

2015 Annual Report of Scientific Activity



Liberty Mutual

RESEARCH INSTITUTE FOR SAFETY

Generating knowledge to help people live safer, more secure lives

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2015 Annual Report of Scientific Activity

Liberty Mutual Research Institute for Safety

Owned and operated by Liberty Mutual Insurance, Boston, Massachusetts, the Liberty Mutual Research Institute for Safety (LMRIS) is an award-winning research facility that has helped improve safety and disability outcomes for businesses and individuals for more than 60 years. Its mission is to conduct innovative scientific research to help reduce injuries and disability at home, at work, in the community and on the road.

Research findings are shared with the worldwide health and safety community through publication in peer-reviewed journals and conference presentations. This process ensures scientific validation of our work and supports the greater endeavor expressed in the Liberty Mutual Creed: to help people live safer, more secure lives.

The Liberty Mutual Creed:

*With our policyholders we are engaged
in a great mutual enterprise.*

*It is great because it seeks to prevent crippling
injuries and death by removing the causes
of home, highway and work accidents.*

*It is great because it deals in the relief
of pain and sorrow and fear and loss.*

*It is great because it works
to preserve and protect the things people earn
and build and own and cherish.*

*Its true greatness will be measured by our power
to help people live safer, more secure lives.*

Inscribed on the wall at Liberty Mutual's home office is our creed, citing our long-standing commitment "to helping people live safer more secure lives." This pledge — shaped by principles of continuous improvement and innovation — is proudly delivered upon at the Liberty Mutual Research Institute for Safety (LMRIS).

For more than 60 years, LMRIS has applied scientific methods to address the root causes of injuries that occur at work and on the road, and to improve disability and return to work outcomes. Today, an expanded research program encompasses a broader spectrum that includes injuries that occur at home and in the community. Focused on four key research areas — driving, workplace, disability and the built environment — LMRIS is aligned to address the rapidly changing safety and disability needs of today's society in ways that also complement Liberty Mutual's business.

In 2015, LMRIS researchers published 43 peer-reviewed papers and presented findings at more than 20 different scientific conferences worldwide. But the communication of safety findings does not stop there. The Institute's new Knowledge Translation Unit (KTU) gained significant traction in its charge to facilitate knowledge exchange between Liberty Mutual's research and strategic business units. The KTU has enabled real-world, real-time knowledge transfer from the research laboratory to the workplace and into the broader community.

I extend my sincere appreciation to the staff of LMRIS for its excellent research and steadfast support of Liberty Mutual's commitment to the safety and well-being of individuals and society.



*David H. Long
Chairman and Chief Executive Officer
Liberty Mutual Insurance Group*

The costs associated with injuries and disability in the U.S. total nearly a trillion dollars each year. At the Liberty Mutual Research Institute for Safety (LMRIS), we conduct innovative scientific research to help reduce injuries and disability for the benefit of individuals and businesses throughout the world, and for the overall good of society.

In 2015, we expanded our research to address areas of greatest societal needs and to position LMRIS for continued success. Our studies addressed a wide range of exposures from slips and falls to drowsy driving to opioid abuse. Scientific productivity and quality remained high, with papers published in respected scientific journals and delivered at major international scientific conferences.

We advanced our strategic knowledge translation initiative, which aims to put our research findings into the hands of our business partners and out to the scientific and professional communities. Our four newly established technical advisory groups, consisting of scientists and key business leaders, shared insights and explored potential solutions to today's most pressing safety and disability concerns. We also organized a forum with business and scientific representatives to gain a deeper understanding of the pervasive and serious problem of slips, trips and falls, and we expanded outreach through enhanced communications. Together with the business, we strengthened Liberty Mutual's position as a leader in developing science-based safety solutions to help make a difference in people's lives.

We are extremely pleased to have received three prestigious awards in recognition of our scientific contributions: the International Ergonomics Association's Human Factors and Ergonomics Prize, as well as awards from the New England College of Occupational and Environmental Medicine and the American College of Occupational and Environmental Medicine.

I encourage you to visit our website to learn more about our research programs and our publications. And as always, I welcome your feedback.



*Y. Ian Noy, Ph.D.
Vice President and Director
Liberty Mutual Research Institute for Safety*



Research

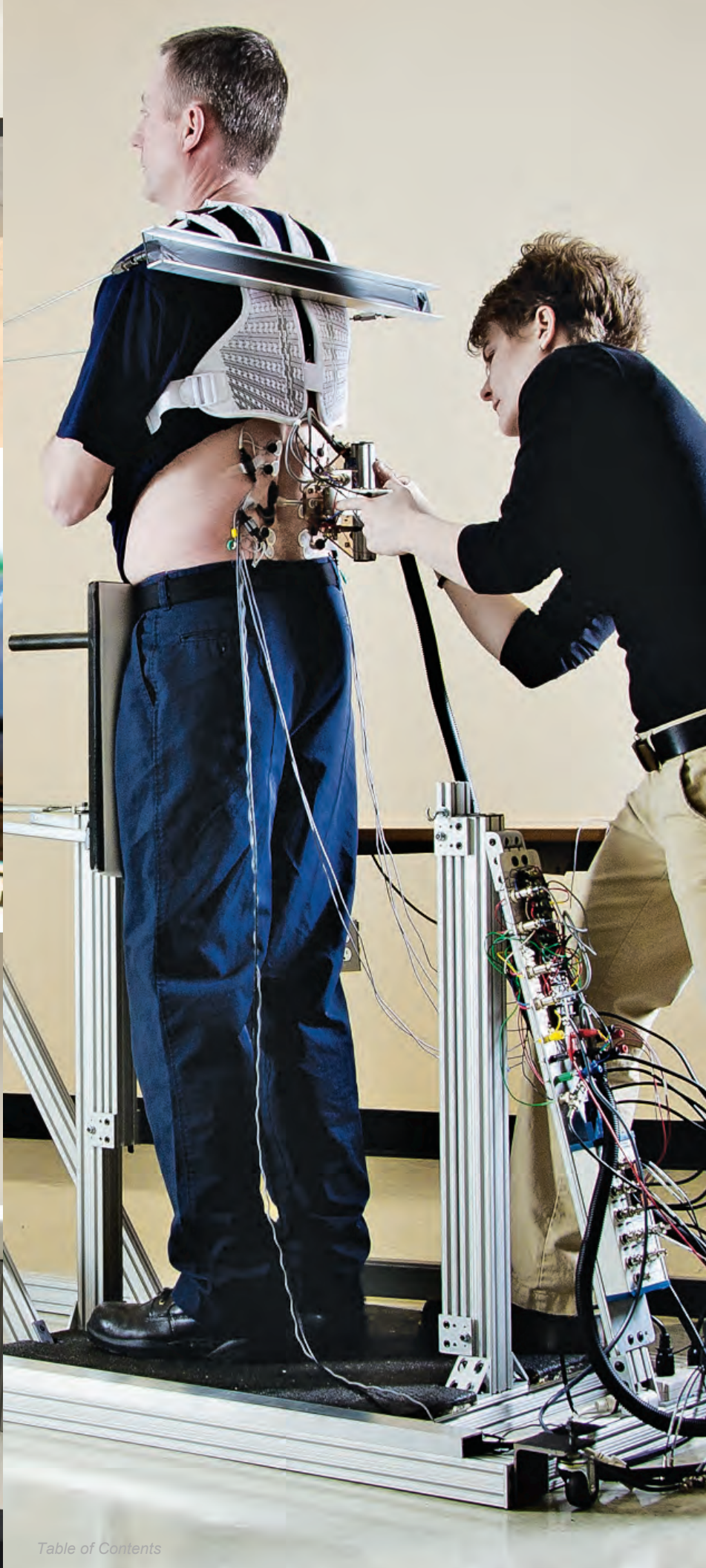
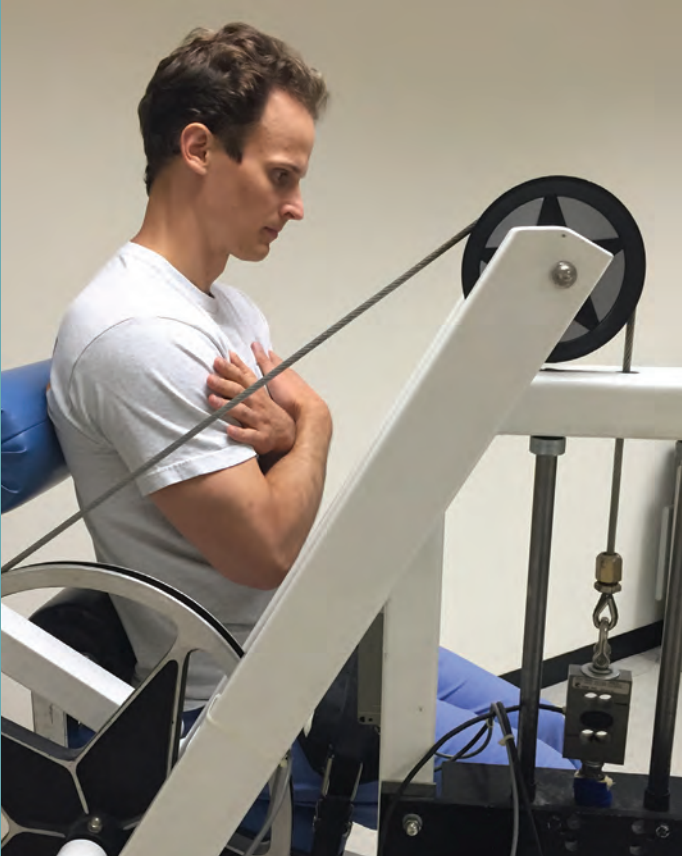
The Liberty Mutual Research Institute for Safety conducts innovative scientific research to help reduce injuries and to improve disability outcomes. Our research programs fall into four areas: driving, built environment, workplace and disability. These areas of focus allow opportunities for collaborative research, align with Liberty Mutual's global operations, and position LMRIS to address the safety concerns of today's rapidly changing society.

With advanced degrees in a wide range of disciplines, including epidemiology, psychology, engineering, human factors and medicine, our scientific staff brings crosscutting insights to safety and disability issues. This unique, multidisciplinary research approach leads to highly informed solutions and interventions.

LMRIS scientists conduct research in 10 fully functional laboratories that offer a wide range of task simulation and measurement capabilities. Laboratories include:

- Biomechanics
- Cognitive Ergonomics
- Disability
- Epidemiology
- Movement Science
- Organizational Safety
- Transportation/Human Factors
- Tribology
- Work Physiology
- Computer Work Systems

In addition, our researchers conduct field investigations in real-world settings and analyze data from various national and international sources.





Driving

Focus: Driving behavior–related injuries

Objective: To understand the risk factors for crashes, such as distraction and fatigue, and to investigate how telematics and vehicle automation impact safety

With the advancement of new vehicle technologies, telematics and automation, it is increasingly important to understand how drivers make decisions, choose behaviors and perceive risks. Especially critical are the risks associated with distraction and fatigue, which are among the most common causes of crashes today. To study these issues, our researchers expose drivers to “hazardous” driving scenarios under controlled conditions, either in a simulator or in a dual-controlled instrumented vehicle.

This year we conducted two new simulator studies to examine factors that impact driver behaviors and safety. The first simulator study applied a conceptual framework to observe how driver calibration — that is, drivers’ perceptions of their own driving abilities — affects performance. The second study examined how a driver’s level of interest in non-driving-related information, in this case radio news items, impacted their performance. Both studies have implications for understanding driver perceptions and performance in various driving settings.

We also examined the precursors to near-crash events based on physiological and driving data collected from drowsy drivers in a prior study. Information from this study increases awareness about the very real dangers associated with driving while fatigued. Findings also have the potential to inform the development of drowsy-driving countermeasures, such as in-vehicle systems that monitor the driver’s condition and warn of potentially dangerous fatigue levels.

Through these and other studies, we gain knowledge to help reduce driving-related fatigue and distraction and to better assess the risks and benefits of evolving vehicle technologies.



Cost of injuries related to driving:
\$379.4 billion

*National Safety Council Injury Facts
2016 Edition. p. 8, based on 2014 U.S. data*



Driver Calibration in Performance Self-Appraisals

Studies indicate that many people believe they are better drivers than they actually are. This miscalibration between a driver's actual and perceived abilities can compromise safety by affecting decision-making, risk tolerance and behavior.

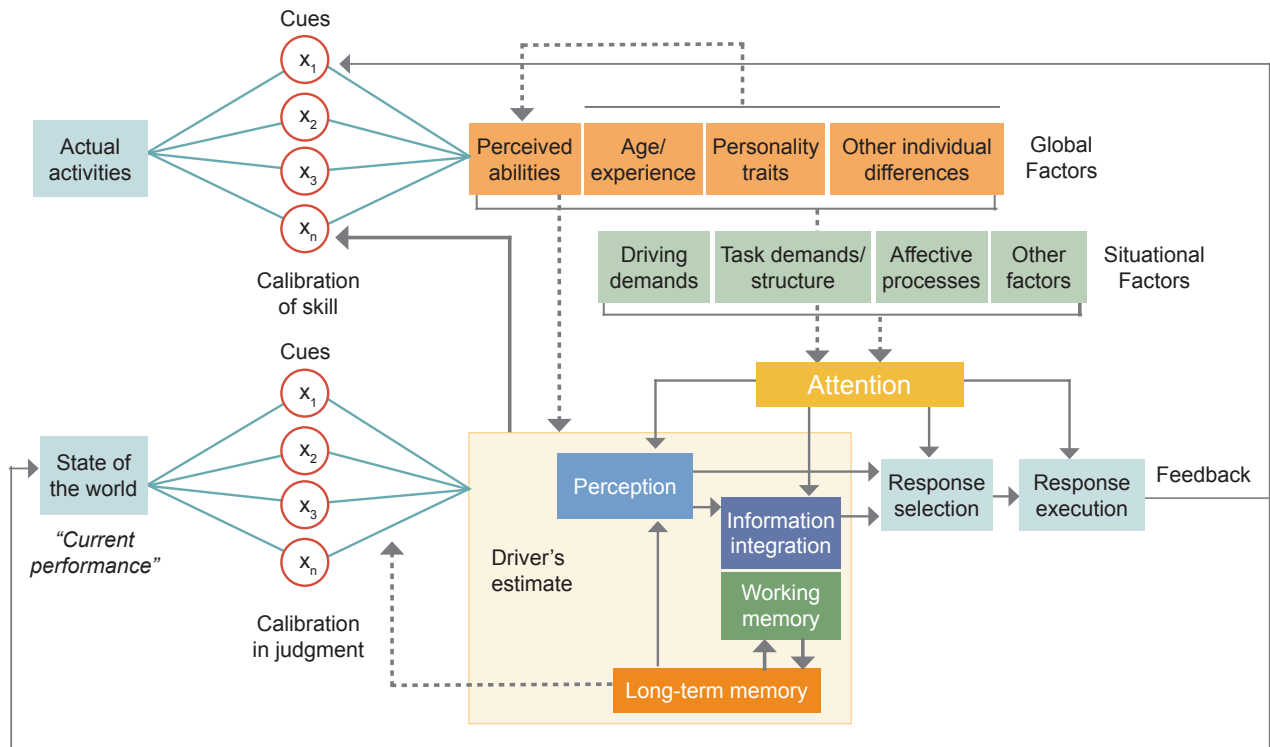
To better describe the many complex factors that can influence driver calibration, our researchers developed a general conceptual framework based on existing models of attentional resources, information processing and integration (see diagram). Our framework will have significant implications in the areas of driver distraction, in-vehicle automation and autonomous vehicles, and driver training.

Researchers applied the framework in a study of the effects of task-related workload on drivers' per-

formance self-appraisals. Drivers completed a series of driving blocks in a driving simulator and were exposed to scenarios of varying levels of difficulty. They were then asked to estimate their workload and rate their driving performance. Researchers recorded objective performance measures (such as lane keeping and speed) during each trial.

A comparison of drivers' self-appraisals with the objective performance measures suggests that drivers were insensitive to the changes in driving demands. The researchers observed more pronounced errors in calibration when driving difficulty increased — that is, under the more difficult condition, many (or most) drivers failed to recognize that performance was getting worse.

Framework for Examining Calibration in Driving



The above conceptual framework, adapted from our research published in *Accident Analysis and Prevention*, 76(2016), 25-33, describes how drivers process information and how situational and global factors can impact the accuracy of self-appraisals (or calibration).



Age-Related Differences in U.S. Fatal Intersection Crashes

Intersections can be dangerous places for pedestrians, bicyclists and drivers, particularly older drivers. Studies show that adults aged 70 and older face a greater risk of crashing at intersections than at any other location. To explore age-related risks and rates for drivers involved in fatal intersection crashes, we conducted an analysis of current pooled data (2011-2014) from the U.S. Fatality Analysis Reporting System (FARS).¹

Using the FARS data, researchers calculated annualized intersection fatal crash rates per 100,000 licensed drivers, and evaluated age- and gender-related risk factors. They found that drivers under the age of 65 accounted for 82.7 percent of all fatal intersection crashes. However, after controlling for exposure, older drivers were found to be overrepresented in these fatal crashes.

Preliminary findings suggest that female drivers ages 65-69 were 25 percent more likely and male drivers ages 70-74 were 14 percent more likely to be involved in a fatal intersection crash than were their 20-24-year-old gender-matched counterparts. By age 85, fatal intersection crash risk for both female and male drivers is almost double that of the 20-24-year-olds.

Significant factors associated with risk differences between younger (<65 years) and older (≥ 65 years) drivers were time of day; lighting and weather conditions; day of week; traffic type; visible traffic controls; estimated driving speed; and impairment by alcohol, drugs or medications at the time of the crash.

Our findings will be used to help identify research priorities and inform interventions for older drivers.



Our researchers calculated annualized intersection fatal crash rates per 100,000 licensed drivers, and evaluated age- and gender-related risk factors

¹Produced by the NHTSA, the Fatality Analysis Reporting System (FARS) is a nationally representative data source for motor vehicle traffic crashes that result in a fatality within 30 days of the crash.



Drowsy Driving: Identifying Physiological Precursors to Crashing

In a joint study with Brigham and Women’s Hospital, we evaluated the effects of night-shift work on sleepiness and driving performance among shift workers. The study found that more than a third of drivers who operated a vehicle on a closed test track after working a night shift were involved in near-crash events. The same drivers, with normal sleep the night before the test, had zero near-crashes. Analysis of the physiological data indicated that post-night-shift drivers experienced more frequent episodes of prolonged blinking and slow eye movements, twice the number of lane departures, and an increased frequency of microsleeps. All of these factors are indicative of the transition from wakefulness to sleep.

This year we began to further analyze the physiological data against performance measures to assess their potential use in predictive crash models. By identifying critical events such as lane drifting and near-crashes, and then analyzing pre-event data streams, our scientists will determine if physiological changes prior to the events (e.g., decreased blink rate, slow eye movement) can be used to indicate an increased risk of a crash.

Findings may be used to inform the development of drowsy-driving countermeasures, such as in-vehicle systems that monitor a driver’s condition and warn of potentially dangerous levels of fatigue.

Comparison of Post-night-shift Drives and Post-sleep Drives



Variable	Post Night Shift	Post Sleep
Drives with emergency brake applied	37.5%	0%
Drive ended early	43.8%	0%
Rate of lane crossing	3.09/min	1.49/min
Slow eye movements	20.1/h	10.6/h
Blink time duration (seconds)	0.18	0.13
Drowsiness*	1.71	0.97
Microsleep episodes	1.00/h	0.47/h

Researchers collected physiological and performance data from drivers who completed both post-sleep and post-night shift driving trials. (See above table.)

*According to the Johns Drowsiness Scale



Impact of Task Engagement on Driving Performance

With an array of embedded and portable technologies such as navigation systems, satellite radio and smartphones in their vehicles, today's drivers are more distracted than ever before. These devices can enhance convenience and productivity, but they also draw attention away from the primary driving task. While many studies have examined the impact of such distractions from a workload perspective, few have looked at the impact of task engagement — the driver's involvement with or level of interest in the distraction — as an important variable.

To study the impact of task engagement on driving performance, we exposed drivers to three conditions of auditory engagement as they drove in a simulator. The first condition involved listening to boring radio scripts, the second involved listening to interesting scripts and the third involved no auditory material.

During each trial, drivers completed a car-following task, and they were instructed to maintain a set distance, or headway, from the vehicle ahead. Researchers collected data on headway, lane keeping and braking response. After each trial, drivers rated their driving performance and completed a survey to assess their perceptions of mental and physical demands, time pressure, frustration and task complexity.

Preliminary findings indicated that response times to critical braking events were longer in the condition of listening to interesting scripts. This suggests that being more engaged in secondary tasks impairs ability to react to hazards. However, performance in both the boring and interesting auditory conditions was more stable for lane keeping and maintaining proper headway compared with the condition of no auditory material. Finally, drivers perceived the interesting material to be less demanding and less complex than the boring material, although both sets of materials were objectively matched using a standardized measure of reading difficulty.

By showing that task engagement can negatively impact driver performance, these preliminary findings suggest that research should consider engagement, not just difficulty, when studying the impact of secondary tasks on driver performance.

Workplace

Focus: Work-related injuries

Objective: To understand why and how workplace injuries occur in order to develop effective preventive recommendations and tools

The nature of the workplace — and the work people do — is continually evolving. Our workplace researchers bring a range of scientific perspectives to current and emerging safety needs. We apply a broad lens that considers workplace safety not only in terms of individual work tasks, but also in terms of organizational factors and demographic trends. In this way, our researchers seek to better understand what causes workplace injuries and how to help prevent them.

This year, our scientists made headway in a laboratory study exploring the feasibility of 3-D video game technology to assess workplace tasks. If proven effective, safety practitioners could use this technology to conduct real-time risk assessments in active work environments. In the field, our researchers examined whether safety climate — a leading indicator of injury outcomes — affects other outcomes, such as employee turnover, job satisfaction and engagement. By examining safety climate from this angle, we seek further evidence of the value of exceptional safety practices in the workplace.

On the data front, we produced the annual Workplace Safety Index and analyzed the data from the first 13 years of the series. These analyses increased our understanding of the leading causes of serious nonfatal workplace injuries and trends over time. Our researchers also developed a highly practical system for classifying narrative text data from large administrative databases — an approach that offers great potential as a way to identify emerging risks.

Through these studies and related research endeavors, we continue to identify the causes of injuries at work and ways to better control them.

Cost of injuries related to work:
\$111.5 billion

National Safety Council Injury Facts
2016 Edition. p. 8, based on 2014 U.S. data





The Liberty Mutual Workplace Safety Index

Now in its 16th year, the Liberty Mutual Workplace Safety Index helps employers, risk managers and safety researchers identify critical risk areas and allocate safety resources effectively. Each year, our researchers rank the top 10 causes of serious, nonfatal workplace injuries and their direct costs to U.S. businesses using information from Liberty Mutual, the U.S. Bureau of Labor Statistics (BLS) and the National Academy of Social Insurance.

According to the *2016 Liberty Mutual Workplace Safety Index*, the most serious, nonfatal workplace injuries amounted to nearly \$62 billion — more than a billion dollars a week — in direct U.S. workers compensation costs. The top 10 injury causes (see figure) comprised 82.5 percent — or \$51.06 billion of the total cost burden.

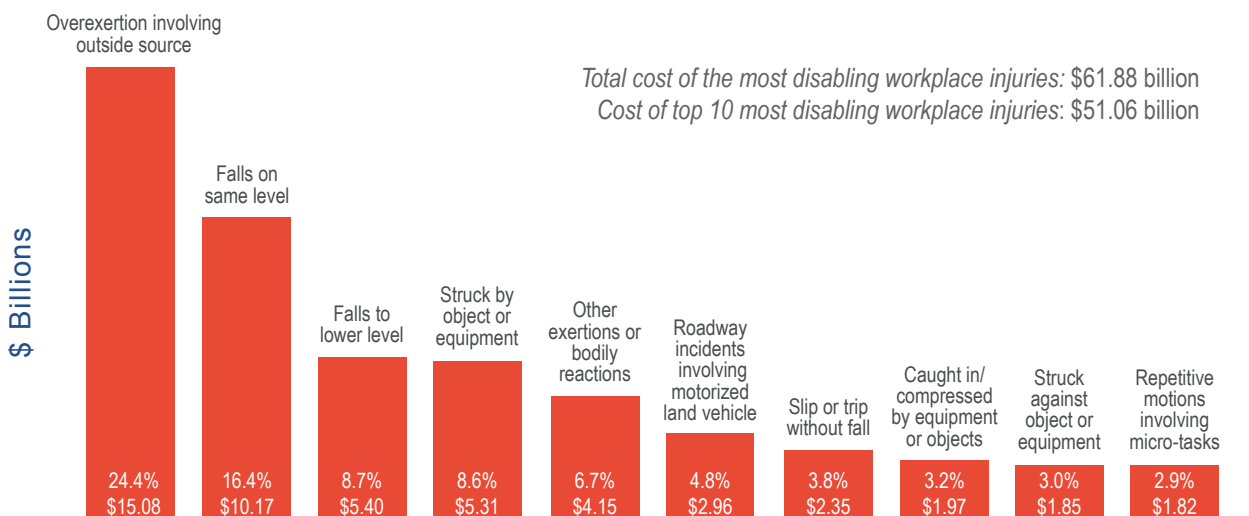
The top five injury causes (led by overexertion, same-level falls and falls to a lower level) accounted for 64.8 percent of the total cost burden, and the remaining five of the top 10 injury causes accounted for 17.7 percent of the total direct cost of disabling injuries.

In addition to producing this year's index, our researchers analyzed the prior index series to better understand how the most serious, disabling workplace injuries trended over time. They found that during the 13-year period from 1998 to 2010, the direct costs of the most disabling U.S. workplace injuries grew nominally by 38 percent, from \$37.1 billion in 1998 to \$51.1 billion in 2010.

During this time period, overexertion consistently ranked first among the top 10 causes, far above any other cause group and making up more than 25 percent of the total burden. Falls on the same level saw the largest increase of all cause groups over the 13-year period, with a 42.3 percent real growth (beyond inflation), while repetitive motion injuries dropped significantly.

These findings support the need for continued development of research and interventions aimed at reducing the U.S. workplace injury burden.

Top 10 Causes and Direct Costs of the Most Disabling U.S. Workplace Injuries



Above is based on 2013 data. Due to a new BLS coding system implemented in 2011, the latest index series (2013, 2014 and 2016) is not directly comparable to the prior series (2000-2012). Based on release date changes, this year's index is titled 2016 Liberty Mutual Workplace Safety Index and does not represent a break in the series.



A Practical Tool for Mining Text Data From Large Data Sets

Narrative text data from large administrative databases, such as workers compensation claims and national surveys, provide valuable information about injury causes, prevention and recovery. To use this information, researchers must be able to accurately classify a representative sample of cases. When done manually, this process can become overly burdensome, especially with large data sets.

To streamline the classification task, researchers developed an analytic human-machine solution to help identify and categorize injury causes and circumstances. The semi-automated approach was based on the application of two Naïve Bayesian probabilistic algorithms. Researchers used the algorithms to classify 15,000 workers compensation narratives into two-digit BLS preinjury event codes. Narratives were filtered out for manual review if the algorithms disagreed or made weak predictions.

This approach resulted in an overall accuracy of 87 percent, with consistently high positive predictive values across all event categories. The algorithms were able to identify and accurately machine code most narratives, leaving only 32 percent (4,853) for manual review.

This semi-automated strategy provides a highly practical, accurate alternative to manual data classification and can provide an effective way to identify emerging risks.



Our researchers found that using algorithms to classify narrative text provides a practical and accurate way to identify emerging risks.

Learn more:

Marucci-Wellman, H.R., Lehto, M.R. & Corns, H.L. (2015). A practical tool for public health surveillance: semi-automated coding of short injury narratives from large administrative databases using Naive Bayes algorithms. *Accident Analysis & Prevention*, 84, 165-176.



Impact of Safety Climate Beyond Safety Outcomes



Defined as “employees’ shared perceptions of the relative priority of safety in an organization,” safety climate has emerged in recent years as a leading indicator of safety outcomes. The Research Institute provides the science to support innovative safety climate tools and insights that are leveraged to help companies improve safety from the ground up.

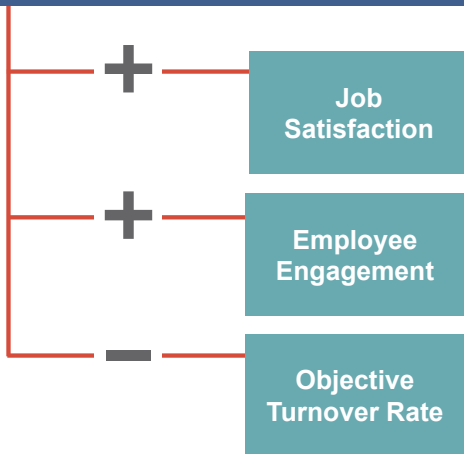
This year, our scientists explored whether safety climate is linked to other important business outcomes beyond safety. To do this, they surveyed more than 6,000 truck drivers from two trucking companies. In addition to the standard safety climate questions, they asked truck drivers questions about their job satisfaction and job engagement. They also examined employee data a year later to see if there was a statistical association between safety climate ratings and turnover.

According to the results, each one-point increase in safety climate ratings corresponded to a decrease in organizational turnover of 30 percent or more. The research also found significant associations between safety climate ratings, job satisfaction and job engagement.

These findings afford further evidence of the value that safety climate holds for companies and suggest that companies that practice safety excellence will benefit from a more engaged and dedicated workforce.

Safety Climate

(Company Level & Group Level)



Our research showed that increases in safety climate ratings corresponded to higher job satisfaction and employee engagement and lower turnover.



Use of Videogaming Technology for Field-Based Motion Analysis

We continued our work to explore the validity of using 3-D videogaming technology as a low-cost, scalable alternative to traditional, laboratory-based motion analysis systems. If validated, the technology could provide a new way for safety practitioners to assess workplace tasks and related risks in field settings.

This year, our scientists examined the use of a portable, Kinect-based motion sensor to measure gait parameters and joint angles during walking. Using both a Kinect sensor and a traditional motion tracking system, they collected full-body movement data on a total of 20 study participants during treadmill walking. They extracted gait parameters and knee and hip joint angles from both devices and compared the data.

Based on the data analysis, researchers concluded that the Kinect sensor provides an adequate measure of gait parameters during walking and may ultimately be used to help mitigate slip-and-fall risk in the workplace.



We continued to explore the validity of using 3-D videogaming technology in the field as a low-cost, scalable alternative to traditional, laboratory-based motion analysis systems.

Learn more:

Xu, X., McGorry, R.W., Chou, L.S., Lin, J.H. & Chang, C.C. (2015). Accuracy of Microsoft Kinect for measuring gait parameters during treadmill walking. *Gait & Posture*, 42(2), 145-151.

Built Environment

Focus: *Injuries that occur in built environments, such as homes, commercial buildings, schools, parks, transportation terminals, walkway systems and public buildings*

Objective: *To understand how injuries, such as falls, occur in these environments, with an emphasis on prevention through design*

The physical design and construction of built environments have a direct impact on people's safety. Our Built Environment research program primarily focuses on understanding what leads to falls and fall-related injuries — the leading injuries treated in U.S. emergency departments each year. Findings are used to inform guidelines and recommendations to reduce slips and falls.

In a research first, our scientists quantified that nearly 80 million falls (with or without a resulting injury) occur each year in the United States. The same study also found that among those adults injured by falls, the distribution was nearly equal among younger, middle-aged and older adults, confirming that falls are a major issue across the life span. This discovery spurred us to examine the potential protective effect of leisure-time exercise among middle-aged adults, an activity known to be protective for older adults.

In laboratory studies, researchers explored the difficulties faced by older adults as they navigate stairs, and they also looked at how visual cues impact gait adjustment as people walk on different floor surfaces and conditions.

We continue to expand our built environment research to better address falls and to advance our knowledge of how people are injured at home and in the community.

Cost of injuries related to built environment:

\$362.5 billion

*National Safety Council Injury Facts
2016 Edition. p. 8, based on 2014 U.S. data*





Falls and Fall-Related Injuries Among U.S. Adults

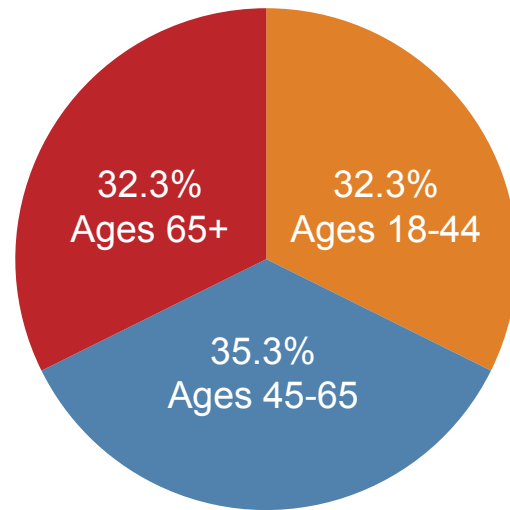
Falls are the leading cause of injuries in the United States. While there is considerable research on falls among older adults (65+), less is known about fall-related injuries in middle-aged and younger adults or about how often people in the United States actually fall. To quantify the national incidence of falls and to better understand fall-related injuries across the adult life span, our scientists analyzed data from the National Health Interview Survey (NHIS).¹

Using data from an NHIS 2008 supplement, our researchers estimated that U.S. adults experienced a total of 80 million falls in the previous year. This estimate, which includes injurious and noninjurious falls, provides the most comprehensive picture to date of the frequency of falls in the United States.

Analysis of 2008-2014 NHIS data showed that 9.9 million fall-related injuries occurred annually among U.S. adults. Of these, 32.3 percent occurred among older adults, 35.3 percent among middle-aged adults and 32.3 percent among younger adults. (See pie chart.)

The high frequency of falls and fall-related injuries across age groups indicates the need for interventions that address the entire adult life span.

Percent of Fall-Related Injuries in the U.S. by Age



Researchers estimated that the 9.9 million fall-related injuries among U.S. adults were almost equally divided across age groups, indicating the need for interventions that address the entire adult life span.

¹The NHIS is an annual, cross-sectional, in-household survey designed to produce national estimates representative of the U.S. civilian, noninstitutionalized population on a broad range of health topics.



Exercise, Falls and Fall-Related Injuries in Middle-Aged Adults

Studies have shown that exercise is protective against falls in older adults (65+). However, while falls are also a substantial concern among middle-aged adults, it is not known whether exercise is protective against falls in that population. In collaboration with the Harvard T.H. Chan School of Public Health, we studied the association between exercise, falls and fall-related injuries among middle-aged adults.

Our scientists analyzed nationally representative data from the 2010 U.S. Behavioral Risk Factor Surveillance Survey. Controlling for sociodemographic and health characteristics, we observed that adults ages 45-54 who exercised in their leisure time were 10-16 percent less likely to fall and 12-31 percent less likely to sustain injuries from falls than those who did not exercise. We noted a similar effect of exercise among adults ages 55-64 as well as 65 years or more.

Our findings build upon the known benefits of leisure-time exercise for middle-aged adults, including lower risk of chronic illness and better overall health. The information can be used to promote the multiple benefits of physical activity for this age group and ultimately to help reduce the risk of falls and fall-related injuries in homes, communities and workplaces.



We observed that adults ages 45-54 who exercised were less likely to fall and less likely to sustain injuries than those who did not exercise.

Learn more:

Caban-Martinez, A.J., Courtney, T.K., Chang, W.R., Lombardi, D.A., Huang, Y.H., Brennan, M.J., Perry, M.J., Katz, J.N., Christiani, D.C. & Verma, S.K. (2015). Leisure-time physical activity, falls, and fall injuries in middle-aged adults. *American Journal of Preventive Medicine*, 49(6), 888-901.



Stair Negotiation and Risk Among Older Adults



Our scientists investigated age-related changes in gait control to better understand what can be done to reduce stair-related injuries in our aging population.

With collaborators at the Harvard T.H. Chan School of Public Health, our scientists investigated age-related changes in neuromuscular gait control as they relate to stair negotiation to better understand what can be done to reduce stair-related injuries in our aging population.

Our researchers collected and compared gait data and whole-body motion measurements from 20 older (ages 68-80) and 20 younger (ages 20-30) healthy adults, during stair-floor transitions. They discovered that healthy aging adults had significantly less independent control of adjacent joints compared with younger adults. This suggests that older adults have less flexibility to modulate inter-joint coordination appropriately during stair-walking transitions. This impairment increases the risk of a fall among older adults as they transition from regular walking to ascend or descend stairs.

Findings from this study will inform intervention strategies and stair-design affordances to help reduce the risk of falls in this growing segment of the population.

Learn more:

Chiu, S.L., Chang, C.C., Dennerlein, J.T. & Xu, X. (2015). Age-related differences in inter-joint coordination during stair walking transitions. *Gait & Posture*, 42(2), 152-157.

Effects of Visual Cues on Gait Adjustments During Walking

The ability to perceive an upcoming slip hazard is a key factor in avoiding same-level falls. In built environments, visual cues (such as surface shine or reflectiveness) influence people’s perceptions of whether or not a surface is slippery. We conducted a study to better understand the association between visual cues, perception of slipperiness and gait adjustments during walking.

Scientists observed 40 participants and measured their gait as they walked on five different floors under three different surface conditions (wet with water, dry and wet with a glycerol mixture). Each participant rated the floor slipperiness before each trial (based primarily on visual cues) and after each trial (based primarily on somatosensory feedback²). The data indicated that when surfaces were more slippery than expected based on visual cues, gait became more protective across trials. When surfaces were less slippery than expected, gait became less protective, and people adjusted their gait to walk faster and with longer strides.

Researchers concluded that visual cues strongly influence people’s ability to anticipate and adapt their gait to slippery conditions. These findings suggest that selecting flooring that communicates reliable information about the level of slipperiness is a vital aspect of design strategies to reduce slips and falls.



In a study of gait and subjective perceptions, our researchers found that visual cues strongly influence people’s ability to anticipate and adapt to slippery conditions.

²Somatosensory feedback includes information gained through contact with the external environment through touch (i.e., physical contact with skin) and position and movement of our body parts (proprioception). *NeuroScience Online*

Disability

***Focus:** Disability and recovery after injury or illness*

***Objective:** To identify innovative and effective medical care, rehabilitation services and other interventions that will improve functional recovery and prevent work disability*

Each year in the U.S., more than 28 million people suffer disabling injuries that keep them out of work or prevent them from participating in their usual activities. Millions more are unable to work as a result of chronic illness. Our disability research strives to find ways to facilitate a person's return to work (RTW) and improve functional recovery following a disabling injury or illness. In 2015, we progressed on several research initiatives aimed at helping improve RTW outcomes for injured workers.

We launched a large-scale study to test an enhanced supervisor training program at six large companies. Building on our past findings, which indicated that training supervisors how to properly respond to an injured worker can significantly improve disability outcomes, this study tests an evidence-based supervisor training program targeting a broader range of potentially disabling injuries and illnesses. Another study explored employee expectations for returning to work after an injury, to uncover why and how such expectations develop. By understanding and addressing workers' fears and uncertainties regarding their RTW after injury or illness, we hope to help these workers achieve better RTW outcomes.

We also completed joint research with the Harvard T.H. Chan School of Public Health to assess the impact of opioid prescribing in the emergency room for workers with low back pain, explored the impact of worker age and job tenure on length of disability, and examined how differences in state regulations impact medical costs and RTW outcomes.

Findings from these and other research studies provide the basis for tools, programs and protocols to help improve recovery and minimize disability.



Missed work days due to injury or illness:

580 million days

National Health Interview Survey 2012



Effects of Supervisor Training Across Multiple Organizations

Long-term work absence due to injury or illness can create significant financial and personal difficulties for individuals, families and employers. Consequently, there is a need for innovative strategies to help facilitate RTW after injury or illness. Our prior research found that one such strategy — injury response training for workplace supervisors — can dramatically improve RTW and recovery outcomes in work-related injuries.

With scientists at Canada's Institute for Work & Health, we began testing the feasibility and effectiveness of a supervisor training program. Our goal is to assess whether a supervisory training intervention that incorporates elements of ergonomics, problem solving and communication is beneficial when administered on a large scale and at multiple locations, across a broad range of potentially disabling conditions.

This year, we recruited six large employers (three in the U.S., three in Canada) representing multiple industries and locations. In addition, the research team revised and expanded the content of the original supervisor training program. We began collecting data and administering training workshops at three of the participating companies.

If proven effective, the updated supervisor training program could help workers attain a higher level of support when they are returning from an absence due to illness or injury. For employers, increased supervisor support may reduce disability costs and turnover and increase employee engagement.



We began a field study to assess whether supervisor training administered on a large scale can improve disability outcomes across a broad range of potentially disabling conditions.



Examining the Effects of Age and Tenure on Work Disability

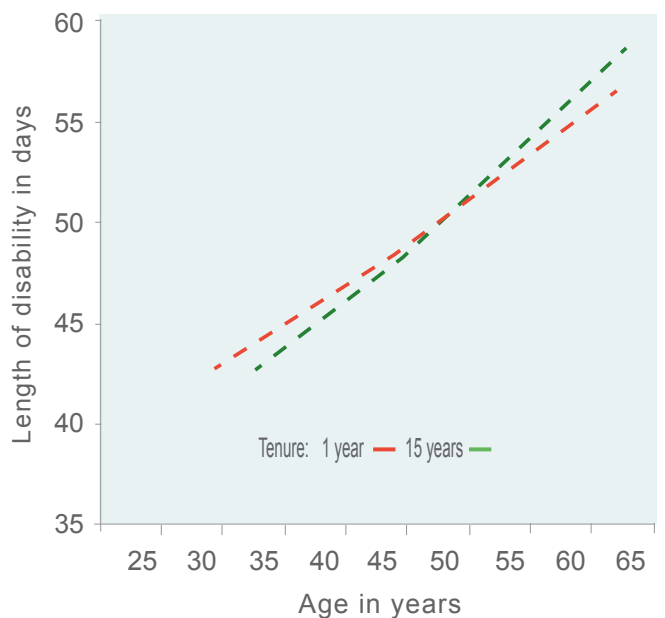
Worker age and job tenure are two factors that have been shown to relate to length of disability. Studies have found that length of disability increases as age increases, and that length of disability decreases as job tenure increases. These findings may seem contradictory, since one might expect job tenure to increase with age. However, today's workers tend to change jobs frequently over the course of their careers, so that even many older workers may have short job tenures in comparison to their counterparts in the past.

We conducted a study to separate the effects of age and tenure, and to further examine how these factors impact length of disability. For the study, researchers analyzed more than 300,000 workers compensation claims to estimate relationships between age, tenure and disability duration.

They found that the relationship between age and disability duration was stronger than that between tenure and disability duration. They also observed that the interaction between age and tenure varied among age groups. For younger workers, disability duration varied little based on tenure; in midlife, disability duration was greater for workers with shorter versus longer tenure, and for the oldest workers, disability increased as tenure increased.

These findings indicate that age has a much greater impact on disability duration than does tenure. However, the impact of tenure is variable depending on age. This finding suggests potential new opportunities to identify certain groups at higher risk of prolonged disability.

Disability Duration by Age and Tenure



Researchers found that the relationship between age and disability duration was stronger than that between tenure and disability duration.

Learn more:

Besen, E., Young, A.E. & Pransky, G.S. (2015). Exploring the relationship between age and tenure with length of disability. *American Journal of Industrial Medicine*, 58(9), 974-987.



Expectations for Return to Work After Injury

Studies have found that employees' expectations for RTW within the first week post-injury are predictive of actual RTW outcomes. However, little is known about how and why these expectations develop. Our disability researchers completed a qualitative study to identify the factors that injured workers consider when forming expectations about their return to work.

Researchers held focus groups with individuals who were off work due to a musculoskeletal condition. At the start of each focus group, participants completed a questionnaire asking about their expectations for returning to work and the factors they considered in forming those expectations. They then reflected on and discussed the factors they had listed.

The questionnaire and focus group discussion data revealed that, although advice received from doctors was important, participants were also influenced by a variety of health, functional, personal and contextual variables. Prominent themes included concerns about employability, desire to get back to normal, availability of a job to return to, anxiety about returning to work, reinjury concerns, the judgments of workplace stakeholders, being needed by their employer, waiting for input from others, waiting until indemnity payment runs out and determining what was in their best interest.

Study findings suggest that efforts to help injured workers dispel negative perceptions and uncertainties related to their return to the workplace could help promote timely, safer and sustained return to work.

Learn more:

Young, A.E., Choi, Y. & Besen, E. (2015). An exploration of the factors considered when forming expectations for returning to work following sickness absence due to a musculoskeletal condition. *PLOS ONE*, 10(11).



Early Opioid Prescribing and Work-Related Low Back Pain

Our prior research identified early opioid prescriptions as a significant risk factor for prolonged disability, extended medical care and prolonged opioid use among workers with occupational low back pain. These studies led to new treatment guidelines that strongly discourage early use of opioids for nontraumatic occupational musculoskeletal injuries. This year, we collaborated with the Harvard T.H. Chan School of Public Health to assess whether these treatment guidelines have had an effect on medical practices and whether early opioid prescribing in the emergency department affects outcomes in work-related low back pain.

Using a nationally representative data set of workers compensation claims, we identified all acute, compensable lost-time low back pain cases seen initially in emergency departments from 2009 to 2011. Examining the data, researchers found a significant decrease in the rates of early opioid prescribing when compared with data from the mid-2000s. After controlling for severity, we found that, among those who were prescribed opioids, there was a significant association with long-term opioid use and increased total medical costs for those in the highest opioid dosage quartile. However, early prescribing was not associated with longer disability duration or increased risk for subsequent low back surgery, perhaps indicating that medical management was better in these cases than that observed in prior studies.

These results suggest that emergency department providers have become more aware of the risks of early opioid use for uncomplicated low back pain and have responded accordingly, and that when prescribed, these medications continue to have adverse long-term impacts.



We collaborated with the Harvard T.H. Chan School of Public Health to assess whether early opioid prescribing in emergency departments affects outcomes in work-related low back pain.



State Variations in Early MRI Prescribing

In an earlier study, our disability researchers found that low back pain patients who received an early MRI (within 30 days of pain onset) were three times more likely to remain on disability than were those who did not have an MRI. Early MRI recipients were also significantly more likely to incur potentially unnecessary and unhelpful services, including surgery. To further understand the impact of early MRI prescribing and what might be contributing to it, our researchers conducted a study of state-by-state variations in MRI prescribing.

Our researchers examined more than 18,000 U.S. workers compensation claims (from 2002 to 2007) involving workers with acute low back pain and lost time from work, excluding recurrent or chronic cases, trauma, hospitalizations, red flags and concurrent disease. We identified early MRI cases and grouped all cases by state. We then examined within- and between-state variabilities of the six highest and six lowest early MRI utilization states.

The findings indicated a wide variation in early MRI scanning rates, with the overall lowest rates in Vermont and the overall highest rates in Arkansas (see table). Higher rates of MRI prescribing correlated strongly with two state-level factors: low state median income and increased availability of nonhospital, freestanding MRI sites. These two factors accounted for 84 percent of the between-state variability and 12.5 percent of the overall variability in early MRI procedures. Results indicate that for-profit diagnostic testing facilities can have a significant impact on inappropriate utilization and suggest opportunities for targeted interventions to decrease unnecessary testing.

Early MRI by State and Severity

	Low-rate States						High-rate States						
Severity	CA	CT	HI	MA	NH	VT	AR	FL	GA	NC	PA	TX	All
Low severity % with early MRI	9.8	11.9	4.2	13.8	13.4	2.2	53.3	46.8	39.1	41.3	42.1	32.5	21.5
High severity % with early MRI	40.7	40.7	17.4	35.7	31.3	20.8	69.0	77.0	62.3	62.9	64.6	66.2	52.5

Above table shows differences in percentage of low back pain cases receiving early MRI by state and severity, comparing the six states with the lowest rate of early MRI with the six states with the highest rate of early MRI.

Learn more:

Pransky, G.S., Foley, G., Cifuentes, M. & Webster, B.S. (2015). Geographic variation in early MRI for acute work-related low back pain and associated factors. *Spine*, 40(21), 1712-1718.



Impact of State Workers Compensation Policy Differences on Disability Outcomes

Differences in state workers compensation policies can affect medical costs and RTW outcomes for injured workers and their employers. With collaborators from UMass Lowell, we examined these differences and their impact in an effort to help identify opportunities for state-level improvements.

Researchers examined nearly 60,000 workers compensation claims involving low back pain, evaluating outcomes at one year post-injury. The claims were filed between 2002 and 2008 and came from 49 states. Our analyses found considerable interstate variations in medical costs and time to RTW, even after adjusting for multiple individual factors.

In states that did not allow employers to select the initial treating provider, medical costs were more than \$300 higher on average and time to RTW was six days longer. States that allowed claimants to change providers one time (independent of initial provider selection) had \$270 lower medical costs on average and more rapid RTW (three days shorter disability). Longer retroactive payment periods (time out of work required to receive reimbursement) were associated with slightly higher medical costs and slightly longer time to RTW.

These results suggest that the ability to initially direct injured employees to providers with expertise in treating work-related injuries can lead to more rapid RTW with less treatment. In addition, enabling injured employees to change providers if they are dissatisfied with their care may help ensure better outcomes.

Learn more:

Shraim, M., Cifuentes, M., Willetts, J.L., Marucci-Wellman, H.R. & Pransky, G.S. (2015). Length of disability and medical costs in low back pain: Do state workers compensation policies make a difference? *Journal of Occupational and Environmental Medicine*, 57(12), 1275-1283.

Collaborations

Collaborative research is vital to the Research Institute's ability to advance safety and health worldwide. To this end, we partner with world-class research organizations, such as Harvard University and the Massachusetts Institute of Technology, as well as invited senior scientists, to study areas of mutual interest. We also work closely with internal business stakeholders to stay informed on key safety issues and to make our published research findings accessible to those who can most benefit from them.

Scientific Partnerships

The Research Institute collaborates with prominent health and safety research organizations on scientific projects and initiatives of mutual interest. These activities promote the exchange of concepts and methods with fellow scientists, increase awareness of important safety and disability issues, and ultimately help reduce injuries and disability.



Harvard University

Our partnership with the Harvard T.H. Chan School of Public Health provides opportunities for collaborative research in areas of mutual interest. Through this program, recent doctoral graduates work to further their careers in partnership with LMRIS scientists and School of Public Health faculty by conducting joint research in ergonomics and human factors, injury epidemiology, or disability and return to work.



HARVARD
T.H. CHAN
SCHOOL OF PUBLIC HEALTH

In 2015, LMRIS researchers collaborated with post-doctoral fellows on several joint research initiatives, including a study of the impact of exercise on fall risk among middle-aged adults (p. 18), a laboratory study of older adults' balance control and coordination during stair negotiation (p. 19), and a study to assess the impact of safety climate beyond safety outcomes (p. 13).

We also collaborated on a closed-loop-track driving study of the effects of extended shifts on sleepiness and driving performance (p. 5) and a data-based study to assess whether early emergency department prescribing of opioids affects outcomes in work-related low back pain (p. 26).

UMass Lowell

The postdoctoral fellowship program with UMass Lowell supports the development of young scientists interested in injury and disability research. Working in close collaboration with LMRIS scientists and UMass Lowell faculty, the fellowship encourages creativity and independent discovery among recent doctoral graduates conducting scientific research in the fields of ergonomics, safety, injury epidemiology, or disability and return to work.



In 2015, postdoctoral fellows from UMass Lowell concluded an investigation of geographic (state-by-state) variations in length of work disability for occupational low back pain (p. 28), and assisted in the development of a sociotechnical systems approach that applies system dynamics modeling to the return-to-work process.

UMass Amherst

Driving safety is the focus of a postdoctoral fellowship program with the Department of Mechanical and Industrial Engineering at UMass Amherst. The program encourages creative collaboration between the two research institutions and fosters development in independent research among the fellows.

In 2015, LMRIS hosted fellows from UMass Amherst. Joint research included studies related to driver fatigue, aging drivers and autonomous vehicles.

The logo for UMass Amherst, featuring the text "UMassAmherst" in a serif font. "UMass" is in a dark blue color and "Amherst" is in a dark red color.

Massachusetts Institute of Technology

In 2015, LMRIS completed its first year collaborating with the SENSEable City Laboratory at the Massachusetts Institute of Technology (MIT). Initial research focused on developing opportunities for big data leverage to better understand the factors that affect human mobility (e.g., walking) and slip-and-fall risk in city environments.

We also began a new collaboration with MIT's Age Lab, examining advanced vehicle technologies. This broad effort, which also involves Liberty Mutual's Global Consumer Markets strategic business unit, employs naturalistic driving approaches and field operational tests to explore real-world use patterns for emerging safety technologies, such as lane-keeping assist, intelligent cruise control and traffic queue assist.



**Massachusetts
Institute of
Technology**

American Society of Safety Engineers Foundation

Each year, LMRIS offers two safety research fellowships in partnership with the American Society of Safety Engineers Foundation. In 2015, fellowships were awarded to doctoral students from Mississippi State University and UMass Boston.

The fellows collaborated with scientists at LMRIS for 12 weeks and made significant contributions to their respective studies. One project examined factors that influence user acceptance of advanced driver assistance systems. The other project explored whether, and how, factors that vary by geographic location may explain age-related variation in length of disability.



2015 Visiting Scholar

Professor Alex Kirlik, Ph.D., of the University of Illinois at Urbana-Champaign, served as the Research Institute's 2015 Visiting Scholar. During his tenure, he focused on two research initiatives.

The first project, worker safety in sociotechnical systems, was generated from a prior Hopkinton Conference on this topic. Dr. Kirlik and Institute research scientists reviewed some of the insights, techniques and research partnerships that grew out of the conference with an aim to develop interventions to improve safety in building construction and rail transportation.

The second project involved driver safety, including issues of mitigating driver distraction, better understanding the implications of forthcoming vehicle automation concepts for drivers, and investigating drivers' ability to estimate their driving performance relative to other drivers or to externally posed driving demands.



Dr. Kirlik

Knowledge Translation

Practice is informed by science; science is informed by practice.

This simple statement is the foundation of the Research Institute's commitment to knowledge translation — the open, two-way exchange of information between LMRIS scientists and internal Liberty Mutual Insurance (LMI) stakeholders. A practice that differentiates LMI in both the insurance marketplace and the research community, scientific knowledge translation is one more way we work together to improve safety and disability outcomes in the real world.

Scientific breakthroughs can make an impact only when they are shared and applied. Our scientists have long collaborated with LMI Risk Control managers to translate research findings into practical safety tools, protocols and recommendations. Over the years, these partnerships have led to important safety applications and employer-based interventions.

Today, LMRIS has a dedicated Knowledge Translation Unit (KTU). Its mission is to bring the science to a broader business community and to help improve LMI customer outcomes. The KTU works with stakeholders across LMI to enhance safety and help improve disability outcomes. In 2015, the KTU gained momentum with several key initiatives related to business engagement, knowledge exchange and communications.



Technical Advisory Groups

As part of its commitment to knowledge translation and exchange, LMRIS created four technical advisory groups (TAGs) to facilitate engagement with our internal business partners. The TAGs constitute the main channels for sharing research findings with internal operations, gauging business relevance of research findings, informing LMRIS perspectives on research opportunities, developing and planning translation objectives and activities, and facilitating the Institute's proprietary activity.

The TAGs correspond to the four LMRIS research domains: driving, built environment, workplace and disability, and broadly align with Liberty Mutual's lines of coverage to provide scientific expertise in these areas.

In 2015, we launched our first full series of quarterly TAG meetings to address a variety of safety and disability issues. Discussions centered on trends, such as telematics, automated driving, aging in place and connected home, bringing new perspectives to today's safety concerns.

Outreach

This year, we communicated our findings more broadly to internal employees, business partners and customers through the use of social media, videos and press releases. Leveraging the content of our online newsletter, "From Research to Reality," we featured findings from our investigations on drowsy driving, impact of early MRI on low back disability, and safety climate as a leading indicator of injury outcomes.

In addition, the KTU facilitated the development of several press releases, which were picked up in various safety trade, mainstream and insurance-related publications.



Our seminal publication, From Research to Reality, focuses on a particular area of research and its real-world application.

Thought Leadership

Each year, LMRIS hosts a forum that focuses on emerging trends and key risk areas. This year, representatives from Liberty Mutual Strategic Business Units and LMRIS convened for the fourth annual Knowledge Transfer & Exchange Forum. The forum, titled "Slip, Trip & Fall Injuries – A Growing Multi-Line Concern," involved two days of intensive workshops, sessions and roundtable discussions on this leading loss area.

Subject matter experts from the business and LMRIS scientists shared research and business perspectives on the problem of slips, trips and falls, with the particular goals of bringing attention to the scope of the falls problem in the U.S. and across the world and informing the development of interventions.

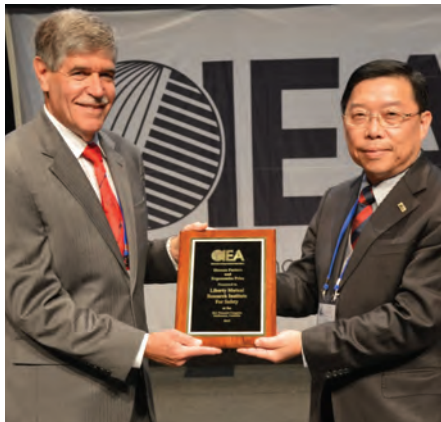
Awards & Honors

Over the years, LMRIS has received numerous awards from prominent organizations around the world. These distinctions recognize our significant contributions to safety and disability research and promote visibility for health and safety concerns. In addition to awards received, LMRIS co-sponsors awards with outside safety and disability organizations to help encourage excellence in health and safety research.

Awards Received

In 2015, LMRIS was honored to receive three awards — the inaugural Human Factors and Ergonomics Prize from the International Ergonomics Association, the New England College of Occupational and Environmental Medicine Harriet Hardy Award, and the American College of Occupational and Environmental Medicine Health Achievement in Occupational Medicine Award.

Human Factors and Ergonomics Prize



“Liberty Mutual has contributed significantly to our professional body of knowledge through its outstanding research. Taken together, the individual and collective contributions of this organization embody the spirit of this award.”

IEA President Professor Eric Min-yang Wang (right) with Research Institute Director Y. Ian Noy, Ph.D.

In August, the International Ergonomics Association (IEA) presented LMRIS with the inaugural Human Factors and Ergonomics Prize. This award is presented to an organization that has made significant contributions to research and development and the application of knowledge in the field of human factors and ergonomics.

The award recognizes the Research Institute’s rich history of research and innovation to help people live safer, more secure lives. Recent examples include studies of risks and benefits of telematics and autonomous vehicles; research on the onset and consequences of fatigue; studies of where, why and how falls occur; and work examining safety climate, sociotechnical systems and return-to-work barriers.

*American College of Occupational and Environmental Medicine (ACOEM)
Health Achievement in Occupational Medicine Award*

Center for Disability Research Director Glenn S. Pransky, M.D., M.Occ.H., received the ACOEM Health Achievement in Occupational Medicine Award. The award commends leadership in the field of occupational and environmental medicine. It was presented in May to Dr. Pransky at the annual American Occupational Health Conference in Baltimore. The college recognized Dr. Pransky for his help and influence in bringing disability prevention and management to the forefront as one of the most vital components in occupational and environmental medicine.

Dr. Pransky joined ACOEM in 1988 and was elevated to fellowship in 2001. He is a member of the Council of Scientific Advisors and the ACOEM-NIOSH Return to Work Guidance Panel. The ACOEM represents nearly 4,500 physicians specializing in occupational and environmental medicine. It is the nation's largest medical society dedicated to promoting the health of workers through preventive medicine, clinical care, disability management, research and education.

*New England College of Occupational and Environmental Medicine (NECOEM)
Harriet Hardy Award*

In July, Dr. Pransky received the Harriet Hardy Award at the NECOEM annual conference held in Louisville, Kentucky. The award recognizes a physician who has made outstanding contributions to the occupational health field and who exemplifies the highest ideals of occupational medicine practice. Recipients demonstrate excellence and leadership in clinical practice, research, public health advocacy or teaching in occupational health.

A pioneer in the occupational medicine field, Dr. Harriet Louise Hardy was a distinguished woman physician who left a legacy in her career of practice, teaching and research. She was the first woman professor at Harvard Medical School, and primarily studied toxicology and environmental-related illness.

The Harriet Hardy Award recognizes a physician who exemplifies the highest ideals of occupational and medicine practice.

The 2015 award was presented to Dr. Pransky (right) at the New England College of Occupational and Environmental Medicine annual conference.



(Photo courtesy of Kathryn Costello)

Awards Presented

LMRIS proudly co-sponsored two awards in 2015 — the International Ergonomics Association/Liberty Mutual Medal in Occupational Safety and Ergonomics and, in partnership with the Institute of Ergonomics and Human Factors, the Liberty Mutual Best Paper Award.

2015 International Ergonomics Association/Liberty Mutual Medal

A team of researchers from the United Kingdom received the 2015 International Ergonomics Association (IEA)/Liberty Mutual Medal. The award recipients were Bob Muffett, Theresa Clarke, Anthony Coplestone, Emma Lowe, John Robinson and Stuart Smith (Ergonomics Team, Network Rail, London, United Kingdom) and John R. Wilson (Human Factors Group, Faculty of Engineering, University of Nottingham and Network Rail, United Kingdom).

The winning paper, “Management of personal safety risk for lever operation in mechanical railway signal boxes,” concerns health and safety problems involving human error and organizational failure at a systems and safety management level. The research seeks to understand physical injury risks in the U.K. rail network resulting from operating lever frame signal boxes. The researchers conducted

the study to determine the nature and extent of the problem and to recommend a management strategy for mitigating future risks.

The most prestigious award of its kind in the field of occupational ergonomics and safety, the IEA/Liberty Mutual Medal is awarded to the authors of an original scientific paper that meets criteria for innovation and impact. Presented annually, the award recognizes outstanding original research leading to the reduction of work-related injuries and/or to the advancement of theory, understanding and development of occupational safety research.

Citation:

Muffett, B., Wilson, J.R., Clarke, T., Coplestone, A., Lowe, E., Robinson, J. & Smith, S. (2014). Management of personal safety risk for lever operation in mechanical railway signal boxes. *Applied Ergonomics*, 45(2), 221-233.

2015 Liberty Mutual Best Paper Award



“After years of trying to fix human factors problems after they were designed into workplaces, my goal was to find ways for human factors to be integrated earlier into engineering design processes.”

Dr. Judy Village, 2015 Liberty Mutual Best Paper winner, right, with Chartered Institute of Ergonomics and Human Factors President Professor Sarah Sharples.

Researchers from Ryerson University, Toronto, Canada, won the 2015 Liberty Mutual Best Paper Award for their research paper “An ergonomics action research demonstration: integrating human factors into assembly design processes.” The research supports early integration of human factors in organizational design processes. The paper describes an action research study in ergonomics in which the researcher participates in the iterative organizational design while simultaneously considering further actions to promote learning for both the organization and the researchers.

The winning researchers from Ryerson University include Judy Village, Ph.D., CCPE, Human Fac-

tors Engineering Lab research associate; Michael Greig, MA.Sc., industrial engineering graduate student; Filippo A. Salustri, Ph.D., P.Eng., Mechanical Engineering Department professor; Saeed Zolfaghari, Ph.D., P.Eng., Industrial Engineering Department professor; and W. Patrick Neumann, Ph.D., Eur.Erg., Department of Mechanical and Industrial Engineering associate professor.

The Best Paper Award, established in 2005 by LMRIS and the Chartered Institute of Ergonomics and Human Factors, recognizes the paper published in the journal *Ergonomics* in the prior year that best contributes to the advancement of ergonomics.

Citation:

Village, J., Greig, M., Salustri, F., Zolfaghari, S. & Neumann, W.P. (2014). An ergonomics action research demonstration: integrating human factors into assembly design processes. *Ergonomics*, 57(10), 1574-1589.

Activities

LMRIS maintains high standards of scientific credibility by participating in activities dedicated to the advancement of safety and disability research. Our researchers are active in various societies and organizations, serve and publish in leading peer-reviewed scientific journals and conference proceedings, and contribute in a variety of roles to safety and health conferences around the world.

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- Publication Activities p. 41
- Conference Activities p. 45

Professional Activities

Research Institute scientists participate in various professional organizations, societies and activities related to their respective areas of expertise. These opportunities allow them to interact with their peers, gain valuable scientific input and recommend changes in the standards and practices applicable to their fields. Listed here are the organizations to which LMRIS scientists belonged during 2015.



American Association on Health and Disability	Macroergonomics Technical Group
American Chronic Pain Association	National Academy for Social Insurance
American College of Occupational and Environmental Medicine	National Institute for Occupational Safety and Health
American Industrial Hygiene Association	National Safety Council
American Pain Society	New England College of Occupational and Environmental Medicine
American Psychological Association	New Hampshire Department of Public Health
American Public Health Association	Organization Design and Management Technical Committee
American Society for Testing and Materials	Population Association of America
American Society of Biomechanics	Psychonomic Society
American Society of Mechanical Engineers	Resilience Engineering Association
American Society of Safety Engineers	Society for Epidemiologic Research
Association for Psychological Science	Society for Industrial and Organizational Psychology
Board of Certification in Professional Ergonomics	Society for Occupational Health Psychology
Board of Certified Safety Professionals	Society of Behavioral Medicine
Case Management Society of America	Transportation Research Board
Case Management Society of New England	Workers Compensation Research Group
Employee Assistance Professionals Association	Workers Compensation Research Institute
Environmental Design Technical Group	Working Time Society
Gerontological Society of America	
Human Factors and Ergonomics Society	
Institute for Work and Health	
Institute of Ergonomics and Human Factors	
International Association for Quality of Life Research	
International Association for the Study of Pain	
International Association of Rehabilitation Professionals	
International Commission on Occupational Health	
International Ergonomics Association	
International Society for Ecological Psychology	
International Society for Posture and Gait Research	

Publication Activities

LMRIS subjects its research to the highest standards of scientific scrutiny through peer-reviewed publication. In addition, many of our researchers serve as scientific editors and reviewers for leading safety and disability journals. Listed here are those researchers who served as invited editors and editorial board members, as well as the scientific journal articles that were accepted or published in 2015.

Invited Editorships

Wen-Ruey Chang, Ph.D., Editor, *Ergonomics*

Theodore K. Courtney, M.S., CSP, Associate Editor, *Accident Analysis & Prevention*

Lawrence J. Hettinger, Ph.D., Human Factors Area Editor, *Displays*

William J. Horrey, Ph.D., Associate Editor, *Human Factors*

Yueng-Hsiang Huang, Ph.D., Associate Editor, *Accident Analysis & Prevention*

Glenn S. Pransky, M.D., M.Occ.H., Associate Editor, *Journal of Occupational Rehabilitation*

William S. Shaw, Ph.D., P.E., Senior Associate Editor, *Journal of Occupational Rehabilitation*

Editorial Board Members

Wen-Ruey Chang, Ph.D.
Applied Ergonomics;
Safety Science;
Journal of Testing and Evaluation

Theodore K. Courtney, M.S., CSP
Injury Epidemiology;
Journal of Occupational and Environmental Hygiene

Marvin J. Dainoff, Ph.D., CPE
International Journal of Human-Computer Interaction

William J. Horrey, Ph.D.
Applied Ergonomics

David A. Lombardi, Ph.D.
Accident Analysis & Prevention;
Conference Papers in Medicine;
Injury Epidemiology;
Scandinavian Journal of Work, Environment and Health

Helen R. Marucci-Wellman, Sc.D.
Journal of Safety Research

Y. Ian Noy, Ph.D., CPE
International Journal of Occupational Safety and Ergonomics

Glenn S. Pransky, M.D., M.Occ.H.
American Journal of Industrial Medicine

Michelle M. Robertson, Ph.D., CPE
IIE Transactions on Occupational Ergonomics and Human Factors

Jeffrey M. Schiffman, Ph.D.
Clinical Biomechanics;
Gait & Posture

William S. Shaw, Ph.D., P.E.
Journal of Occupational Health Psychology

Santosh K. Verma, Sc.D., M.D., M.P.H.
Accident Analysis & Prevention;
Injury Epidemiology

Amanda E. Young, Ph.D.
Disability and Rehabilitation

Peer-Reviewed Publications

- Banks, J.J., Chang, W.R., Xu, X. & Chang, C.C. (2015). Using horizontal heel displacement to identify heel strike instants in normal gait. *Gait & Posture*, 42(1), 101-103. doi:10.1016/j.gaitpost.2015.03.015
- Besen, E., Harrell, M. & Pransky, G.S. Lag times in reporting injuries, receiving medical care, and missing work: Associations with the length of work disability in occupational back injuries. Accepted for publication in *Journal of Occupational and Environmental Medicine*.
- Besen, E. & Pransky, G.S. (2015). Examining the relationship between productivity loss trajectories and work disability outcomes using the panel study of income dynamics. *Journal of Occupational and Environmental Medicine*, 57(8), 829-835. doi:10.1097/JOM.0000000000000493
- Besen, E., Young, A.E., Gaines, B. & Pransky, G.S. The relationship between age, tenure and disability duration in persons with compensated work-related conditions. Accepted for publication in *Journal of Occupational and Environmental Medicine*.
- Besen, E., Young, A.E. & Pransky, G.S. (2015). Exploring the relationship between age and tenure with length of disability. *American Journal of Industrial Medicine*, 58(9), 974-987. doi:10.1002/ajim.22481
- Besen, E., Young, A.E. & Shaw, W.S. (2015). Returning to work following low back pain: Towards a model of individual psychosocial factors. *Journal of Occupational Rehabilitation*, 25(1), 25-37. doi:10.1007/s10926-014-9522-9
- Boot, C.R., de Kruif, A., Shaw, W.S., Van der Beek, A., Deeg, D.J. & Abma, T. Factors important for work participation among older workers with depression, cardiovascular disease, and osteoarthritis: A mixed methods study. Accepted for publication in *Journal of Occupational Rehabilitation*.
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Conference Activities

The Research Institute's participation in scientific and professional conferences helps promote the exchange of ideas and technologies, increase awareness, and enhance safety and health worldwide. In 2015, our researchers helped organize several conferences, planned a number of conference tracks and sessions, and shared their findings at scientific conferences worldwide.

Conference Collaborations

Ergonomics and Human Factors 2015, Daventry, United Kingdom, April 13-16. Technical Program Committee: Wen-Ruey Chang, Ph.D.

National Occupational Injury Research Symposium (NOIRS), Kingwood, West Virginia, May 19-21. Scientific Planning Committee: Jeffrey M. Schiffman, Ph.D.

International Ergonomics Association 19th Triennial Congress, Melbourne, Australia, August 9-14. International Technical Committee: Wen-Ruey Chang, Ph.D.

7th International Conference on Automotive User Interfaces and Interactive Vehicular Applications, Nottingham, United Kingdom, September 1-3. Program Committee: William J. Horrey, Ph.D.

2015 International Annual Meeting of the Human Factors and Ergonomics Society, Los Angeles, California, October 26-30: Environmental Design Panel Co-chair: Michelle M. Robertson, Ph.D., CPE

4th International Conference on Driver Distraction and Inattention, Sydney, Australia, November 9-11. Program Committee: William J. Horrey, Ph.D.

Conference Presentations

- Albin, T., Bazley, C., Honan, M., Robertson, M.M., Hedge, A. & Vink, P. (2015). New ways of work: Different perspectives influencing environmental design. *International Meeting of the Human Factors and Ergonomics Society*. Los Angeles, California.
- Besen, E. & Gaines, B. (2015). Delays in the work disability process following work-related illness or injury using workers compensation claims from 2002-2008. *Workers Compensation Research Group*. Hopkinton, Massachusetts.
- Besen, E. & Pransky, G.S. (2015). Assessing the relationship between chronic health conditions and productivity loss trajectories. *Work, Stress and Health Conference*. Atlanta, Georgia.
- Caird, J.K., Wiley, K., Johnston, K., Willness, C. & Horrey, W.J. (2015). A meta-analysis of the effects of mobile phone conversation and dialing on driving. *4th International Conference on Driver Distraction and Inattention*. Melbourne, Australia.
- Chang, W.R., Chang, C.C., Lesch, M.F. & Matz, S. (2015). Factors affecting the utilized coefficient of friction. *National Occupational Injury Research Symposium*. Kingwood, West Virginia.
- Chang, W.R., Chang, C.C., Lesch, M.F. & Matz, S. (2015). Gait adaptation on surfaces with different degrees of slipperiness. *19th Triennial Congress of the International Ergonomics Association*. Melbourne, Australia.
- Cheung, J., Huang, Y.H., Lee, J. & McFadden, A. (2015). Differentiation between high and low safety climate in trucking: An item response theory approach. *Work, Stress and Health Conference*. Atlanta, Georgia.
- Cheung, J., Huang, Y.H., Lee, J., McFadden, A. & Robertson, M.M. (2015). Recommendations for safety interventions in the trucking industry: A work systems analysis. *Work, Stress and Health Conference*. Atlanta, Georgia.
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- Courtney, T.K., Verma, S.K., Chang, W.R., Lombardi, D.A., Huang, Y.H., Brennan, M. & Perry, M. (2015). Slipperiness perception and future risk of slipping. *National Occupational Injury Research Symposium*. Kingwood, West Virginia.
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- Hettinger, L.J., Dainoff, M.J. & Flach, J. (2015). On the nature and role of organizational dynamics in adaptive safety. *6th Resilience Engineering Symposium*. Lisbon, Portugal.
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- Horrey, W.J., Lesch, M.F., Garabet, A., Simmons, L.A. & Maikala, R.V. (2015). Engagement in distracting tasks: Subjective and physiological responses to interesting and boring information and the implications for driving performance. *19th Triennial Congress of the International Ergonomics Association*. Melbourne, Australia.
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- Shaw, W.S., Besen, E., Pransky, G.S. & McLellan, R.K. (2015). Manage at work: A self-management group intervention for workers with chronic physical health conditions. *Work, Stress and Health Conference*. Atlanta, Georgia.
- Verma, S.K., Zhao, Z., Courtney, T.K., Chang, W.R., Huang, Y.H., Lombardi, D.A., Brennan, M.J. & Perry, M.J. (2015). Duration of slip-resistant shoe usage and the rate of slipping in limited-service restaurant workers. *19th Triennial Congress International Ergonomics Association*. Melbourne, Australia.
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