Virginia Tech
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Safety on City Streets

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Project Overview

- The purpose of this project is to provide a greater understanding of the scale, type, and location of crashes on city streets
  - Determined through an analysis of the Second Strategic Highway Research Program (SHRP 2) database and Google's Self-Driving Car Project
  - Supplemented with publicly available crash data obtained from government agencies

Research Questions

1. How would crash rates be affected by adjusting for unreported rates?
2. What is the current level of comparison between general crash rates and self-driving car rates?
3. What is the difference in crash rates on different types of streets broken down by speed zone categories?
4. What are the most common unreported types of crashes?
5. What were contributing factors of unreported crashes?

SHRP 2 Characteristics of Self-Driving Car Events

- SHRP2 Crash Severity Definitions
  - Level 1: Most Severe
  - Level 2: Police Reportable
  - Level 3: Minor Crash (considered not police-reportable)

SHRP 2 Characteristics of Self-Driving Car Events

- VTTI reviewed and reduced crashes for Google's Self-Driving Car Project
  - Used the SHRP2 data dictionary to evaluate each crash
  - Crash severity determined
  - Crashes considered for this study were those in automated mode

Crash Severity Levels for SHRP2, Self-Driving Vehicles

- SHRP2 had about 34.0 million miles of driving recorded.
- Self-driving vehicles had about 1.3 million.

Crash Severity	SHRP 2 Overall	SHRP 2 Known Police-Reported	Self-Driving Car in Automated Mode
Level 1	120	34	2
Level 2	179	12	2
Level 3	633	0	7

Research Question 1

How would crash rates be affected by adjusting for unreported rates?

Reported Crash Rates

- Reported crash numbers were compiled from state & federal agencies
  - Fatal, Injury, Property Damage Only (PDO)
- Rate of reported crashes computed per 1 million miles traveled
  - Santa Clara County, CA
  - Los Angeles County, CA
  - King County, WA
  - National Average

Unreported Crash Estimates

- Low Estimate (NHTSA 2015a, Telephone Survey)
  - 15% Unreported rate for injury crashes
  - 35% Unreported rate for PDO crashes
  - Likely an underestimate

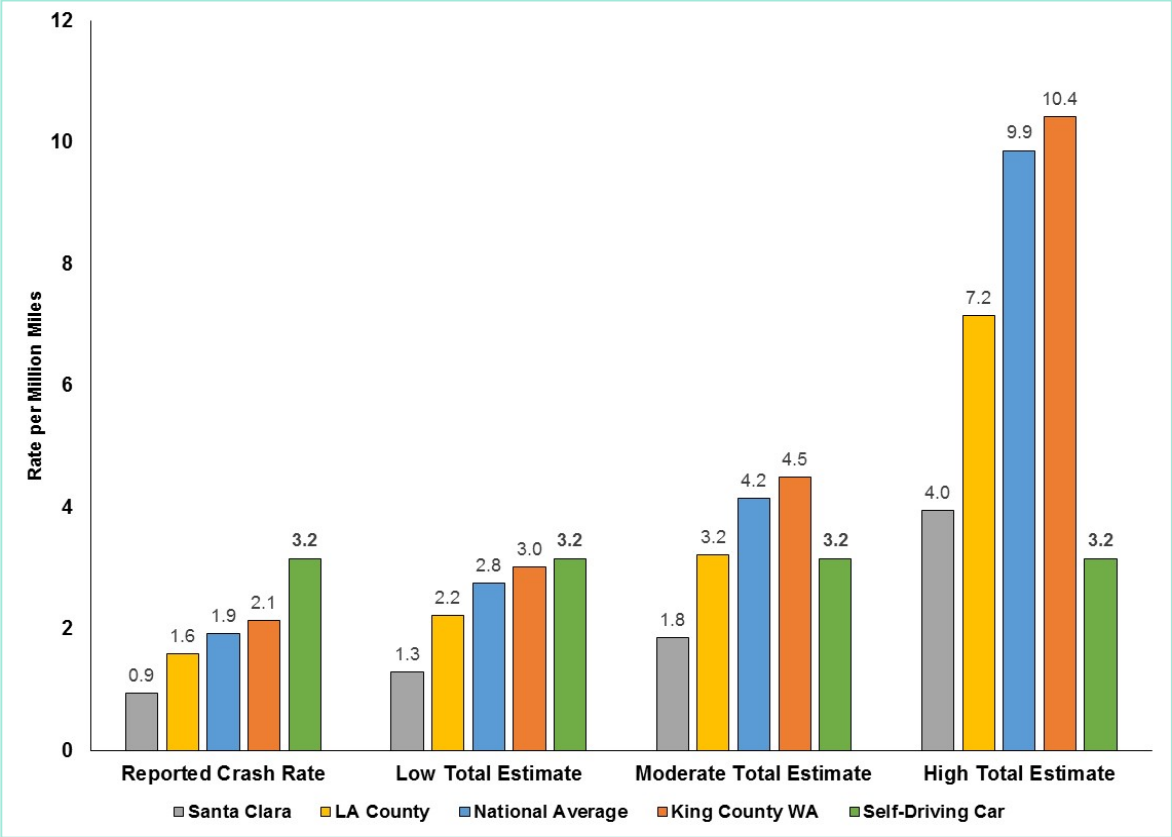
Unreported Crash Estimates

- Moderate (NHTSA 2015b, Economic Impact)
  - 25% Unreported rate for injury crashes
  - 60% Unreported rate for PDO crashes
  - Most often cited rates

Unreported Crash Estimates

- High (SHRP 2 known reported rates)
  - 72% Unreported rate for injury crashes (NHTSA 2015b)
  - 93% Unreported rate for PDO crashes (Ratio of known reported to reportable in SHRP2)
  - Likely an overestimate

Reported and Unreported Variations by Locality



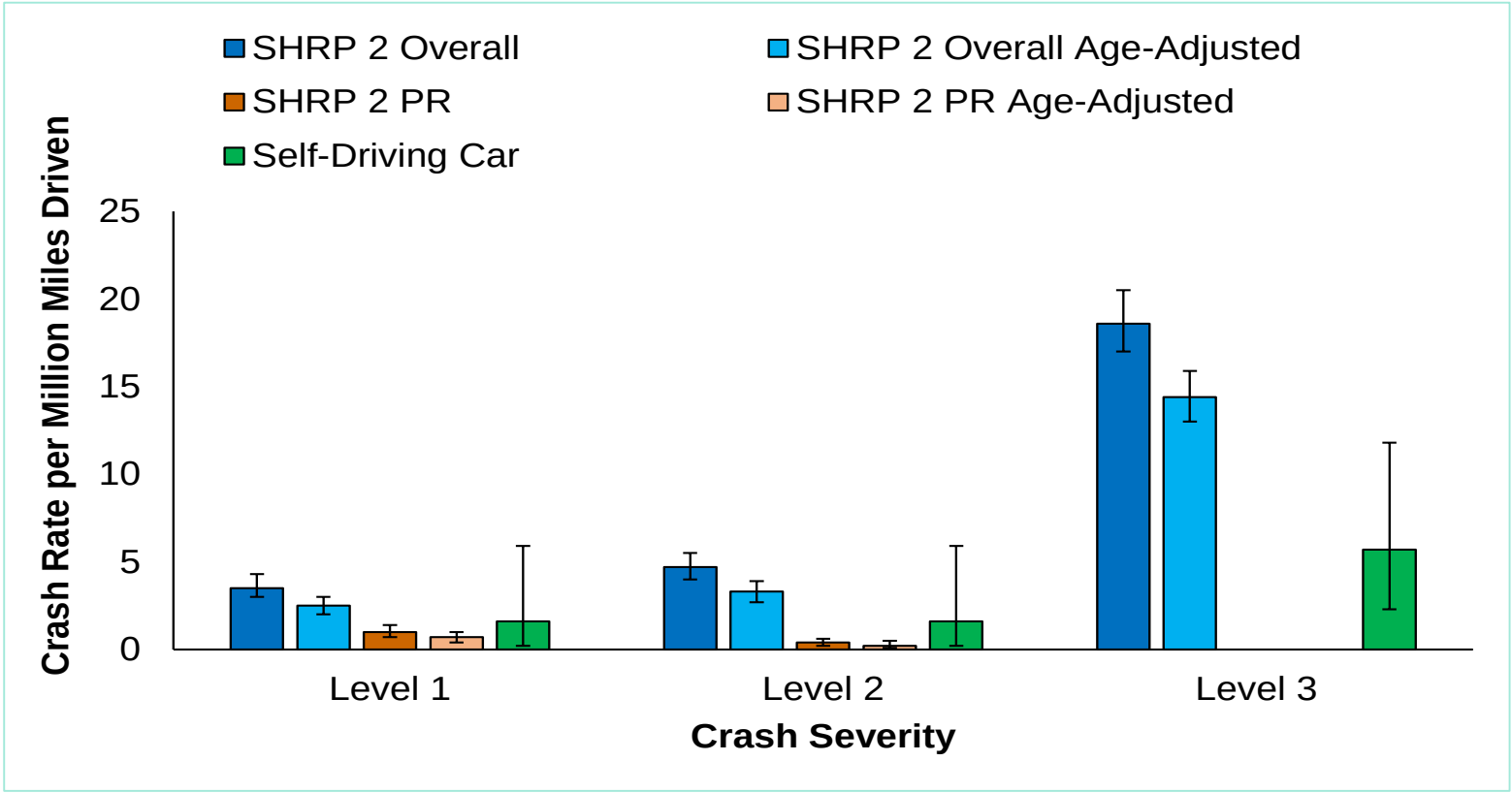
Research Question 2

What is the current level of comparison between general crash rates and self-driving car rates?

Research Question 2

- Confidence intervals are calculated for SHRP 2 and Self-Driving Car crash rates levels 1-3
  - SHRP 2 confidence intervals are calculated using the bias corrected/accelerated bootstrap method, while self-driving was calculated using the exact Poisson confidence interval
  - SHRP 2 rates are adjusted for bias in the age distribution
  - Non-overlapping confidence intervals were considered to be significantly different

Crash Rates by Severity Levels

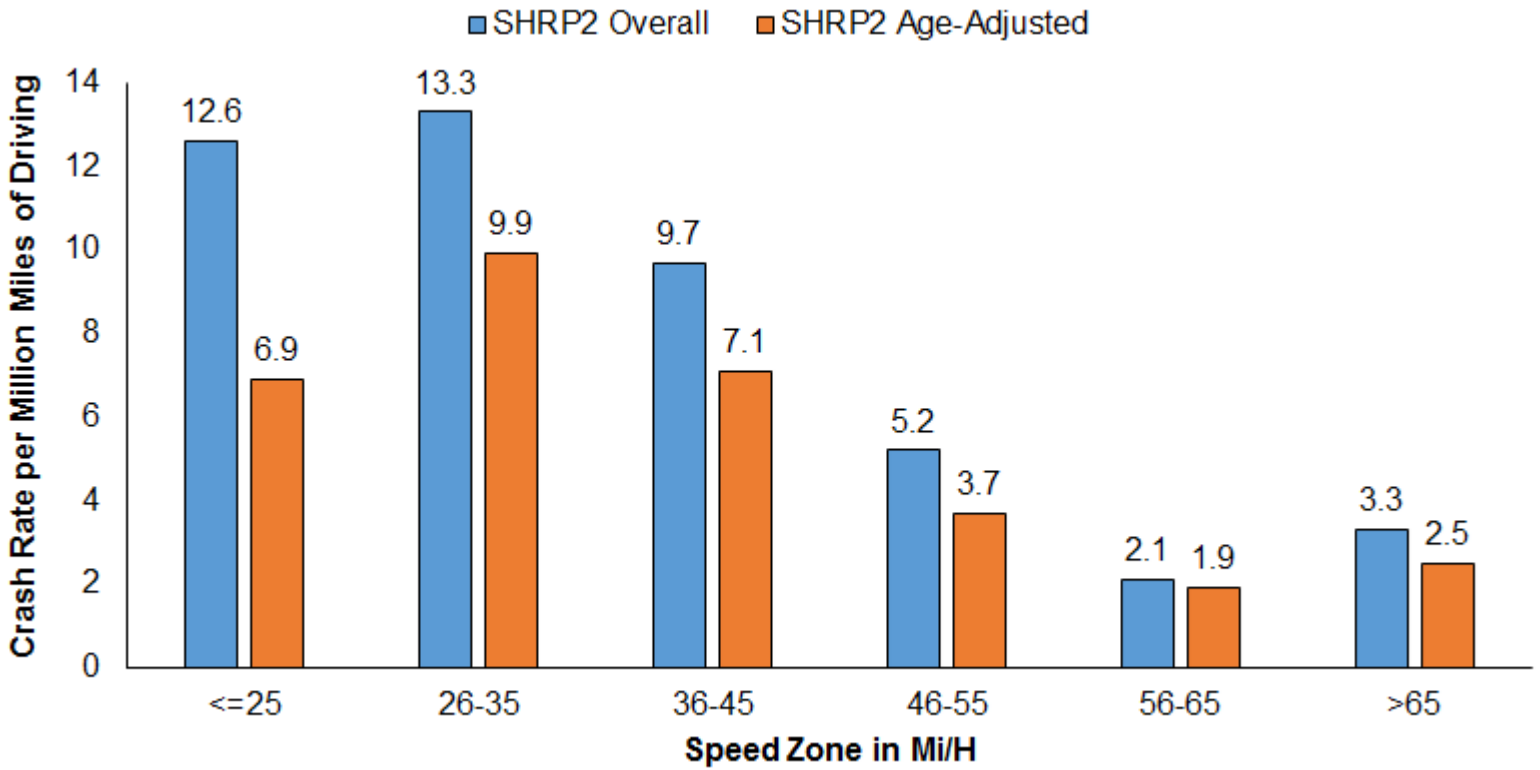


Research Question 3

What is the difference in crash rates on different types of streets broken down by speed zone categories and localities?

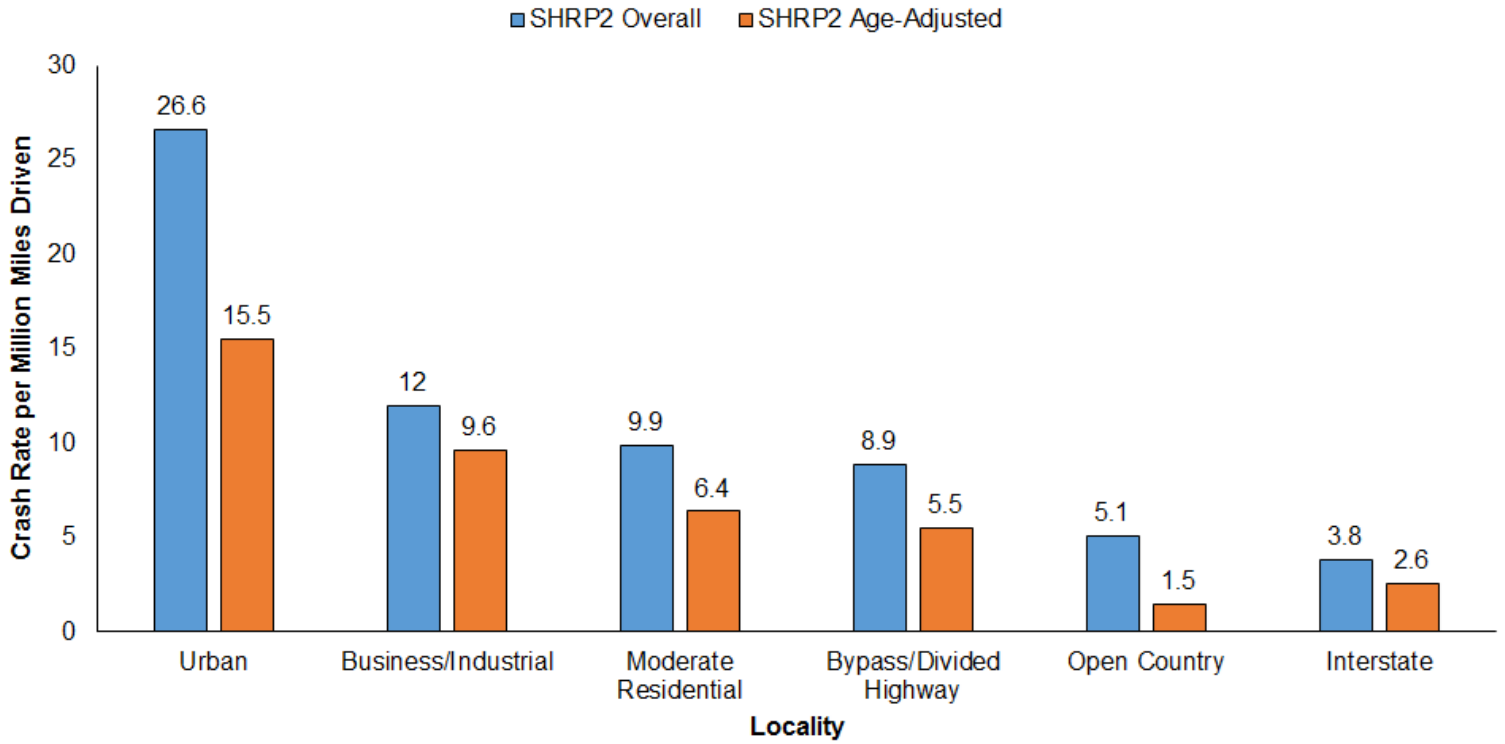
Police-Reportable Crash Rates Per Million Miles

Different Speed Zones



Police-Reportable Crash Rates Per Million Miles

Different Localities



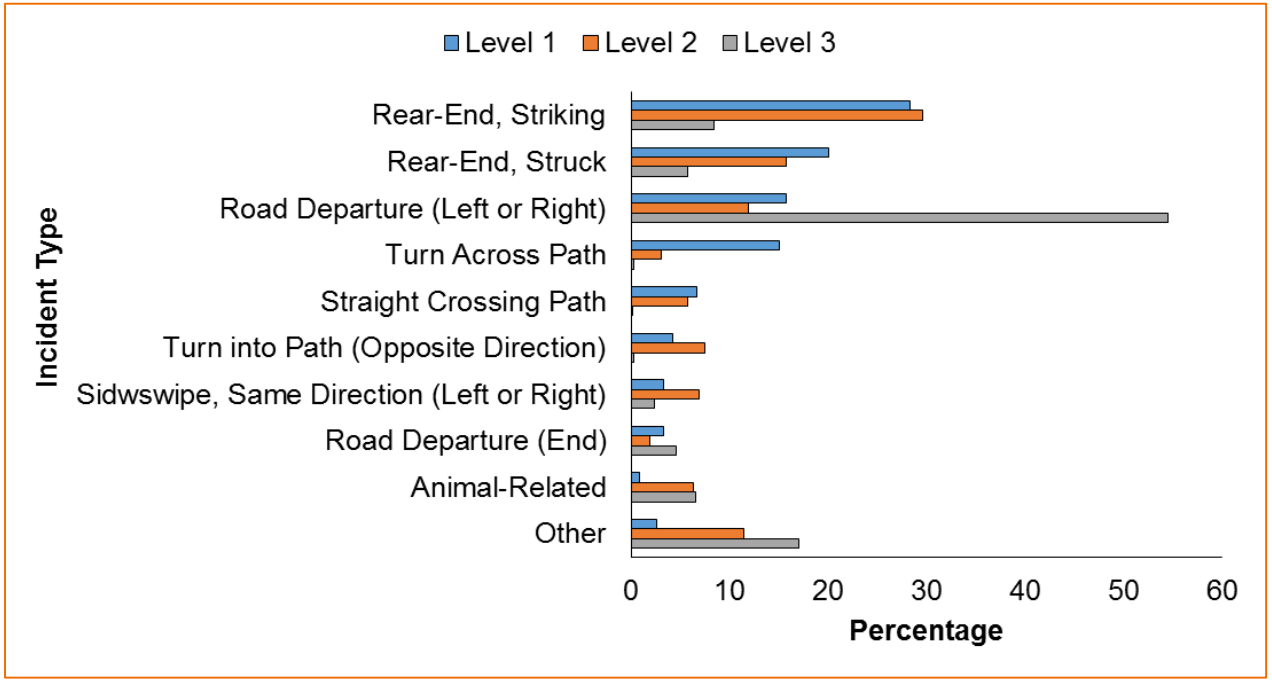
Research Question 4

What are the most common unreported types of crashes on city streets?

SHRP2 crashes with no known police report were examined for this question

No-PAR Crash Type - Manner of Collision

Incident Type



Research Question 5

What were contributing factors of unreported crashes?

Contributing Factors

No Known PAR (includes SHRP 2 Levels 1 and 2)

Most (about 52 percent) involved a rear-ending, either by the subject driver or the following vehicle

In many cases (about 32 percent), the subject driver was distracted

In many cases (about 33 percent), the subject driver's maneuvering was either unsafe or illegal

SHRP 2 Level 3 - Not Reportable

Most (about 60 percent) were road departures

In many cases (about 38 percent), the subject driver was distracted

In many cases (about 33 percent), the subject driver's maneuvering was either unsafe or illegal

Key Takeaways

At least 25% of Injury Crashes and 60% of Property Damage crashes likely go unreported (SHRP2 known reported rates are higher)

A majority of the Self-Driving Car crashes are not reportable under SHRP2 definitions

Reportable Self-Driving Car crash rates are not different than the estimated Total Rates of crashes for the national average

The rates for minor Self-Driving Car crashes are significantly lower than the observed minor crash rates in the SHRP2 data set

Most High Severity Crashes in SHRP2 occur in urban areas and low speed zones

Most No-PAR Crashes in SHRP2 were rear end (severe) or road departure (minor)

Distraction and Unsafe/Illegal maneuvers are contributing factors to No-PAR crashes

Thank you!

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Data Sources

- Federal Sources:
  - Telephone Survey of Unreported Crashes (NHTSA, 2015a: http://www-nrd.nhtsa.dot.gov/Pubs/812183.pdf)
  - The Economic and Societal Impact of Motor Vehicle Crashes, 2010 (Revised) (NHTSA, 2015b: http://www-nrd.nhtsa.dot.gov/pubs/812013.pdf)
  - Traffic Safety Facts 2013 (NHTSA, 2015c: http://www-nrd.nhtsa.dot.gov/Pubs/812139.pdf)

Data Sources

- State Sources
  - California Statewide Integrated Traffic Records System (http://iswitrs.chp.ca.gov/)
  - 2013 California Public Road Data (http://www.dot.ca.gov/hq/tsip/hpms/hpmslibrary/prd/2013prd/2013PublicRoadData.pdf)
  - Washington State Annual Collision Summary 2009-2013 (http://www.wsdot.wa.gov/mapsdata/collision/collisionannual.htm)

Data Sources

- Self-Driving Car Project Data
- VTTI Sources
  - Strategic Highway Research Program 2 (SHRP 2)

SHRP2 Age Comparison with National Population