- **Keywords:** Road crash severity; Fines; Policy intervention; Mobile phone; Britain

Youngran Choi, James R. Gibson. *The effect of COVID-19 on self-reported safety incidents in aviation: An examination of the heterogeneous effects using causal machine learning.* Pages 393-403.

Introduction: Disruptions to aviation operations occur daily on a micro-level with negligible impacts beyond the inconvenience of rebooking and changing aircrew schedules. The unprecedented disruption in global aviation due to COVID-19 highlighted a need to evaluate emergent safety issues rapidly. Method: This paper uses causal machine learning to examine the heterogeneous effects of COVID-19 on reported aircraft incursions/excursions. The analysis utilized self report data from NASA Aviation Safety Reporting System collected from 2018 to 2020. The report attributes include self identified group characteristics and expert categorization of factors and outcomes. The analysis identified attributes and subgroup characteristics that were most sensitive to COVID-19 in inducing incursions/excursions. The method included the generalized random forest and difference-in-difference techniques to explore causal effects. Results: The analysis indicates first officers are more prone to experiencing incursion/excursion events during the pandemic. In addition, events categorized with the human factors confusion, distraction, and the causal factor fatigue increased incursion/excursion events. Practical Applications: Understanding the attributes associated with the likelihood of incursion/excursion events provides policymakers and aviation organizations insights to improve prevention mechanisms for future pandemics or extended periods of reduced aviation operations.

- **Keywords:** Aviation incursions/excursions; COVID-19; Machine learning; Heterogeneous treatment effects

Brian J. Pugliese, Benjamin K. Barton, Gerardo Lopez. *Predicting behavioral intentions for unsafe off-highway vehicle use.* Pages 404-410.

Introduction: Hundreds of adults are killed or injured each year while operating off-highway vehicles. Four common risk-taking behaviors were identified on off-highway vehicles in the literature and examined intention to engage in such behaviors within the context of the Theory of Planned Behavior. Method: One hundred and sixty-one adults completed measures of experience on off-highway vehicles and injury exposure followed by a self-report created according to the predictive structure of the Theory of Planned Behavior. Behavioral intentions to engage in the four common injury risk behaviors on off-highway vehicles were predicted. Results: Similar to research on other risk behaviors, perceived behavioral control and attitudes emerged as consistently significant predictors. Subjective norms, the number of vehicles operated, and injury exposure showed varying relationships to the four injury risk behaviors. Results are discussed in the context of similar studies, intrapersonal predictors of injury risk behaviors, and with regard to implications for injury prevention efforts.

- **Keywords:** Theory of Planned Behavior; Off-highway vehicles; ATV; Safety; Behavioral control

Ibraheem M. Karaye, Kameron Farhadi, Grace Sengstock, Shihab Shahidullah, Rachel Taravella, Rida Nasir. *Recent trends in fatal unintentional drowning rates in the United States, 1999–2020. Pages 411-417.*

Background: This study aimed to examine the trends in fatal unintentional drowning rates among persons aged ≤ 29 years by sex, age, race/ethnicity, and the U.S. census region from 1999 through 2020. Methods: Data were abstracted from the Centers for Disease Control and Prevention's WONDER database. International Classification of Diseases Codes, 10th Revision; V90, V92, W65-W74 were used to identify persons aged ≤ 29 years who died of unintentional drowning. Age adjusted mortality rates (AAMR) were extracted by age, sex, race/ethnicity, and U.S. census region. Five-year simple moving averages were used to assess trends overall, and Joinpoint regression models were fitted to estimate average annual percentage changes (AAPC) and annual percentage changes (APC) in AAMR during the study period. 95 % confidence intervals were derived using Monte Carlo Permutation. Results: Between 1999 and 2020, a total of 35,904 persons aged ≤ 29 years died of unintentional drowning in the United States. Mortality rates were highest among males (age adjusted mortality rate (AAMR) = 2.0 per 100,000; 95 % CI: 2.0–2.0), American Indians/Alaska Natives (AAMR = 2.5; 95 % CI: 2.3–2.7), decedents aged 1–4 years (AAMR = 2.8; 95 % CI: 2.7–2.8), and decedents from the Southern U.S. census region (AAMR = 1.7; 95 % CI: 1.6–1.7). Unintentional drowning deaths, overall, have stabilized from 2014 to 2020 (APC = 0.6; 95 % CI: –1.6, 2.8). Recent trends have either declined or stabilized by age, sex, race/ethnicity, and U.S. census region. Conclusions: Unintentional fatal drowning rates have improved in recent years. The results reinforce the need for continued research efforts and improved policies for sustained reduction in trends.

- **Keywords:** Drowning; Unintentional; Deaths; United States; Trends

Numan Ahmad, Behram Wali, Asad J. Khattak. *Heterogeneous ensemble learning for enhanced crash forecasts – A frequentist and machine learning based stacking Framework. Pages 418-434.*

Introduction: This study aims to increase the prediction accuracy of crash frequency on roadway segments that can forecast future safety on roadway facilities. A variety of statistical and machine learning (ML) methods are used to model crash frequency with ML methods generally having a higher prediction accuracy. Recently, heterogeneous ensemble methods (HEM), including "stacking," have emerged as more accurate and robust intelligent techniques providing more reliable and accurate predictions. Methods: This study applies "Stacking" to model crash frequency on five-lane undivided (5T) segments of urban and suburban arterials. The prediction performance of "Stacking" is compared with parametric statistical models (Poisson and negative binomial) and three state-of-the-art ML techniques (Decision tree, random forest, and gradient boosting), each of which is termed as the base-learner. By employing an optimal weight scheme to combine individual base-learners through stacking, the problem of biased predictions in individual base-learners due to differences in specifications and prediction accuracies is avoided. Data including crash, traffic, and roadway inventory were collected and integrated from 2013 to 2017. The data are split into training (2013–2015), validation (2016), and testing (2017) datasets. After training five individual base-learners using training data, prediction outcomes are obtained for the five base-learners using validation data that are then used to train a meta-learner. Results: Results of statistical models reveal that crashes increase with the density (number per mile) of commercial driveways whereas decrease with average offset distance to fixed objects. Individual ML methods

show similar results – in terms of variable importance. A comparison of out-of-sample predictions of various models or methods confirms the superiority of “Stacking” over the alternative methods considered. Conclusions and practical applications: From a practical standpoint, “stacking” can enhance prediction accuracy (compared to only one base-learner with a particular specification). When applied systemically, stacking can help identify more appropriate countermeasures.

- **Keywords:** Crash frequency; Crash prediction; Count data models; Machine learning; Base-learners; Meta-learner; Stacking

Viet Quan Nguyen, Nick Turner, Julian Barling, Carolyn M. Axtell, Simon Davies. *Reconciling general transformational leadership and safety-specific transformational leadership: A paradox perspective. Pages 435-447.*

Introduction: Research exploring the relationship between transformational leadership and safety has used transformational leadership in context-free (e.g., “general transformational leadership,” or GTL) and context-specific forms (e.g., “safety-specific transformational leadership,” or SSTL), assuming these constructs are theoretically and empirically equivalent. In this paper, a paradox theory is drawn on (Schad et al., 2016, Smith and Lewis, 2011) to reconcile the relationship between these two forms of transformational leadership and safety. Method: This is done by: (a) investigating whether GTL and SSTL are empirically distinguishable; (b) testing the relative importance of GTL and SSTL in explaining variance in context-free work outcomes (i.e., in-role performance, organizational citizenship behaviors) and context-specific (i.e., safety compliance, safety participation); and (c) examining the extent to which perceived safety concern in the work environment renders GTL and SSTL distinguishable. Results: Two studies (one cross-sectional, one short-term longitudinal) show that GTL and SSTL are psychometrically distinct albeit highly correlated. Furthermore, SSTL explained statistically more variance than GTL in both safety participation and organizational citizenship behaviors, whereas GTL explained more variance in in-role performance than did SSTL. However, GTL and SSTL were only distinguishable in low-concern contexts but not high-concern contexts. Conclusions and Practical Applications: These findings challenge the “either-or” (vs “both-and”) approach to considering safety and performance, cautioning researchers to consider nuanced differences in context-free and context-specific forms of leadership and to avoid further proliferation of often redundant context-specific operationalizations of leadership.

- **Keywords:** Paradox; Relative weight analysis; Safety; Transformational leadership