



Department
for Transport

Summary of study into Pedal Misapplication

14-5-2023

Introduction

- **Study conducted by TRL on behalf of the UK Department for Transport**
- **The study examined the characteristics of collisions related to pedal misapplication utilising the RAIDS database.**
- Specific goals were to examine the role of the driver, vehicle, roadway, and environmental characteristics; and the extent of injury severities caused by these errors.



Definitions

Current working definitions for ACPE:

- ACPE is a system to control an unintended acceleration. - ACPE-01
- ACPE is a system able to inhibit acceleration when a potential pedal error is detected - Industry

Pedal Misapplication



Pedal Misapplication is when the driver applies the wrong pedal of a vehicle, for example: accelerating instead of braking and braking instead of accelerating. – TRL Definition



Pedal Confusion

Pedal Confusion is one of the main causes for Pedal Misapplication.

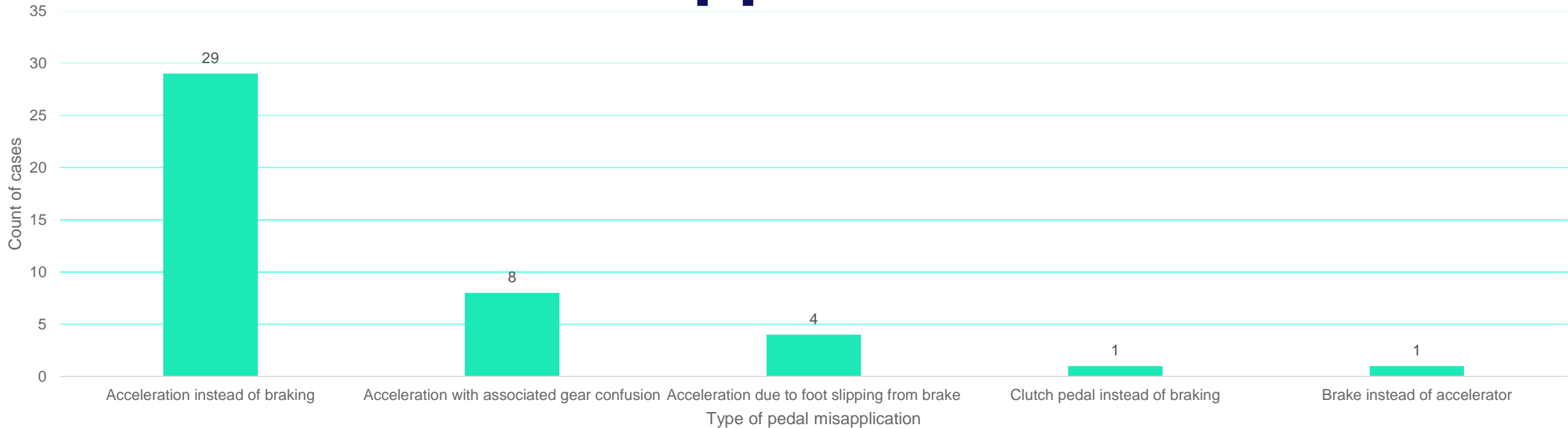
Pedal confusion is the manoeuvre where a driver confuses the acceleration pedal with the brake pedal resulting in either sudden unintended acceleration (SUA) or harsh braking.

*It should be noted that pedal misapplication is not synonymous with pedal confusion, rather a potential outcome of pedal confusion.

Data Analysis from RAIDS Database

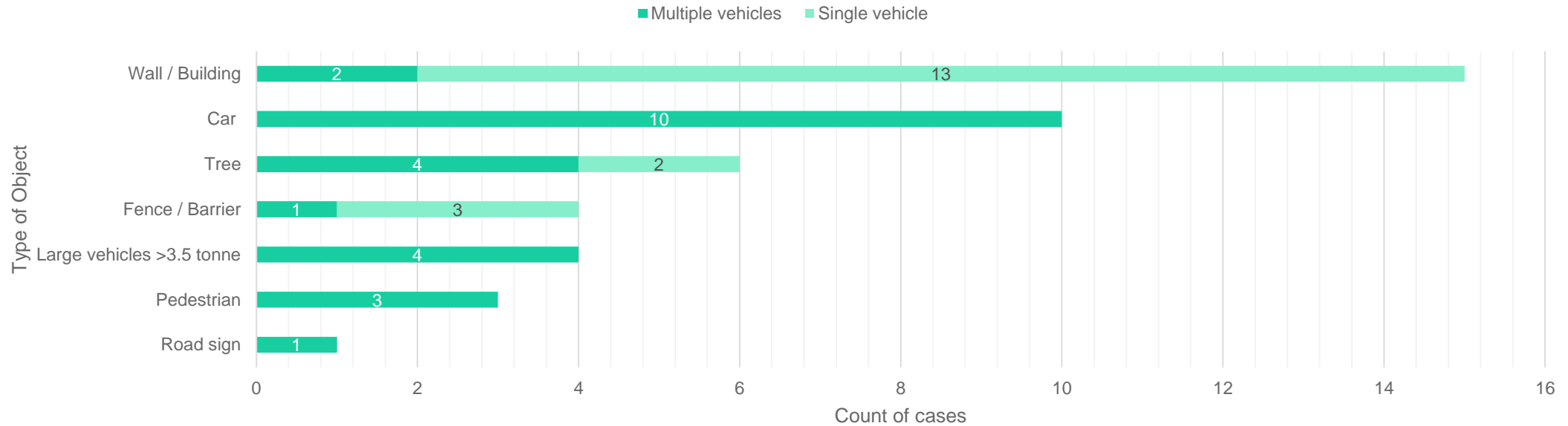
- Crash data collected between 2012 and 2023 for the UK Road Accident In-Depth Study (RAIDS) was used in this study. RAIDS is managed by TRL on behalf of the UK Department for Transport. The study is designed to create an evidence base to support improved road safety. The full report can be found here [TRL Report](#).
- RAIDS investigations differ from those of the police because they are designed to understand all factors influencing a collision and its outcome rather than necessarily determine responsibility. Typically, the RAIDS team will investigate around 200 cases per year; these are a mix of investigations carried out at the live collision scene and retrospective investigations based on vehicle examinations and analysis of police collision reports. Since the start of RAIDS, over 150 research studies have accessed RAIDS for research projects.
- At the time of analysis, the RAIDS database contained 2321 cases. Within the database, 43 (2%) applicable pedal misapplication cases were identified. In 42 cases, the vehicle that experienced the pedal misapplication was a car, the remaining case was a light goods vehicle. 93% (2164) of the cases in the RAIDS database involved at least one car or light goods vehicle.

Number of cases for each type of pedal misapplication



- In most cases (29, 67%) where the incorrect pedal is depressed, the driver accelerates instead of applying brakes; in 1 instance, the clutch is depressed rather than the brake, and in another instance, the brake is depressed instead of the accelerator. In 4 of the cases, the driver's foot is initially applied to the brake but slips off onto the accelerator; one of these cases was due to wet footwear/pedals due to wet weather conditions prior to them entering the vehicle.
- The remaining 8 cases occur where the driver chooses the incorrect gear accidentally and press acceleration pedal. These 8 collisions were not directly caused due to pedal confusion; however, in those instances, drivers failed to correct their actions, continuing to accelerate in the wrong direction for a prolonged duration, leading to a collision. 4 of the drivers selected 'Drive' or 1st gear instead of 'Reverse', 3 selected 'Reverse' instead of 'Park' and 1 selected 'Drive' instead of 'Park'.

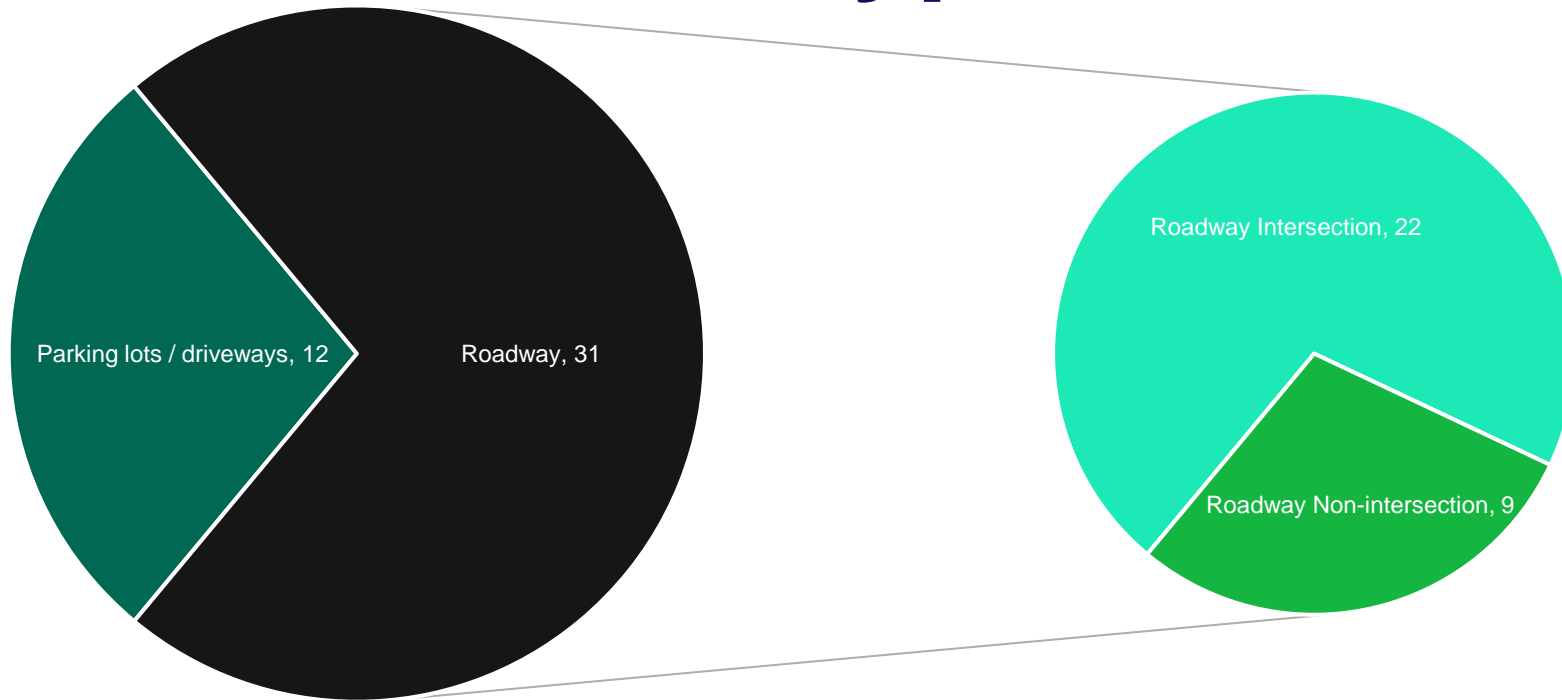
Object collided with due to pedal misapplication



The number of cases for each type of object collideded with by the pedal misapplication vehicle, with single vehicle vs multiple vehicle collisions identified.

- Fifteen cases (35%) resulted in a situation where the vehicle impacted a wall / building.
- Most of these cases were single vehicle collisions. Roadside furniture including trees, fences/ barriers and road sign were impacted in 25% of cases. Cars, large vehicles and pedestrians were the remaining 40% of cases.
- The majority of impacts are into objects which would likely cause the vehicle to come to a stop, with the exception of pedestrians, who will likely be coded as the most severe impact as they are vulnerable road users who often suffer serious injuries even during relatively low speed collisions.

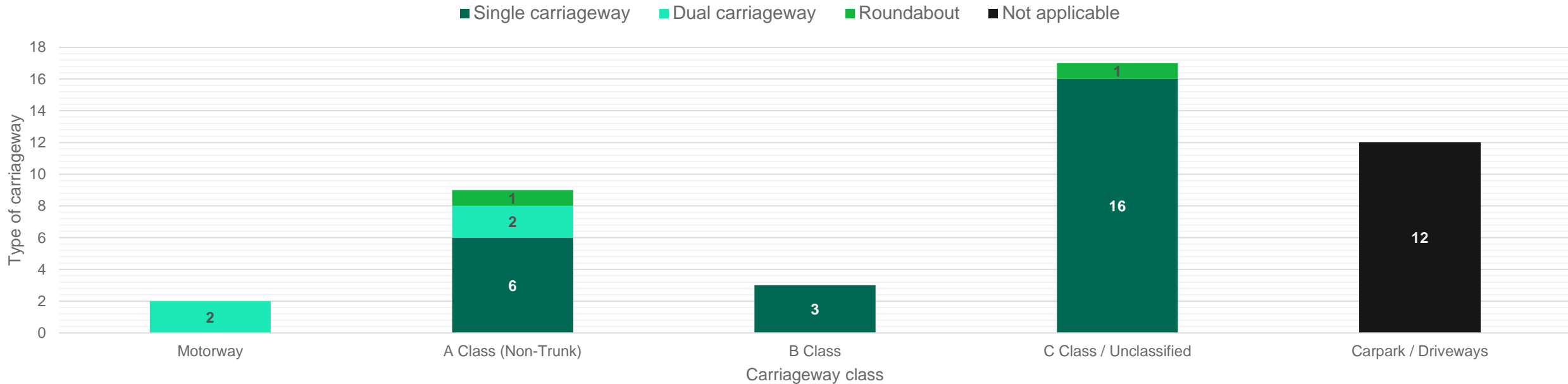
Road Type



Number of pedal misapplication cases in parking lots and driveways verses roadways, with roadways split between intersections and non-intersections

- 28% of the pedal misapplication crashes occurred in parking lots or driveways, and 72% occurred on roadways. 29% of the cases occurring on roadways were at non-intersection locations, and 71% were at intersection-related locations.

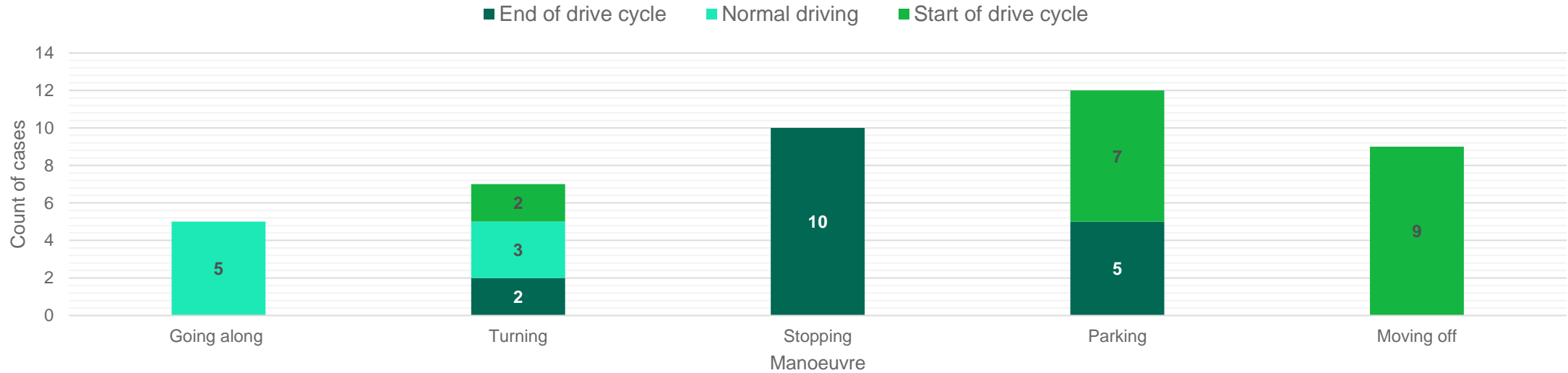
Road Type



The number of cases which occurred on each carriageway class and on each type of carriageway

- Of all RAIDS cases involving cars and light goods vehicles, 33% occurred on A class roads, with 29% on C-class / Unclassified/ Car Parks/ Driveways.
- However, it can be observed that pedal misapplication cases tend to take place on C Class/ Unclassified (17, 40%) and Carparks/Driveways (12, 30%) where vehicles are likely to be moving slower and/or manoeuvring.
- 68% of the RAIDS cases involving cars and vans are on single carriageways which would reflect the high occurrence (81%) within the pedal misapplication cases that occurred on a roadway. Dual carriageways (13%) and roundabouts (6%) are also seen within the pedal misapplication cases which occurred on a roadway.

Pre-Crash Manoeuvre

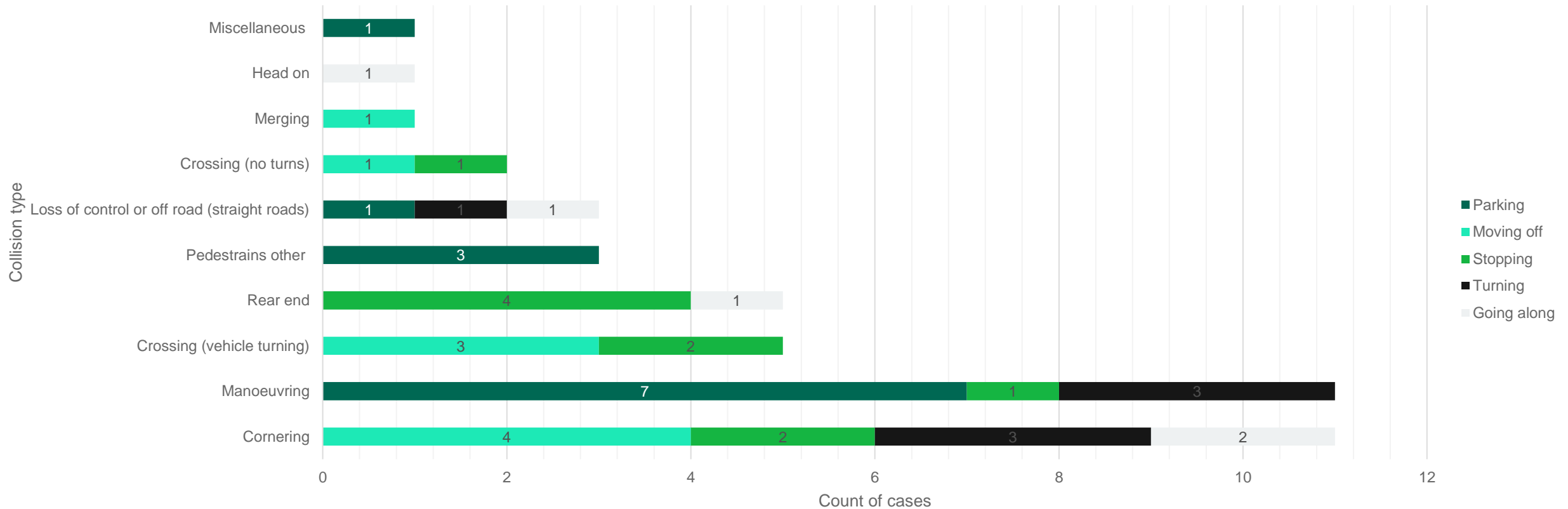


Start of Drive Cycle – When moving off from standstill position e.g., Traffic signal / Junction etc.

End of Drive Cycle – towards the End of the Drive Cycle e.g., Parking or Coming to a stop at traffic lights or giving way.

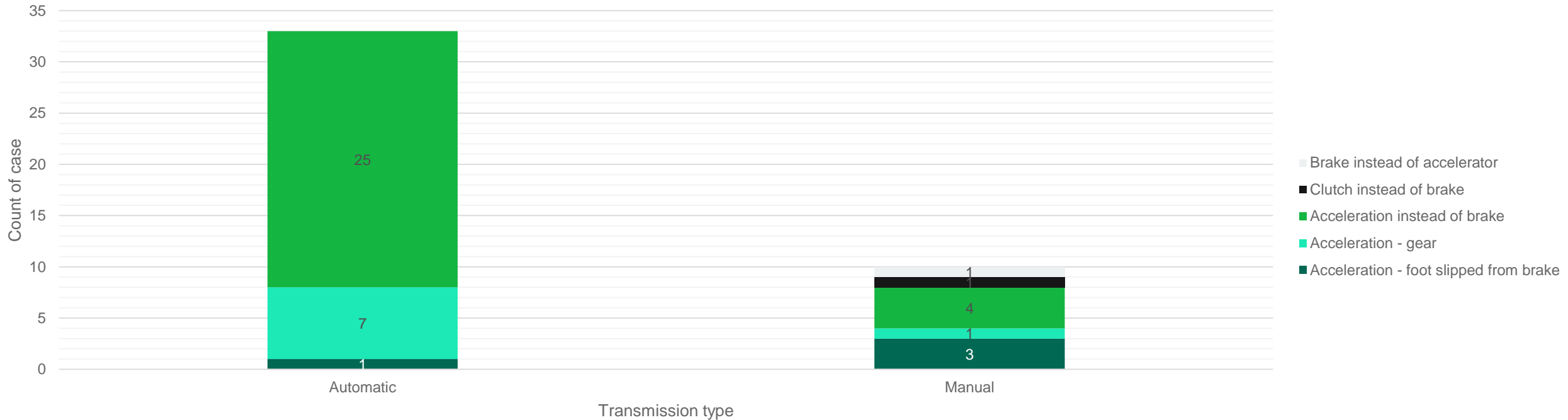
- Pedal misapplication while parking occurred either at the start or end of the drive cycle, depending on whether they were pulling away from a parking space or coming to a stop while parking. Pedal misapplication while turning occurred during, at the start, or end of the drive cycle, influenced by the turning manoeuvre such as a three-point turn, U-turn or turning at a junction.
- Five of the vehicles conducting a parking manoeuvre accelerated in reverse and had associated gear confusion, and all other vehicles suffered pedal misapplication whilst moving forward.
- The highest percentage of drivers (28%) were performing parking manoeuvres when the pedal misapplication occurred

Number of cases for each collision type split by pedal misapplication vehicle's manoeuvre



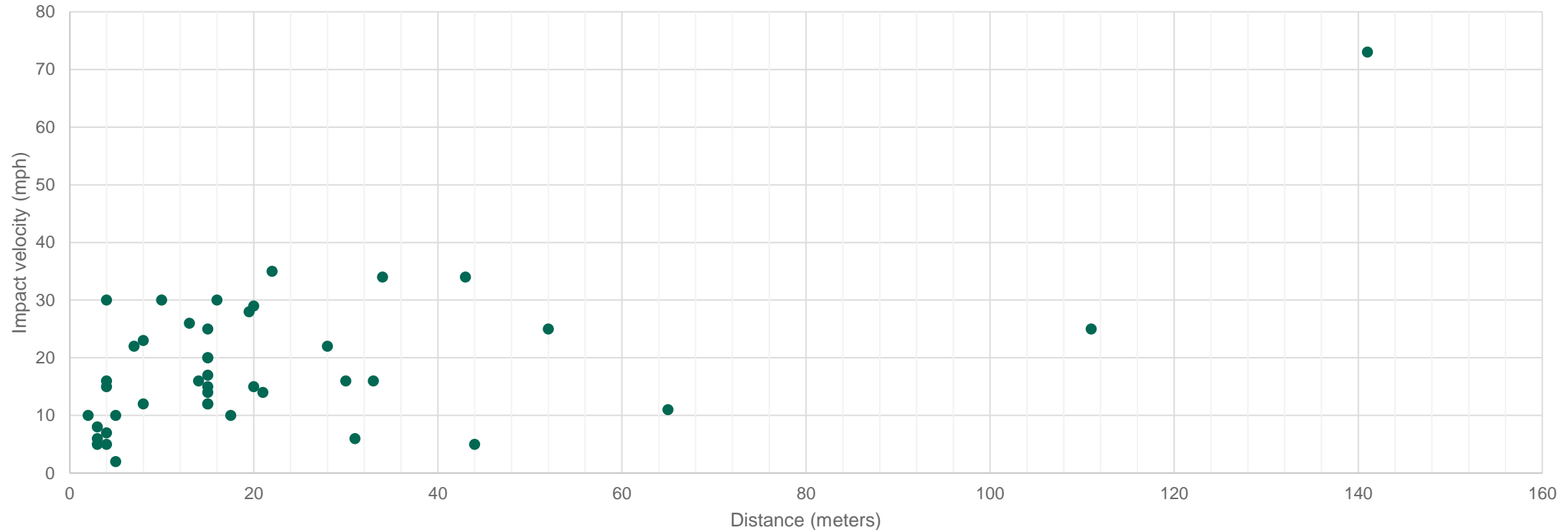
- Both cornering and manoeuvring had 11 cases each (26%) recorded, being the joint most frequently coded collision type. Crossing (vehicles turning) accounted for 12% (5 cases) with the top three collision types all involving some aspect of turning / manoeuvring and accounting for 63% overall.

Number of pedal misapplication vehicles by transmission type and the type of pedal misapplication experienced.



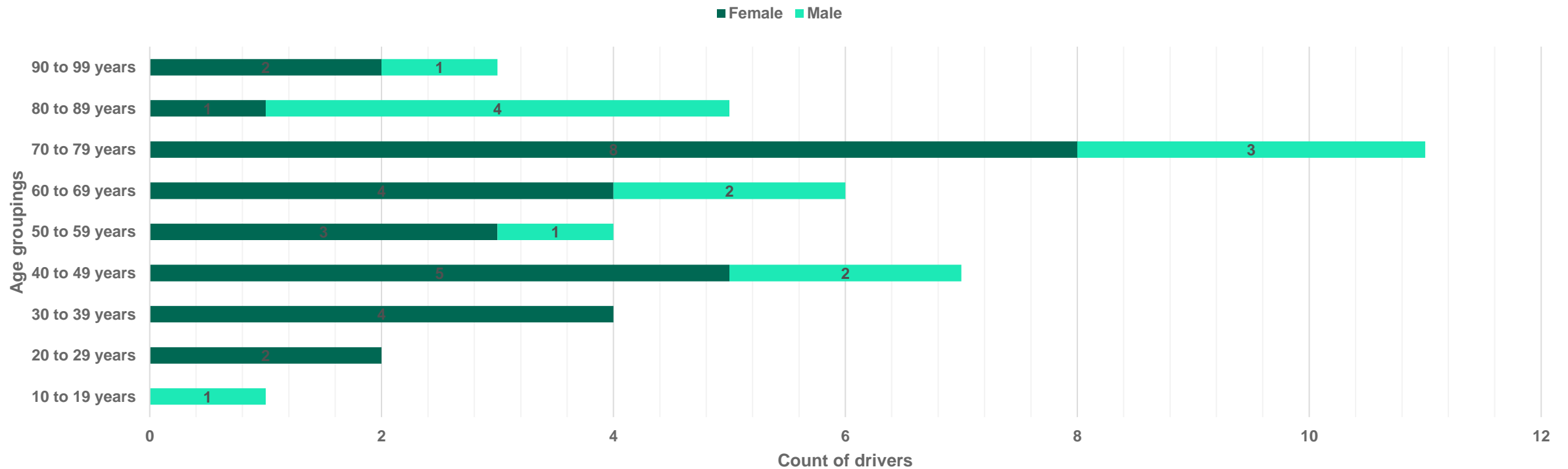
- With the RAIDS database, out of all the cases involving cars and vans, 24% were vehicle fitted with an automatic transmission, in comparison to 77% of the vehicles in pedal misapplication cases. This is a considerable indication that pedal confusion are more frequently associate with automatic transmissions than the manual transmission types.
- 7 out of the 8 pedal misapplications with associated gear confusion are automatics, it would suggest that automatics are more susceptible to selecting the wrong gear.

The distance travelled and the impact velocity for each vehicle suffering from pedal misapplication



- Distance travelled is from the point of when pedal misapplication occurred to when the impact occurred.
- The majority of the cases had an impact speed of up to 35 mph (98%), with an average impact speed of 19 mph. Most vehicles were accelerated just before impact, suggesting that the vehicles were travelling at a relatively low speed when the pedal misapplication occurred.

Number of drivers suffering pedal misapplication by age bands and gender



- Of all available RAIDS cases involving cars and light goods vehicles, 37% had a female driver. Within the pedal misapplication cases, 67% of the driver were female (29 Female and 14 Male).
- 74% of drivers of all RAIDS cases were less than 60 years old. However, in the pedal misapplication cases, only 40% of drivers were less than 60 years old. 51% of females and 71% of males were 60 years and above. The mean ages for pedal misapplication drivers is 61 years.

Additional risk factors associated with pedal misapplication

- **Further pedal misapplication risk factors were identified in addition to those discussed. They were:**
 - cognitive impairment
 - small stepover pedal configuration
 - incorrect foot positioning
 - hesitant braking
 - short stature
 - smaller shoe size

Conclusion

- The majority of the RAIDS pedal misapplications (about 49%) occurred at the initial start-up of the vehicle, followed by 33% occurring at the end of the driving cycle and the rest occurring during the normal driving cycle.
- Analysis of RAIDS pedal misapplication crashes indicated that 28% of the crashes occurred in parking lots and driveways, while roadways accounted for 72%, of which the majority (55%) occurred in a C class or unclassified road. The result suggests that crashes resulting from pedal misapplication tended to occur on smaller, lower-class carriageways or private parking spaces with lower speed limits compared to other crashes.
- A significant number of RAIDS pedal misapplication collisions occurred during turning (7) or parking manoeuvres (12) where there is a high chance of the head and body position being away from the ideal driving position (i.e., front/centre), which can also affect foot movement accuracy.
- Within the RAIDS database, vehicles fitted with automatic transmissions are more frequently associated with pedal misapplication cases.
- From the analysis of RAIDS data, it is apparent that females were overrepresented in pedal misapplication crashes compared to their representation in all crashes in RAIDS. Males and females are physically different; females are on average shorter and have smaller foot sizes than males, potentially resulting in imperfect access to the pedals.
- One of the limitations of this study is the available number of relevant cases within RAIDS database. It is important to note that the RAIDS case collection criteria biases collisions involving injuries and those which have taken place on a public road. Therefore, damage-only crashes (i.e., with no reported injury) and those that occurred solely in a private car park are underrepresented.