

# Rear-end Crash Analysis Using SHRP2 Naturalistic Driving Database: Comparing Teen and Adult Crash Frequency and TTC

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## Problem

Motor vehicle crashes are the leading cause of death for teens. Previous teen and adult crash rates have been based upon fatal crashes, police reported crashes, and estimated miles driven. The Strategic Highway Research Program 2 (SHRP2) driving database contains extensive real world data on teen and adult driving and offers the opportunity to compute accurate crash rates and study braking behavior using a reliable methodology to capture crashes and driving exposure.

## Research Questions

- Do Teens and Adults React Differently in Emergency Situations?
- Do Teens Experience Elevated Crash and Near Crash Rates?
- Why?

## Method

- A subset of the SHRP2 dataset was obtained via a data sharing agreement with VTTI

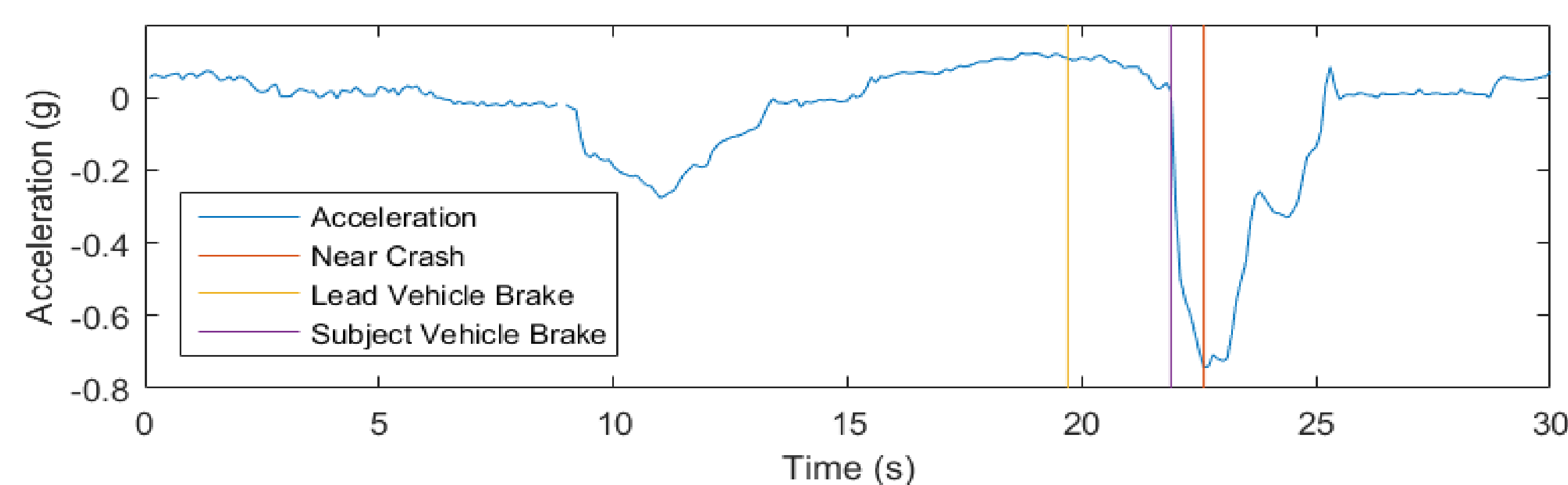
## Data

- 3420 Drivers were studied in SHRP2
- 1140 Drivers in teen and adult control group
- Subset contains 1487 crash and near crash events with scene videos, event narratives, and time series data collected at 10 Hz

	SHRP2 Subset	Trips	Miles Driven	Rear-End	Rear-End Near
Novice Teen Age: 16 - 19	549	764,845	2,895,783	39	42
Experienced Adult Age: 35 - 54	591	892,950	2,829,248	5	9

## Analysis

- Variables of Interest:
  - Event Timestamp, Crash Avoidance Braking Timestamp, Headway Distance at Braking, Relative Velocity at Braking, Time to Collision (TTC) at Braking
- Crash Avoidance Braking Timestamp was found using pattern recognition algorithm on acceleration time series data (Indicated by the [Purple Line](#) in below plot)



- By observing the conditions in the moments leading up to an event, a driver's response to an impending emergency situation can be analyzed and the causes of the situation can be identified.

## Results

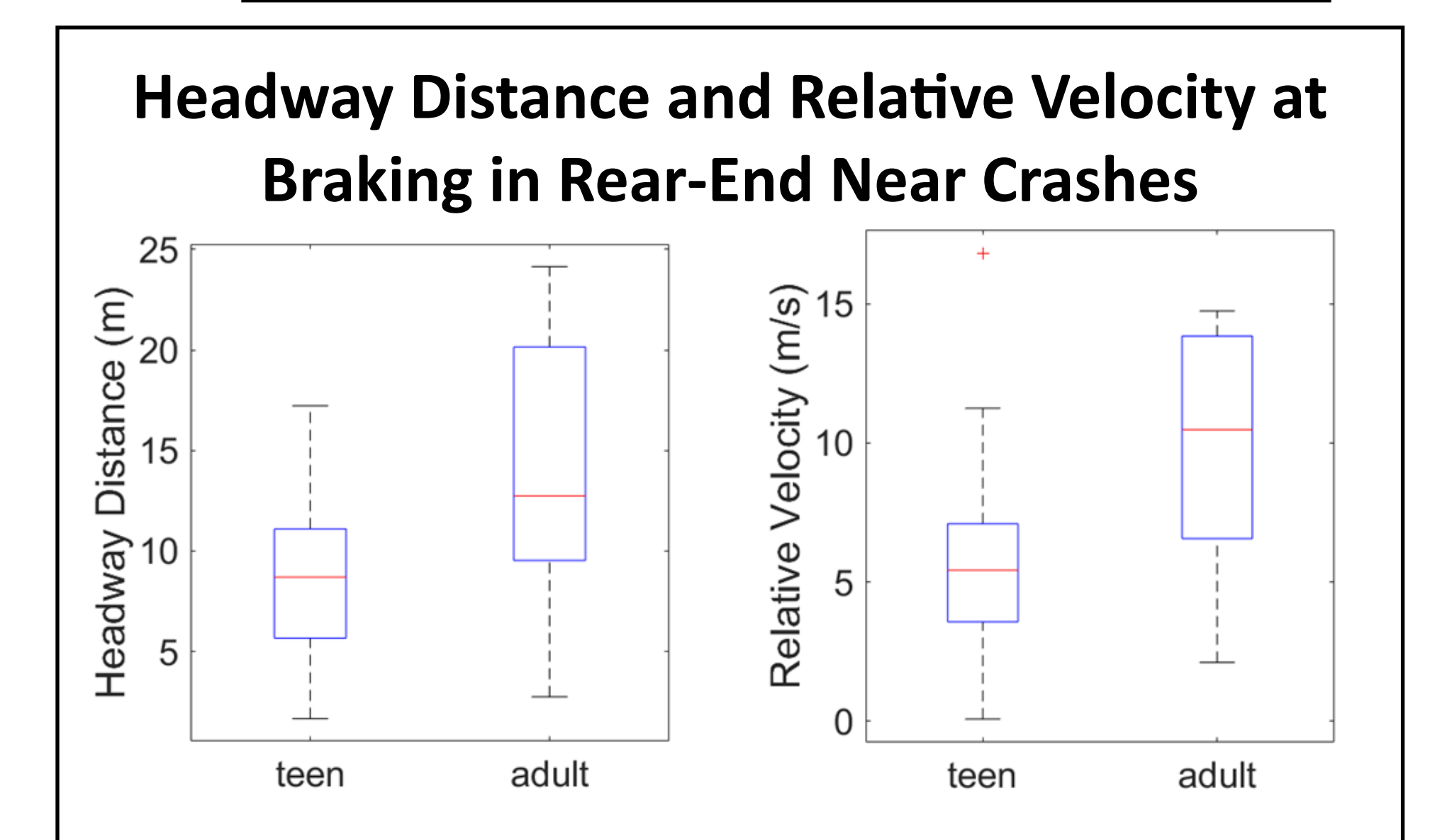
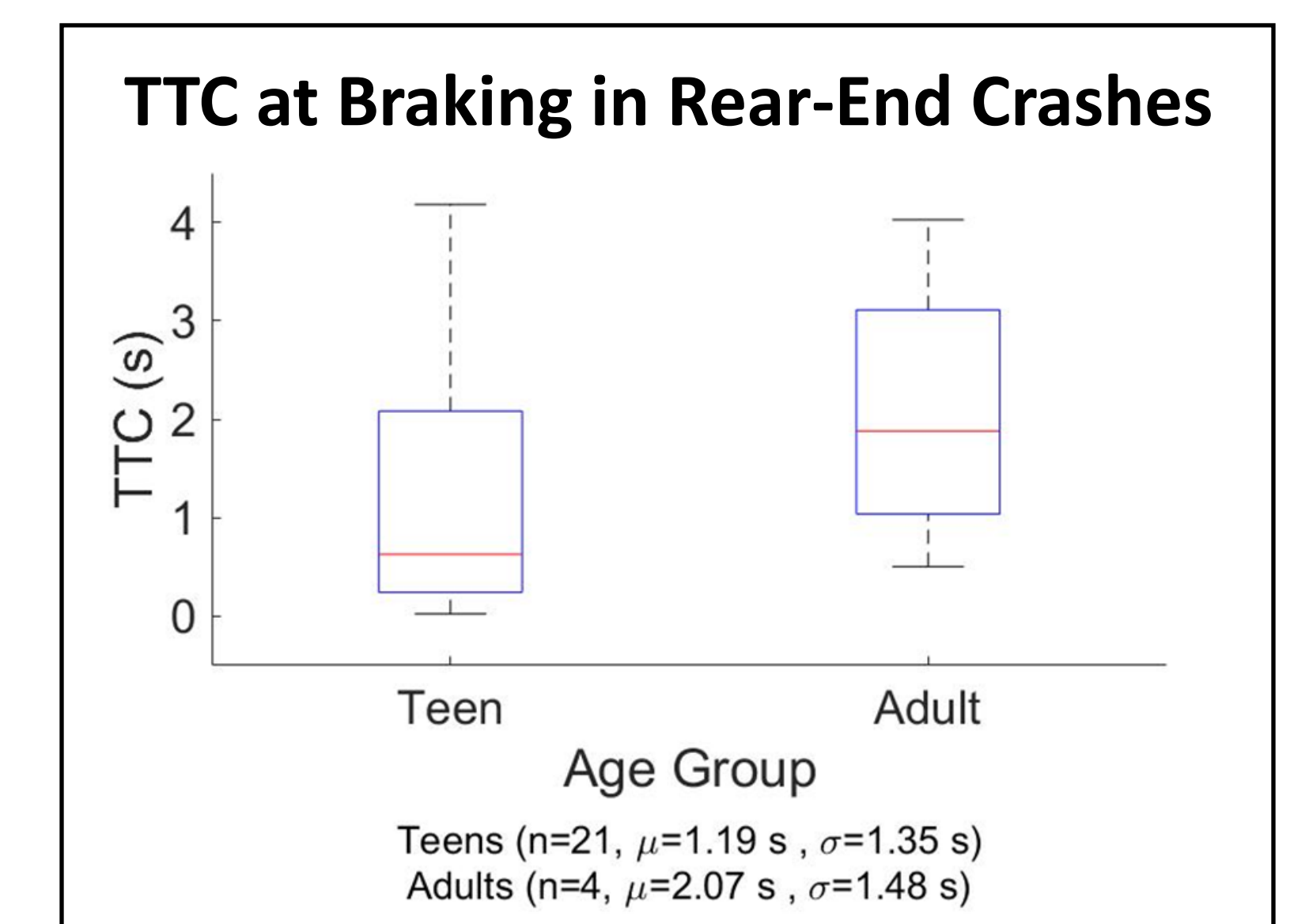
### Crash and Near Crash Rates

	Rear-End Crashes	Rear-End Near Crashes	Miles Driven	Crash Rate (per million miles)	Near Crash Rate (per million miles)
Novice Teen Age: 16 - 19	39	42	2,895,783	13.5	14.5
Experienced Adult Age: 35 - 54	5	9	2,829,248	1.8	3.2

- **Crash Rate Ratio (teen/adult) : 7.5**
- **Near Crash Rate Ratio (teen/adult) : 4.53**
- **Novice teens exhibited significantly more rear-end crashes** ( $p < 0.01$ ) **and rear-end near crashes** ( $p < 0.05$ ) than experienced adult drivers.

### Time to Collision at Braking

- **TTC=Headway Distance/Relative Velocity**
- Only events with valid radar data can be analyzed.
- **Novice teens exhibited significantly lower TTC at braking** ( $p < 0.05$ ) in crash scenarios than experienced adult drivers.
- **Median TTC: Teen = 0.63 seconds**  
**Adult = 1.88 seconds**
- No Significant difference in TTC at braking was observed in near crash scenarios
- **Novice teens Exhibited significantly lower headway distance at braking** ( $p < 0.05$ ) than experienced adult drivers in near crash scenarios.



- **Headway Distance: Teen = 9.03 ± 3.93 meters**  
**Adult = 13.7 ± 7.62 meters**

## Discussion

- The lower TTC and headway distance exhibited by novice teens at braking could account for the dramatically increased frequency of rear-end crashes and near crashes.

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