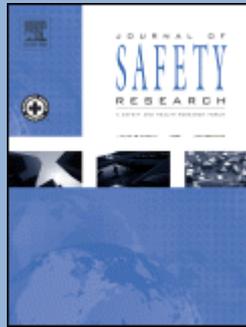


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**Abbas Sheykhfard, Farshidreza Haghghi. *Driver distraction by digital billboards? Structural equation modeling based on naturalistic driving study data: A case study of Iran.* Pages 1-8.**

**Introduction:** Digital billboards (DBs) are a competing factor for attracting drivers' attention; evidence shows that DBs may cause crashes and vehicle conflicts because they catch drivers' attention. Because of the complexity of a system that includes road conditions, driver features, and environmental factors, it is simply not possible to identify relationships between these factors. Thus, the present study was conducted to provide a well-organized procedure to analyze the effects of DBs on drivers' behavior and measure factors responsible for drivers' distraction in Babol, Iran, as a case study. **Method:** Corresponding data were collected through a Naturalistic Driving Study (NDS) of 78 participants when facing DBs (1,326 samples). These data were analyzed by applying structural equation modeling (SEM) to concurrently recognize relationships between endogenous and exogenous variables. Human, environmental, and road factors were determined as exogenous latent variables in a model to evaluate their influences on drivers' distraction as an endogenous variable. **Results:** The results showed that road, environmental, and human factors reciprocally interact with drivers' distraction, although the estimated coefficient of human factors was more of a factor than that of the other groups. Furthermore, younger drivers, beginner drivers, and male drivers (as human factors); night and unclear weather like a rainy day (as environmental factors); and installing DBs at complicated traffic positions like near-intersections (as road factors) were determined to be the main factors that increase the possibility of drivers' distraction. Finally, model assessment was suggested using the goodness-of-fit indices.

- **Keywords:** Driver behavior; Distracted driving; Digital billboards; Structural equation modeling

**Katherine Freund, Alycia Bayne, Laurie Beck, Alexa Siegfried, Joe Warren, Tori Nadel, Amarjothi Natarajan. *Characteristics of ride share services for older adults in the United States.* Pages 9-19.**

**Introduction:** Safe and accessible transportation options are important for older adults' health, safety, mobility, and independence. Ride share services may promote older adult health and well-being. This is the first study that describes ride share services available to older adults (65+ years) in the United States, including factors that may affect use of services. **Methods:** We analyzed secondary data from two research and administrative databases provided by ITNAmerica, a national non-profit transportation service for older

adults: ITNRides, which tracks information on older adults who used ITN in 29 locations across the United States from 1996 to 2019, and Rides in Sight, the largest national data source on ride share services for older adults. We conducted a literature review, and telephone interviews with nine key informants representing ride share services, referral services, and other organizations. We offer a conceptual framework describing factors that may affect older adults' use of ride share services. **Results:** This study identified 917 non-profit ride share services and eleven for-profit ride share services available for older adults in the United States as of August 2018. Services varied by corporate structure, location, use of technology, and business model. The majority of non-profit services served primarily older adults, while the for-profit services served primarily younger adults. Riders from one multi-site non-profit service had a median age of 82. Use of ride share services is affected by individual needs and preferences; social conditions; and business and policy factors. **Conclusion:** Ride share services may offer a promising alternative to driving for older adults and may help to address negative health consequences associated with driving cessation. **Practical applications:** These findings may help policy makers, practitioners, and other stakeholders understand older adults' needs related to use of ride share services in order to offer solutions that prioritize public health and safety.

- **Keywords:** Driving cessation; Safety; Mobility; Health; Ride hailing

**Lin Hu, Xinting Hu, Jing Wan, Miao Lin, Jing Huang. *The injury epidemiology of adult riders in vehicle-two-wheeler crashes in China, Ningbo, 2011–2015. Pages 21-28.***

**Introduction:** We used road crashes between vehicles and two-wheelers from Yinzhou District Ningbo in 2011–2015 from the China In-depth Accident Study (CIDAS) as sample cases. The risk factors of different injury severity grades were analyzed. **Method:** The classification tree model was used to screen the possible interaction items, and the corresponding regression model was constructed according to the results of the tree model to explore the influencing factors of cyclist injury. **Results:** The road types, weather types, gender, age of the riders, and vehicle speed were significantly correlated with the dependent variables. The interaction effect of gender\*road type, weather\*age, weather\*speed and speed\*age were obtained through a tree model. **Conclusions:** The risk of male casualties at the crossroads was 3.31 times higher than that of female casualties at the straight roads. On sunny days, the risk of crash casualties in Ningbo was low, and the fatality risk when the speed reached 38km/h was 10%. Under the interaction effect of weather and age, the fatality risk in cloudy/foggy and rainy days was almost coincident, and the serious risk in cloudy/foggy conditions was the highest. **Practical applications:** Through factor analysis, it is confirmed that there is interaction effect among the factors, and it can provide reference for relevant departments to formulate more targeted and effective governance strategies.

- **Keywords:** Vehicle-two-wheeler crash; Logistic regression model; CIDAS; Crash characteristic

**Xinfeng Ye, Shuang Ren, Xinchun Li, Zhining Wang. *The mediating role of psychological capital between perceived management commitment and safety behavior. Pages 29-40.***

**Introduction:** Among attempts that address high incidences of fatalities and injuries in coal mines, increasing attention has been paid to management commitment to complement the traditional focus on technological advances in safety management. However, more research is needed to explain the influence of perceived management commitment, with extant research drawing commonly on Griffin and Neal (2000) to focus on safety knowledge, skills, and motivation. This study draws on social cognitive theory (Bandura, 1986) to investigate psychological capital as a link between thought process

and safety behavior. **Method:** This study uses survey data from 400 frontline workers in China's coal mines to test hypotheses. **Result:** Results suggest that perceived management commitment to safety correlates positively with workers' safety compliance and participation, and four constituents of psychological capital—self-efficacy, hope, optimism, and resilience—explain the influence of perceived management commitment on safety compliance and participation. **Practical Applications:** Findings offer both researchers and practitioners an explanation of how perceived management commitment influences safety behaviors, and clarify the roles psychological capital constituents play in explaining the influence of perceived management commitment on safety compliance and safety participation.

- **Keywords:** Perceived management commitment; Safety compliance; Safety participation; Psychological capital

**Jill L. Jenkins, Gregory B. Rodgers. *Combining measures of risk exposure with injury incidence estimates to estimate nursery product injury rates.* Pages 41-46.**

**Introduction:** Nursery product hazards have been a frequent topic in the published literature. However, because information on the exposure to nursery product risks has not been generally available, there has been little evaluation of exposure-adjusted injury rates. **Methods:** A national survey of durable nursery product use, by nursery product type, was conducted in 2013. Two measures of risk exposure were developed for each nursery product type: the number used frequently (i.e., used every day or a few times a week) and the total number in use by households, regardless of usage frequency. These data were combined with national estimates of nursery product injuries treated in U.S. hospital emergency departments to determine exposure-adjusted injury rates. **Results:** For the 13 nursery products examined, there were an estimated 79.9 million in use; 81.6% were reportedly used frequently. When combined with injury estimates, there were an average of 104.1 injuries per 100,000 frequently used nursery products and 85.0 injuries per 100,000 in use. The exposure-adjusted injury rate rankings for the 13 products, from highest to lowest, varied substantially from rankings based on injury incidence alone. Although the injury rate rankings for the two risk exposure measures were not identical, they were highly correlated. **Conclusions:** The use of exposure-adjusted injury rates provides an enhanced understanding of product-related injury patterns, and can play an important role in program development and evaluation. Estimates of frequently used products may be preferable to products in use as a measure of risk exposure, because such estimates may better reflect intensity of use; both, however, represent valid alternatives that can result in improved program and policy analysis. **Practical Applications:** Exposure-adjusted injury rates can provide for a more comprehensive evaluation of injury patterns than incidence estimates alone. Analysts should, when possible, take risk exposure into account when evaluating safety programs and policy options.

- **Keywords:** NEISS; Exposure survey; Nursery products; Risk; CPSC

**Anna Paolillo, Silvia A. Silva, Helena Carvalho, Margherita Pasini. *Exploring patterns of multiple climates and their effects on safety performance at the department level.* Pages 47-60.**

**Introduction:** This paper represents a first attempt to fill a gap in research about different specific climates and safety outcomes, by empirically identifying patterns of climates and exploring the possible effect of different climates at the department level on some specific safety outcomes. The first objective was to explore how different specific climates (safety, communication, diversity and inclusion) can be associated to each other, considering the department level of analysis. The second objective was to examine the relationships between those patterns of climates with safety performance

(compliance and participation behaviors). **Method:** A total of 429 blue-collar workers in 35 departments answered a questionnaire covering safety, diversity, inclusion, and communication climate measures. Cluster analysis was performed to identify clusters of departments with different climate patterns and their impact on safety compliance and safety participation behaviors. Subsequently, a hierarchical multiple linear regression was conducted at the individual-level to test the effect of climate patterns, by controlling for some sociodemographic variables. **Results:** Results showed the existence of four differentiated clusters of departments. Three of those clusters showed homogenous patterns (coherent association among perceptions of low, medium and high climates) and one heterogeneous (low and medium perceptions). The findings also revealed that the higher the climates perceptions, the higher the levels of safety participation and safety compliance, with safety participation being more affected than compliance. **Conclusions:** The present research showed the associated effects of some organizational climate factors, such as fair treatment, inclusion, safety and communication within the organization, which had not been previously studied in their combined relationships, on safety behaviors. **Practical applications:** Several other organizational climate factors, such as fair treatment, inclusiveness and communication, may play an important role in safety, showing the importance of broadening the focus on safety climate as one of the main predictors of safety behaviors.

- **Keywords:** Safety; Diversity; Inclusion; Communication; Climate

**Alice M. Dalton, Florence Sumner, Andy P. Jones. *Digital screen use for a road safety campaign message was not associated with road safety awareness of passers-by: A quasi-experimental study.* Pages 61-66.**

**Introduction:** Recent evidence suggests fatality risks for cyclists may be increasing in Britain. Understanding how to increase levels of cycling while keeping risk low is paramount. Educating drivers about cyclists may help with road safety, and mass-media messaging is a possible avenue, potentially utilizing digital displays screens in public areas. However, no studies have examined the use of these screens for road safety campaigns. **Methods:** A quasi-experiment was conducted to examine if digital screens may be effective to raise awareness of a campaign message and encourage recall of car drivers. A digital campaign image was selected that encouraged car drivers and cyclists to 'look out for each other,' and stated that 80% of cyclists owned a driving license. Views and knowledge on driver priorities around cyclists were examined before (control) and after campaign exposure (intervention), and tested using regression modelling. **Results:** 364 people were interviewed over five days. Those interviewed on intervention days were more likely to rank 'Look out for cyclists' as being more important compared to those interviewed on control days (OR 1.20), but this was not statistically significant ( $p = 0.355$ ). Those who said they had seen the image did not rank 'Look out for cyclists' higher than those who said they had not seen it ( $p = 0.778$ ). The disparity between reported and displayed percentage of cyclists with a driving license did not differ between intervention and control days, but was 8% higher amongst those who claimed to have seen the image ( $p = 0.026$ ). **Conclusions:** We did not find strong evidence that use of an image on digital screens increased public awareness or recall of a casualty reduction campaign message. Work is needed to investigate the effects of longer-term exposure to road safety images. **Practical Applications:** Short-term use of digital signage is not recommended for raising awareness of road safety campaigns.

- **Keywords:** Cyclist; Road safety; Casualty reduction; Car driver behavior and education; Digital screens

**Darren Walton, Dan Jenkins, Roselle Thoreau, Simon Kingham, Michael Keall. *Why is the rate of annual road fatalities increasing? A unit record analysis of New Zealand data (2010–2017)*. Pages 67-74.**

**Introduction:** Recent increases in road crashes have reversed New Zealand's formerly declining crash rates to produce annual fatal and serious injury counts that are 49% higher than the lowest rates achieved in 2013. **Method:** We model twenty-one factors in fatal and serious injury crashes, four years before and after 2013 using logistic regression. Three major factors are significantly different in the period after 2013, when crash rates increased: (1) alcohol as a cause, (2) learner licence holders, and (3) a regional effect for Auckland. Newly defined speed zones are a more common setting for crashes in the period of upturn but there is no coinciding elevated likelihood of 'speed as a causal factor'. Three factors related to road safety were less common: aged under 25-years old, fatigue, and not wearing a seatbelt. **Results:** Results are compared to rates of prosecutions for alcohol-related driving offences over this period. It is possible that New Zealand's successful road safety initiatives of the past have been undermined by reduced levels of enforcement and an unexpected outcome from the graduated driving licence system.

- **Keywords:** Annual Crash Statistics; Road safety; Enforcement; Learner licenses; Fatalities.

**David Johnston, Mark Pagell, Anthony Veltri, Robert Klassen. *Values-in-action that support safe production*. Pages 75-91.**

**Introduction:** Safe production is a sustainable approach to managing an organization's operations that considers the interests of both management and workers as salient stakeholders in a productive and safe workplace. A supportive culture enacts values versus only espousing them. These values-in-action are beliefs shared by both management and workers that align what should happen in performing organizational routines to be safe and be productive with what actually is done. However, the operations and safety management literature provides little guidance on which values-in-action are most important to safe production and how they work together to create a supportive culture. **Method:** The researchers conducted exploratory case studies in 10 manufacturing plants of 9 firms. The researchers compared plant managers' top-down perspectives on safety in the performance of work and workers' bottom-up experiences of the safety climate and their rates of injury on the job. Each case study used data collected from interviewing multiple managers, the administration of a climate survey to workers and the examination of the plant's injury rates over time as reported to its third party health and safety insurer. **Results:** The researchers found that plants with four values-in-action —a commitment to safety, discipline, prevention and participation—were capable of safe production, while plants without those values were neither safe nor productive. Where culture and climate aligned lower rates of injury were experienced. **Discussion and conclusion:** The four value-in-actions must all be present and work together in a self-reinforcing manner to engage workers and managers in achieving safe production. **Practical application:** Managers of both operations and safety functions do impact safety outcomes such as reducing injuries by creating a participatory environment that encourage learning that improves both safety and production routines.

- **Keywords:** Organizational culture and climate; Values; Occupational safety; Sustainable production; Organizational routines

**Peixia Cheng, Ruotong Li, David C. Schwebel, Motao Zhu, Guoqing Hu. *Traumatic brain injury mortality among U.S. children and adolescents ages 0–19 years, 1999–2017. Pages 93-100.***

**Introduction:** To examine recent traumatic brain injury (TBI) mortality changes among Americans aged 0–19 years by sex, age, urbanicity, state, and intent/causes of injury. **Method:** TBI mortality per 100,000 population and average annual percent changes (AAPCs), plus 95% confidence intervals (CIs) based on Joinpoint regression models. **Results:** Age-adjusted TBI mortality among Americans aged 0–19 years declined consistently, though at varying rates between 1999 and 2013 (AAPC = –4.8%, 95%CI: –6.3%, –3.2%), and then significantly increased from 4.42 per 100,000 population in 2013 to 5.17 per 100,000 population in 2017 (AAPC = 3.4%, 95% CI: 1.7%, 5.1%). During the study time period, boys, rural children, and youth aged 15–19 years had higher TBI mortality rates than girls, urban children, and younger children, respectively. TBI mortality from unintentional transport crashes decreased substantially in all age groups between 1999 and 2017, and especially from 1999 to 2010. TBI mortality from suicide increased significantly from 2008 to 2017 in the 10–14-year age group (AAPC = 14.6%, 95% CI: 12.6%, 16.6%) and from 2007 to 2017 in the 15–19-year age group (AAPC = 6.3%, 95% CI: 3.8%, 8.7%). Unintentional transport crashes were the leading cause of TBI-related mortality in 46 states in 1999, but by 2017, suicide became the first leading cause in 14 states. **Conclusions:** Pediatric TBI mortality declined consistently between 1999 and 2013 and increased significantly from 2013 to 2017, driven primarily by the mortality decrease from unintentional transport crashes and increase in suicide mortality. The spectrum of leading causes of pediatric TBI mortality changed across age groups and over time from 1999 to 2017. **Practical Applications:** TBI mortality increases in the United States since 2013 are driven primarily by increasing suicide rates, a trend that merits the attention of policy-makers and injury researchers. Action should be taken to curb growing TBI mortality rates among adolescents aged 10–19 years.

- **Keywords:** Traumatic brain injury; Mortality; Children and teenager; Intervention; The United States

**Hagai Tapiro, Tal Oron-Gilad, Yisrael Parmet. *Pedestrian distraction: The effects of road environment complexity and age on pedestrian’s visual attention and crossing behavior. Pages 101-109.***

**Introduction:** Little is known about how characteristics of the environment affect pedestrians’ road crossing behavior. **Method:** In this work, the effect of typical urban visual clutter created by objects and elements in the road proximity (e.g., billboards) on adults and children (aged 9–13) road crossing behavior was examined in a controlled laboratory environment, utilizing virtual reality scenarios projected on a large dome screen. **Results:** Divided into three levels of visual load, results showed that high visual load affected children’s and adults’ road crossing behavior and visual attention. The main effect on participants’ crossing decisions was seen in missed crossing opportunities. Children and adults missed more opportunities to cross the road when exposed to more cluttered road environments. An interaction with age was found in the dispersion of the visual attention measure. Children, 9–10 and 11–13 years old, had a wider spread of gazes across the scene when the environment was highly loaded—an effect not seen with adults. However, unexpectedly, no other indication of the deterring effect was found in the current study. Still, according to the results, it is reasonable to assume that busier road environments can be more hazardous to adult and child pedestrians. **Practical Applications:** In that context, it is important to further investigate the possible distracting effect of causal objects in the road environment on pedestrians, and especially children. This knowledge can help to create better safety guideline for children and assist urban planners in creating safer urban environments.

- **Keywords:** Road crossing; Visual clutter; Distraction; Urban environment; Pedestrian; Children

**Anat Meir, Tal Oron-Gilad. *Understanding complex traffic road scenes: The case of child-pedestrians' hazard perception. Pages 111-126.***

**Introduction:** Understanding the shortcomings of child-pedestrians in evaluating traffic situations may contribute to producing intervention techniques that may increase their awareness to potential hazards as well as inform and inspire designers of autonomous vehicle and infrastructure systems to deal with the complications of crossing pedestrians.

**Method:** The present work examined pedestrians' hazard-perception (HP) skills in complex traffic scenes. Two experiments explored how pedestrians' HP abilities vary with age and experience. In the first, adults and youngsters (7–13-year-olds) were presented with pairs of photographs displaying traffic situations and instructed to compare between the hazard levels of the two. Findings revealed a marked trend where experienced-adults tended to rate photographs depicting field of view partially obscured by parked vehicles as more hazardous. Moreover, adults tended to rate photographs depicting vehicles closer to the crossing site as more hazardous. Lastly, adults tended to rate photographs depicting complex configurations like traffic circles, as more hazardous than T-junctions.

**Results:** Findings suggested that youngsters may be highly influenced by cueing. Next, pedestrians' HP was tested using a crossing decision task. Participants observed traffic scenes presented in a dynamic simulated environment of an urban road from a pedestrian's perspective and pressed a response button whenever they assumed it was safe to cross. Compared to experienced-adults and 7–8-year-olds, 9–13-year-olds presented a less decisive performance. Compared to previous findings regarding simpler road crossing configurations, most participants, regardless of age, related more to the approaching vehicles and presence of a pedestrian crossing while refraining from addressing the road configuration. Implications for road-safety are discussed.

- **Keywords:** Hazard Perception; Child-pedestrians; Paired comparison; Virtual reality; Road crossing

**Sathish Kumar Sivasankaran, Venkatesh Balasubramanian. *Exploring the severity of bicycle: vehicle crashes using latent class clustering approach in India. Pages 127-138.***

**Introduction:** Bicyclists are vulnerable users in the shared asset like roadways. However, people still prefer to use bicycles for environmental, societal, and health benefits. In India, the bicycle plays a role in supporting the mobility to more people at lower cost and are often associated with the urban poor. Bicyclists represents one of the road user categories with highest risk of injuries and fatalities. According to the report by the Ministry of Road Transport and Highways (Accidents, 2017) in India, there is a sharp increase in the number of fatal victims for bicyclists in 2017 over 2016. The number of cyclists killed jumped from 2,585 in 2016 to 3,559 in 2017, a 37.7% increase. **Method:** Few studies have only investigated the crash risk perceived by the bicyclists while interacting with other road users. The present paper investigates the injury severity of bicyclists in bicycle-vehicle crashes that occurred in the state of Tamilnadu, India during the nine year period (2009–2017). The analyses demonstrate that dividing bicycle-vehicle collision data into five clusters helps in reducing the systematic heterogeneity present in the data and identify the hidden relationship between the injury severity levels of bicyclists and cyclists demographics, vehicle, environmental, temporal cause for the crashes. **Results:** Latent Class Clustering (LCC) approach was used in the present study as a preliminary tool for the segmentation of 9,978 crashes. Later, logistic regression analysis was used to identify the factors that influence bicycle crash severity for the whole dataset as well as for the clusters that were obtained from the LCC model. Results of this study show that combined use of both techniques reveals further information that wouldn't be obtained without prior segmentation of the data. Few variables such as

season, weather conditions, and light conditions were significant for certain clusters that were hidden in the whole dataset. This study can help domain experts or traffic safety researchers to segment traffic crashes and develop targeted countermeasures to mitigate injury severity.

- **Keywords:** Bicycle Crashes; Latent Class Clustering; Crash Severity; Cluster Analysis

**Julien Adrian, David Hue, Sophie Porte, Johan Le Brun. *Validation of the driver ecological glare test.* Pages 139-143.**

**Introduction:** The present study proposes to validate the Driver Ecological Glare Test (DEGT), a test developed to measure the benefit of a headlight glare Advanced Driver Assistance System (ADAS), by comparing it to a laboratory glare test. **Method:** Twenty-four participants, aged from 55 to 70 years, were recruited to complete a visual examination, including monocular halo size measurement for both eyes using Vision Monitor device (MonCv3; Metrovision). An on-field evaluation took place at night at the UTAC CERAM test track to obtain disability glare measures using the DEGT. **Results:** A significant correlation was found between the two glare tests and Bland-Altman analysis reveals a good agreement with a bias of 73.7 arcmin between the halo size measurements obtained from the DEGT and Vision Monitor. The results of the present study demonstrate that the DEGT is a valid method to test halo size and is adapted to evaluate the benefits of an antiglare device for drivers in an ecological situation.

- **Keywords:** Glare; Driving Glare test; Disability glare; Halo size measurement

**Eric R. Teoh. *What's in a name? Drivers' perceptions of the use of five SAE Level 2 driving automation systems.* Pages 145-151.**

**Introduction:** Automobile manufacturers are developing increasingly sophisticated driving automation systems. Currently, the highest level of automation available on the market is SAE Level 2, which provides sustained assistance for both lateral and longitudinal vehicle control. The purpose of this study was to evaluate how drivers' perceptions of what behaviors secondary to driving are safe while a Level 2 system is operating vary by system name. **Methods:** A nationally representative telephone survey of 2005 drivers was conducted in 2018 with questions about behaviors respondents perceived as safe while a Level 2 driving automation system is in operation. Each respondent was asked about two out of five system names at random for a balanced study design. **Results:** The name "Autopilot" was associated with the highest likelihood that drivers believed a behavior was safe while in operation, for every behavior measured. There was less variation observed among the other four SAE Level 2 system names when compared with each other. A limited proportion of drivers had experience with advanced driver assistance systems and fewer of these reported driving a vehicle in which Level 2 systems were available. Drivers reported that they would consult a variety of sources for information on how to use a Level 2 system. **Conclusions:** The names of SAE Level 2 driving automation systems influence drivers' perceptions of how to use them, and the name "Autopilot" was associated with the strongest effect. While a name alone cannot properly instruct drivers on how to use a system, it is a piece of information and must be considered so that drivers are not misled about the correct usage of these systems. **Practical Applications:** Manufacturers, suppliers, and organizations regulating or evaluating SAE Level 2 automated driving systems should ensure that systems are named so as not to mislead drivers about their safe use.

- **Keywords:** Driving automation systems; SAE Level 2; Branding; Automation; Advanced driver assistance systems

**Yimin He, Stephanie C. Payne, Xiang Yao, Rachel Smallman. *Improving workplace safety by thinking about what might have been: A first look at the role of counterfactual thinking*. Pages 153-164.**

**Introduction:** Information processing theories of workplace safety suggest that cognition is an antecedent of safety behavior. However, little research has directly tested cognitive factors as predictors of workplace safety within organizational psychology and behavior research. Counterfactuals (cognitions about “what might have been”) can be functional when they consist of characteristics (e.g., “upward” – focusing on better outcomes) that alter behavior in a manner consistent with those outcomes. This field study aimed to examine the influence of counterfactual thinking on safety behavior and explanatory mechanisms and boundary conditions of that relationship. **Method:** A sample of 240 medical providers from a hospital in China responded to three surveys over a four-month time frame. **Results:** Results showed that upward counterfactuals were positively related to supervisor ratings of safety compliance and participation. These relationships were mediated by safety knowledge but not by safety motivation. Upward counterfactuals were more strongly related to safety behavior and knowledge than downward counterfactuals. As expected, safety locus of control strengthened the mediating effects of safety knowledge on the relationship between upward counterfactuals and safety behavior. **Conclusions and Practical Applications:** The findings demonstrated that counterfactual thinking is positively associated with safety behavior and knowledge, thus expanding the variables related to workplace safety and laying some initial groundwork for new safety interventions incorporating counterfactual thinking.

- **Keywords:** Counterfactual thinking; Safety behavior; Safety knowledge

**F. Dennis Thomas, Anne E. Dickerson, Lindsey A. Graham, M. Chandler Coleman, Kraig A. Finstad, Richard D. Blomberg, Timothy J. Wright. *Teaching older drivers to navigate GPS technology*. Pages 165-171.**

**Background and objectives:** New technologies are being implemented in motor vehicles. One key technology is the electronic navigation system (ENS) that assists the driver in wayfinding, or actually guides the vehicle in higher level automation vehicles. It is unclear how older adults interact with ENSs and the best approach to train older adults to use the devices. The objectives of this study were to explore how older drivers interacted with an ENS while driving on live roadways and how various training approaches impacted older drivers’ ability to accurately enter destinations into the ENS. **Research design and methods:** In Experiment 1, 80 older drivers navigated unfamiliar routes using an ENS or paper directions and completed a series of ENS destination entry tasks. In Experiment 2, 60 older drivers completed one of three training conditions (ENS video only, ENS video with hands-on training, placebo) to examine the impacts of training on destination entry performance. **Results and discussion:** Driving performance was aided by the use of the ENS, but many older drivers had difficulty entering destinations into the device (Experiment 1). The combined video with hands-on ENS training resulted in the best overall destination entry performance (Experiment 2). **Practical applications:** The results suggest older drivers may experience problems entering destinations into ENSs, but training can improve performance. These performance issues may be especially important as more vehicle features require interaction with computer systems to select destinations or other automation related features. Further research is needed to determine how to prepare the next generation of older drivers who will interact with technologies aimed at increasing mobility.

- **Keywords:** Vehicle automation; Driver behavior; Aging processes; Navigation; Training evaluation; Designing for the elderly

**Xinyun Hu, Gabriel Lodewijks. *Detecting fatigue in car drivers and aircraft pilots by using non-invasive measures: The value of differentiation of sleepiness and mental fatigue.* Pages 173-187.**

**Introduction:** Fatigue is one of the most crucial factors that contribute to a decrease of the operating performance of aircraft pilots and car drivers and, as such, plays a dangerous role in transport safety. To reduce fatigue-related tragedies and to increase the quality of a healthy life, many studies have focused on exploring effective methods and psychophysiological indicators for detecting and monitoring fatigue. However, those fatigue indicators rose many discrepancies among simulator and field studies, due to the vague conceptualism of fatigue, per se, which hinders the development of fatigue monitoring devices. **Method:** This paper aims to give psychological insight of the existing non-invasive measures for driver and pilot fatigue by differentiating sleepiness and mental fatigue. Such a study helps to improve research results for a wide range of researchers whose interests lie in the development of in-vehicle fatigue detection devices. First, the nature of fatigue for drivers/pilots is elucidated regarding fatigue types and fatigue responses, which reshapes our understanding of the fatigue issue in the transport industry. Secondly, the widely used objective neurophysiological methods, including electroencephalography (EEG), electrooculography (EOG), and electrocardiography (ECG), physical movement-based methods, vehicle-based methods, fitness-for-duty test as well as subjective methods (self-rating scales) are introduced. On the one hand, considering the difference between mental fatigue and sleepiness effects, the links between the objective and subjective indicators and fatigue are thoroughly investigated and reviewed. On the other hand, to better determine fatigue occurrence, a new combination of measures is recommended, as a single measure is not sufficient to yield a convincing benchmark of fatigue. Finally, since video-based techniques of measuring eye metrics offer a promising and practical method for monitoring operator fatigue, the relationship between fatigue and these eye metrics, that include blink-based, pupil-based, and saccade-based features, are also discussed. To realize a pragmatic fatigue detector for operators in the future, this paper concludes with a discussion on the future directions in terms of methodology of conducting operator fatigue research and fatigue analysis by using eye-related parameters.

- **Keywords:** Driver fatigue; Pilot fatigue; Fatigue detection; Eye metrics; EEG

**Rebecca J. Guerin, Michael D. Toland. *An application of a modified theory of planned behavior model to investigate adolescents' job safety knowledge, norms, attitude and intention to enact workplace safety and health skills.* Pages 189-198.**

**Introduction:** For many reasons, including a lack of adequate safety training and education, U.S. adolescents experience a higher rate of job-related injury compared to adult workers. Widely used social-psychological theories in public health research and practice, such as the theory of planned behavior, may provide guidance for developing and evaluating school-based interventions to prepare adolescents for workplace hazards and risks. **Method:** Using a structural equation modeling approach, the current study explores whether a modified theory of planned behavior model provides insight on 1,748 eighth graders' occupational safety and health (OSH) attitude, subjective norm, self-efficacy and behavioral intention, before and after receiving instruction on a free, national young worker safety and health curriculum. Reliability estimates for the measures were produced and direct and indirect associations between knowledge and other model constructs assessed. **Results:** Overall, the findings align with the theory of planned behavior. The structural equation model adequately fit the data; most path coefficients are statistically significant and knowledge has indirect effects on behavioral intention. Confirmatory factor analyses suggest that the knowledge, attitude, self-efficacy, and behavioral intention measures each reflect a unique dimension (reliability

estimates  $\geq 0.86$ ), while the subjective norm measure did not perform adequately. **Conclusion:** The findings presented provide support for using behavioral theory (specifically a modified theory of planned behavior) to investigate adolescents' knowledge, perceptions, and behavioral intention to engage in safe and healthful activities at work, an understanding of which may contribute to reducing the downstream burden of injury on this vulnerable population—the future workforce. **Practical application:** Health behavior theories, commonly used in the social and behavioral sciences, have utility and provide guidance for developing and evaluating OSH interventions, including those aimed at preventing injuries and promoting the health and safety of adolescent workers in the U.S., who are injured at higher rates than are adults.

- **Keywords:** Occupational safety and health; Young worker; Injury prevention; Theory of planned behavior; Item response theory; Structural equation modeling