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NEAR CRASH CHARACTERISTICS AMONG RISKY DRIVERS USING THE SHPR2 NATURALISTIC DRIVING STUDY

Thomas Seacrist, Ethan Douglas, Aditya Belwadi, Helen Loeb

Center for Injury Research and Prevention

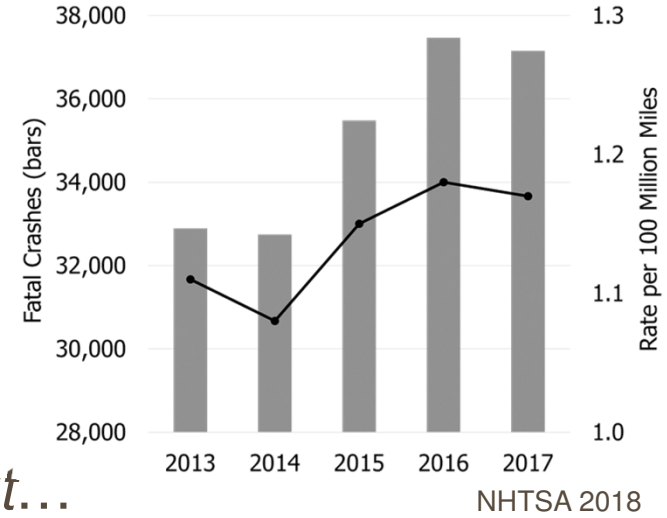
The Children's Hospital of Philadelphia

Children's Hospital of Philadelphia RESEARCH INSTITUTE

THE OHIO STATE UNIVERSITY WEXNER MEDICAL CENTER

BACKGROUND

- Despite advances in passive & active safety, motor vehicle fatalities continue to be a major problem
  - More than **37,000** MV fatalities in 2017 (NHTSA 2018)
- *Risky drivers* disproportionately represented in MVCs
  - MV Fatalities in 2016 (IIHS 2016)
    - **2,413** teen deaths
    - **4,379** young adult deaths
    - **4,792** older driver deaths
  - Teen crash rate **10x** greater than experienced drivers (Seacrist et al. 2016, 2018)
    - Helps illustrate scope of problem, *but*…



RELEVANCE OF NEAR CRASHES

…*crashes* do not tell the whole story.

- Study of **near crashes** is needed to fully understand scope of *risky driver* errors
  - At-fault near crashes involve preventable error
  - May differ in *type*, *contributing factors*, or *crash avoidance mechanisms*
- Near crashes not reported in archival data
  - Naturalistic driving studies are a reliable method to study near crashes

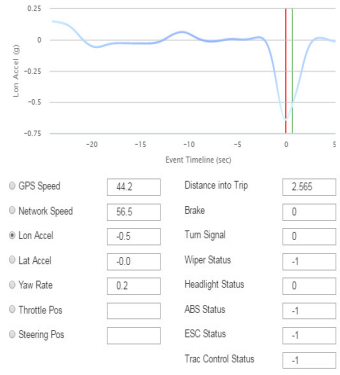
PREVIOUS NATURALISTIC STUDIES

- 100-Car Study (Dingus et al. 2006)
  - Driving behavior of 18+ yrs for one year
  - Increased near crashes among Younger vs. Older drivers
- Simons-Morton et al. (2011)
  - 42 teens/parents for first 18 months of licensure
  - Significantly more near crashes among teens vs. parents
- Guo et. al (2010)
  - Used 100-Car Study to compare crashes to near crashes
  - Increased # of factors for rear-end crashes vs. near crashes
- Studies provide useful information, however…
  - *Larger* study needed for generalization
  - Inclusive of *young* teen drivers (16-17 yrs)

STRATEGIC HIGHWAY SAFETY PROGRAM 2 (SHRP2) NATURALISTIC DRIVING STUDY

ADVANTAGES OF SHRP2 DATASET:

- Reliably capture crashes and driving exposure
  - Inclusive of *all* crashes and near crashes
  - Accurate number of miles driven
- Driver behavior
  - In-board cameras, secondary tasks
- Environment
  - Scene videos, crash type
- Vehicle Dynamics
  - Radar data, acceleration



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OBJECTIVE

- To compute near crash rates for risky drivers and experienced adult drivers using SHRP2
  - Focus on rear-end striking events
    - Most common crash scenario for young drivers (McDonald 2014)
- Compare near crashes to crashes

METHODOLOGY
DATA SOURCE

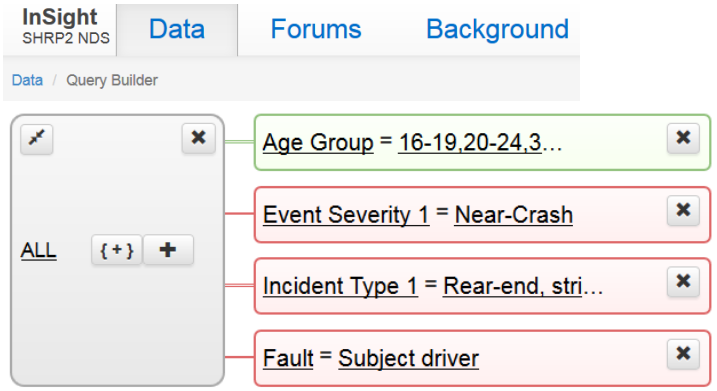
- SHRP2 InDepth: All crashes & near crashes for:

Group	Age (yrs)	# Drivers
Teens	16-19	550
Young Adults	20-24	748
Adults	35-54	591
Older Drivers	70+	672

- Scene videos
- Event narratives
- Time series data
  - Acceleration, Velocity, Radar data

SHRP2 Raw Video Data

METHODOLOGY
DATA REDUCTION/VIDEO REVIEW

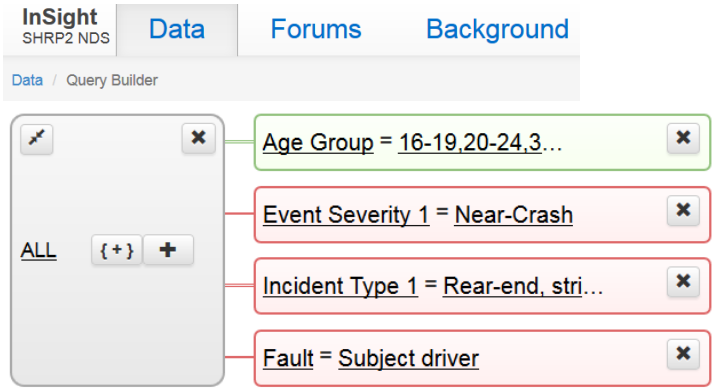


Incident Types

- Rear-End Strikes
- Road Departures
- Intersections
- Pedestrian/Cyclist
- Side-Swipe
- Head-On
- Animal
- Other

- **Near Crash** – at-fault event involving evasive maneuver to avoid a crash or departing the roadway
  - Filtered SHRP2 near crashes by incident type and fault
- Scene videos reviewed by 2 video coders
  - Discrepancies were reconciled by 3rd coder

METHODOLOGY
DATA REDUCTION/VIDEO REVIEW



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METRICS

- Near crash rates per million miles driven
  - Incident Type
  - Secondary Tasks
  - Evasive Maneuvers
  - Vehicle Dynamics

  } Compared across age

- Comparison of *crashes* & *near crashes*

RESULTS
EXEMPLAR NEAR CRASHES

Teen

Adult

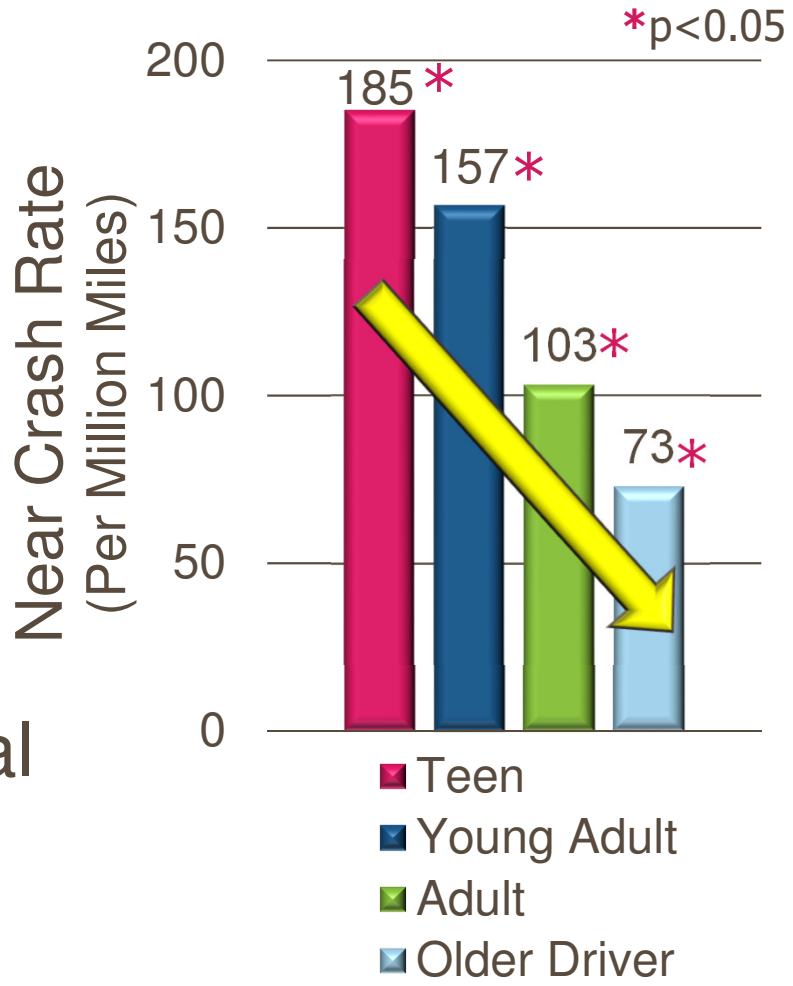
- Both events involve distracted drivers (cell phone use)

NEAR CRASH RATES & EXPOSURE

Group	Miles Driven	Near Crashes
Teens	4,205,474	779
Young Adults	7,691,129	1206
Adults	5,651,315	583
Older Drivers	4,766,699	348
Total	22,314,617	2916

- Greater near crash rate with decreasing age
- Elevated near crash risk reflective of previous archival & naturalistic crash data

(Williams et al. 2003; Dingus et al. 2006; Guo et al. 2010; Simons-Morton et al. 2011; Seacrist et al. 2016)



NEAR CRASH RATES BY INCIDENT TYPE

Group	Miles Driven	Rear-End	Road Departure	Intersection	Pedestrian/ Cyclist
Teens	4,205,474	147.4*	12.6*	11.4	2.4*
Young Adults	7,691,129	125.5*	4.9	9.5	3.5
Adults	5,651,315	72.5*	2.5	11.9	5.1
Older Drivers	4,766,699	42.8*	1.9	14.7	4.0

*p<0.05

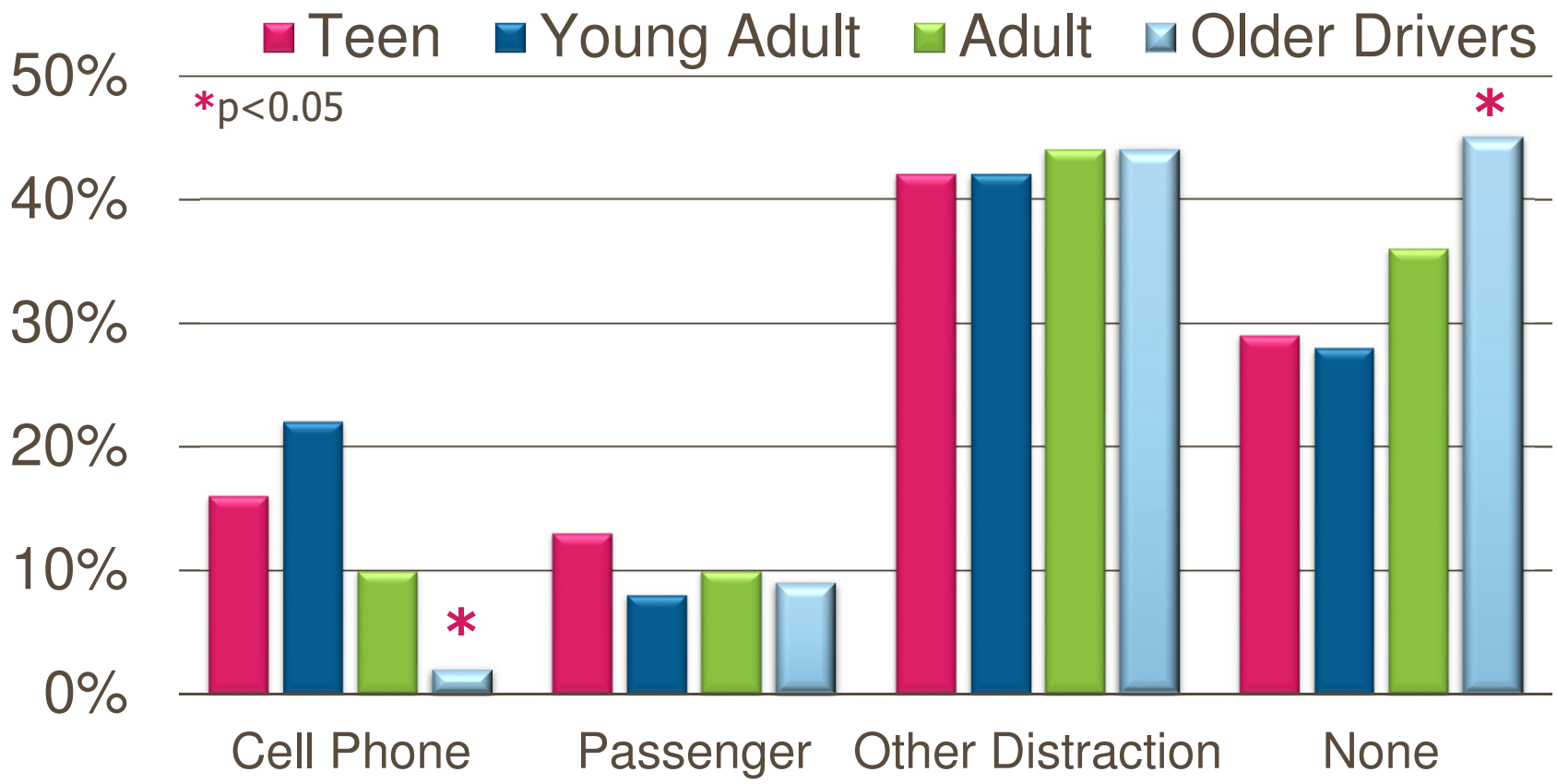
- Teens had greater Rear-End, Road Departure rates
- Intersection near crashes did not vary by group
  - Potentially a persistent problem across age
- Teens exhibited lowest pedestrian/cyclist rate
  - Possible differences in road type traveled (urban vs. rural)

PEDESTRIAN NEAR CRASHES

Teen

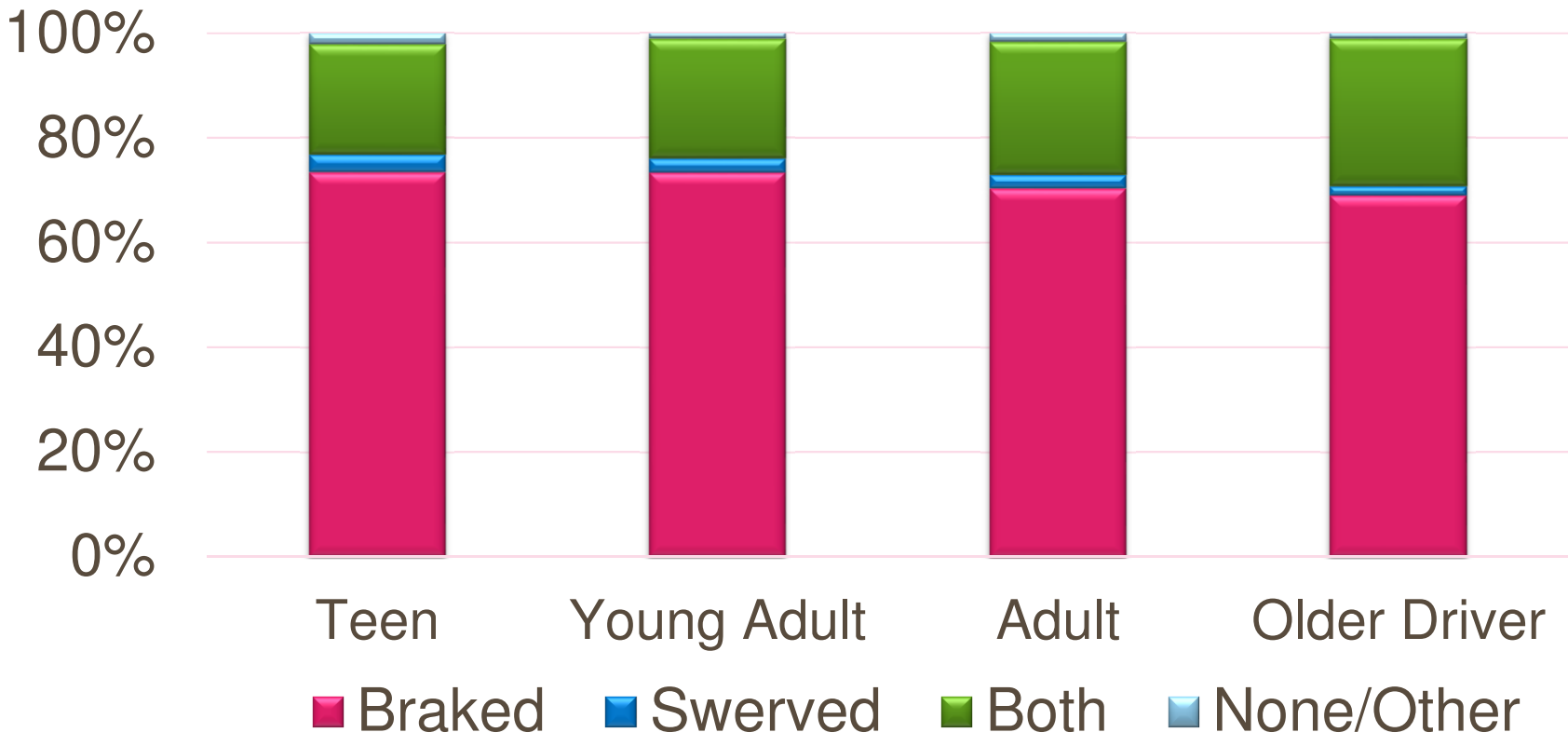
Adult

SECONDARY TASKS



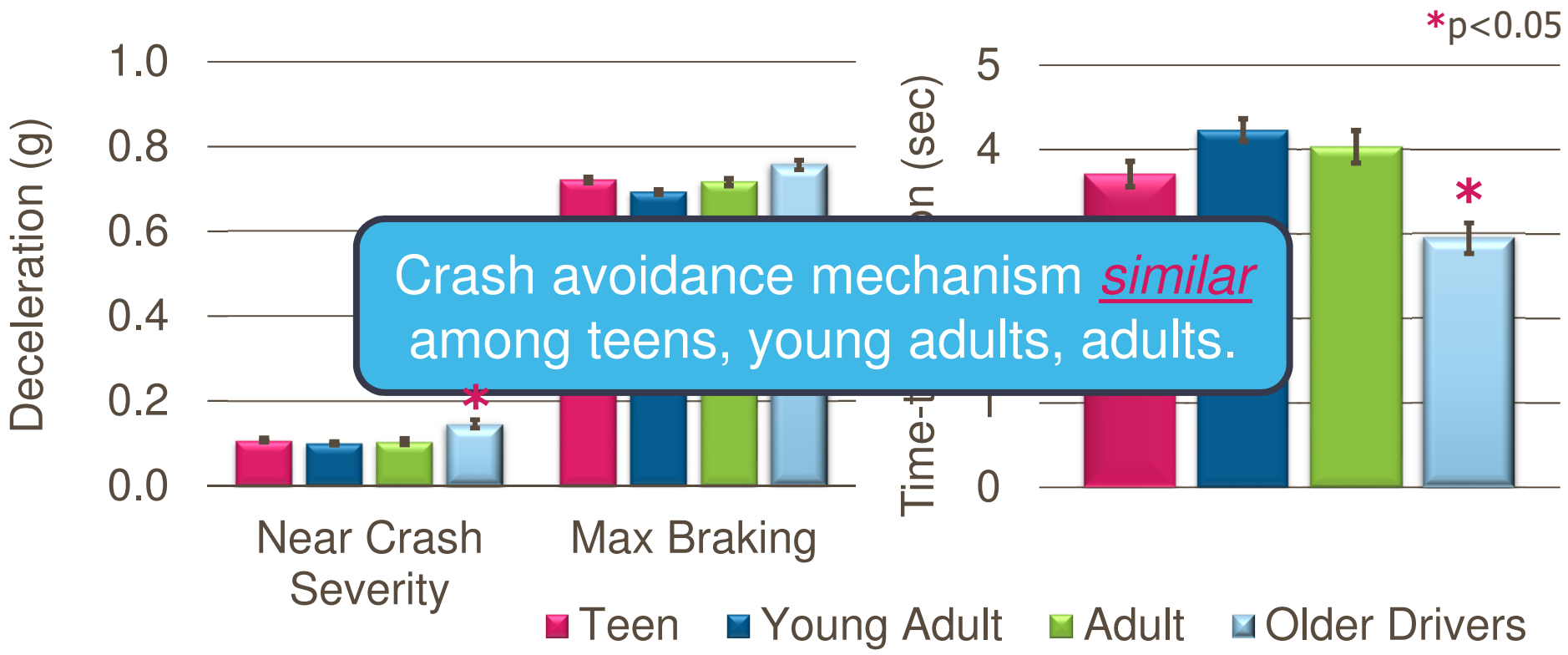
No major differences in secondary tasks between ages

NEAR CRASH EVASIVE MANEUVERS



No differences in evasive maneuver type between groups

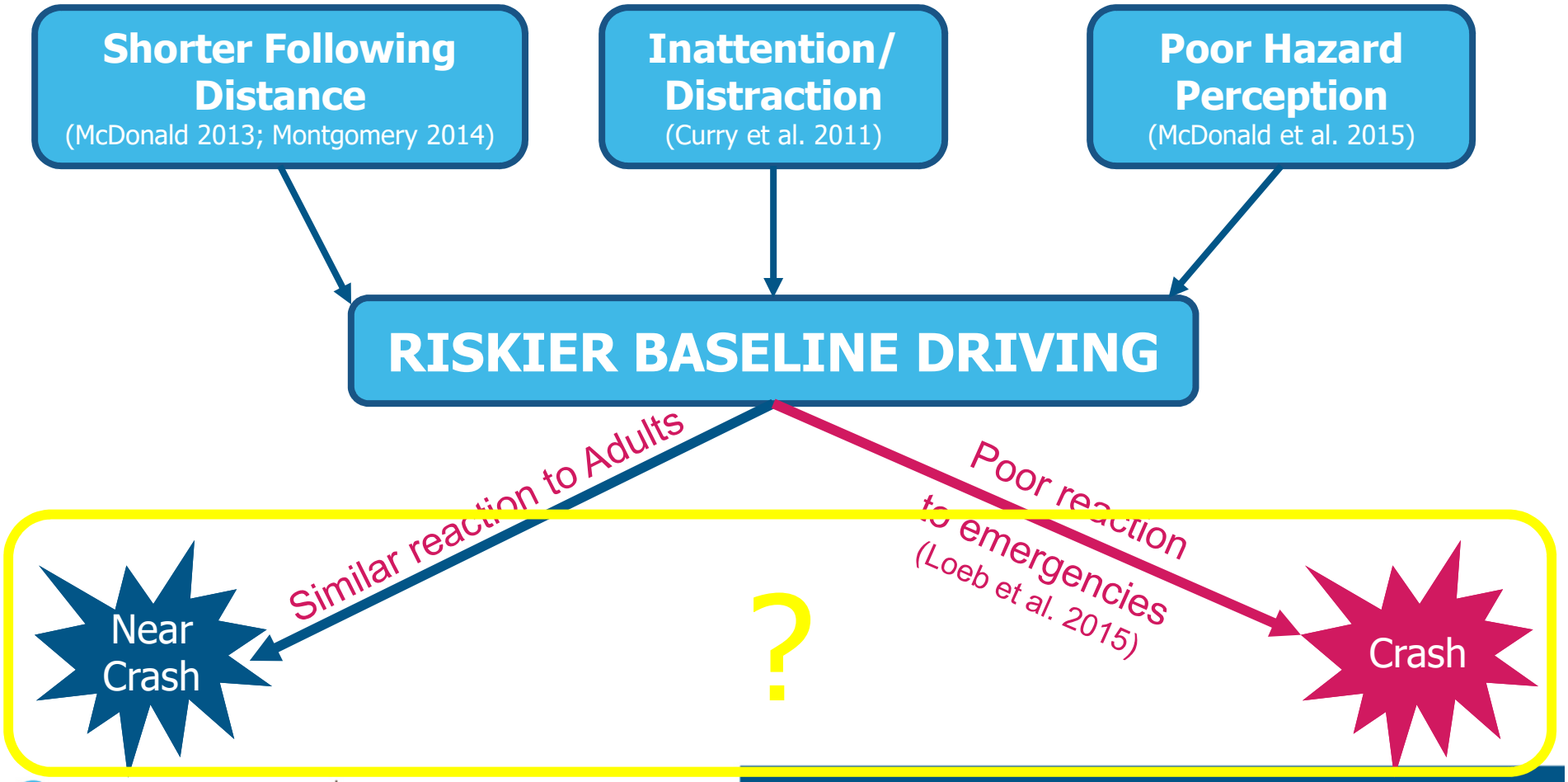
NEAR CRASH VEHICLE DYNAMICS
REAR-END STRIKING



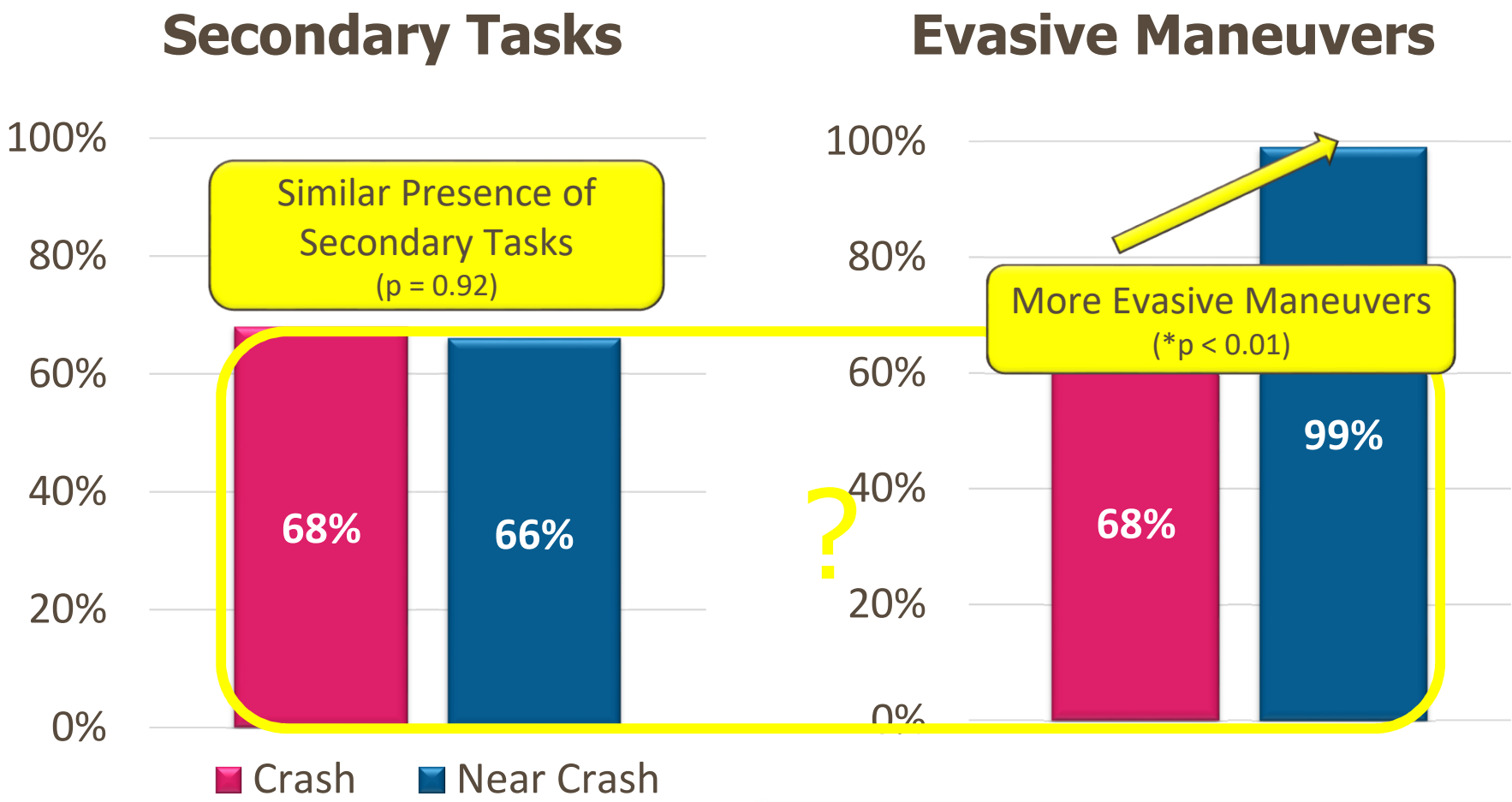
$$Near\ Crash\ Severity = \frac{\Delta V^2}{2 \cdot \Delta X}$$

*Near Crash Severity and TTC at time of braking

WHY DO YOUNG DRIVERS ENCOUNTER *MORE* CRITICAL EVENTS?



CRASHES VS. NEAR CRASHES
SECONDARY TASKS & EVASIVE MANEUVERS



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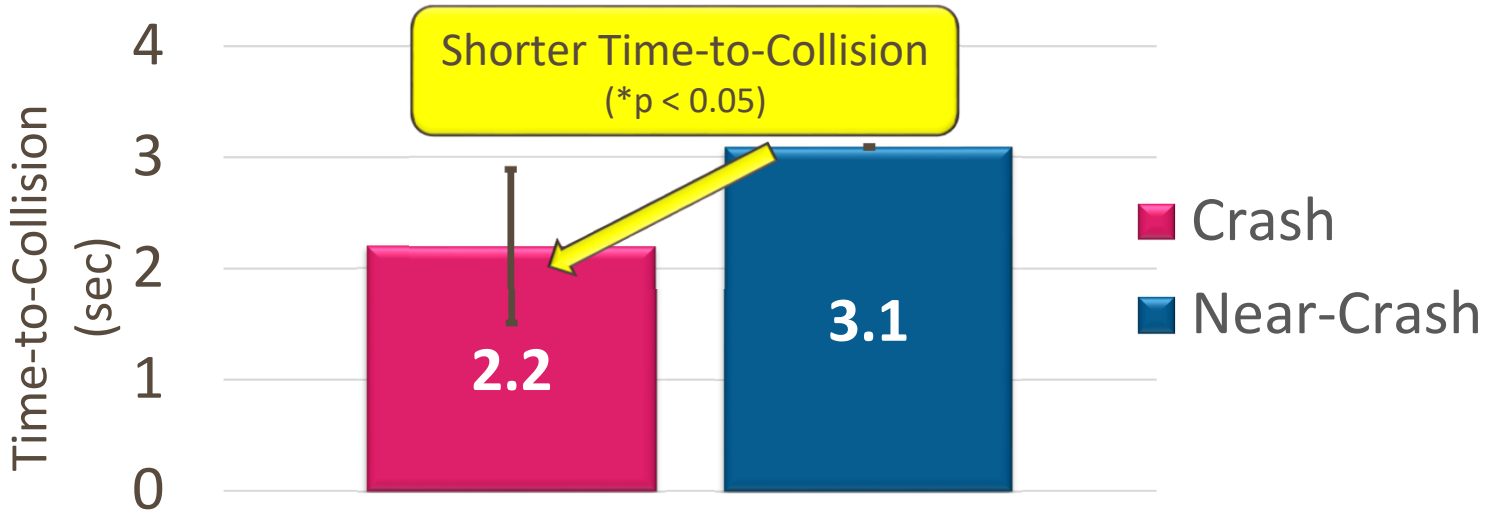
CRASHES VS. NEAR CRASHES
TIME-TO-COLLISION AT BRAKING



- Drivers respond later during rear-end crashes
- Other potential factors
  - Environmental (weather, time of day, road type)
  - Driver (sociodemographic, behavioral, experience)

LIMITATIONS & FUTURE WORK

- Vehicle Dynamics analysis focused on rear-ends
- Radar data available for ~55% of rear-end near crashes
  - Subset may not be representative of all events
- Included *at-fault* events only
- Did not account for driver, environment variables
  - In-depth analysis an area of future work

CONCLUSIONS

- Provides comparison of near crashes among risky drivers using large naturalistic dataset
  - Frequency, type, tasks, evasive maneuvers
  - Comparison to crashes

1) Tailor driver training to target common errors
2) Inform driver-specific ADAS

Teen – emphasize rear-end, road departure
Adult – pedestrian zone interventions
All Groups – intersection persistent problem

ACKNOWLEDGEMENTS

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HONDA The Power of Dreams

LEAR CORPORATION

GM

NHTSA

TRC

GRACO

HUMANETICS Innovative Solutions

TOYOTA

CR Consumer Reports

mifold The grab-and-go booster seat

MHS

FEDERAL AVIATION ADMINISTRATION

Calspan

FCA FIAT CHRYSLER AUTOMOBILES

- VTTI Staff for assistance with SHRP2 data/DUL

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