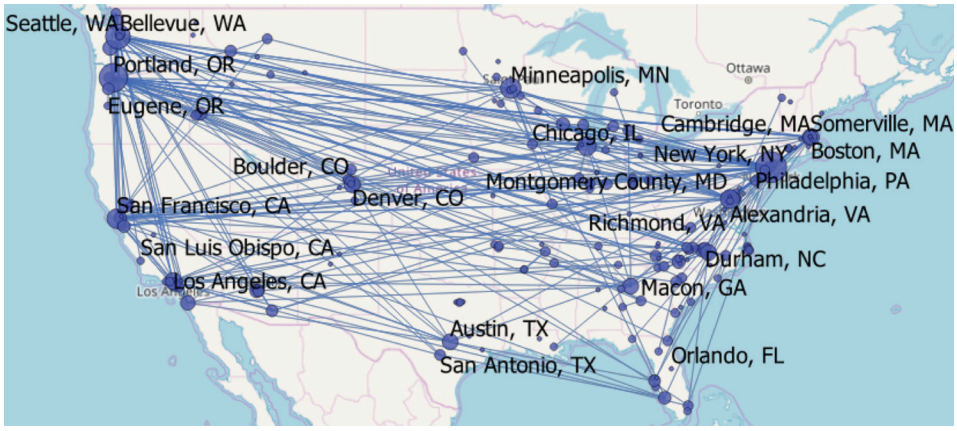
Collaborative Sciences Center for ROAD SAFETY

RESEARCH BRIEF

# Structures of Stakeholder Relationships in Making Road Safety Decisions




*A social network of U.S. road safety professionals. Larger circles show cities that have high degrees of social influence in traffic safety. Cities which are labeled operate Vision Zero programs.*

Traffic injuries and fatalities on U.S. roadways have risen in recent years. This project used tools and methods to help safety professionals more rapidly implement effective road safety practices.

Researchers surveyed nearly 200 U.S. road safety professionals in engineering, EMS, law enforcement, planning and public health fields to describe the diffusion of Vision Zero among road safety professionals through their awareness of the concept; to identify influential professionals, organizations and cities, toward accelerating other places' adoption of Vision Zero programs; and to explore the structure of cross-sectoral relationships in cities' Vision Zero coalitions.

The study identified several opinion-leading and boundary-spanning U.S. cities (denoted on the map above with larger circles), all of which operate Vision Zero programs. It also explained the structure and function of two of the opinion-leading cities' Vision Zero coalitions. Findings from this project provide direction for future research and road safety intervention work.

## PROJECT-PRODUCED RESEARCH


Evenson, K. R., LaJeunesse, S., & Heiny, S. (2018). Awareness of Vision Zero among United States' road safety professionals. *Injury Epidemiology*, 5(1), 1-6. doi:10.1186/s40621-018-0151-1.

LaJeunesse, S., Heiny, S., Evenson, K. R., Fiedler, L. M., & Cooper, J. F. (2019). Diffusing innovative road safety practice: A social network approach to identifying opinion leading U.S. cities. *Traffic Injury Prevention*, 2018; 19(8), 832-837.

Naumann, R. B., Heiny, S., Evenson, K. R., LaJeunesse, S., Cooper, J. F., Doggett, S., Marshall, S. W. (in press). Organizational networks in road safety: case studies of U.S. Vision Zero cities. *Traffic Injury Prevention*.



## PRINCIPAL INVESTIGATOR

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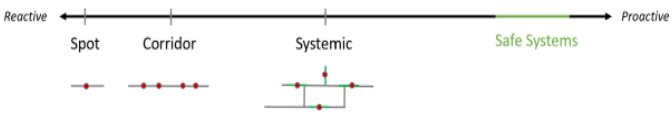
Collaborative Sciences Center for ROAD SAFETY

RESEARCH BRIEF

# An Enhanced Systemic Approach to Safety

The traditional transportation safety management approach involves the identification of crash hotspots, in which public agencies prioritize locations eligible for safety improvements based on historical collision concentrations. This project presents an enhanced approach that consists of targeting systemic improvements at high-risk sites across a road network based on specific roadway features that are associated with a particular crash type.

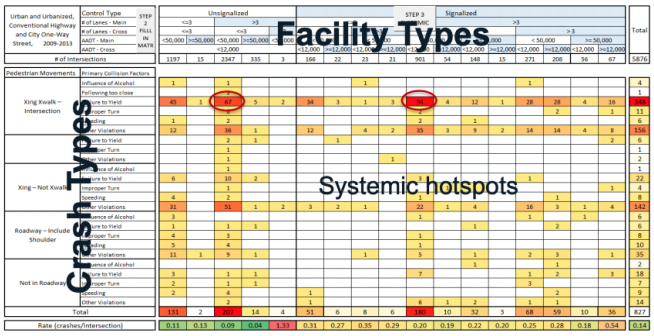



*Continuum of reactive to proactive approaches to injury prevention.*

The systemic approach uses historical crash data to identify the types of roadways that suffer from recurring safety concerns, designating it as reactive to data, but also provides a more proactive mechanism to make improvements to sites that have the same risk factors present but have not experienced many—or any—crashes. The systemic approach is a flexible, data-informed methodology that aims to identify recurring safety concerns by identifying the crash profiles that are associated with certain roadway features.

For this study, researchers developed a method for agencies to conduct a systemic safety analysis that takes the form of a transparent systemic crash matrix and shows what types of crashes occur on what types of facilities, with rows representing crash characteristics and columns corresponding to facility types.

Using such a matrix provides agencies with a snapshot of systemic problems within their networks, which is both easy to assemble and to interpret, thus overcoming potential barriers to changes in road safety management due to limited institutional capacity or financial means. The framework is flexible enough to allow agencies different safety priorities and with varying degrees of data availability to implement it. The report includes background principles, detailed guidance on data management, analysis, and interpretation, and a case study using California crash data.




*Example systemic pedestrian matrix illustrating what types of crashes are happening on what type of facilities, using California data.*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RESEARCH BRIEF

# Safe Systems: Guiding Principles and International Applications

This is a two-part study that provides a comprehensive examination of the theoretical and practical applications of Safe Systems.

The first part examines the current literature on Safe Systems, as well as emerging knowledge in the related domains of organizational systems safety, traffic psychology, and behavioral economics.

A key finding of this effort was the need for a better understanding of the nature of crash causation, one that focused not only on the immediate pre-crash behaviors of road users involved in a crash event, but also on the underlying the "latent conditions" that may trigger, or prevent these behaviors.

Latent conditions are the underlying geometric and environmental design conditions the establish the transportation context in which operational decisions are made, and are influenced not only by a roadway's design, but also the upstream planning and policy decisions that influence the design and configuration of the transportation system.


This section details the policy and development process that may establish latent crash conditions, and presents a model process for the project planning and design process that can be applied to eliminate them.

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The second section of the report examines the policies and practices of the four countries that have the most well-established Safe Systems programs: Sweden, the Netherlands, Australia, and New Zealand. Specifically sought was an understanding of processes by which these programs were developed and implemented, as well as information on the success of their implementation.

Collectively, the findings from this report provide the most comprehensive examination of Safe Systems applications to date, identifying the current global state-of-the-practice, as well as presenting important future directions for reducing traffic-related deaths and injuries through a Safe Systems approach.

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RESEARCH BRIEF

# Completing the Picture of Traffic Injuries: Understanding Data Needs and Opportunities for Road Safety

This study provides a comprehensive analysis of pre-crash, crash, environment and post-crash datasets that inform road safety; including linkages between datasets and implications for safety.

Although traditional police-recorded crash data has improved over time, additional data and analytics demonstrate a more "complete picture" of crashes and injuries. Researchers examined this complete picture of crashes and determined which elements of data that exist outside of conventional crash data can contribute to this picture – building on existing efforts and understanding how emerging datasets can be mapped to crash data.

The main body of the report is meant to frame the issue of data that can be relevant to understanding crashes and show how they interface with conventional crash datasets. As a quick-reference guide, practitioners and researchers can understand how datasets relate to each other. The report concludes with a series of applications that can assist with, from seatbelt use to planning policies that can assist policy makers and contribute to visualization that helps tell compelling safety stories that guide safety improvements.


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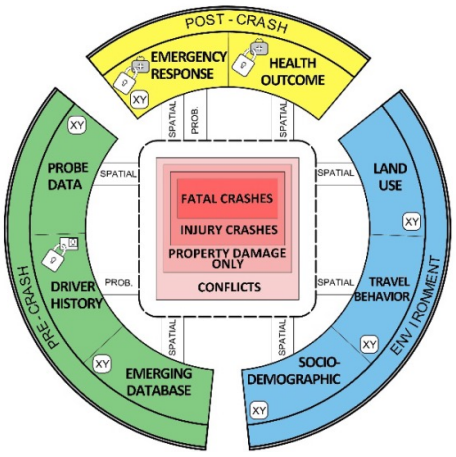


**COMPLETE PICTURE**


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RESEARCH BRIEF

# Traffic Safety Practices in U.S. Cities:

## Survey and Focus Group Results

This project entails a survey of the safety practices of the 150 largest cities in the United States, as well as a focus group of representatives from 10 cities at the forefront of traffic safety.

It finds that cities view themselves as prioritizing safety more heavily than state departments of transportation or metropolitan planning organizations, though the focus of city safety concerns lies principally in addressing the needs of pedestrians and cyclists.

Further, while many cities have adopted high-level policy goals relating to traffic safety, comparatively few have translated them into formal mechanisms that guide the design and construction of municipal transportation projects. Instead, city safety activities tend to concentrate on programs aimed at pedestrians and cyclists, such as pedestrian and bicycle master plans, complete streets policies, and safe routes to schools programs.

While these programs may increase the comfort of pedestrians and cyclists, it remains unclear whether they translate into improved safety outcomes.

This study concludes by encouraging safety researchers and professionals to better link safety practices to broader municipal concerns about land valuation and quality-of-life, and to translate this knowledge into actionable policies that can be integrated into the project development processes used by cities.

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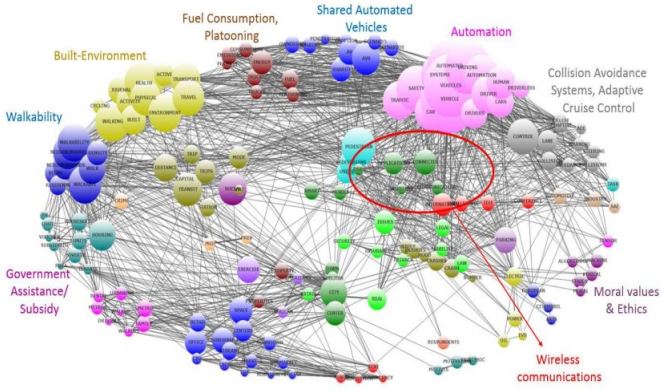
RESEARCH BRIEF

# Connected and Automated Vehicles and Safety of Vulnerable Road Users: A Systems Approach

Technological advances of connected and automated vehicles (CAVs) will not uniformly decrease crash risks as some environments, crash types, and user groups will continue to experience elevated risks, particularly vulnerable road users such as pedestrians. This project addresses these critical safety issues by: 1) assessing the current and future landscape of pedestrian and vehicle conflicts; 2) identifying how vehicle technology, planning policies, and data analytics can provide systemic solutions to pedestrian-vehicle conflicts; and 3) using data analytics to identify dangerous pre-crash behaviors.

This trans-disciplinary and multimodal approach includes literature reviews on current patterns of pedestrian-vehicle conflicts, and assessment of how planning and physical design strategies can reduce pedestrian-CAV conflicts. Furthermore, a risk analysis was conducted using Fatality Accident Reporting System (FARS) data and SHRP2 Naturalistic Driving Study data.




*Co-Presence Structure of Words Across Key Topics in Literature Review.*

Overall, the study applied innovative statistical, artificial intelligence, and visualization tools (see figure) to extract valuable information from studies and data, with the purpose of improving safety across modes, especially for vulnerable road users. The report includes seven key recommendations:

1. Maintain infrastructure and policies to support conventional (human-driven) motor vehicles and non-vehicular travel modes.
2. Establish minimum criteria for the effectiveness of pedestrian detection and resolution technology.
3. Expand knowledge on likely relationships between CAVs and other travel modes.
4. Expand knowledge base regarding the impacts of CAV-supportive infrastructure investments on pedestrian comfort, safety, and the built environment.
5. Evolve and adapt to new conditions and demands imposed by a CAV-dominant system.
6. Support and test existing and new vehicle-to-pedestrian technologies that can result in better detection (by cameras and other sensors), processing of data in real-time, and user (pedestrian and vehicle driver) alerts and warnings through notification systems.
7. Build links among engineering, planning, policy, public health, and other fields, and account for the emergence and penetration of CAVs.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RESEARCH BRIEF

# Development and Evaluation of Vehicle to Pedestrian (V2P) Safety Interventions

With increasing worldwide focus on autonomous vehicles, it is not clear that such advanced technology can account for vulnerable road users such as pedestrians. This research effort looked at the behaviors of pedestrians crossing a road while texting on a smartphone that would also alert them to the presence of an oncoming car, with varying degrees of reliability. The goal of this experiment was to examine how pedestrians, who were distracted by their smartphones, behaved in a road crossing scenario when an alert of varying reliability warned them of a possible collision.

This experiment was conducted in a controlled roadway environment with 30 pedestrian participants approaching a road crossing while performing a secondary data entry task on a smartphone. The measure of a safe event used in the analysis was whether people stopped at or before approximately two feet from the road's edge, rather than continue to cross in front of an oncoming vehicle (regulated by the study team), after receiving a phone-based warning.

The study found that about 20 percent of participants demonstrated risky or unsafe crossing behaviors, with crossing decisions that varied based on the timing of the warning.

| | Safe | Risky | Unsafe | Total |
|---|---|---|---|---|
| **Early** | 45 (5%) | 0 (0) | 0 (0) | 45 (5%) |
| **Just-in-time** | 645 (71.6%) | 161 (18%) | 0 (0) | 806 (89.6%) |
| **Late** | 33 (3.4%) | 0 (0) | 16 (2%) | 49 (5.4%) |
| **Total** | 723 (80%) | 161 (18%) | 16 (2%) | 900 |

*The number (percentage of total) of safe vs. risky vs. unsafe crossings as a function of time of alerting.*

Participants generally underestimated the time available to cross based on the timing of the warning signal and at times appeared to trust the alert app more than they did their own judgment, even when the app generated late alerts. This study provides evidence, consistent with a number of other simulator studies (Rahimian et al., 2018; Rahimian et al., 2018) that indicate that alerts on mobile phones are not particularly useful for crash prevention and may even encourage maladaptive behaviors and an overreliance on alerts. An opportunistic experimental factor emerged in the form of comparing US-born participants with an equal number of participants from other countries. Results suggest that national origin plays an important role in the use of technology and solutions may not be generalizable across countries.

The study calls into question the use of phone-based warning systems for pedestrians, especially those of different national origin. This research suggests that system design criteria might be elucidated from use of machine learning classification methods in concert with controlled experiments. More research is needed to determine warning timing thresholds, accounting for variations in trust due to nationality, environment, and other factors. Allowing nonpartisan researchers to access data and develop safety-based models to be shared across manufacturers could accelerate injury prevention.

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RESEARCH BRIEF

# Development of Resources to Guide Parents in Helping Teens Learn to Drive

Graduated driver licensing (GDL), a pioneering system concieved at HSRC and first implemented in the U.S. in 1997, has reduced crashes among 16-year-olds by up to 50 percent. Nonetheless, teenage drivers continue to be overrepresented in motor vehicle crashes and fatalities.

An important feature missing from current efforts to improve young driver safety is the lack of adequate support for parents of novice teen drivers. Although parents are expected to play a key role in helping their teen learn to drive, they receive almost no sound guidance for what to do or how to do it. Parents are involved in many different aspects of the licensing process. They influence the timing of licensure, supervise their teens' early driving experience, influence choice of vehicles, are the primary "enforcers" of their teens' license restrictions, and may further limit driving conditions or extend limits beyond what the state requires.

The objective of this project was to develop, implement, and test a comprehensive system, called *Time to Drive*, to support parents of new drivers. This system provides critical guidance to parents at various points in the licensing process when this guidance is most needed.

*Time to Drive* includes:

- An in-person parent coaching session that encourages parents to provide their teens with a substantial amount of supervised driving practice in a wide variety of settings;
- A method for driver education instructors to meet with parents to discuss the progress and proficiency of their teen driver, and to remind them of their role and responsibility in helping their teen become a safe driver;
- A smartphone app that encourages diversified practice during supervised driving and allows parents to easily keep track of the amount and variety of practice teens have gained;
- A competency assessment guide that helps parents gauge a teen's readiness to drive independently, and to determine the types of settings/environments in which the teen still needs practice;
- Tools for parents about how to enforce GDL restrictions and how to choose a safe vehicle for a new teen driver; and
- A network of trained professionals who provide individualized support to parents of new drivers.

This comprehensive support program, along with a series of formative evaluation findings, is the first such program in the nation and may serve as a model for other states.


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RESEARCH BRIEF

# Concepts of Operations for Autonomous Vehicle Dispatch Operations

While remote operations centers exist for several modes of transportation—such as air traffic control, flight dispatch, and rail dispatch—limited attention has been given to the design of remote operations centers for highly automated vehicles (HAVs). This research effort describes various Concepts of Operations (CONOPs) that address how dispatch operations for traditional and HAVs could evolve in both public and private settings.

Five different concepts of operations are explored, with a focus on the CONOPs for a regional public safety dispatch center, including how the insertion of HAV tasking would likely change staffing models. A case study was developed that looked at how the arrival of HAVs could impact a regional dispatch center.

| FUNCTION\CONOPS | OEM AVs (1) | Robo-Taxis (2) | Autonomous Trucks (3) | Public AVs (4) | State/ Regional (5) |
|---|---|---|---|---|---|
| Communication | ✓ | ✓ | + | + | + |
| Resource Allocation | ✓ | ✓ | + | + | + |
| Navigation | ✓ | ✓ | + | + | + |
| Contingency Management | ✓ | ✓ | + | + | + |
| Monitoring | ✓ | ✓ | + | + | + |
| Paperwork | ✓ | ✓ | + | + | + |
| Training | ✓ | ✓ | + | + | + |
| Remote Control | ✓ | ✓ | ✓ | ✓ | (✓) |
| Passenger Communication | ✓ | ✓ | | ✓ | (✓) |
| Fleet Management | ✓ | ✓ | + | ✓ | (✓) |

*Functions for Various Dispatcher CONOPs*

A discrete event simulation that focuses on dispatcher workload yielded several models that examined both single and two-person dispatcher teams under both typical and emergency operations. These models indicated that even with minimal new tasking caused by the arrival of HAVs, the additional workload would likely be too much for a single dispatcher, even under a normal operational tempo, and so an additional dispatcher would likely be needed.

It was further demonstrated that in order to ensure dispatchers had enough to do and would not be bored and distracted, in this specific regional dispatch center example, it would be better for dispatchers to share tasks instead of one focusing on typical tasks and one specializing in HAVs. While there would likely be additional training costs including possibly refresher training, the case study demonstrated that teams of two dispatchers sharing tasks provide a level of robustness to emerging events and could prevent workload from rising at untenable rates.

Going forward, companies and government agencies should start developing such models, understanding that they can only provide broad estimates for future operational needs. it is critical that agencies share best practices as well as data from such models and actual operations so that the entire surface transportation network can benefit.


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RESEARCH BRIEF

# Machine Learning Tools for Informing Transportation Technology and Policy

Little work has been conducted to study practitioner-induced subjectivities introduced into machine learning applications, which is important in understanding causes, influences, and methods for avoidance, particularly in transportation settings. To help fill this gap, this study uses two transportation datasets to examine car and pedestrian crash fatalities, deploying two different machine learning techniques of low and high complexity (logistic regression and neural networks), shown in terms of their relative complexity below.


*Complexity map of common machine learning models.*

Using both large and small transportation data sets with various features to predict driver and pedestrian injuries and fatalities, the results of these models are compared with one another, as well as with different possible interpretations of the neural network features. The results demonstrate that both the type of model and feature interpretation method produce different results in terms of model performance and assessment of feature importance.

These modeling results highlight several points of human-inserted subjectivity, which include:

- Picking the model to be used,
- Picking stopping rules for training performance factors (software dependent),
- Selecting data training and testing ratios,
- Picking threshold values between fatal and non-fatal values,
- Choosing thresholds between important and unimportant features, and
- Deciding across models with slightly different results, what the actual important features were.

These modeling results highlight other core issues not often discussed in practical applications of these methods, including issues with imbalanced data, which occurs when one class of data (e.g., non-fatalities in the data set utilized) significantly dominates over another (e.g., fatalities).

Another significant issue with the use of such powerful but potentially brittle analytical tools is a lack of checks and balances for results generation and interpretation. There is a very real possibility that decisions could be made from results generated by models that are not exactly wrong but also are not completely correct. Such inherent data-analytic weaknesses need to be accounted for when policymakers make decisions based on machine learning-generated results.

**PRINCIPAL INVESTIGATOR**

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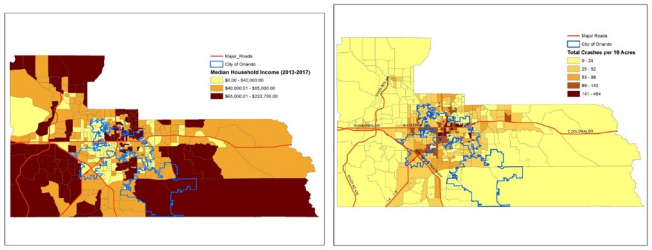
RESEARCH BRIEF

# The Influence of the Built Environment on Crash Risk in Lower-Income and Higher-Income Communities

This study sought to understand the environmental factors that influence crash incidence in lower-income communities in Orange County, Florida, as well as whether the factors associated with crash risk in these communities differ from the factors affecting more affluent communities and the population as a whole.

The study used three sets of negative binomial regression models: one for the Orange County region as a whole, a second for lower-income communities defined as block groups with median household income of $40,000 or less, and a third for higher-income communities defined as block groups with median household incomes of greater than $65,000.



*Left: Median Household Income in Orange County, Florida (ACS, 2013-2017); Right: Total Crashes by Land Area in Orange County, Florida (2014-2016).*

The results of this study suggest that income has a far more complex relationship to crash incidence than previously supposed—one that appears to be compounded by issues of race. First, urban arterials are far more problematic for lower-income communities than for more affluent ones. Each mile of urban arterial was associated with a 9% increase in total and fatal or injury crashes in affluent communities, while they were associated with nearly a 30% increase in these same crash types in lower-income areas. Further, while the presence of arterials in affluent communities had little effect on pedestrian collisions, each additional mile of urban arterial was associated with a 20% increase in pedestrian collisions in less affluent areas.

| Income Group | Min | Max | Mean | Std. Dev |
|---|---|---|---|---|
| Lower-income | 0% | 100% | 45% | 29% |
| Higher-income | 48% | 100% | 83% | 11.3% |

*Percentages of Whites in High-income and Low-income Communities.*

While race did not have a statistically-meaningful relationship to crash incidence in higher-income block groups, the percentage of whites in lower-income block groups was significantly associated with reductions in total, fatal/injury, and pedestrian crashes. Stated another way, racial disparities exacerbate the crash risk already experienced by lower-income communities. This study thus attempts to begin to disentangle these issues and concludes with a call for greater consideration to the manner in which the design of the built environment may exacerbate, or prevent, traffic safety inequalities associated with race and income.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RESEARCH BRIEF

# Linking Crash & Post-Crash Data to Improve Injury Estimates & Explore Emergency Medical Service Response

This project sought to build on prior efforts to link Calinfornia crash and emergency medical services (EMS) data in order to 1) provide a more accurate picture of traffic injuries by utilizing medical data to fill in where police crash reports may not capture a crash or may have limited information, and 2) to get a more accurate picture of EMS (or pre-hospital) response times in relation to crash location and other factors.

The study utilized the California Emergency Medical Services Information System (CEMSIS), a secure, consolidated data system that collects information about emergency medical service calls, patients treated at hospitals, and emergency medical service providers (CEMSIS, n.d.). These data included the zip code in which the incident occurred, the time at which an EMS unit was notified of the incident, the time at which the EMS unit was en route to the patient, the arrival and departure times to and from the scene, and the time when the EMS unit reached their hospital or trauma center destination. Demographic variables, such as patient gender and ethnicity, were requested but were not released due to privacy concerns. Only records that listed the cause of injury as a motor vehicle traffic accident were included.

The findings from the analysis showed substantial differences in response, scene, and transport times between collisions that occured in urban and rural zip codes. Average transport time was more than twice as long in rural zip codes as in urban zip codes for all study years. There were also substantial differences in the response times, both in urban and rural areas, for crashes occurring on tribal reservation land in relation to other parts of the state (see figure).

| Crash Location | State | Tribal |
|---|---|---|
| Urban | 14.3 | 19.6 |
| Rural | 50.1 | 61.4 |

*Average Time (in Minutes) from Crashes to Nearest Trauma Center in California.*

Although the present study cannot analyze the effect of longer prehospital times on patient outcome, other research has found that longer prehospital times negatively impacted patient health.

This study resulted in several recommendations, aimed to support the state in improving EMS response and crash victim outcomes. These included recommendations for developing measures to evaluate patient offload times as an indicator of EMS performance, improving CEMSIS data coverage and quality, and improving the data records such that EMS data can be more readily linked to police datasets. As data system improvements are made, additional research can be conducted to account for more variables that may influence the relationship between prehospital time and patient outcome.

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RESEARCH BRIEF

# Associating Ridesourcing with Road Safety Outcomes: Insights from Austin, Texas

The advent of transportation network companies (or TNCs) offering ridesourcing expands mobility options in cities and may impact road safety outcomes. This study analyzes the effects of ridesourcing use on road crashes, injuries, fatalities, and driving while intoxicated (DWI) offenses in Travis County (Austin), Texas.

This research leverages real-time ridesourcing data to explain variation in road safety outcomes. Researchers used origin-destination data from the TNC RideAustin, to examine the effect of ridesourcing exposure on road safety outcomes, including crashes, injuries, fatalities, and DWI offenses. Spatial panel data models with fixed effects were deployed to examine whether the use of ridesourcing was significantly associated with these safety metrics.

The results found that for every 10 percent increase in ridesourcing trips, there was an expected 0.12 percent decrease in road crashes, a 0.25 percent decrease in road injuries, and a 0.36 percent decrease in DWI offenses in Travis County. Ridesourcing use was not significantly associated with road fatalities. While positive, the magnitude of these effects is quite small.

The key finding from this research is that increases in ridesourcing were not associated with decreases in safety. This analysis augments existing work in the field by accounting for spatial distributions of ridesourcing use, road safety outcomes, and other socioeconomic characteristics in the given region. Contributions include developing a data-rich approach for assessing the impacts of ridesourcing use on transportation system safety, which may serve as a template for future analyses for other cities.

Future research should also focus on which populations and subpopulations road safety outcomes can be improved through ridesourcing use by (a) exploring the relationship of ridesourcing and road safety outcomes for different household income and employment percentage panels and (b) identifying critical drivers of where potential public health benefits of ridesourcing utilization can be the greatest.

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RESEARCH BRIEF

# Creating a Clearinghouse for Bicyclist and Pedestrian Safety-Related Data

## Phase I: Inventory & Framework

Safety researchers in the United States, especially those studying bicycle and pedestrian safety, often struggle to obtain sufficiently high-quality data to conduct robust safety studies. The goal of this project is to create an online centralized data clearinghouse for bicycle and pedestrian safety-related data as a national resource for safety researchers to expedite research on this topic.

In the first phase of this work, we produced a pilot online pedestrian and bicycle safety data resource clearinghouse available at **pedbikedata.org**. It allows researchers to search from over 4,000 pedestrian and bicycle safety-related data resources by geographic location (national, state, region, county or city), data type (collision, counts, infrastructure, or other), data format and availability.

The search results provide information on the time period for which the data are available as well as the owner of the data and a link to the online dataset itself. The final report details a system for rating the datasets and shows that there is a great need for higher quality data of all types. This project is expected to continue with a second phase to improve the web-based clearinghouse and user interface.

Visit: **http://pedbikedata.org/**


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RESEARCH BRIEF

# Integrating Spatial Safety Data into Transportation Planning Processes

Transportation planning is a collaborative process that incorporates the input of many stakeholders to define future policies, goals, and investments that prepare for future needs. Transportation planners analyze a range of alternatives and impacts when selecting designs, but too often safety evaluations are neglected or assessed as a separate post-process. Integrating safety into the planning process, and explicitly building tools and models for alternative scenario evaluation to account for safety outcomes is critical. Despite previous attempts to integrate road safety to planning models, one area needing further attention is the safety of road users (rather than road entities) and an examination of how changes in demographics, housing choices, and travel patterns affect safety.

The objectives of this research effort were to:

1. Introduce a new index for measuring road safety, accounting for road user's home location and develop a safety performance function to account for travel demand; and
2. Estimate and compare the safety outcomes of existing long-term planning models in relation to the new safety index.

This study created a Home-Based Approach (HBA) method to generate a Safety Performance Function. Unlike the majority of road safety studies, which attribute crashes to specific intersections or roadway types, in this study the research team attributed traffic crashes to the home address of the road users involved, measuring crash frequency at the traffic analysis zone (TAZ) level. The HBA accounts for both travel demand characteristics and safety at the TAZ corresponding to the residential address of the road users, allowing for the exploration of the relationship between travel demand and the safety outcomes of several modes of travel.

Four case studies were presented to illustrate how the HBA can be integrated into travel demand models as well as other relevant sources of data. Each case study illustrates different applications of the HBA to explore factors affecting road safety. These methods can be used by safety planners to evaluate the safety impacts of transportation network design alternatives, changes in the transportation system management, as well as zoning and land use patterns impact on exposure to a crash.


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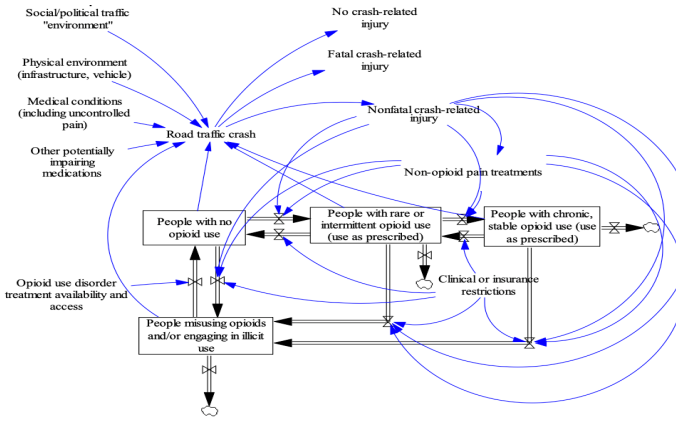
RESEARCH BRIEF

# Opioids at the Health and Transportation Safety Nexus

Despite known associations between transportation and opiod use, current approaches typically involve separate analyses using discrete databases. This research examines the linkage potential of two rich population-based data systems, prescription drug monitoring programs (PDMP) and police-reported crash databases, and identifies knowledge gaps amenable to data linkage studies.




*System map linking Road Traffic Crashes with Opioid Use*

Crash and PDMP population-based data systems contain rich information on prescription drug histories and detailed crash circumstances, providing a valuable opportunity to advance understanding of prescription drug trajectories leading to crash events and effects of crashes on subsequent prescription drug patterns.

Standardized templates were used to abstract specific data elements and attributes of MV crash and PDMP databases for all 50 states and DC. Abstracted PDMP elements included accessibility of PDMP data and schedules of controlled substances monitored in each state, while crash-related elements included whether crash reports document the type of drug test administered at the scene and the granularity of test results recorded.

Results show a majority of PDMPs (94%) are authorized to release data for research purposes. Schedules II-V controlled substances are tracked in 76% of PDMPs, with the remaining tracking II-IV. Drug-related elements captured in crash reports varied considerably by state. Eighty-six percent of states document the type of drug test administered; however, 54% of states only record whether a drug test was positive or negative, with less than a third of states citing specific drugs. Collection of personal identifiers is required in all crash and PDMP databases, suggesting high potential for effective linkage.

The lack of integration between crash and PDMP databases hinders advancement of the evidence base on the interconnected causes of unintentional injury death. While crash reports and PDMPs possess their own sets of strengths and weaknesses, linkage of these two data sources could fill critical research gaps.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RESEARCH BRIEF

# Strengthening Existing and Facilitating New Vision Zero Plans

In the United States, the roadway fatality rate is significantly higher than other high-income countries. Many communities are adopting ambitious safety plans to address this public health crisis. One important policy tool that municipalities, counties, or other entities can use is the development, adoption, and implementation of a Vision Zero plan. A Vision Zero plan is a public document that provides the vision for future efforts to reduce traffic fatalities and serious injuries to zero. This project aimed to: 1) Create an inventory of existing Vision Zero plans, 2) identify features of high-quality Vision Zero plans, and 3) develop guidance to facilitate and assist future plan-makers in developing and implementing sound injury prevention plans, with the ultimate goal of improving our traffic fatality rate.

The reserachers found Vision Zero plans from communities across the country, which are archived in a Plan Library. The team systematically analyzed the content of each plan to see if it reflected elements of a high-quality plan, such as: 1) Does the plan identify the community's vision and goals? 2) Are the vision and goals supported by current and past conditions for safety? 3) Did the plan development involve a participatory process? 4) Does the plan review existing policies, ordinances, and programs that might impact overlapping goals identified in the Vision Zero plans? and 5) Does the plan include concrete details for implementation?

The critical analysis revealed several findings: most Vision Zero plans need more deliberate and wide-reaching public engagement, more specific and measurable goals, as well as evaluation plans that clearly identify funding sources and responsible groups to oversee implementation activities. Although the "E" framework—engineering, enforcement, education, etc.—is commonly used, additional themes such as engagement, equity, and Safe System principles could reinforce goals to achieve the plan's vision. Stronger connections are needed between local plans and state-level plans, programs, and processes.

These findings motivated the development of a Guide to Developing a Vision Zero Plan, which offers evidence-based recommendations, examples, checklists, and other resources to help stakeholders and decision-makers strengthen the foundational elements of their Vision Zero plans and related processes.


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RESEARCH BRIEF

# Examining Potential Safety Risks Associated with the Introduction of Urban Light Rail Transit

Although transit is widely considered to be safer than other forms of surface transportation, there remains a lack of knowledge regarding the short and longer-term safety impacts of introducing transit for other forms of travel. This study conducted a before-after analysis of two systems—the Orlando, Florida SunRail commuter rail system and the Charlotte, North Carolina Lynx light rail system—in order to understand how the introduction of service influences the incidence of total roadway crashes, as well as fatal-severe-minor crashes (also called KAB crashes), near stations and along affected intersectons and cooridors where light rail operates.

The study examined changes in total and KAB crashes within 0.1 miles and 0.25 miles of each station, as well as changes in crashes occurring within 250 feet of an at-grade intersection. Within 0.1 miles of a SunRail station, total crashes increased by 133% and KAB crashes increased by 67% (see table). For the Lynx system, total crashes within 0.1 miles of a station decreased by 31% in the after period, while KAB crashes decreased by 21%.

| | KAB* | | | Total* | | |
|---|---|---|---|---|---|---|
| **Station Area (0.1 Mile)** | **Before** | **After** | **% Change** | **Before** | **After** | **% Change** |
| Altamonte Springs | 0 | 6 | 600.00% | 9 | 32 | 255.56% |
| Church Street | 5 | 5 | 0.00% | 25 | 57 | 128.00% |
| DeBary | 0 | 3 | 300.00% | 0 | 4 | 400.00% |
| Advent Health | 1 | 4 | 300.00% | 2 | 14 | 600.00% |
| Lake Mary | 1 | 0 | -100.00% | 2 | 4 | 100.00% |
| Longwood | 2 | 5 | 150.00% | 7 | 22 | 214.29% |
| Lynx Central | 6 | 0 | -100.00% | 28 | 38 | 35.71% |
| Maitland | 0 | 0 | 0.00% | 1 | 0 | -100.00% |
| Orlando Health | 0 | 0 | 0.00% | 3 | 1 | -66.67% |
| Sand Lake Road | 0 | 1 | 100.00% | 1 | 4 | 300.00% |
| Sanford | 0 | 0 | 0.00% | 0 | 0 | 0.00% |
| Winter Park | 0 | 1 | 100.00% | 6 | 20 | 233.33% |
| **Total** | 15 | 25 | 66.67% | 84 | 196 | 133.33% |
| | Wilcoxon z=1.330; p(z)=0.1848 | | | Wilcoxon z=2.592; p(z)=0.0095 | | |

*Where there are 0 values, the percent change is reported as 100% of absolute crash count.

*Crash Types within 0.25 Miles of a SunRail Station.*


*High-crash Intersections along the Lynx System.*

This study concludes that safety issues pertaining to urban transit extend beyond crashes involving rail vehicles. Changes in the use of station areas, and the design and operation of affected intersections, can have a profound influence on multiple-vehicle and vehicle-pedestrian crashes as well. The study identifies fruitful areas of future research and makes suggestions regarding how guidance, such as that in the *Manual for Uniform Traffic Control Devices*, may be enhanced to address these needs.


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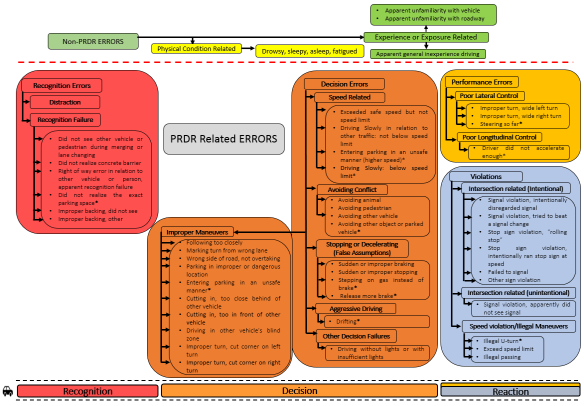
RESEARCH BRIEF

# Developing a Taxonomy of Human Errors and Violations that Lead to Crashes

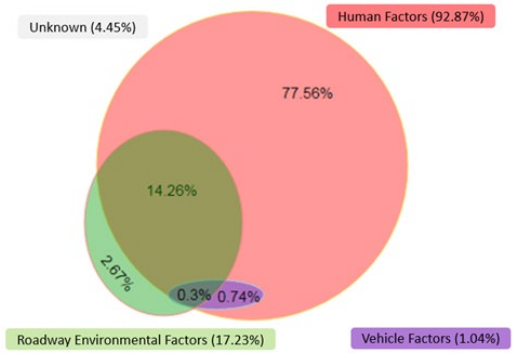
Driver errors and violations are highly relevant to the safe systems approach as human errors tend to be a predominant cause of crash occurrence. This study develops a deeper understanding of critical pre-crash driver errors and violations that have significant potential in reducing dangerous behaviors on roadways.

This project first quantifies the contribution of key factors (i.e., human, vehicle, and roadway/environment) resulting in crashes. Furthermore, a taxonomy of driving errors and violations was developed to understand the factors that contribute to crashes, and it is applied using Naturalistic Driving Study (NDS) data.




*Systematic Taxonomy for Driver Errors and Violations*

The findings reveal that human errors and violations contributed in 93% of the crashes, while roadway factors contributed in 17% of crashes. Recognition errors can be particularly hazardous, given their prevalence in crashes compared with their share in baselines (regular driving), and they were also more frequently associated with severe crashes (51%) compared with other errors and violations. The study identifies land uses that contribute to various types of errors, uncovering pathways from the built-environment and errors to crashes. We found that due to the complexity of urban environments, they are associated with higher crash frequencies and by inducing more recognition errors, the chances of crashes increase even further.




*Contributing factors in crashes (by subject drivers-NDS data)*

In the future, connected and automated vehicles have the potential to overcome a large portion of the driving errors and violations which presently contribute to a significant percentage of crashes. More research is needed on such safety intervention programs, e.g., collision warning and control assist systems to explore how they may help during the recognition, decision, and reaction phases, and re-engage the driver of a highly automated vehicle in hazardous situations.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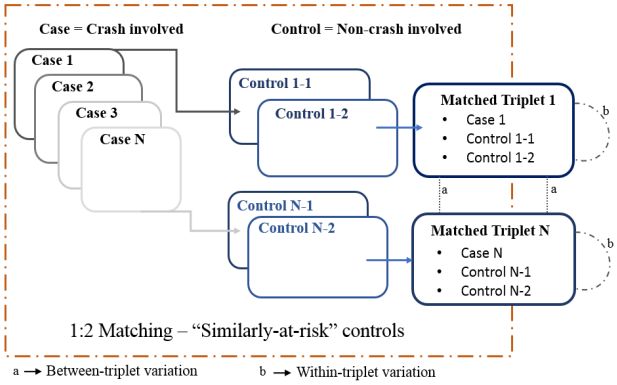
RESEARCH BRIEF

# Investigating the Vulnerability of Motorcyclists to Crashes and Injury

Motorcyclists are fatally injured 25 to 30 times more frequently than passenger vehicle occupants after accounting for vehicle miles traveled. This project uses the Injury Severity Score (ISS) as a response variable and focuses on a unique database of motorcycle crashes, the federally collected Motorcycle Crash Causation Study (MCCS), to explore the role of demographics and how key risk factors vary from one context to another, i.e., the settings in which motorcycle travel takes place.

This study conducts a rigorous heterogeneity-based case-control analysis to account for both within and between matched case-control variations (see figure).




*A Matched Case-Control Framework.*

The project addresses critical safety issues related to motorcyclists:

- Motorcycle crash risk factors, especially how visual conspicuity (bright-colored or reflective clothing) influences their likelihood of being involved in a crash;
- How the frequency and causes of crashes among young and inexperienced riders differ from those of older, experienced riders;
- How training and education programs relate to crash outcomes; and
- New automation technologies.

The results show several key factors related to rider experience, alcohol/multiple drug use, apparel and head coverage had correlations with ISS. The study showed that if a rider's shoes were motorcycle-specific, ISS were lower. Given a crash, partial helmet coverage was positively correlated with higher ISS, which is intuitive as such helmets provide less coverage compared to full face helmets and thus pose a higher risk of injury. It was also found that such helmets were associated with lower crash risk.

One implication of this work is the need for helmets that have broader coverage, but that also allow the rider to hear and see well. In the future, researchers can simultaneously model the injury severity sustained by different body parts of the same rider to account for unobserved heterogeneity. Also, one may examine the occurrence and outcomes of motorcycle crashes once connected and automated vehicle technology diffuses through the system.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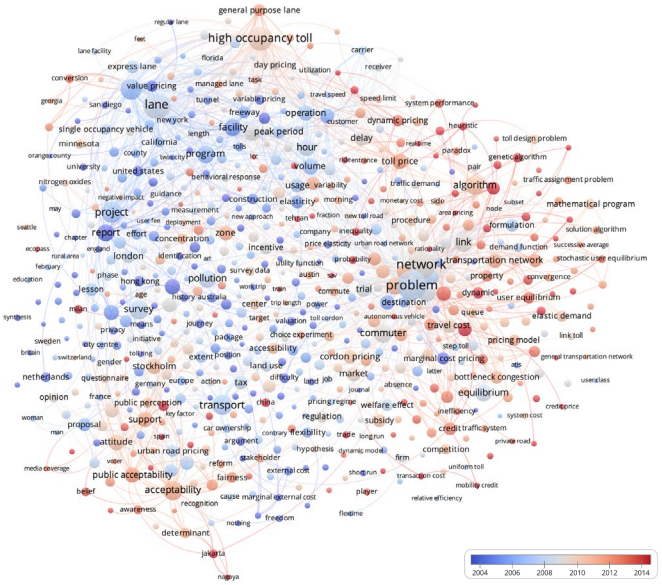
RESEARCH BRIEF

# A Systems Approach to Pedestrian Safety, PHASE II: Using System Dynamics Tools to Examine Congestion Pricing Policies

This report features three parts: a bibliometric analysis of toll-based congestion pricing literature, a detailed review of studies examining the impact of congestion pricing policies on road user safety, and a system dynamics learning model exploring potential pedestrian safety impacts of congestion pricing policies under a range of scenarios.

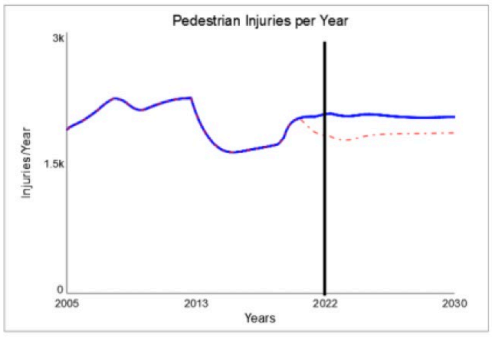
A bibliometric analysis was conducted to broadly identify themes and patterns in the congestion pricing evidence base and identify potential research gaps. An analysis of 2,333 publications from 1956-2021 revealed research themes related to public perception and acceptability, policy implementation characteristics and specifics, and advanced modeling techniques to study policy impacts. Identified gaps included studies focused on safety, specific road user types (e.g., bicyclists, motorcyclists), and equity.




*Study title and abstract terms with time overlay*

The second part of the project honed in on specific findings from the few studies (n= 18) examining congestion pricing policy safety impacts. Research indicated potential safety benefits for car occupants following congestion pricing policy implementation. However, some studies indicated short-term increases in injuries and crashes for vulnerable road users, like bicyclists and motorcyclists, which eventually decreased after a few years. Findings indicated that cities planning to implement these policies should consider potential mode shifts and safety supports for all road users (e.g., bicyclists, pedestrians).

The third part of this project involved building a system dynamics learning model to explore pedestrian safety impacts of congestion pricing policy implementation in New York City under a range of scenaiors. One important policy take-away from this work was that a congestion pricing policy combined with other pedestrian efforts (e.g., infrastructure improvements) has substantial potential for positive gains in public health. To explore the model and outcomes of various scenarios, please visit: bit.ly/CPPinjury.




*Example output from system dynamics learning model comparing pedestrian injury trends under different hypothetical implementation scenarios pre & post congestion pricing policy*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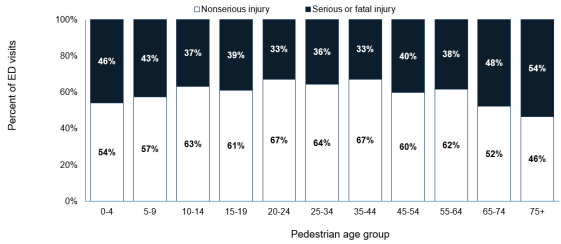
RESEARCH BRIEF

# Using Integrated Data to Examine Characteristics Related to Pedestrian Injuries

There is a lack of nonfatal pedestrian injury data, especially nonfatal pedestrian injury data integrated with police-reported motor vehicle crash data and other data sources. This study analysed five years of population-based, integrated, police-reported crash and emergency department visit data to examine vehicle, crash, roadway, and person-level factors and their association with serious pedestrian injuries, *ascertained using clinical metrics*, rather than police-reported injury severity indices.

We linked data from 6,923 pedestrians injured in North Carolina police-reported motor vehicle crashes (MVCs) to NC DETECT emergency department visit data from October 1, 2010 through September 30, 2015; of which 38% had injuries classified as serious based on the medical information. The results of the descriptive analysis were used to inform a multivariate logistic regression analysis, in which significant predictors of serious pedestrian injury were identified. In addition, the integrated crash-emergency department visit data were used to describe both the nature (laceration, fracture, etc.) and location (head, upper extremity, etc.) of injury to have a better understanding of pedestrian injury patterns following a motor vehicle crash.

Pedestrians were most frequently injured in crashes in which the pedestrian was struck while crossing the roadway, with the vehicle traveling straight (37%). Pedestrian crash type was statistically significantly associated with injury severity, with pedestrian crossing roadway, traveling straight (55%) and MV loss of control (34%) having the highest frequency of serious pedestrian injuries for roadway and non-roadway collisions, respectively.




*Frequency of serious pedestrian injuries by age group: NC, 2010-15*

Regarding injured pedestrian demographics, most were male, and a plurality were identified as white, not Hispanic/Latino. Black, non Hispanic/Latino pedestrians were overrepresented in the patient population, making up 45% of pedestrians treated in NC EDs, but only 23% of the NC population in 2015 (National Center for Health Statistics, Centers for Disease Control and Preventio, 2020). Nearly one-third of pedestrians treated in NC EDs for MVC-related injuries had one or more recorded comorbidities associated with premature mortality. Children aged 0-4 (46%) and older adults 65-74 (48%) and ≥75 (54%) years were the most likely to be diagnosed with serious injuries.

This study hopes to contribute to further research on data collection efforts using clinical metrics rather than police-reported injury severity indices.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RESEARCH BRIEF

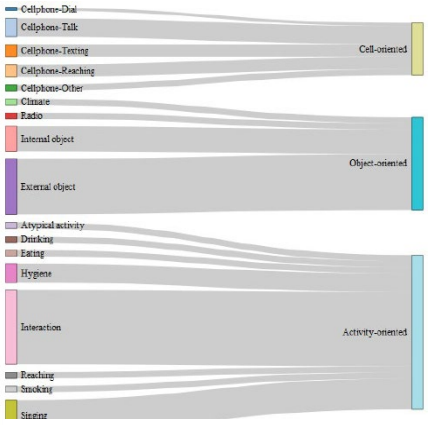
# Driver impairment detection and safety enhancement through comprehensive volatility analysis

This report had three main research objectives:
1. Develop a framework for obtaining, processing, and analyzing high-frequency multi-dimensional large-scale data using sensors that monitor the driver, vehicle, and roadways.
2. Analyze the naturalistic driving study data from the SHRP-2 program for in-depth analysis on impairment and distracted driving.
3. Use experimentation in simulated and naturalistic settings, demonstrate collection and processing of driver biometric, vehicle, and roadway surroundings data.

Findings from a literature review showed three gaps: the association of duration of secondary tasks and driving impairment on crash risk, the correlation of distraction and impairment on instability in driving and the overall association with crash risk and severity, and the real-time prediction of crash risk using leading indicators embedded in driver biometrics.

The researchers also developed a framework for obtaining, processing, and analyzing high-frequency multi-dimensional large-scale data using vehicle-based sensors that monitor the driver, vehicle, and roadways. The framework harnesses the data and quantify variations in driver biometrics and behavior, vehicle kinematics, and roadway/environmental conditions utilizing the concept of volatility.

Additionally, this study identified three main groups of distraction and quantified the duration of distraction by different types to study their association with crash risk, including cellphone-oriented, object-oriented, and activity-oriented distractions. The duration of all types of distracted driving are positively and significantly associated with the probability of the occurrence of a safety critical event (i.e. near-crash and crash events). The results suggest that the association of duration of distraction with crash risk is non-linear and with increased engagement with a secondary task.




*Categorization of secondary tasks*

The analysis presented created foundation for further experimentation in simulated and naturalistic settings. The next phase of the research will provide diverse sets of biometric data that can be analyzed further.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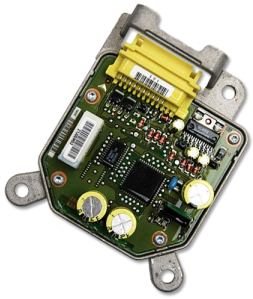
RESEARCH BRIEF

# Advancing crash investigation with connected and automated vehicle data

While current Event Data Recorders (EDRs) provide effective supplemental information supporting physical evidence, Connected and Automated Vehicle (CAV) sensor data can serve as an automated witness to accurately preserve the scene of a crash event and events leading to crash. The ability to record, report, and store accurate crash data would benefit future investigators, safety researchers, and manufacturers by improving the reliability of crash reports. This study assessed law enforcement stakeholder perspectives on how CAV data can be leveraged to improve crash investigation procedures. We performed a literature review to identify which sensors are most commonly included in CAV research and how they can supplement EDR data.



*An Event Data Recorder (Image: Crash Data Group, www.https://www.crashdatagroup.com/)*

Key findings of this research include:

- CAV sensor literature shows that functional range, pedestrian detection, and speed/steering control are the most important capabilities.
- The recommended combination includes camera and LiDAR technologies, which can provide a complete and visually descriptive depiction of the environment outside and inside the vehicle.
- LiDAR is a robust environmental sensor based on the identified capabilities and limitations.
- Law enforcement officers agreed that abundant information and helpful data are the best advantage of modern EDRs.
- The most common EDR improvement recommendation was universal cables or other common systems for data access.
- The two most recommended pieces of information by law enforcement included camera data and information about automation system's performance.
- The results of the law enforcement surveys are consistent with similar efforts to develop guidelines for reporting crash data for CAVs.

A key element of the project is the use of safe systems approach incorporating key stakeholders, data collection processes, technological capabilities, and harnessing microscopic level data. The results of this work can help improve crash reconstruction procedures when combined with the opinions and interpretations of other crash reconstruction experts. It will be important to understand the perspectives of other key stakeholders to design a useful dataset that will not only help in future crash reconstruction efforts, but also help researchers improve the safety of all road users.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RESEARCH BRIEF

# Understanding Micromobility Safety Behavior and Standardizing Safety Metrics for Transportation System Integration

The purpose of this study was to accelerate shared learning around micromobility safety impacts and to fast-track improvements to injury surveillance of emerging modes such as e-scooters and related micromobility devices (e-bikes, electric skateboards, hoverboards, etc.) used on and around city streets and paths. The research focused on four specific tasks:

1. Establish available data sources to support safety evaluations across multiple geographies;
2. Engage stakeholders, examine current practices, and identify approaches to enhance injury surveillance systems;
3. Develop a behavior-oriented survey instrument; and
4. Formulate data structure(s) for continuous tracking and analysis of shared micromobility safety.

For Task 1, our research team obtained access to data from more than one million high-resolution shared e-scooter trips in the Nashville over the span of September 1, 2018, to August 31, 2019, to classify the trip types. We identified five main types of e-scooter trips in Nashville: 1) daytime short errand trips, 2) utilitarian trips, 3) evening social trips, 4) night-time entertainment district trips, and 5) morning commute trips. Findings such as these can inform better e-scooter policies.

For Task 2, our research team formed a collaboration with stakeholders across the nation, called the "E-scooter Injury Surveillance Workgroup." Our research team developed a poster titled, "New Modes, New Codes" to assist clinicians and medical coders in categorizing and assigning existing ICD-10-CM codes for the purposes of injury surveillance activities. Our work also contributed to the addition of new codes in the FY 2021 version of ICD-10-CM. We also worked on new codes for e-bikes for FY 2022

For Task 3, we created a survey library with standardized questions for e-scooters and related micromobility devices. This will substantially simplify survey generation for practitioners and allow the surveys to be consistently worded that will result in comparable outcomes. We partnered with the World Resource Institute New Urban Mobility Alliance (NUMO) to disseminate this work.

Lastly, for Task 4 we applied the Pedestrian and Bicycle Crash Analysis Tool (PBCAT) developed by the Highway Safety Research Center to examine a comprehensive set of police crash reports concerning micromobility modes over the past two years in Nashville, Tennessee. In total, 52 unique e-scooter and 79 bicycle crashes from April 2018 to 2020 were identified and analyzed from the Tennessee's Integrated Traffic Analysis Network (TITAN). Our findings are valuable as they can inform specific design and policy improvements for both e-scooters and bicycles, both of which are considered vulnerable in a crash scenario.


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RESEARCH BRIEF

# Shaping the narrative around traffic injury: A media framing guide for transportation and public health professionals

This guide calls for professionals who work in injury prevention and transportation planning and design to coordinate with journalists and re-shape the narrative around traffic injury in our communities.

Messages and framing of media stories evoke values. For example, a media story that frames a road injury as delaying motor vehicle traffic appeals to Power values for control over one's time and use of road space. Activating people's values for control (Power) can suppress their concern for the welfare of others (Universalism). On the other hand, the "human interest" or "victim narrative" story appeals to values of Universalism, concern for others.


*Above: Universal human values arranged in a circumplex (Common Cause Foundation, 2014); Right: Types and definitions of human values (adapted from Bardi and Schwartz, 2016).*

| Types of Values | Definition |
|---|---|
| Power | Social status and prestige, control or dominance over people and resources |
| Achievement | Personal success through demonstrating competence according to social standards |
| Hedonism | Pleasure and sensuous gratification for oneself |
| Stimulation | Excitement, novelty, and challenge in life |
| Self-Direction | Independent thought and action-choosing, creating, exploring |
| Universalism | Understanding, appreciation, tolerance and protection of the welfare of all people and of nature |
| Benevolence | Preservation and enhancement of the welfare of people with whom one is in frequent personal contact |
| Tradition | Respect, commitment and acceptance of the customs and ideas that traditional culture or religion provide the self |
| Conformity | Restraint of actions, inclinations, and impulses likely to upset or harm others and violate social expectations or norms |
| Security | Safety, harmony and stability of society, of relationships, and of self |

We recommend that transportation, public health, and journalists frame road trauma in three humanizing and inter-related ways:

1. Appeal to intrinsic values
2. Depict themes over events
3. Inspire pragmatic "can-doism"

Appealing to "bigger than self" problems (intrinsic values); centering crashes in a larger narrative themes about road injury, rather than treating injuries as isolated from one another; and framing serious crashes as preventable through use of common-sense can activate people's sense of concern for others, increase public support for addressing social issues, and tap into an American sense of "can do" (Maio, 2012; Swim and Becker, 2012; Ting, 2017; Thompson, 2016).


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RESEARCH BRIEF

# Urban Freight and Road Safety: Trends and Innovative Strategies

Freight traffic has increased on American streets due to rising e-commerce. Previous CSCRS research found that freight-involved injury and fatalities rates are increasing more rapidly than overall rates. This study analyzes the road safety threat to pedestrians and bicyclists – vulnerable road users (VRU) – from commercial traffic. The project also assesses novel last-mile delivery options to identify impacts on road safety.

This report describes work in two parts:

**Part I**

"Exploring the Determinants of Crash Severity for Incidents Involving Vulnerable Road Users and Commercial Vehicles in North Carolina and Tennessee" explores the spatial and temporal patterns of freight vehicle interactions with VRU in urban areas of North Carolina and Tennessee. We find a statistically significant increase in these crashes in both North Carolina and Tennessee, highlighting the importance of looking at VRU-commercial vehicle crashes to improve traffic safety. This section also examines the impacts of crash-level characteristics on the severity of crashes, revealing that using small vehicles for last-mile delivery is less likely to produce crashes causing severe injuries or fatalities.

**Part II**

"Last Mile Strategies for Urban Freight Delivery" presents a systematic review of the literature to identify last-mile delivery strategies. As freight volumes rise, logistics firms are seeking new ways to deliver packages the costly last-mile.We identifiy four types of last-mile delivery strategies: innovative vehicles, urban goods consolidation, technological and routing advancements in city logistics, and emerging planning tools and policies. We find that the efficiency in terms of time, costs, and emissions have been well-studied but there is limited work assessing how the proposed strategies impact safety outcomes. This section also assesses the advantages and disadvantages of e-cargo bikes to address last-mile delivery in urban communities.

These studies contribute to a better understanding of research issues related to improving urban freight road safety and last-mile delivery strategies. The research results could inform policymaking to improve road safety associated with last-mile delivery and VRU. They also elaborate on the existing novel last-mile delivery strategies that logistics firms and public agencies could compare and adopt to promote efficient and safe last-mile delivery. They also identify research directions for freight researchers to improve the understanding of different last-mile delivery strategies.

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RESEARCH BRIEF

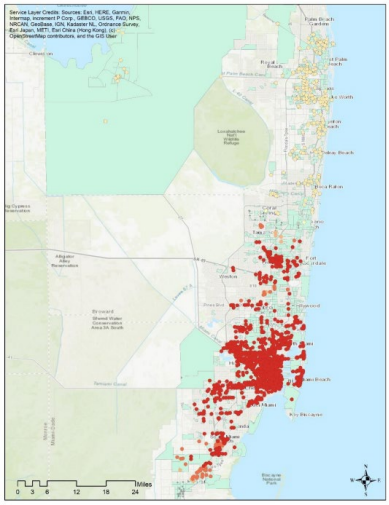
# Crash Risk for Low-Income and Minority Populations: An Examination of At-risk Population Segments & Underlying Risk Factors

Socio-economic status (SES) is a well-known predictor of crash risk. Lower-income, minority, and less-educated persons are disproportionately likely to be injured or killed in a traffic accident.

This study examines pedestrian and cyclist crashes occurring in lower-income areas in Broward, Palm Beach, and Miami-Dade counties with three specific objectives: (1) estimate the relative risk of pedestrian and cyclist crashes in lower-income communities, compared to their more affluent counterparts to understand the nature of the pedestrian and cyclist crash risk in lower-income areas; (2) identify specific at-risk population cohorts within lower-income census block groups, stratified by age, gender, and the time of day to develop a profile of the unique characteristics of crashes experienced by pedestrians and cyclists in these areas; and (3) examine the effect of the commuting patterns on vehicle-pedestrian and vehicle-cyclist collisions.

This study, like much of the prevailing road safety research, found that crashes involving pedestrians and bicyclists are more common in lower-income areas than more affluent ones. This study sought to fill a critical gap in our understanding of pedestrian and bicyclist crashes in lower-income areas by identifying the characteristics of specific at-risk cohorts, as well as the environmental risk factors that may exacerbate this risk.

This study concludes by discussing the underlying causes of crashes occurring in lower-income areas, which appear to be principally the result of normal travel activities undertaken in poorly adapted environments to high levels of walking and bicycling.



*Hotspots of vehicle-pedestrian collisions involving adult pedestrians (aged 20+)*

Much of the observed safety issues are not solely the result of deficiencies in the transportation system, but rather the product of inconsistencies between the design and operation of the transportation system and local land development policies, which result in conflicts of use and errors of expectancy.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RESEARCH BRIEF

# Applying Civic Innovation Methods to Advance Safety Education: A Pilot Program

One of the major barriers to the implementation of Safe Systems is the lack of clarity and understanding of the subject among project stakeholders, particularly among minority and disadvantaged populations. Advancing safety requires us to not only enhance our planning and design processes, but also to establish local cultural and belief systems that value, prioritize, and advocate for traffic safety.

This effort sought to apply "creative placemaking" techniques to advance traffic safety in Miami-Dade County. Specifically, this effort sought to engage non-traditional stakeholders in addressing the traffic safety challenges facing their communities, aiding them in both visualizing desired safety outcomes and advocating for the associated traffic safety improvements.

This report details a pilot effort to link creative placemaking techniques with traffic safety through events focused on the Little Havana neighborhood, a lower-income, predominantly immigrant community in Miami.

The project team had originally planned to hold three "urban interventions" in 2019 and 2020, but was only able to hold one intervention and an auxillary event as a result of Covid-19-related restrictions. However, the broader effort was successful in bringing together local stakeholders to advocate for safety investments.

*Children designing transportation networks to build safe connections throughout a model city.*

The report provides guidance that can be used by other communities seeking to engage non-traditional partners in the planning and programming of safety investments, such as: recognizing the immense importance of bi-lingual facilitation; including children in activities; experimenting with the framing of engagement and activation efforts; including street safety information in all meetings; and including community members from the very beginning.


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