The Lesser Known Side of Highway Safety

Rick O. Drumm, P.E.
Road School 2016
March 8, 2016
“Highway Safety is a good thing.”

- Rick O. Drumm, P.E.
Lesser Known Side of Highway Safety

- An hour of stories
  ... and data
  ... and research
  ... and discussion on traffic safety.
Story Time
It all started with:

Henry Wells
On May 30, 1896…”The wagon [automobile] operated by Henry Wells, of Springfield, Mass., wobbled furiously, going in a zig-zag fashion, until it seemed that the driver had lost control of it. Evylyn Thomas, of No. 459 West Ninetieth-St., was approaching on her bicycle, when suddenly the wheel and horseless carriage met, and

there was a crash.”
“A crowd gathered, and the woman was picked up unconscious, her leg fractured. An ambulance took her to the Manhattan Hospital, where last night it was reported that she would recover soon. Wells was taken to the West One-hundred-and-twenty-fifth-st. station, and held pending the result of the injuries to Miss Thomas. The wagon went on in charge of another operator.” – New York Daily Tribune.
“...there was a crash.”

May 30, 1896
Data Analysis
A Fool-Proof Method of Reducing Highway Fatalities
Motor vehicle crash deaths and unemployment rate 1950-2013

Motor vehicle crash deaths

Unemployment rate

7%
32,719
There are many influences to highway safety. Some are not in our control. Some are.

On those, we shall concentrate.
Some Thoughts on Self-Driving Vehicles
Stop 1:
Small groups of 3-5.
Best safety improvement you have seen.
Be prepared to share one.
Simpson’s Paradox
Which state has safer roads?

Fatality Rates

CA: 1.27

SD: 2.12
## Fatality Rates

<table>
<thead>
<tr>
<th>State</th>
<th>Fatality Rates (per 100 MVMT)</th>
<th>Distribution of VMT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rural</td>
<td>Urban</td>
</tr>
<tr>
<td>California</td>
<td>2.68</td>
<td>0.92</td>
</tr>
<tr>
<td>South Dakota</td>
<td>2.49</td>
<td>0.87</td>
</tr>
</tbody>
</table>

CA: 1.27
SD: 2.12

**CA:**
- Rural: 2.68
- Urban: 0.92
- Total: 1.27

**SD:**
- Rural: 2.49
- Urban: 0.87
- Total: 2.12
The Lesson:
Be Careful When Comparing
Motor Vehicle Traffic Fatalities by Year and Location, 2004-2013

Distribution of Blood Alcohol Concentration (BAC) of Drivers Involved in Fatal Crashes, by Location, 2013

Source: FARS 2013 ARF
Story Time
Another infamous point in history:

Bridget Driscoll
On August 17, 1896, in London, Bridget Driscoll, age 44, became the world's first person to be killed in an automobile accident.
As she and her teenage daughter crossed the grounds of the Crystal Palace, an automobile belonging to the Anglo-French Motor Car Company and being used to give demonstration rides struck her at "tremendous speed", according to witnesses - some 4 MPH (6.4 km/h). The driver had apparently modified the engine to allow the car to go faster.
The jury returned a verdict of "accidental death" after an inquest lasting some six hours. The coroner said: "This must never happen again."
"This must never happen again."

August 17, 1896

In response to first reported traffic fatality.
The Venn Diagram
Systems Approach: Contributing Factors to Crashes

- Roadway: 34%
- Driver: 93%
- Vehicle: 12%

- 3% overlap between Roadway and Driver
- 6% overlap between Driver and Vehicle
- 2% overlap between Roadway and Vehicle
- 27% overlap between all three (Roadway, Driver, and Vehicle)
SHRP 2
Naturalistic Driving Study
SHRP 2 Safety data: NDS & RID

Captured System:
Driver-Vehicle-Roadway

NDS Data
Linked
RID (GIS)

~ 1950 DAS
~ 3000 participants
~ 5.4 million trips
~ 1 M hrs video

Recorded continuously
exposure data
Passenger Car, Van,
SUV, Pickup
Crashes: 1,465
Near-crashes: TBD

Context for each of the trips
New data collected and QA
• 12,500 centerline miles
Consistent amongst six states

Acquired data (DOTs, others)
• 200,000 centerline miles
• Roadway, Weather, Traffic
• 7 yrs crash histories,
• Safety laws and campaigns
• Work zones, 511...

Six NDS sites
SHRP 2 Naturalistic Driving Data

- Driver data, incl. PII
- Driving data, incl. PII
- Vehicle data
- Surrounding traffic data
- 3000 probes operating over a 1-2 yr period and all trips continuously recorded key-on/off
- 5.4 Million trips
- 50 Million miles travelled
- Six study sites
Data acquisition system (DAS)
Driver, Driving, Veh.

- Vehicle type
- Multiple Videos
- Computer Vision
  - Lane Tracker
- Accelerometer Data (3 axis)
- Rate Sensors (3 axis)
- GPS
- Forward Radar
  - X and Y positions
  - X and Y Velocities

**Driver/Participant Data:**
- Age & Gender
- Visual perception
- Visual–cognitive ability
- Psychomotor ability
- Physical ability
- Health and medication status
- Psychological factors
- Driving knowledge
- Driving history

- Illuminance sensor
- Infrared illumination
- Passive alcohol sensor
- Incident push button
  - Audio (only on incident push button)

**Vehicle network data**
- Accelerator
- Brake pedal activation
- ABS
- Gear position
- Steering wheel angle
- Speed
- Horn
- Seat Belt Information
- Airbag deployment
- Turn signals
- Many more variables...
FL Trips (out of the 5.4M, 4/6 sites)
IN Trips (out of the 5.4M, 5/6 sites)
Why SHRP 2 NDS/RID?

• Driver behavior is contributing factor in more than 90% of crashes
• Complex and the thing we know the least about due to lack of observational data
• Crash reports/ self reporting – current data source
• Now with NDS—crash, pre-crash, near-crash, and “normal” driving data – exposure data for risk analysis
• RID provides context – key component to understanding
Why SHRP 2 NDS/RID?

- What do drivers really do? Speeding, tailgating, cell phone, alcohol...
- What were they doing just before they crashed?
- Now we can see fraction of second by second what happened
- How did they avoid a crash?
- How do the roadway, vehicle, and environment impact driving?
Lots, Lots, Lots of Data. 
Lots of Analysis. 
Research for Years.
Stop 2:
Small groups of 3-5.
One action you can take to improve safety on your roads. Be prepared to share one as a group.
Story Time
Yet another infamous point in history:

Henry H. Bliss
HISTORIC SITE

Here at West 74th Street and Central Park West, Henry H. Bliss dismounted from a streetcar and was struck and knocked unconscious by an automobile on the evening of September 13, 1899. When Mr. Bliss, a New York real estate man, died the next morning from his injuries, he became the first recorded motor vehicle fatality in the Western Hemisphere. This sign was erected to remember Mr. Bliss on the centennial of his untimely death and to promote safety on our streets and highways.

City of New York
Parks & Recreation

Rudolph W. Giuliani, Mayor
Henry J. Stern, Commissioner

September 1999
“... promote safety on our streets and highways.”

September, 1999

on Centennial of first traffic fatality in USA
Additional Safety Data Of Interest (at least to Me)
**Roads**
- Roads resurfacing and rehabilitation ($7,830 million) - 20%
- Roads reconstruction (increased capacity) ($4,710 million) - 12%
- Roads reconstruction (no added capacity) ($4,020 million) - 10%
- Roads (new construction) ($1,780 million) - 5%

**Safety, enhancements and other improvements**
- Safety improvements ($2,580 million) - 7%
- Sidewalks and bicycle trails ($520 million) - 7%
- Other enhancements ($330 million) - 1%

**Bridges**
- Bridge improvements ($660 million) - Less than 2%
- Bridge rehabilitation and replacement (increased capacity) ($1,440 million) - 10%
- Bridge rehabilitation and replacement (no added capacity) ($3,950 million) - 4%

**Other**
- Other ($2,660 million) - 17%

**Project development activities**
- ($7,760 million) - 20%

Source: GAO analysis of Federal Highway Administration data. | GAO-15-33
War is hell.

-William Tecumseh Sherman
Americans Killed in Combat vs. Motor Vehicle Accidents*

The Impact of Funding on Road Safety

The Example of Highway-Railroad Crossings
# Vehicle-Railroad Crossing Crash Data (Indiana)

<table>
<thead>
<tr>
<th>Category</th>
<th>1975-79 Avg</th>
<th>2003-07 Avg</th>
<th>Reduced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crashes</td>
<td>776</td>
<td>155</td>
<td>80.05%</td>
</tr>
<tr>
<td>Injuries</td>
<td>259</td>
<td>35</td>
<td>86.65%</td>
</tr>
<tr>
<td>Deaths</td>
<td>67</td>
<td>20</td>
<td>70.33%</td>
</tr>
</tbody>
</table>
Battle of the Sexes
Battle of the Sexes
Battle of the Genders
Battle of the Genders

Traffic Fatality Rate (per cent)

- Male: 66.8
- Female: 33.1
Battle of the Genders

**Ped Fatality Rate**

- Male: 2.0
- Female: 0.5

**Ped Injury Rate**

- Male: 25.0
- Female: 15.5
Data Can Be Confusing: Focus on the Understandable
Actions to Take

• Know Your Numbers (ARIES)
• Know Your Crashes
  – locations
  – severities
  – types

Hire a Digital Native Hackathon?
Actions to Take

• Know Your Numbers (ARIES)

• Know Your Crashes
  – locations
  – severities
  – types

• Select Locations or Systemics

• Conduct RSAs

• Program and Implement Projects
Stories

• In our ears, hear – “...there was a crash.”

• Our mindset should be... “this must never happen again.”

• Our job is to “... promote safety on our streets and highways.”
Let me explain. No, there is too much. Let me sum up...

• “Highway Safety is a good thing.”
• Stories inform and motivate.
• Data is becoming more plentiful. Use it. Use it wisely.
• Take Action on What We Can Influence.
Please let me know of safety countermeasures in your area
Cause Safety