

Human Factors Considerations: Unintended Acceleration & Pedal Errors



Richard P. Compton

Director Office of Behavioral Safety
Research

Overview

- ▶ Human factors are a contributing factor in more than 90 percent of all crashes
- ▶ Human error plays a role in some UA incidents
- ▶ Likely causes of UA-related human error
- ▶ Current NHTSA study on pedal errors (began in 2008)

NC Study of Pedal Errors

Pedal Error is a known contributor to crashes, e.g.:

- ▶ A study of 219 crashes in North Carolina's crash database in which the driver's foot contacted the accelerator rather than the brake
 - Most misapplications
 - Occurred during driving cycle – not at startup
 - Were not hurried
 - About half resulted from the driver's foot slipping from the brake to the accelerator (Schmidt, Young, Ayres & Wong, 1997)

How Common is Pedal Misapplication?

Not known precisely, but consider:

- ▶ Over 200 million licensed drivers
- ▶ One trip a day = 200 million trips
- ▶ Assume 50 brake applications per trip

Result: **10 billion** opportunities a day for error to result in misapplication

NTSB Investigations of UA Crashes

NTSB has investigated a number of unintended acceleration crashes

- ▶ Reports include details about driving experience; medical, vehicle, and environmental factors
 - Between 1997 and 2008, NTSB investigated 7 unintended acceleration crashes
 - 1 passenger car
 - 5 buses
 - 1 fire truck
 - In each instance, investigators determined that the crashes resulted from the driver's pedal error

Recent Reports on Pedal Errors

- ▶ *In my car the brake is on the right: Pedal errors among older drivers* (Freund, Colgrove, Petrakos & McLeod, 2007)
 - Study to assess extent specific cognitive functions contribute to pedal errors among older driver
 - 180 subjects drove a driving simulator
 - Suggests executive dysfunction contributes to pedal errors in older drivers.

Apparent Overrepresentation in Pedal Error Crashes

Based on available literature:

- ▶ Drivers of unfamiliar vehicles (NTSB, Pollard and Sussman, 1989)
- ▶ Younger drivers
 - Have limited driving experience, so may be less familiar with brake position
 - Have not fully developed the prefrontal cortical structures that facilitate overriding an incorrect response (Lococo and Tucker, in press)
- ▶ Older drivers
 - May experience age-related declines in these structures (Lococo and Tucker, in press)

Likely Causes of Pedal Misapplication

- ▶ The driver correctly selects the brake
- ▶ Variability in the processes that determine the trajectory and endpoint of the movement
 - Driver turning to check the side mirror or look over their shoulder – results in error in foot placement, particularly if the driver's response is forceful
- ▶ Rarely, the driver's foot hits a point a bit to the right of the brake – the accelerator

Variability in Behavior

- ▶ Schmidt (1989) explored the relationship between driver's movement control and unintended acceleration to determine:
 - Source of foot placement errors
 - Why a driver would fail to immediately perceive the error
 - Why a driver would persist in pressing the wrong pedal for several seconds or more

Variability in Skilled Performance



Movement Error Research

- ▶ Focused on arm and hand movements, but findings should apply to leg and foot movement
 - Larger limbs showed more trajectory variability (Langolf, Chaffin & Foulke, 1976)
 - Accuracy in acquiring an unseen target declined substantially when participants turned their heads (but not their gazes) by 10 – 30°.

Failure to Correct

- ▶ Drivers brake successfully on a regular basis – the driver is confident that he or she can brake accurately, even without confirmatory feedback
- ▶ Driver confidence that the foot is on the brake makes it difficult for the driver to detect and respond appropriately when the foot is actually on the accelerator
- ▶ The driver is convinced that his or her foot is on the brake, and may “brake” more firmly, exacerbating the situation

Possible Causes of Failure to Correct

- ▶ Why do drivers sometimes persist in pedal errors – for more than a few seconds ?
 - **Hypervigilance** – response to an event that is
 - Strong, startling
 - Potentially life threatening
 - Must be addressed immediately

Hypervigilance

- ▶ Hypervigilance may result in:
 - Impaired information processing
 - Failure to recognize appropriate solutions such as turning the car off, putting it in neutral or applying the hand brake
 - Distraction by a variety of stimuli
 - Vacillation among a range of potential responses (Janis & Mann, 1977)

Perceptual Narrowing

- ▶ Stress narrows attentional focus to highly relevant events, reducing the ability to address unlikely peripheral events (Weltman & Egstrom, 1966)
- ▶ Driver ignores the odd feel of the “brake” and instead focuses on the more central events associated with the unexpected vehicle response
- ▶ Consistent with driver **perseverance** in the error and with drivers’ reports that they “just froze”

Current Work on Pedal Errors in Older Drivers

- ▶ NHTSA has a study underway to explore the current frequency of pedal application errors in older drivers
- ▶ Planned and initiated several years ago

Objectives

- ▶ Determine the extent of pedal error crashes
- ▶ Identify groups overrepresented in these crashes –
 - Novice drivers?
 - Older drivers?
- ▶ Identify typical situations/circumstances

Literature Review

- Technical literature
- News media reviews
 - Pedal error crashes in the US between 2000 and 2010
 - Searched for key phrases in newspapers (daily, weekly), TV and radio broadcast transcripts, news wire services, internet media
- Limitations of media reviews
 - No control over which crashes were reported
 - Reports are sometimes purged from archives due to space limitations
 - Whether a crash was reported might be influenced by other newsworthy events
 - These crashes may be more newsworthy in some locales than others
 - Not all publications provide their full text articles to Lexis-Nexis, America's Newspapers, and Google News

News Media Interim Results: Driver Age

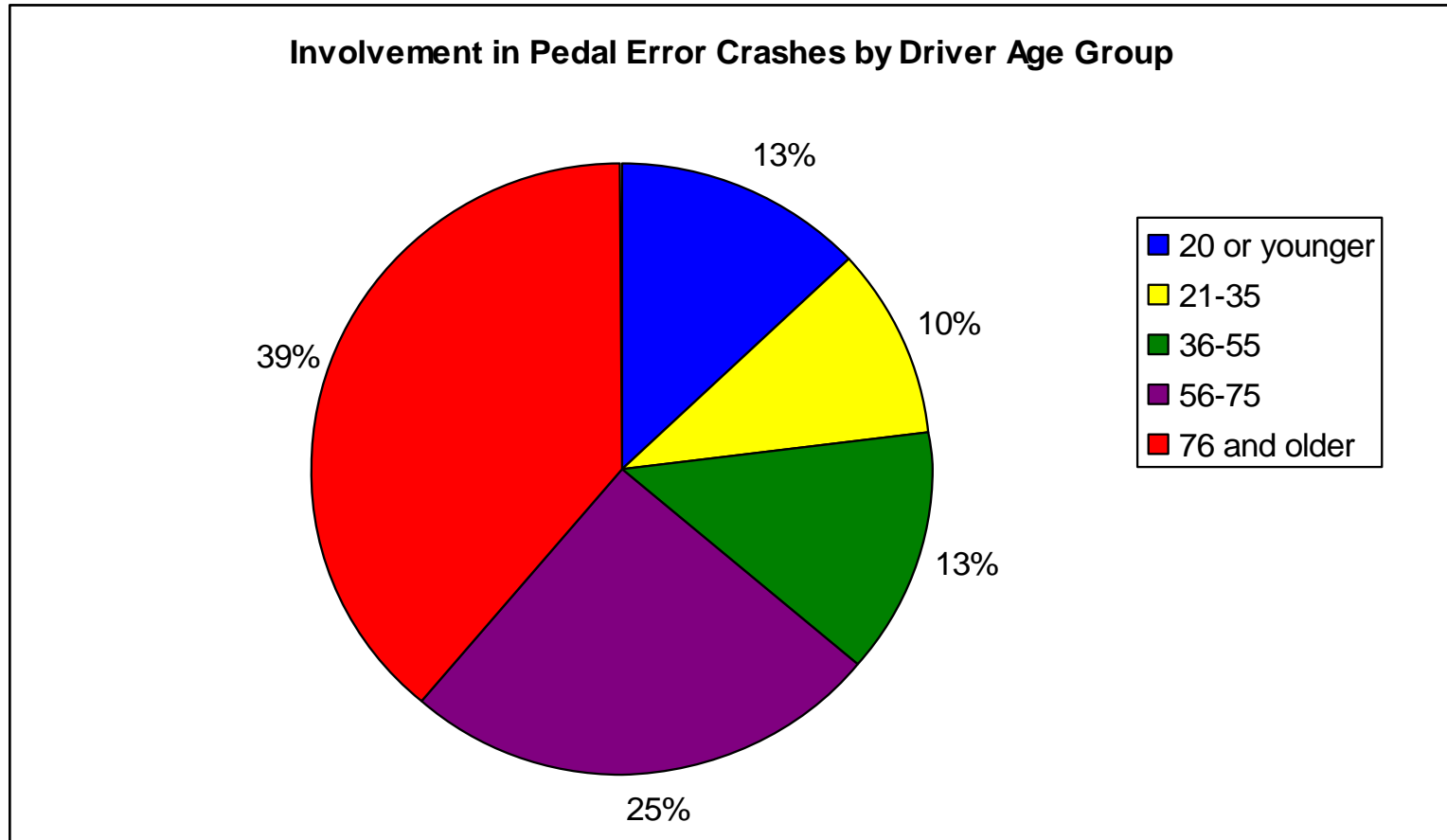
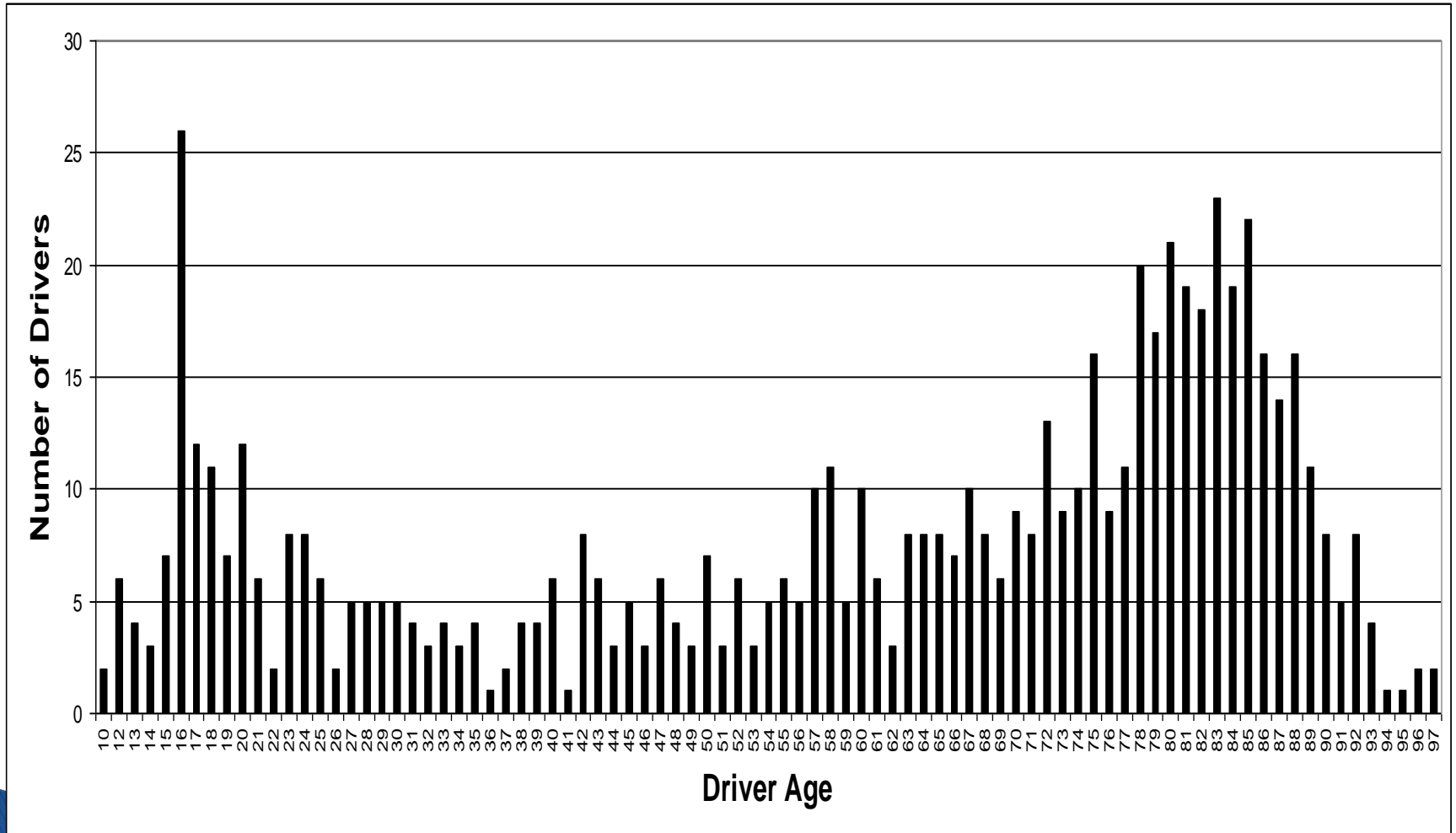


Figure 1. Involvement in Pedal Error Crashes by Driver Age Group (n=683).

Interim Results: Driver Age



Interim Results: Location

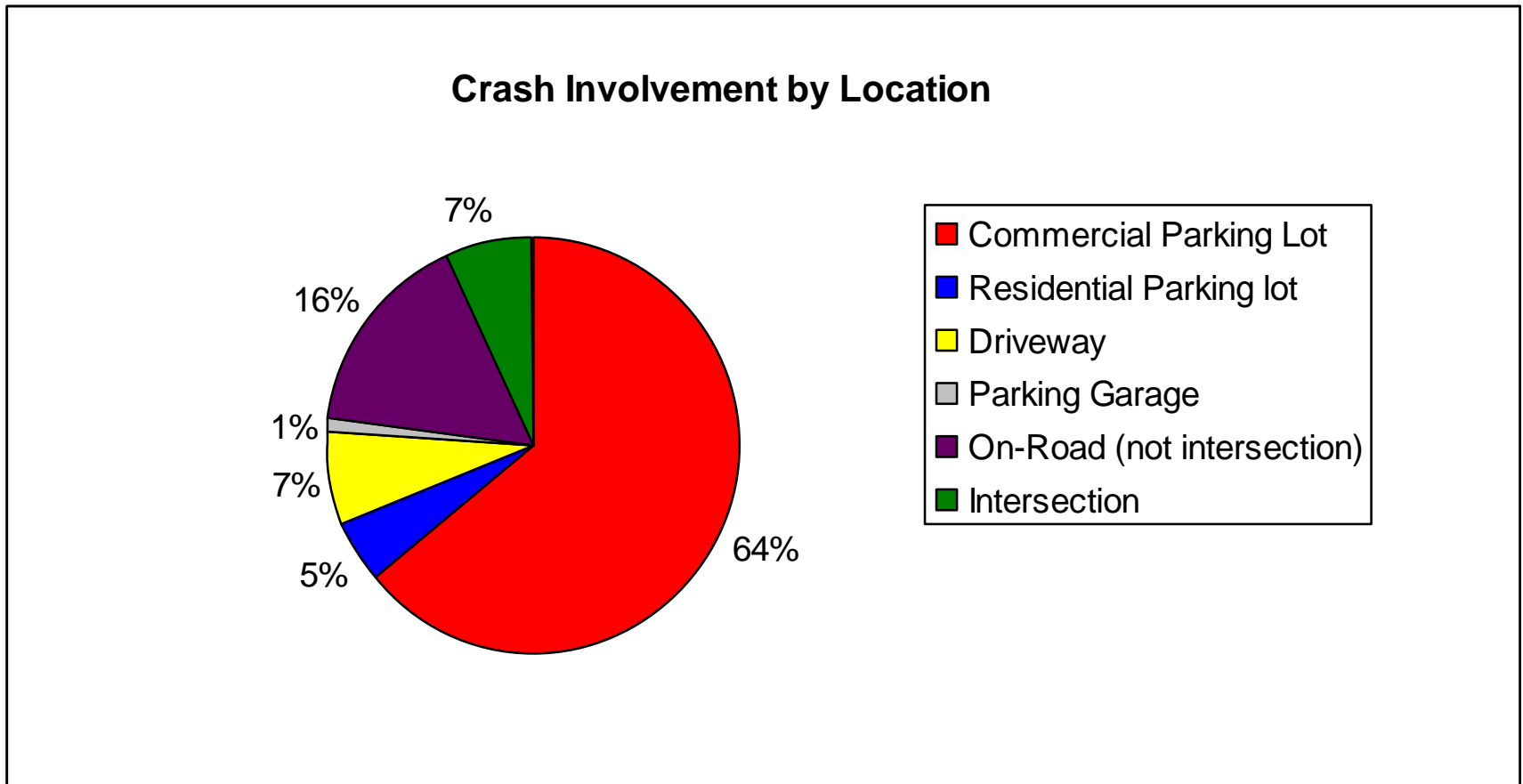


Figure 3. Crash Involvement by Location (n=861).

Interim Results: Pre-crash Maneuver

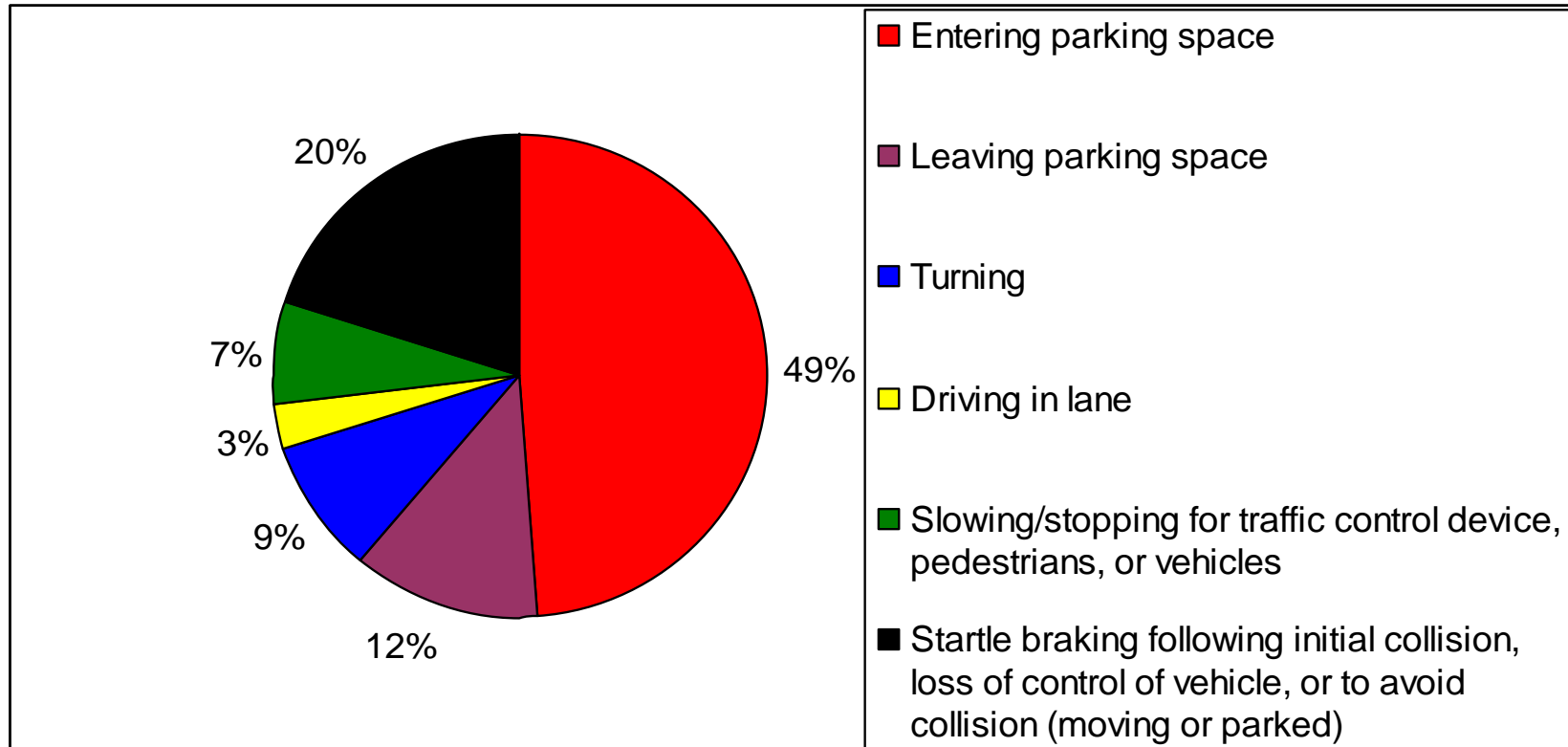


Figure 4. Prevalence of Pre-Crash Maneuvers, Collapsing Slowing/Stopping Categories and Startle Categories (n=661).

Conclusions

- ▶ Human error is one important cause of unintended acceleration
- ▶ Human performance is variable; people make mistakes
 - Pedal error is understandable
 - Failures in error detection and error correction need to be addressed
- ▶ How this panel can help:
 - Address human error as a cause of UA
 - Determine whether electronic controls affect prevalence of pedal error
 - Make suggestions for reducing likelihood or effect of pedal error through (a) vehicle design, and (b) behavioral training and adjustment