

## **Journal of Safety Research – rok 2013, ročník 44**

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**Sophia Vardaki, George Yannis. *Investigating the self-reported behavior of drivers and their attitudes to traffic violations.* Pages 1-11.**

#### Introduction

Driving behavior theoretical models consider attitudes as an important determinant of driver behavior. Moreover, the association between the self-reported tendency to commit violations and accident involvement is widely recognized. This research investigates drivers' self-reported behavior and attitudes to risky behaviors related to the traffic violations of speeding, drink-driving, and cell phone use using cluster analysis.

#### Method

A sample of 601 Greek drivers participating at the SARTRE 4 pan-European survey is utilized. The analysis identified three clusters of drivers. Drivers in Cluster 1 commit traffic violations more often; drivers in Cluster 2 favor traffic violation countermeasures while having moderate views toward compliance with traffic rules; and drivers in Cluster 3 strongly support traffic violation countermeasures and also have strong views toward compliance with traffic rules. Risky behaviors and related attitudes that differentiate the three distinct groups of drivers (clusters) were determined.

#### Results

The findings indicate that differences in attitudes and behaviors may be attributed to factors such as age, gender, and area of residence. The research findings also provided some insight about the current level of drivers' attitudes to traffic violations, especially those that negatively affect traffic safety. The pattern of their views on violations may form the basis of risk behavior-related interventions tailored to the identified groups, aiming at informing, educating, and raising the awareness of the public.

#### Impact on Industry

Agencies focused on safety interventions could exploit this information in designing and implementing education campaigns, enforcement programs and in defining relevant priorities.

- **Keywords:** Road safety; Driving violations; Driver attitudes; Driver behaviors; Demographics

**C. Goldenbeld, S. de Craen. *The comparison of road safety survey answers between web-panel and face-to-face; Dutch results of SARTRE-4 survey.* Pages 13-20.**

#### Introduction

In the Netherlands, a comparison of an online and a face-to-face sample of car drivers was made to study differences on a number of selected questions from the SARTRE-4 road safety survey.

#### Results

Contrary to expectations, there was no indication that online respondents were more likely to come from higher educated or more privileged social groups. Confirming earlier research, the results indicated that online respondents were less inclined to give socially desirable answers and were less inclined to use more extreme ratings in their opinions about measures. Contrary to expectations, face-to-face respondents did not tend to give more positive answers in judgment of road safety measures. Weighting to make samples comparable on gender, age, and education had almost no effect on outcomes.

#### Conclusions

The implications for a transition from face-to-face survey to online panel method are discussed.

- **Keywords:** Survey; Road safety; Web-based panel; Face-to-face survey; Comparison

**M. Felisa Latorre Navarro, Francisco J. Gracia Lerín, Inés Tomás, José María Peiró Silla. *Validation of the group nuclear safety climate questionnaire.* Pages 21-30.**

#### Introduction

Group safety climate is a leading indicator of safety performance in high reliability organizations. Zohar and Luria (2005) developed a Group Safety Climate scale (ZGSC) and found it to have a single factor.

#### Method

The ZGSC scale was used as a basis in this study with the researchers rewording almost half of the items on this scale, changing the referents from the leader to the group, and trying to validate a two-factor scale. The sample was composed of 566 employees in 50 groups from a Spanish nuclear power plant. Item analysis, reliability, correlations, aggregation indexes and CFA were performed.

#### Results

Results revealed that the construct was shared by each unit, and our reworded Group Safety Climate (GSC) scale showed a one-factor structure and correlated to organizational safety climate, formalized procedures, safety behavior, and time pressure.

#### "Impact on Industry

This validation of the one-factor structure of the Zohar and Luria (2005) scale could strengthen and spread this scale and measure group safety climate more effectively.

- **Keywords:** Safety climate; group level safety climate; supervisor perceptions; group perceptions

**Luis F. Miranda-Moreno, Shahram Heydari, Dominique Lord, Liping Fu. *Bayesian road safety analysis: Incorporation of past evidence and effect of hyper-prior choice. Pages 31-40.***

#### Problem

This paper aims to address two related issues when applying hierarchical Bayesian models for road safety analysis, namely: (a) how to incorporate available information from previous studies or past experiences in the (hyper) prior distributions for model parameters and (b) what are the potential benefits of incorporating past evidence on the results of a road safety analysis when working with scarce accident data (i.e., when calibrating models with crash datasets characterized by a very low average number of accidents and a small number of sites).

#### Method

A simulation framework was developed to evaluate the performance of alternative hyper-priors including informative and non-informative Gamma, Pareto, as well as Uniform distributions. Based on this simulation framework, different data scenarios (i.e., number of observations and years of data) were defined and tested using crash data collected at 3-legged rural intersections in California and crash data collected for rural 4-lane highway segments in Texas.

#### Results

This study shows how the accuracy of model parameter estimates (inverse dispersion parameter) is considerably improved when incorporating past evidence, in particular when working with the small number of observations and crash data with low mean. The results also illustrates that when the sample size (more than 100 sites) and the number of years of crash data is relatively large, neither the incorporation of past experience nor the choice of the hyper-prior distribution may affect the final results of a traffic safety analysis.

#### Conclusions

As a potential solution to the problem of low sample mean and small sample size, this paper suggests some practical guidance on how to incorporate past evidence into informative hyper-priors. By combining evidence from past studies and data available, the model parameter estimates can significantly be improved. The effect of prior choice seems to be less important on the hotspot identification.

#### Impact on Industry

The results show the benefits of incorporating prior information when working with limited crash data in road safety studies.

- **Keywords:** road safety; Bayesian approach; past evidence; hyper-prior assumptions

**P. Gulliver, D. Begg, R. Brookland, S. Ameratunga, J. Langley. *Learner driver experiences and crash risk as an unsupervised driver*. Pages 41-46.**

#### Objective

The purpose of this study was to describe the driving experiences of learner licensed drivers and examine the association between these driving experiences, associated factors, and on-road car crash involvement during the unsupervised restricted license stage.

#### Methods

Data were drawn from a cohort investigation of newly licensed drivers. Information on demographic characteristics, personality, and risk behaviors was collected at the baseline interview. At the first follow-up interview (restricted license stage) study members were asked details about their experiences as a learner licensed driver: professional driving lessons, supervised driving, unsupervised driving, and driving courses in which they participated. During the second follow-up interview (full license stage), data were collected on crash involvement and driving exposure during the restricted license stage. Regression analysis was used to determine independent relationships between learner license driving experience variables and crash involvement.

#### Results

After adjusting for demographic, personality factors, and driving exposure at the restricted license stage, increased time spent on the learner license was associated with a reduced risk of crash involvement during the unsupervised restricted license stage.

#### Conclusion

Results presented in this paper suggest that learner drivers in New Zealand should be encouraged to spend more time on their learner license to enable them to gain skills and experience to help reduce their crash risk when they are allowed to drive unsupervised.

#### Impact on Industry

Compared with novice drivers who are on their learner license for the least amount of time, those who spend the most amount of time on their learner license have reduced risk of on-road crash involvement as an unsupervised driver.

Learner drivers and their supervisors need to be aware of the length of time required for practice in order to reduce the risks of crash involvement when they are able to drive unsupervised (O'Brien et al., 2012).

The recently introduced increase in the minimum driver licensing age in NZ, tougher restricted license stage driving test (aimed at encouraging 120 hours of supervised driving), and the Safe Teen driver campaign (NZ Transport Agency, 2012) are all strategies targeted at improving the safety of learner drivers. These strategies need to be evaluated to ensure they are achieving their goals.

- **Keywords:** Novice drivers; crash involvement; unsupervised driving

**Alessandra Falco, Alessandra Piccirelli, Damiano Girardi, Laura Dal Corso, Nicola A. De Carlo. *Risky riding behavior on two wheels: The role of cognitive, social, and personality variables among young adolescents.* Pages 47-57.**

Objective

The main objective of this study was to analyze and estimate the relations between risky riding behaviors and some personality and sociocognitive variables through structural equation modeling. We focused on two-wheel riding behavior among a sample of 1,028 Italian adolescents at their first driving experience.

Conclusions

The main findings confirmed the role of personality in influencing riding behavior directly as well as indirectly through risk perception. In particular, risk perception was a significant mediator between personality, social norm, and riding behavior. The significant relations that emerged in the general sample were further confirmed in the two specific sub-samples of males and females. In terms of social marketing and educational communication, it may consequently be advisable to proceed in an integrated and coordinated manner at both the cognitive and social level, taking into account some "dispositions to risk" related to personality.

Impact on industry

The integrated and coordinated action on different levels - cognitive, social, and personality - may therefore allow more effective and significant results in reducing those risky riding behaviors that often underlie young two-wheel riders' higher involvement in traffic accidents.

- **Keywords:** Risky riding behavior; Adolescents people on two wheels; Risk perception; Gender; Personality

**Niclas A. Krüger. *Fatal connections—socioeconomic determinants of road accident risk and drunk driving in Sweden.* Pages 59-65.**

**Problem:** In recent years a considerable number of papers have examined socioeconomic factors influencing the number and the outcome of traffic accidents. There is however more research needed to confirm the previous results in order to generalize them and a need to examine additional factors that might have an impact. **Method:** This paper uses both regional panel data and national time series data combined with filtering techniques to determine what factors influence the number of accidents, the accident outcome and detected drunk driving. **Results:** Using time series data, it is found that the number of traffic fatalities increases for both per capita and per person kilometer travelled during economic booms. This indicates that the death risk rises not only because of increased mileage or motorization during booms. Using panel data, it is found that traffic fatalities decrease with unemployment, whereas personal injuries increase on a per capita basis with youth and the number of cars. In contrast to property crimes and other types of crime, drunk driving in Sweden decreases during economic contractions. **Discussion:** The main policy conclusion from our results is that resources for safety measures should not be spend uniformly across time and space. Instead, safety measures should be concentrated to areas with a high share of young people and to periods with low unemployment. The results of the time series analysis suggest that factors other than increased mileage during booms contribute to the higher rate of fatalities during good times. Increased risk taking, such as drunk driving, might be an explanatory factor. **Impact on Industry:** The results might be interesting for safety-oriented car and truck producers as well for developers of traffic safety products, since the results indicate

in what regional markets and under what market conditions their products are most needed.

- **Keywords:** Traffic accidents; Drunk driving; Business cycle

**Kirolos Haleem, Albert Gan. *Effect of driver's age and side of impact on crash severity along urban freeways: A mixed logit approach.* Pages 67-76.**

#### Introduction

This study identifies geometric, traffic, environmental, vehicle-related, and driver-related predictors of crash injury severity on urban freeways.

#### Method

The study takes advantage of the mixed logit model's ability to account for unobserved effects that are difficult to quantify and may affect the model estimation, such as the driver's reaction at the time of crash. Crashes of 5 years occurring on 89 urban freeway segments throughout the state of Florida in the United States were used. Examples of severity predictors explored include traffic volume, distance of the crash to the nearest ramp, and detailed driver's age, vehicle types, and sides of impact. To show how the parameter estimates could vary, a binary logit model was compared with the mixed logit model.

#### Results

It was found that the at-fault driver's age, traffic volume, distance of the crash to the nearest ramp, vehicle type, side of impact, and percentage of trucks significantly influence severity on urban freeways. Additionally, young at-fault drivers were associated with a significant severity risk increase relative to other age groups. It was also observed that some variables in the binary logit model yielded illogic estimates due to ignoring the random variation of the estimation. Since the at-fault driver's age and side of impact were significant random parameters in the mixed logit model, an in-depth investigation was performed. It was noticed that back, left, and right impacts had the highest risk among middle-aged drivers, followed by young drivers, very young drivers, and finally, old and very old drivers.

#### Impact on Industry

To reduce side impacts due to lane changing, two primary strategies can be recommended. The first strategy is to conduct campaigns to convey the hazardous effect of changing lanes at higher speeds. The second is to devise in-vehicle side crash avoidance systems to alert drivers of a potential crash risk.

#### Conclusions

The study provided a promising approach to screening the predictors before fitting the mixed logit model using the random forest technique. Furthermore, potential countermeasures were proposed to reduce the severity of impacts.

- **Keywords:** Mixed Logit; Severity; Urban Freeway; Driver's Age; Side of Impact

**Kelli England Will, Krystall E. Dunaway, Edward J. Lorek Jr. *Tweens at risk: Examining car safety practices in four economically disadvantaged urban elementary schools in Virginia. Pages 77-82.***

Introduction

Children aged 8- to 12-years-old ("tweens") are at high risk for crash injury, and motor vehicle crashes are their leading cause of death.

Method

Data are presented from behavioral observations (N = 243), surveys (N = 677), and focus groups (N = 26) conducted with tweens attending four urban elementary schools in Virginia. The populations assessed were predominantly Black (77.9%) and economically disadvantaged (61.9%).

Results

Focus groups revealed a number of inconsistencies in and misconceptions about safety practices. Among the 677 tweens who completed anonymous surveys, the majority (58.1%) reported wearing their seat belts "not very much at all" or "never." Many students (47.8%) reported usually sitting in the front seat or sitting in the front and back seats equally. This is despite the fact that most (92.0%) knew that the back seat was the safest place to sit. Of the 243 tweens observed in vehicles, 65.0% were unrestrained and 60.1% were seated in the front passenger seat.

Impact on Industry

Findings of this study shed light on the great disparity between the national rates for child safety practices and those of children living in an economically disadvantaged urban school district. Additional intervention programs that are culturally appropriate and specifically target this age group are needed.

- **Keywords:** children; occupant protection; seat belt; motor vehicle; health disparities

**Cameron Shew, Anurag Pande, Cornelius Nuworsoo. *Transferability and robustness of real-time freeway crash risk assessment. Pages 83-90.***

Introduction

This study examines the data from single loop detectors on northbound (NB) US-101 in San Jose, California to estimate real-time crash risk assessment models.

Method

The classification tree and neural network based crash risk assessment models developed with data from NB US-101 are applied to data from the same freeway, as well as to the data from nearby segments of the SB US-101, NB I-880, and SB I-880 corridors. The performance of crash risk assessment models on these nearby segments is the focus of this research.

Results

The model applications show that it is in fact possible to use the same model for multiple freeways, as the underlying relationships between traffic data and crash risk remain similar.

## Impact on Industry

The framework provided here may be helpful to authorities for freeway segments with newly installed traffic surveillance apparatuses, since the real-time crash risk assessment models from nearby freeways with existing infrastructure would be able to provide a reasonable estimate of crash risk. The robustness of the model output is also assessed by location, time of day, and day of week. The analysis shows that on some locations the models may require further learning due to higher than expected false positive (e.g., the I-680/I-280 interchange on US-101 NB) or false negative rates. The approach for post-processing the results from the model provides ideas to refine the model prior to or during the implementation.

- **Keywords:** Real-time crash risk; Transferability; Freeway safety; Classification trees; Neural networks

## **Rongjie Yu, Mohamed Abdel-Aty. *Investigating the different characteristics of weekday and weekend crashes. Pages 91-97.***

### Introduction

This study provides a systematic approach to investigate the different characteristics of weekday and weekend crashes.

### Method

Weekend crashes were defined as crashes occurring between Friday 9 p.m. and Sunday 9 p.m., while the other crashes were labeled as weekday crashes. In order to reveal the various features for weekday and weekend crashes, multi-level traffic safety analyses have been conducted. For the aggregate analysis, crash frequency models have been developed through Bayesian inference technique; correlation effects of weekday and weekend crash frequencies have been accounted. A multivariate Poisson model and correlated random effects Poisson model were estimated; model goodness-of-fits have been compared through DIC values. In addition to the safety performance functions, a disaggregate crash time propensity model was calibrated with Bayesian logistic regression model. Moreover, in order to account for the cross-section unobserved heterogeneity, random effects Bayesian logistic regression model was employed.

### Results

It was concluded that weekday crashes are more probable to happen during congested sections, while the weekend crashes mostly occur under free flow conditions. Finally, for the purpose of confirming the aforementioned conclusions, real-time crash prediction models have been developed. Random effects Bayesian logistic regression models incorporating the microscopic traffic data were developed. Results of the real-time crash prediction models are consistent with the crash time propensity analysis. Furthermore, results from these models would shed some lights on future geometric improvements and traffic management strategies to improve traffic safety.

### Impact on Industry

Utilizing safety performance to identify potential geometric improvements to reduce crash occurrence and monitoring real-time crash risks to pro-actively improve traffic safety.

- **Keywords:** Multivariate Poisson model; Weekend crash; Random effects Bayesian logistic regression; Mountainous freeway traffic safety

**Saman Aminbakhsh, Murat Gunduz, Rifat Sonmez. *Safety risk assessment using analytic hierarchy process (AHP) during planning and budgeting of construction projects. Pages 99-105.***

Introduction

The inherent and unique risks on construction projects quite often present key challenges to contractors. Health and safety risks are among the most significant risks in construction projects since the construction industry is characterized by a relatively high injury and death rate compared to other industries. In construction project management, safety risk assessment is an important step toward identifying potential hazards and evaluating the risks associated with the hazards. Adequate prioritization of safety risks during risk assessment is crucial for planning, budgeting, and management of safety related risks.

Method

In this paper, a safety risk assessment framework is presented based on the theory of cost of safety (COS) model and the analytic hierarchy process (AHP). The main contribution of the proposed framework is that it presents a robust method for prioritization of safety risks in construction projects to create a rational budget and to set realistic goals without compromising safety.

The impact to the industry

The framework provides a decision tool for the decision makers to determine the adequate accident/injury prevention investments while considering the funding limits. The proposed safety risk framework is illustrated using a real-life construction project and the advantages and limitations of the framework are discussed.

- **Keywords:** Occupational health and safety; Analytic hierarchy process; Risk assessment; Finance; Prioritization

**Lisa J. Molnar, David W. Eby, Jim Langford, Judith L. Charlton, Renée M. St. Louis, J. Scott Roberts. *Tactical, strategic, and life-goal self-regulation of driving by older adults: Development and testing of a questionnaire. Pages 107-117.***

Introduction

Appropriate self-regulation of driving – that is, adjusting one's driving patterns by driving less or avoiding specific situations considered challenging – shows promise as a strategy for extending safe driving. However, results on the extent of self-regulatory practices among older drivers vary considerably across studies.

Method

The purpose of this study was to develop and test a questionnaire to measure self-regulation at multiple levels of driver performance and decision making, using a sample of older drivers comprised of individuals with clinically-determined functional impairments, as well as older adults recruited from the general population.

Results

Results suggest that the questionnaire is a user-friendly instrument for gathering information from older adults about their self-regulatory practices which has good construct validity. Feedback on the questionnaire was positive. Construct validity of the

questionnaire was assessed by comparing the recruitment populations along various dimensions on which they might be expected to differ (e.g., self-rated health and functioning, abilities for safe driving, and feelings of driving comfort/safety) and looking for correlations between variables that one would reasonably expect to be correlated.

### Conclusions

Overall, participants rated their general health and functioning, and abilities for safe driving quite highly. However, participants from the clinic population rated themselves lower than participants from the general population on several abilities including seeing clearly during the day and night, remembering things, and processing information. While participants reported high levels of driving comfort and safety for most driving situations, the clinic population reported lower levels of comfort and safety for every driving circumstance except driving alone. High correlations were found between comfort and safety and the absolute mean scores were nearly identical for each driving circumstance. Finally, the clinic population was more likely to report trying to avoid driving at night, in unfamiliar areas, and on the expressway, as well as chatting with passengers.

### Impact on the industry

Results of this pilot work provide insights into the self-regulatory driving process that could eventually inform efforts to extend safe mobility among older adults.

- **Keywords:** Self-regulatory practices; Mobility; Driving avoidance; Older drivers

**Suzanne M. Marsh, Larry L. Jackson. *A comparison of fatal occupational injury event characteristics from the Census of Fatal Occupational Injuries and the Vital Statistics Mortality System*. Pages 119-125.**

### Objectives

The aim of this study was to examine utility of appending International Classification of Diseases (ICD) codes from Vital Statistics Mortality (VSM) data to Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries (CFOI), and compare occupational event characteristics based on ICD external cause and BLS Occupational Injury and Illness Classification System (OIICS) event codes.

### Methods

We linked VSM records with CFOI records for 2003 and 2004.

### Results

Ninety-five percent of approximately 11,000 CFOI cases were linked to VSM cases. Linked data suggest that CFOI OIICS event and VSM ICD codes identified similar leading events. However, VSM data were generally less specific.

### Conclusion

Lack of detail inherent in ICD codes and death narratives limits specificity of injury characteristics in VSM data. Appending ICD codes to CFOI appears to offer little value. Research comparing work- and non-work-related events may be better served by having a defined framework to crosswalk both coding schemes to facilitate comparisons.

## Impact on industry

Over the last two decades, both ICD and OIICS have been used to characterize occupational injury circumstances; however, this is the first study to use linked case comparisons of the OIICS and ICD codes at a detailed level. This study confirmed that multiple source data systems provide more detail surrounding an incident than a single source data system does. Our results suggest that OIICS-coded CFOI data are a better source for occupational injury research and prevention purposes. For future comparison studies requiring ICD, it would be advantageous to have a defined framework that could easily be used to map both coding schemes (OIICS and ICD).

- **Keywords:** Occupational fatalities; CFOI; Vital statistics; OIICS; ICD

## **Sigurdur O. Sigurdsson, Matthew A. Taylor, Oliver Wirth. *Discounting the value of safety: Effects of perceived risk and effort.* Pages 127-134.**

### Introduction

Although falls from heights remain the most prevalent cause of fatalities in the construction industry, factors impacting safety-related choices associated with work at heights are not completely understood. Better tools are needed to identify and study the factors influencing safety-related choices and decision making.

### Method

Using a computer-based task within a behavioral economics paradigm, college students were presented a choice between two hypothetical scenarios that differed in working height and effort associated with retrieving and donning a safety harness. Participants were instructed to choose the scenario in which they were more likely to wear the safety harness. Based on choice patterns, switch points were identified, indicating when the perceived risk in both scenarios was equivalent.

### Results

Switch points were a systematic function of working height and effort, and the quantified relation between perceived risk and effort was described well by a hyperbolic equation.

### Conclusion

Choice patterns revealed that the perceived risk of working at heights decreased as the effort to retrieve and don a safety harness increased.

### Impact on industry

Results contribute to the development of computer-based procedure for assessing risk discounting within a behavioral economics framework. Such a procedure can be used as a research tool to study factors that influence safety-related decision making with a goal of informing more effective prevention and intervention strategies.

- **Keywords:** Behavioral economics; Risk assessment; Risk discounting; Decision making; Construction

**Chengcheng Xu, Wei Wang, Pan Liu. *Identifying crash-prone traffic conditions under different weather on freeways.* Pages 135-144.**

#### Introduction

Understanding the relationships between traffic flow characteristics and crash risk under adverse weather conditions will help highway agencies develop proactive safety management strategies to improve traffic safety in adverse weather conditions.

#### Method

The primary objective is to develop separate crash risk prediction models for different weather conditions. The crash data, weather data, and traffic data used in this study were collected on the I-880N freeway in California in 2008 and 2010. This study considered three different weather conditions: clear weather, rainy weather, and reduced visibility weather. The preliminary analysis showed that there was some heterogeneity in the risk estimates for traffic flow characteristics by weather conditions, and that the crash risk prediction model for all weather conditions cannot capture the impacts of the traffic flow variables on crash risk under adverse weather conditions. The Bayesian random intercept logistic regression models were applied to link the likelihood of crash occurrence with various traffic flow characteristics under different weather conditions. The crash risk prediction models were compared to their corresponding logistic regression model.

#### Results

It was found that the random intercept model improved the goodness-of-fit of the crash risk prediction models. The model estimation results showed that the traffic flow characteristics contributing to crash risk were different across different weather conditions. The speed difference between upstream and downstream stations was found to be significant in each crash risk prediction model. Speed difference between upstream and downstream stations had the largest impact on crash risk in reduced visibility weather, followed by that in rainy weather. The ROC curves were further developed to evaluate the predictive performance of the crash risk prediction models under different weather conditions. The predictive performance of the crash risk model for clear weather was better than those of the crash risk models for adverse weather conditions.

#### Impact on industry

The research results could promote a better understanding of the impacts of traffic flow characteristics on crash risk under adverse weather conditions, which will help transportation professionals to develop better crash prevention strategies in adverse weather.

- **Keywords:** Adverse weather; Crash risk; Bayesian random intercept logistic regression; Real-time safety management; Freeway

**Eric Boelhouwer, Jerry Davis, Ana Franco-Watkins, Nathan Dorris, Claudiu Lungu. *Comprehension of hazard communication: Effects of pictograms on safety data sheets and labels. Pages 145-155.***

#### Introduction

The United Nations has proposed the Globally Harmonized System (GHS) of Classification and Labelling of Chemicals to make hazard communication more uniform and to improve comprehension.

#### Method

Two experiments were conducted to test whether the addition of hazard and precautionary pictograms to safety data sheets and product labels would improve the transfer of information to users compared to safety data sheets and product labels containing text only. Additionally, naïve users, workers, and experts were tested to determine any potential differences among users.

#### Results

The effect of adding pictograms to safety data sheets and labels was statistically significant for some conditions, but was not significant across all conditions. One benefit of the addition of pictograms was that the time to respond to the survey questions decreased when the pictograms were present for both the SDS and the labels. GHS format SDS and labels do provide benefits to users, but the system will need further enhancements and modifications to continue to improve the effectiveness of hazard communication.

#### Impact on industry

The final rule to modify the HCS to include the Globally Harmonized System (GHS) for the Classification and Labelling of Chemicals announced by [OSHA \(2012b\)](#) will change the information content of every chemical SDS and label used in commerce. This study suggests that the inclusion of GHS hazard pictograms and precautionary pictograms to SDS and labels may benefit the user.

- **Keywords:** Hazard communication; GHS; SDS; Safety data sheet; Label

**Luigi dell'Olio, Angel Ibeas, Rosa Barreda, Roberto Sañudo. *Passenger behavior in trains during emergency situations. Pages 157-166.***

#### Introduction

This research presents a methodology for analyzing the behavior of people (passengers and crew) involved in emergency situations on passenger trains.

#### Methods

This methodological tool centers around a qualitative character study coming from Focus Groups (FG) and in-depth interviews to extract the determinant variables on passenger and crew behavior when faced with certain emergency situations on trains.

## Results

This research has led to the creation of a classification of possible behaviors associated to each type of incident and dependent on certain variables. The qualitative study was used as the basis for modeling stated preference data using logit type discrete choice models to characterize and quantify the behavior. The most important results show that the determinant variables on passenger behavior correspond to the type of emergency suffered (its degree of seriousness), the type of passenger, the reasons for the journey (demands of time), the information received during the incident, the relationship between crew and passengers, the duration of the incident and the conditions (temperature control, availability of water, occupancy of the train), the distance to the destination station, and finally, the outside weather conditions. This research was carried out using the Spanish railway network as its reference, although it is applicable to any geographical area.

## Impact on Industry

The results show that the information variable should be considered in the development of future research and that the evidences of this research can be used to develop behavioral models for modeling railway passenger evacuations.

- **Keywords:** Passenger behavior; Emergency situation; Focus Group; Railway; Discrete choice models

## **Ruth A. Shults, Allan F. Williams. *Trends in driver licensing status and driving among high school seniors in the United States, 1996–2010.* Pages 167-170.**

### Introduction

Understanding the reasons for fluctuations in teenage driver crashes over time in the United States is clouded by the lack of information on licensure rates and driving exposure.

### Methods

We examined results from the Monitoring the Future survey to estimate the proportion of high school seniors who possessed a driver's license and the proportion of seniors who did not drive "during an average week" during the 15-year period of 1996–2010.

### Results

During 1996–2010, the proportion of high school seniors in United States who reported having a driver's license declined by 12 percentage points (14%) from 85% to 73%. Two-thirds of the decline (8 percentage points) occurred during 2006–2010. During the same 15-year period, the proportion of high school seniors who did not drive during an average week increased by 7 percentage points (47%) from 15% in 1996 to 22% in 2010, with essentially all of the increase occurring during 2006–2009.

### Discussion

Findings in this report suggest that the economic recession in recent years has reduced rates of licensure and driving among high school seniors.

- **Keywords:** Adolescent; Teenagers; Motor vehicles; Automobile driving; Licensure