

Pedal Misapplication: Crash Characteristics and Contributing Factors

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ABSTRACT

Pedal misapplication events were examined using police-reported crash data to determine crash characteristics and other contributing factors.

The study used police-reported crash data narratives from North Carolina (1994-2009) and included detailed manual review of each selected police report to identify possible pedal misapplication events. A comprehensive keyword search of all the records in the North Carolina data was performed to identify crashes most likely to be associated with pedal misapplications. The identified records were reviewed by engineers and classified as either "Yes," "Possible," or "No" pedal misapplication. For the "Yes" and "Possible" records, examination was made of the sequence of events leading up to the possible pedal misapplication.

Findings show that the most frequently reported pedal misapplication events include: parking, slowing, stopped, starting, and backing, which are all low-speed events.

Statistical analyses were also performed for crash characteristics such as location, road type, road condition; vehicle factors such as vehicle type, crash type; and driver factors such as travel speed, distraction, failure to keep lane, driver action prior to pedal misapplication, alcohol, fatigue and inattention.

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INTRODUCTION

Vehicle and driver factors associated with pedal misapplication events resulting in crashes have been a topic of discussion for decades. According to the National Highway Traffic Safety Administration (NHTSA), pedal misapplication, such as foot slippage or using the wrong pedal, is underreported and underestimated for a variety of reasons, including the fact that crash reports lack a code for pedal misapplication and that police rely on drivers to self-report on behavior. Identification of these events typically must be made through careful review of the narratives recorded in police accident reports. The rate of pedal misapplications can vary across vehicle types, crash types, driver demographics, crash location, speed and vehicular factors including pedal design and pedal location.

This study examines some of the factors associated with pedal misapplications.

BACKGROUND

Several studies have been performed to date to address the factors relating to pedal misapplications in the last two decades. NHTSA (1989) performed a comprehensive study that showed the role of human factors or ergonomic control design considerations which might lead to pedal misapplications [1]. Schmidt et.al (1997) reviewed about 200 crashes from North Carolina data for 1979-1980 and found that most of the pedal misapplications were associated with driving situations that occurred well after initial start-up [2]. Freund et.al. (2008) performed a study of 180 subjects to assess cognitive functions contributing to pedal errors among older drivers and concluded executive dysfunction for older drivers may be an important contributor to pedal errors [3]. The National Transportation Safety Board (NTSB) completed their investigation of 2003 Santa Monica incident concluding that the 86-year-old driver continued to press on the accelerator pedal, thinking he was actually pressing the brake, even after experiencing the initial impact [4]. Recently, the

HSRC (2012) study on pedal application errors that examined driver, vehicle, roadway and environmental factors associated with pedal misapplication crashes estimated 15 pedal misapplication crashes per month in the U.S. and concluded that there was significant over-involvement by the youngest (16-20) and oldest (76 and older) drivers for these pedal misapplication crashes [5].

This study updates and expands some of the earlier studies that purported to address factors associated with pedal errors by conducting a comprehensive manual review of crash data from North Carolina.

METHODOLOGY

As part of this study, a comprehensive keyword search was performed of all the records in the North Carolina data files to identify crashes possibly associated with pedal misapplication.

Appendix 1 presents the keywords used to identify crash records for manual review. The keywords included search terms identified by prior research addressing this issue as well as a set of additional words/phrases in order to obtain a broad definition that could potentially include pedal misapplication events. Over 100 keyword terms/phrases were used to select records for manual review. The manual review was performed in iterative steps: 1) Review an initial set of over 500 crash records to identify additional (if any) keywords; 2) Develop keywords to eliminate crashes that are definitely not related to pedal misapplication (e.g., gas tank); 3) Develop coding procedures to classify crashes as pedal misapplication events: "Yes"; "Possible"; or "No"¹. A comprehensive manual review was performed to code pedal misapplication events and further identify driver, vehicular and environmental factors associated with pedal misapplication related crashes.

The North Carolina data contains over 3,000,000 light vehicle² crashes with narratives that involved 5,235,211 light vehicles from 1994-2009. The keyword search produced 19,502 crashes involving 35,087 vehicles. Every one of these 35,087 vehicle records was manually reviewed to perform this study.

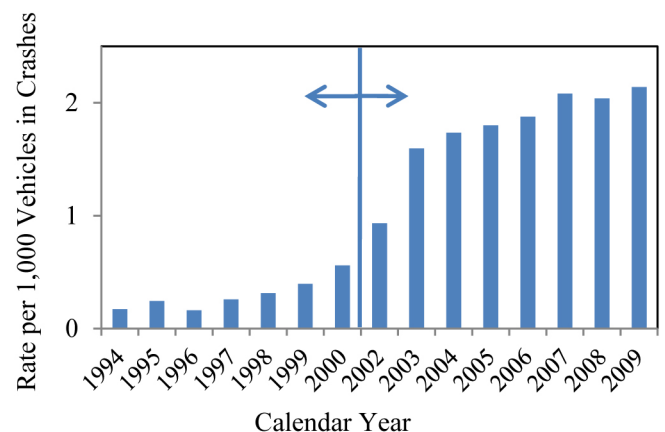
Each of the records was manually reviewed at least twice by the engineering team to identify pedal misapplication events including pressing the accelerator instead of the brake, slipping from the brake and onto the accelerator, and hitting both pedals. Any differences in event identification were then re-reviewed. The results are discussed in subsequent sections.

RESULTS

The North Carolina data included over five million light vehicles involved in crashes for the years 1994-2009. Based on the keyword search of the associated narratives followed

by manual review, 6,560 vehicles in crashes were identified as "yes" (97%) or "possible" (3%) driver pedal misapplication events, resulting in a pedal misapplication rate of 1.3 per 1,000 vehicles in crashes. The pedal misapplication events and the North Carolina vehicle registration data³ were used to estimate the rate of pedal misapplication events for passenger cars and light trucks. The rate for cars and light trucks combined was 2.3 per 10,000 registered vehicle years. However, the rate for cars (2.5 per 10,000 RVY) was statistically significantly higher ($p < .05$) than the rate for light trucks (2.0 per 10,000 RVY).

While the North Carolina State crash data is suitable to examine pedal misapplication events, the rates might be an underestimate since the threshold for inclusion of crashes in the police reported database requires a crash resulting in an injury/fatality or property damage of at least \$1,000. In addition, the narratives were more detailed for the years 2002-2009 as compared to prior years. Figure 1 presents the rate of pedal misapplication events by calendar year based on manual review. The data cannot be interpreted as showing an increase in pedal error rates, but rather, the North Carolina data has more detailed narratives with more descriptive verbiage after 2002, which facilitates a more comprehensive capture of keywords associated with pedal error events.



Source: North Carolina 1994-2009

Figure 1. Rate of Pedal Misapplication Crashes by Calendar Year

The following sections detail the road factors, vehicular factors and driver factors associated with crashes/vehicles involved in pedal misapplication events.

Roadway Factors

Table 1 presents the distribution of road types for pedal misapplication events. As seen in Table 1, 43% of pedal misapplication events occur in parking lots and 35% occur in

¹"Y" records were clearly pedal misapplications while "P" records were slightly more ambiguous.

²Light vehicles include passenger cars, light trucks, & SUVs

³Registration data was obtained from R.L. Polk & Company.

local streets. Of the parking lot crashes, about half of them (47%) occurred on driveways.

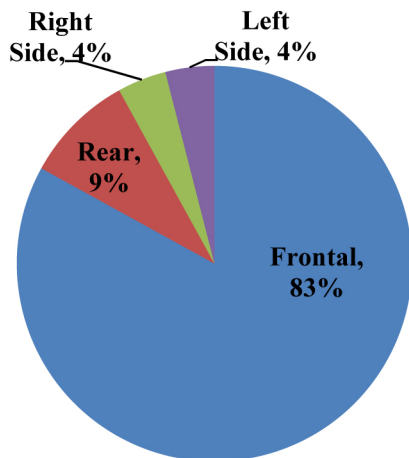
Table 1. Distribution of Road Type among Vehicles in Pedal Misapplication Crashes

Road Type	Number of Crashes	Percent of Crashes
Parking Lot / Public Area	2,819	43%
Local Street	2,240	35%
Interstate / State Route	1,151	18%
Other	283	4%

Crash Characteristics/Crash Type

The manually reviewed crash data also showed that, 37% of the pedal misapplication crashes were single vehicle crashes and over 60% were two vehicle crashes. A significant portion of these crashes were frontal impacts.

Figure 2 presents the distribution of all pedal misapplication crashes by impact area. 83% of vehicles involved in pedal misapplication crashes were frontal impacts and 9% were rear impacts.



Source: North Carolina 1994-2009

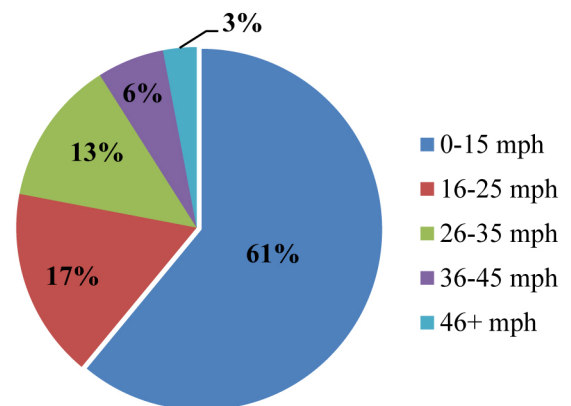
Figure 2. Distribution of Pedal Misapplication Crashes by Crash Type

Table 2. Action Prior to Impact among Vehicles in Pedal Misapplication Crashes

Action Prior to Impact	Number of Vehicles	Percent of Vehicles
Driving	3,100	50%
Parking/ Parked / Stopped	1,489	24%
Slowing / Starting	881	14%
Backing	551	9%
Other	158	3%

Travel Speed

The crash data for pedal misapplication was examined to identify travel speed reported in police reports for the pedal misapplication crashes. As indicated earlier, a significant portion of pedal misapplication events tend to occur in low speeds. Of the pedal misapplication related crashes with reported travel speeds, over 60% had travel speeds less than or equal to 15 mph and over 90% of the crashes had travel speeds less than or equal to 35 mph. Only 3% of crashes were associated with travel speeds over 45 mph. About 25% of these crashes were associated with travel speeds less than or equal to 5 mph.



Source: North Carolina 1994-2009

Figure 3. Distribution of Pedal Misapplication By Travel Speed

Sequence of Events

The data was examined to identify the actions of driver prior to crashes involving pedal misapplication. The actions identified included: driving (changing lanes/going straight/making turns); backing, parking maneuvers and slowing/stopping/starting/leaving parked position. As Table 2 shows 47% of prior driver action included slow speed events such as backing, parking or slowing or starting from stopped position. It is also interesting to note that 9% of prior actions were backing, consistent with the 9% rear crashes seen in Figure 2.

Figure 4 presents the rate of pedal misapplication events for each travel speed category. Once again, the rate of pedal misapplication events was higher for low speed categories. For example, 3 out of 1,000 crashes in low travel speeds (less than or equal to 15 mph) result in pedal misapplication events, while the corresponding rate is .2 per 1,000 for crashes with travel speed greater than 45 mph. Hence, pedal misapplication events are 15 times more likely to occur in low speeds.