

Injury Research in Highway Safety



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Highway safety is a broad field that involves several activities that, in theory, work together to reduce the number and severity of crashes. This lecture introduces the fundamental activities of highway safety and provides some examples of the application of injury research in these activities. Upon completing the lecture, the reader should be able to:

1. List the various disciplines that have a stake in highway safety
2. Identify the research traditions that exist in investigating highway safety issues
3. Recognize that many activities in injury research have opportunities for overlap (or collaboration)

This lecture seeks to build upon a recent effort to identify the Core Competencies for Highway Safety by providing introductory material for students new to the area of highway safety. Further details on the core competencies are available at: Core Competencies for Highway Safety: www.trb.org/safety

Other recommended reading:

John Graham. Injury Control, Traffic Safety, and Evaluation Research. In Preventing Automobile Injury. John Graham (ed.). Auburn House Publishing, Dover, MA, 1988

Objectives

- Recognize who has an interest in highway safety and where current programs are managed
- Understand the current environment which shape highway safety priorities
- Understand the fundamental approaches to research in highway safety

The primary objectives for this lecture are outlined above. Highway safety is a complex, multi-disciplinary field when it functions best. Being able to communicate with individuals with different disciplines and work with them in this complex environment can be daunting, at times, but is a pre-requisite for success in terms of the ultimate goal of reducing road crashes and their severity. This lecture is meant to identify the major disciplines involved in highway safety and to outline some of the research approaches commonly used in these areas.

Multi-disciplinary Nature of Highway Safety

- Engineering
- Public Health
- Law Enforcement
- Emergency/Acute Care
- Biomechanics
- Policy/Planning
- Transportation Industry
- and others

Many, many disciplines have a role to play in ensuring highway safety. The major groups which contribute to road safety are listed here. Effective programs to improve road safety require the integration of these disciplines. Unfortunately, many individuals do not yet recognize the contributions that all of these fields make to road accident prevention.

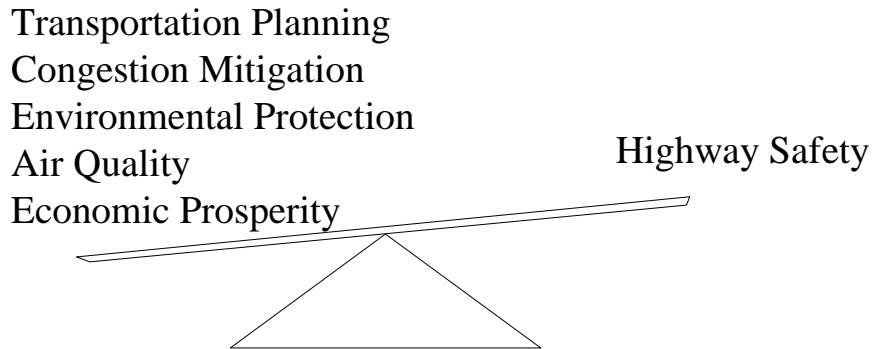
Responsibility for Highway Safety

- Government
 - Federal
 - regional (state)
 - local (county)
- Transportation Modes
 - Public Transportation
 - Commercial
- Private Sector
 - Automotive industry
 - Construction industry
 - Planners/Architects

Many groups take responsibility for highway safety in one form or another. Governments (federal, state, and local) are the primary agencies responsible for highway safety in the United States. Several individuals from the disciplines noted on the previous slide contribute to programs at the governmental level for road safety. The transportation industry also bears some responsibility for road safety. This is at a smaller programmatic effort than seen for governments, as it is usually focused on specific sectors of transportation, e.g. trucking, public transport, etc. The private sector also has a responsible role in highway safety. While regulations exist which govern the conduct of the design of products and services of private companies, the common goal of companies involved in the transportation sector is to increase the use of their goods and services. A safe environment contributes to this growth.

Current Environment

....often a tradeoff between highway safety and other transportation priorities



The current environment for highway safety programs, though, is tenuous. Highway safety programs often have to compete for funding with several other transportation and social issues related to transportation projects (e.g. traffic congestion mitigation, environmental planning). Safety, in reality, should be a part of the decisions and actions of these issues. However, in practice, few individuals recognize the role of safety in their actions and arguments. Thus, highway safety programs often compete for funds and priorities as a separate entity, rather than as a joint, collaborative effort.

Research Traditions in Traffic Safety

- Crash Investigation
- Injury Epidemiology
- Field Data Analysis
- Human Factors
- Biomechanics

Graham J

Several research approaches exist in the highway safety field. The major scientific research traditions in highway safety are outlined here. A discussion of each follows.

Further reading:

John Graham. Injury Control, Traffic Safety, and Evaluation Research. In Preventing Automobile Injury. John Graham (ed.). Auburn House Publishing, Dover, MA, 1988

Crash Investigation

- Crash scene investigation
- Unit of analysis: one crash
- Questions:
 - What factors caused the crash
 - What factors contributed to injury
- Behavioural, vehicle, and environmental factors are identified

Graham J

Investigations of crashes and crash scenes are one of the most widely known fields of research in highway safety. In this field, extensive investigations of individual crashes are conducted to identify the factors that contributed to the crash, and also the factors that led to injury as a result of the crash. Investigators are trained professionals who search for information regarding the behavior of the driver before and during the crash, the performance of the motor vehicle at the time of the crash, and the contributions to the crash from the environment.

CDS: Crashworthiness Data System

- There are 27 field research teams that study about 5,000 crashes a year involving passenger cars, pickup trucks, and vans. Since 1979, CDS has collected data on over 140,000 crashes.
- Trained crash researchers obtain data and photographs from crash sites collecting evidence such as skid marks, fluid spills, broken glass, and bent guardrails. They locate the vehicles involved, photograph them, measure the crash damage and identify interior locations that were struck by the occupants.
- These researchers follow up their on-site investigations by interviewing crash victims and reviewing medical records to determine the nature and severity of injuries.

<http://www-nrd.nhtsa.dot.gov/departments/nrd-30/nrsa/NASS.html>

While many accident investigators are employed, their investigations are often conducted for local authorities or insurance companies. In the US government, the Crashworthiness Data System is a collection of data gathered from accident investigations around the country. This information is pooled in the CDS for use as a research tool to analyze not one crash, but the characteristics of several similar crashes.

CDS

- Reviews a sample of all motor vehicle crashes
- Reviews crashes in special studies
 - Airbag deaths
 - Tire Pressure Study
 - Pedestrian Crashes

An example of recent efforts conducted under the Crashworthiness Data System include the identification of the role of airbags in the deaths of occupants of motor vehicles. Every known crash that involved an airbag deployment that led to the death of an occupant was singled out for an in-depth investigation by the CDS teams. The data from these investigations were pooled and it was then possible to learn information about who was at most risk for death from airbag deployment and the circumstances surrounding these deaths. Changes in policy came from this work, namely the emphasis on placing children in the backseat of motor vehicles.

Current efforts are underway to learn more about crashes caused by inadequate tire pressure and crashes involving pedestrians.

Injury Epidemiology

- Identify frequency of crash injury, patterns in crash injury, causal factors in crash injury.
- Unit of analysis: population of crashes or population in general
- Behavioural, vehicle, and environmental factors can be examined

Graham J

Injury epidemiology is a fundamental research tradition in highway safety. This effort was first recognized because of the development of surveillance systems to identify the descriptive data common to crashes. The FARS and GES systems are two examples of epidemiological input into highway safety. Recently, epidemiology has broadened its contribution, but seeking to conduct analytical studies (rather than descriptive studies) to identify and quantify risk factors for crashes, or the injuries from crashes.

Passenger Seating Position and the Risk of Passenger Death in Traffic Crashes

One example, among many, of an analytical epidemiology study in the highway safety field is the recent paper by Smith and Cummings. This study was conducted to identify what the implications of a policy of having children seated in the rear of a vehicle might be. The authors use a unique study design in this effort, a matched cohort study within the FARS data. They found that adults are not compromised (from a safety perspective) from sitting in the front passenger seat, provided that the car has an airbag, and that the passenger wears a seat belt.

See: Smith KM, Cummings P. Passenger seating position and the risk of passenger death in traffic crashes; a matched cohort study. *Injury Prevention* 12:83-86, 2006

Field Data Analysis

- Examines historical data on crashes to understand the traffic safety system
- Unit of analysis: years of data on crashes
- Behavioural, vehicle, and environmental factors can be examined

Graham J

Another discipline in highway safety is field data analysis. It concentrates on the analysis of historical data on crashes and injury to learn more about traffic safety policies or existing systems. The studies in this area can be simple, looking at trends over time by common crash factors, or the studies can be complex investigations that attempt to measure the combined effects of driver behavior, vehicle factors, and environmental variables (Graham).

John Graham. Injury Control, Traffic Safety, and Evaluation Research. In Preventing Automobile Injury. John Graham (ed.). Auburn House Publishing, Dover, MA, 1988

Human Factors

- Addresses the role of human behavior in causing crashes and injuries
- Unit of analysis: multiple individuals in experimental settings (often)
- Approaches:
 - Measure risky driving behavior
 - Assess performance of humans in executing driving tasks

Graham J

Perhaps the most common research tradition in highway safety is human factors research. Human factors research seeks to identify what role human behavior plays in crash causation or injury occurrence. Several studies exist in this field. Most take either of two approaches; studies to measure risky behaviors, or studies to assess how humans perform in the driving tasks.

100 Car Naturalistic Study

One recent study of a human factors nature is the 100 Car Naturalistic Study. This study will become a landmark study in the highway safety field. In the study, 100 cars were outfitted with equipment and cameras to record various measures on the car during driving operation and to record the behavior of the driver in these situations. Several results are emerging, perhaps the largest finding was the role that distraction plays in the development of road traffic crashes.

See: Neale VL, Dingus TA, Klauer SG, Goodman M. An overview of the 100-car naturalistic study and findings. Available online at http://www-nrd.nhtsa.dot.gov/pdf/nrd-12/100Car_ESV05summary.pdf

Biomechanics

- Addresses the biomechanical aspects of impacts on the human body
- Unit of analysis: individuals in experimental settings
- Often assess specific regions of the body, e.g. head, abdomen

Graham J

Research in biomechanics is the fifth fundamental research tradition in highway safety. This research field investigates issues such as how crashes impact the human body, and how the specific aspects of the crash contribute to injury. Many of these studies are conducted with crash-test dummies in learn more about energy transfer and how it leads to injury.

Key Lecture Points

- Several research approaches exist to examine injuries from road traffic accidents.
- Many of the existing approaches overlap, and epidemiology has a role to play in most segments of highway safety.
- In the current environment, highway safety is often pitted against other issues of concern (e.g. traffic planning, environmental quality). Unfortunately, highway safety is often low on the list.