Human Factors Considerations: Unintended Acceleration & Pedal Errors

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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 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 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

![Driver Age Bar Chart](attachment:image.png)

Number of Drivers

Driver Age

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Interim Results: Location

Crash Involvement by Location

- Commercial Parking Lot: 64%
- Residential Parking lot: 5%
- Driveway: 16%
- Parking Garage: 7%
- On-Road (not intersection): 7%
- Intersection: 1%

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