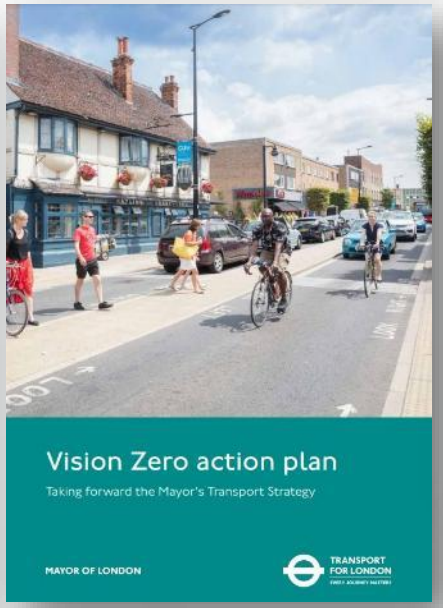
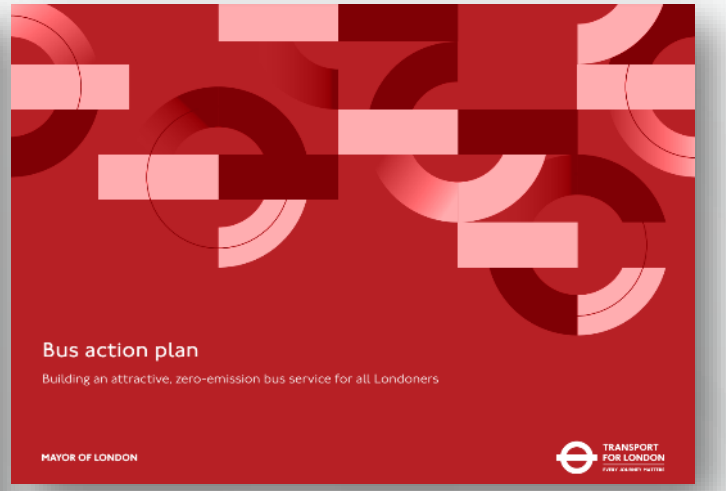
Pedal Application Error

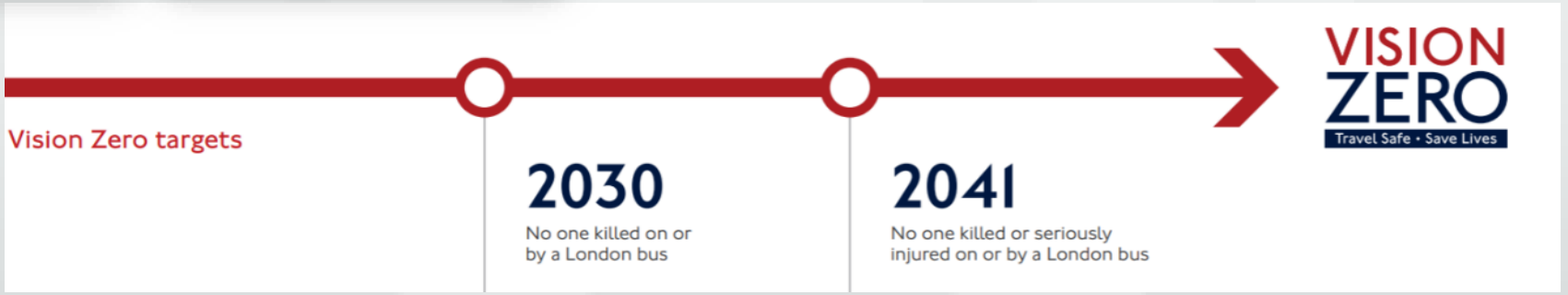
Apollo Vehicle Safety

TRANSPORT FOR LONDON
EVERY JOURNEY MATTERS

TfL's Vision Zero Strategy



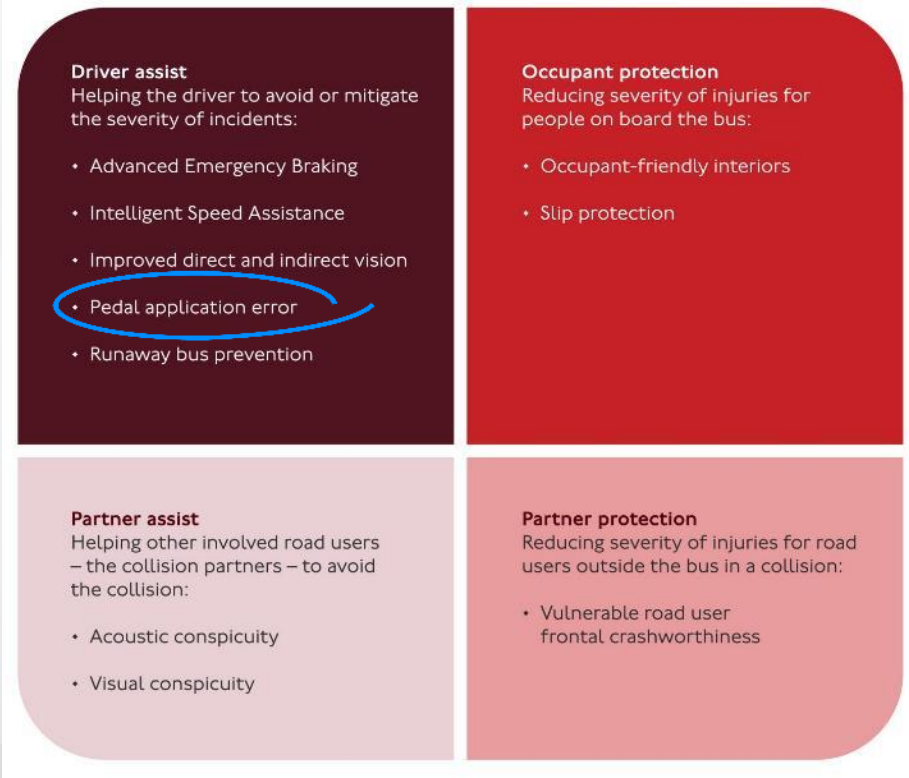




TfL's Bus safety programme

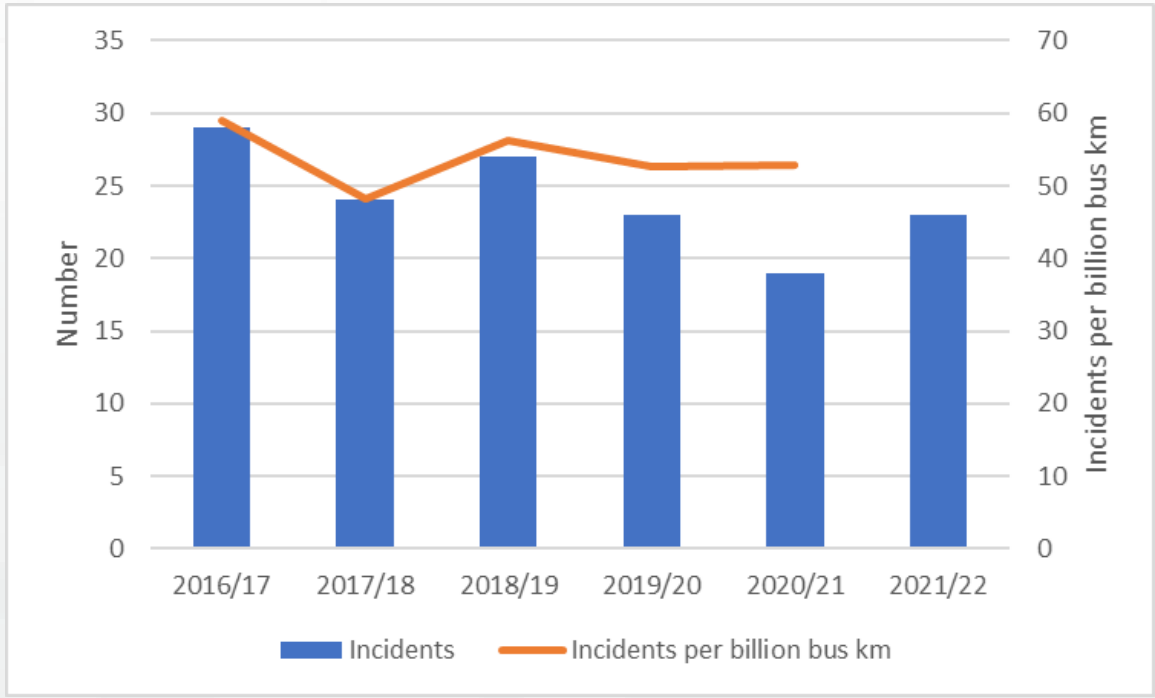
Safe System approach

Safe Vehicles: Bus Safety Standard (BSS)



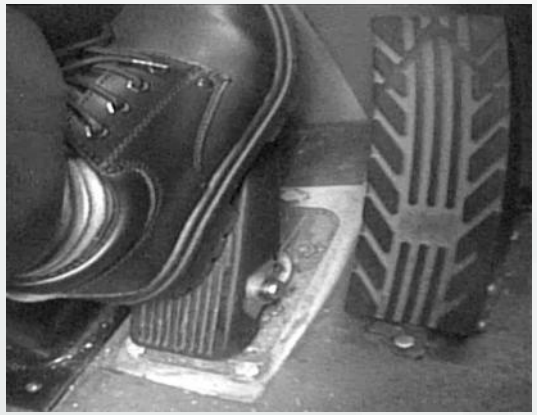
Quantifying the problem

- Incidents are rare but potentially severe when they do occur.
  - 54 cases/billion bus km, or
  - one event every 18.5 million bus km.

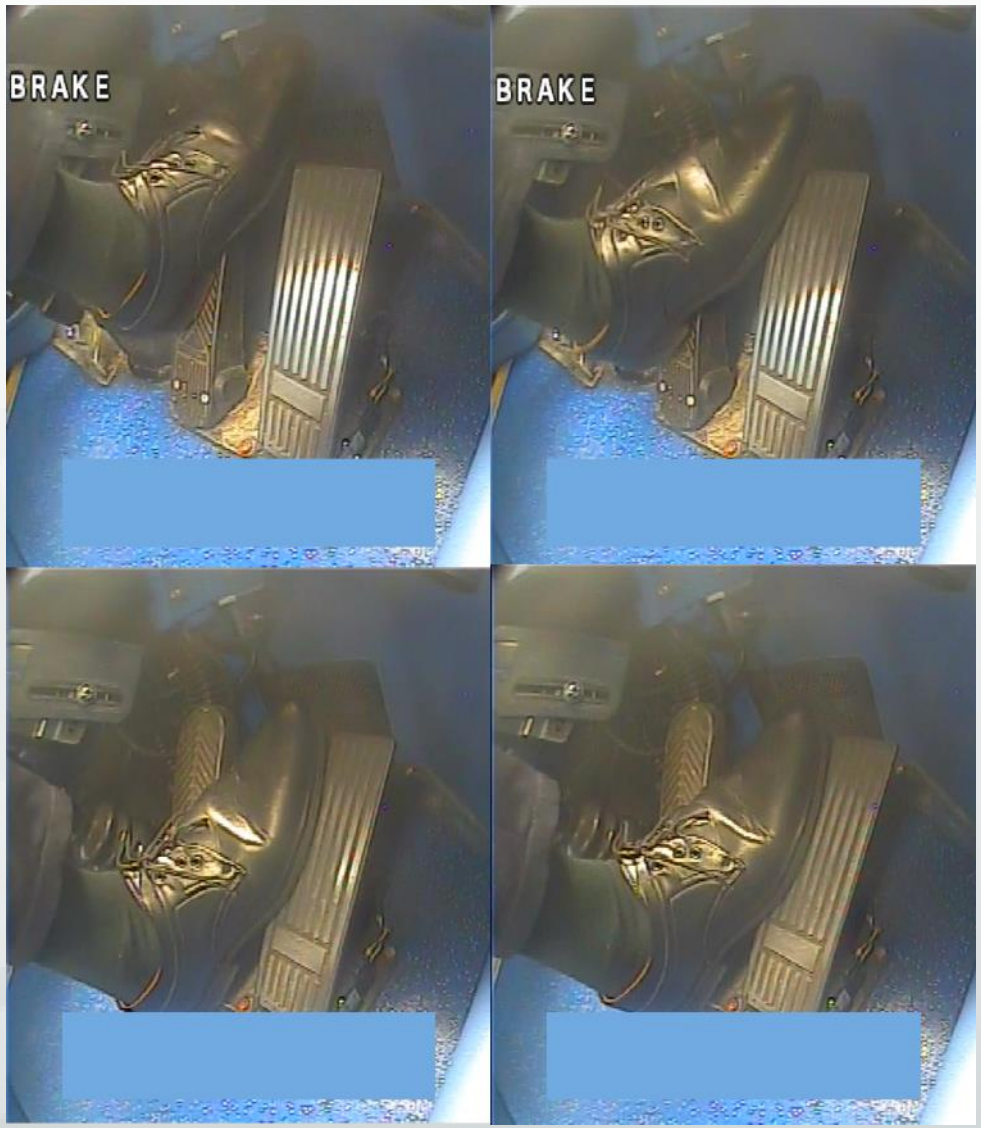


CCTV footage of normal driving

- CCTV of normal driving
  - Foot movement was variable
  - Most cases "lift & place"



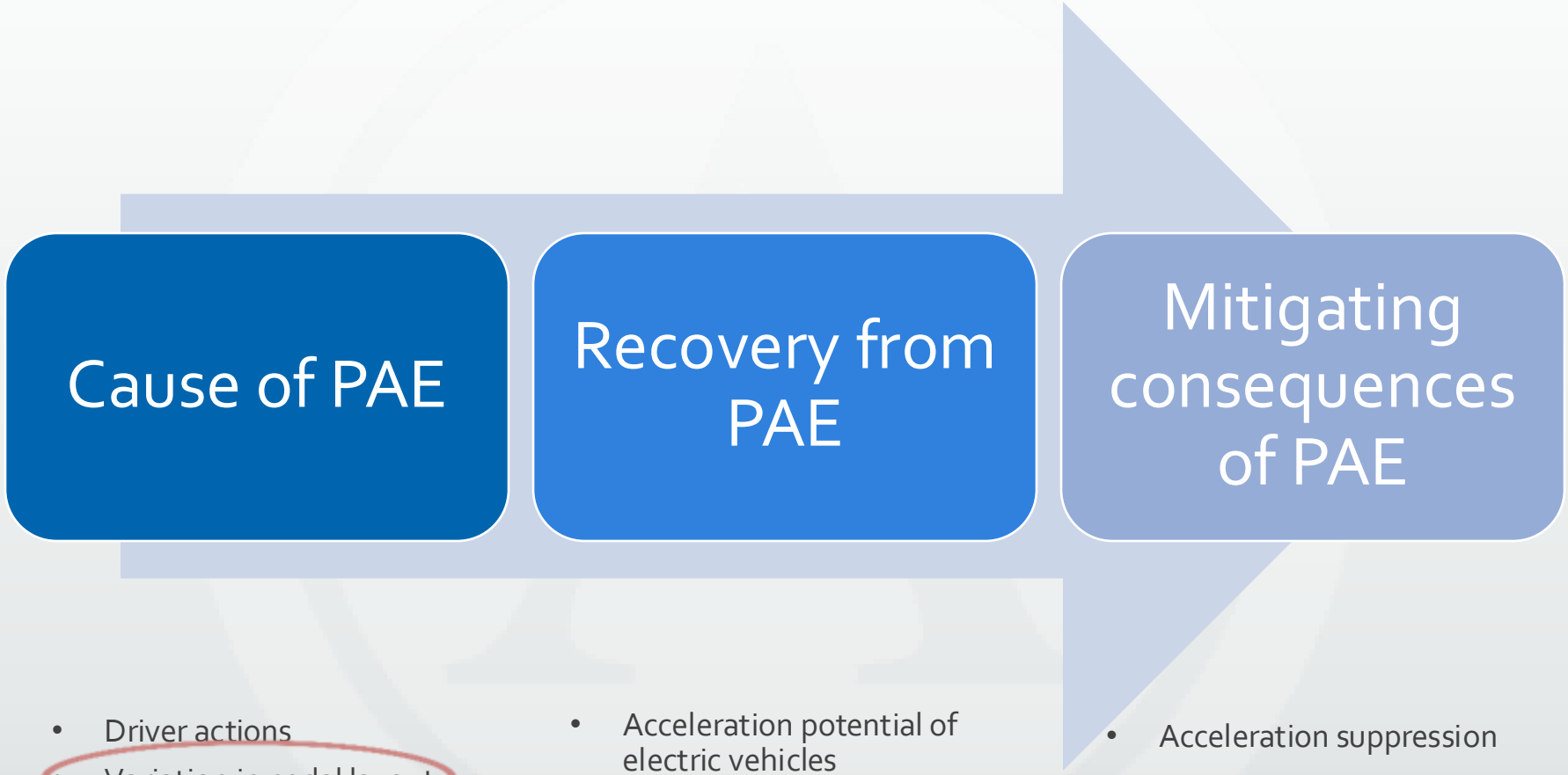
- Some evidence of sliding between pedals -------->



CCTV of incidents

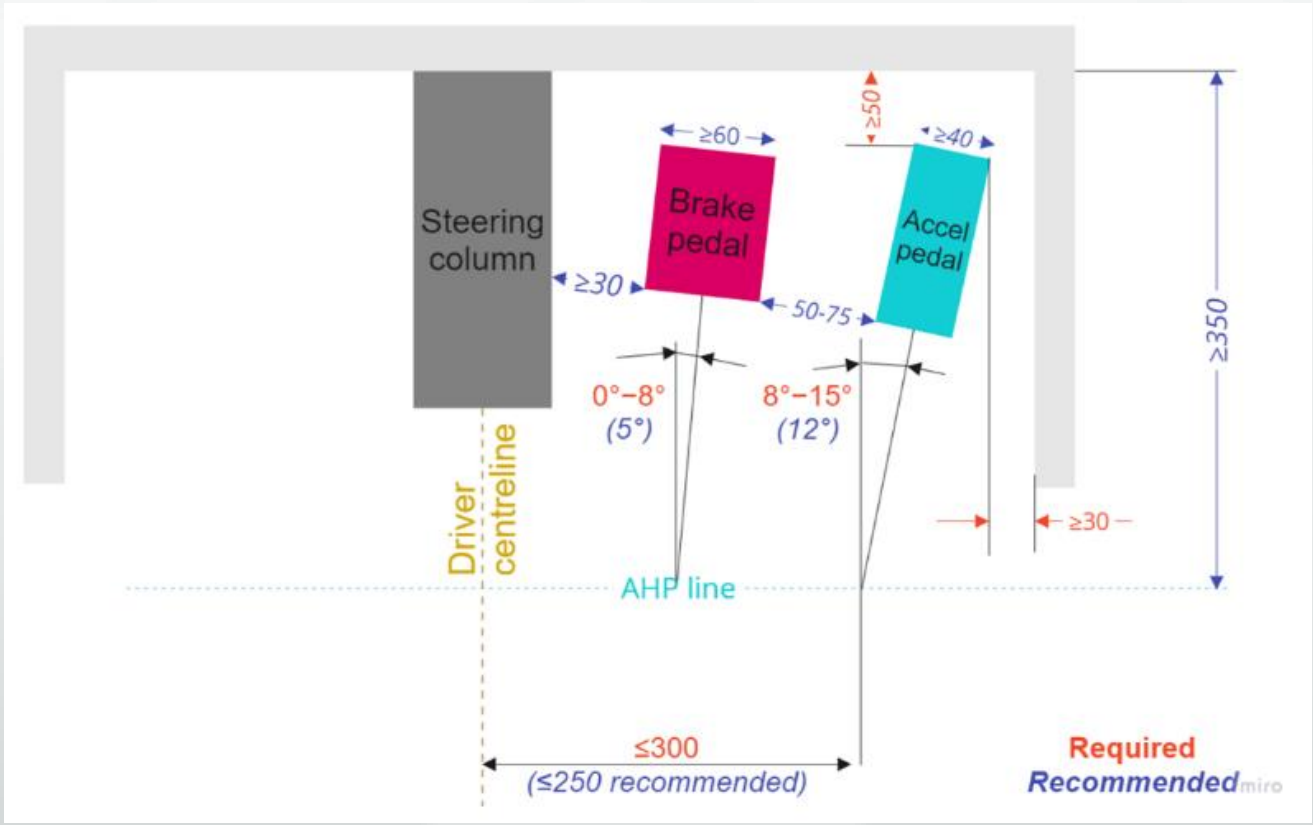
- Small number of cases (<20) reviewed
- Incident CCTV showed:
  - Most incidents do not involve foot movement between pedals (contrary to much behavioural research)
    - One incident appears to show foot moving right to 'ghost' accelerator and back left to initial position as if to move from accelerator to brake.
  - Most low speed incidents (< 10km/h)…some up to 30km/h
  - Some involve vehicle "creeping" along prior to incident
  - Some form of head, body, steering movement present in most, but not all, cases
    - Potential for distraction and/or cognitive load to be a factor?

Characterising the problem

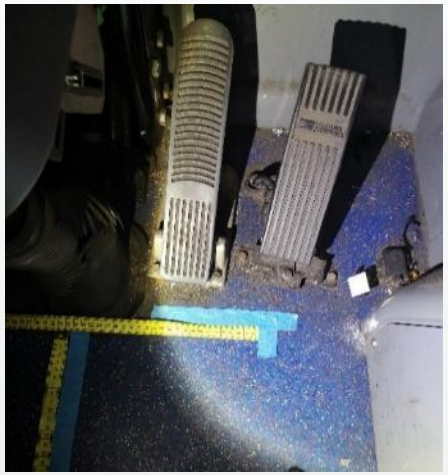


Pedal layout – ISO 16121

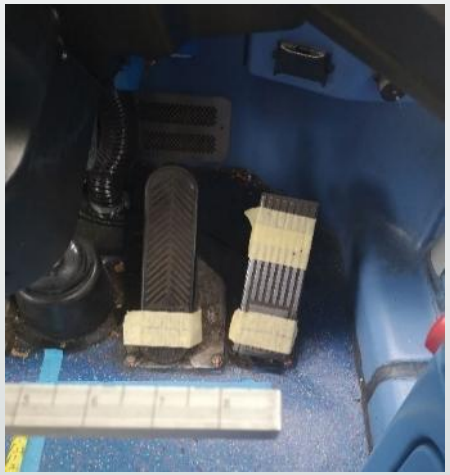
- Defines position and arrangement of pedals
- Not a mandatory standard but bus manufacturers cite this as the basis for their pedal designs

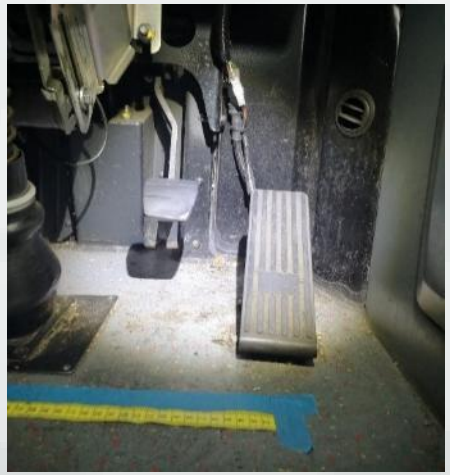


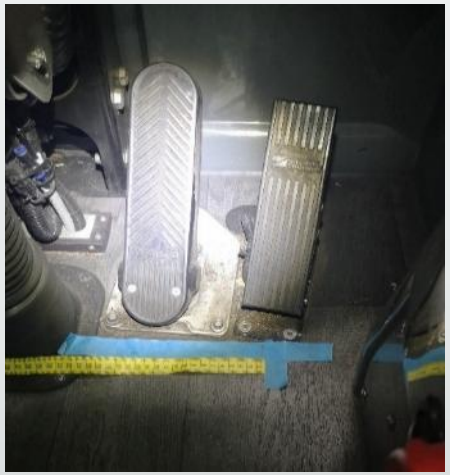
Pedals, pedals, pedals

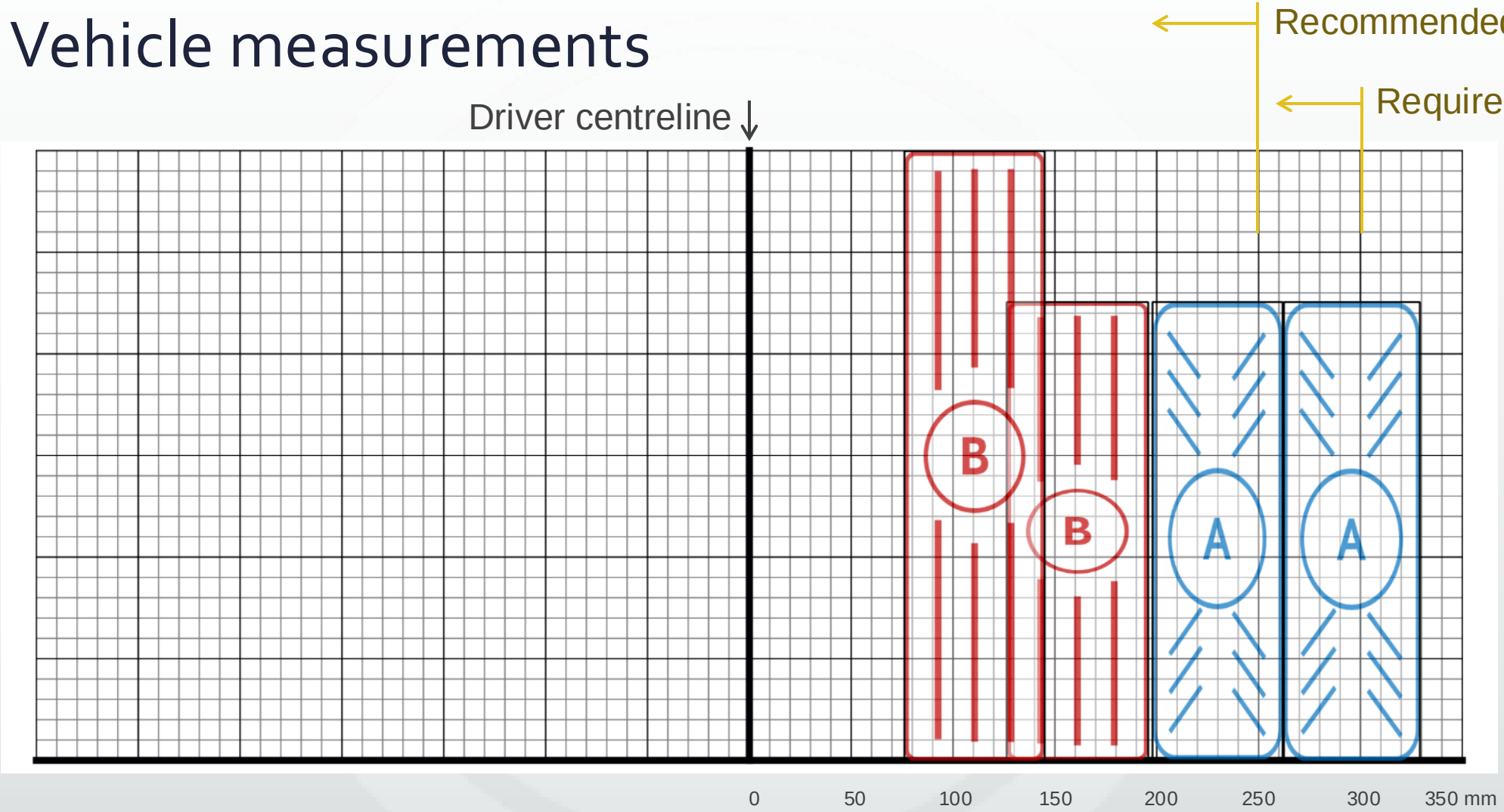






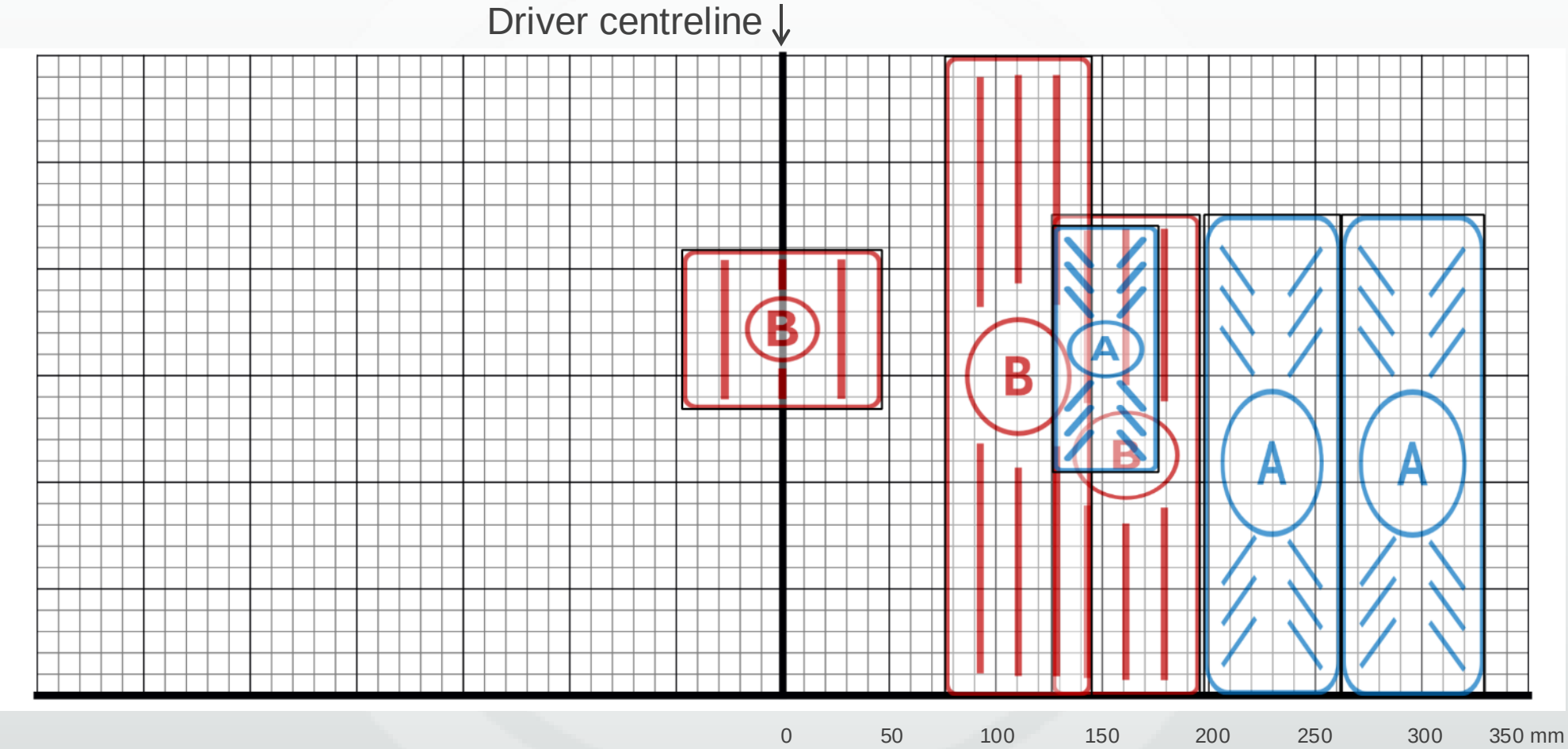


Vehicle measurements



Leftmost and rightmost pedals

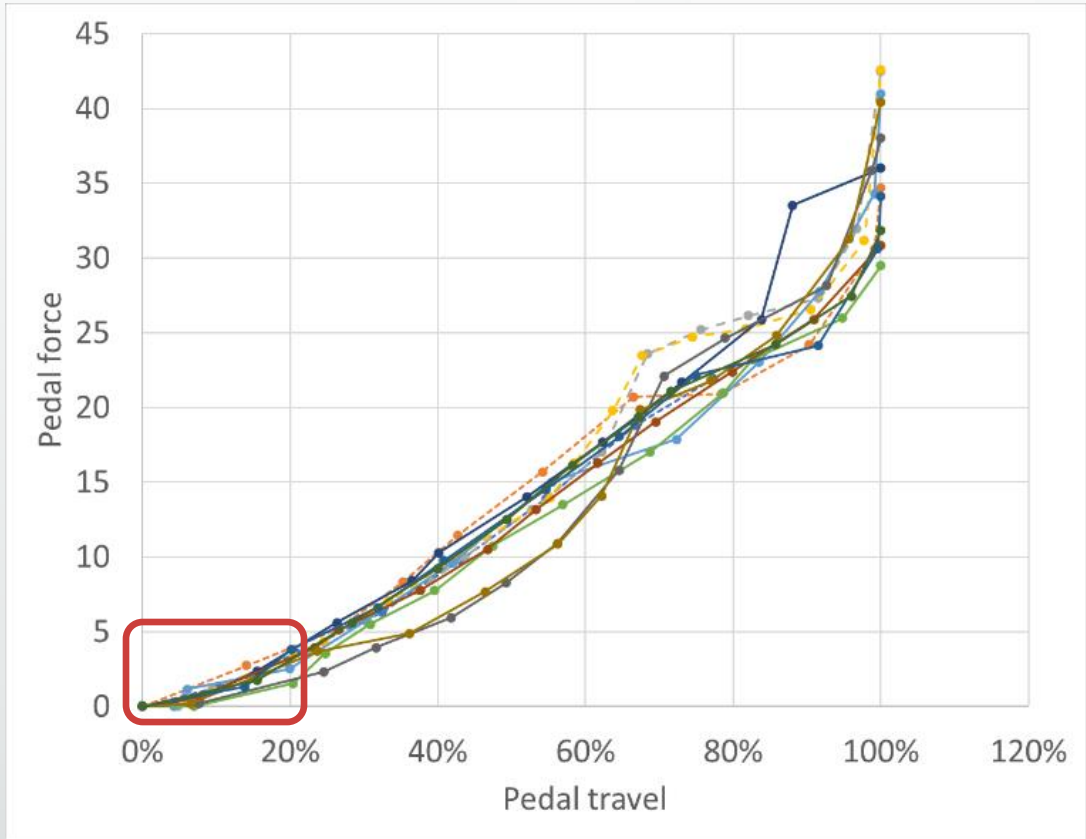
Vehicle measurements



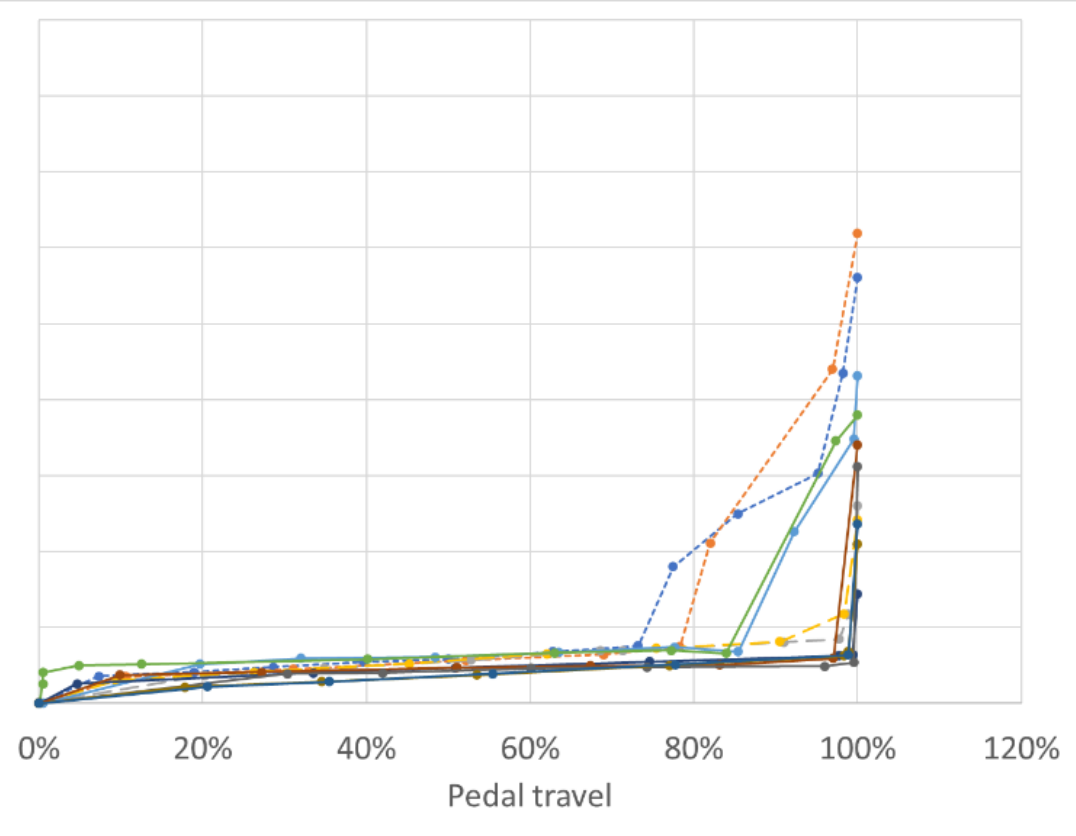
Leftmost and rightmost pedals and a typical car layout

Pedal feel

Brake pedal

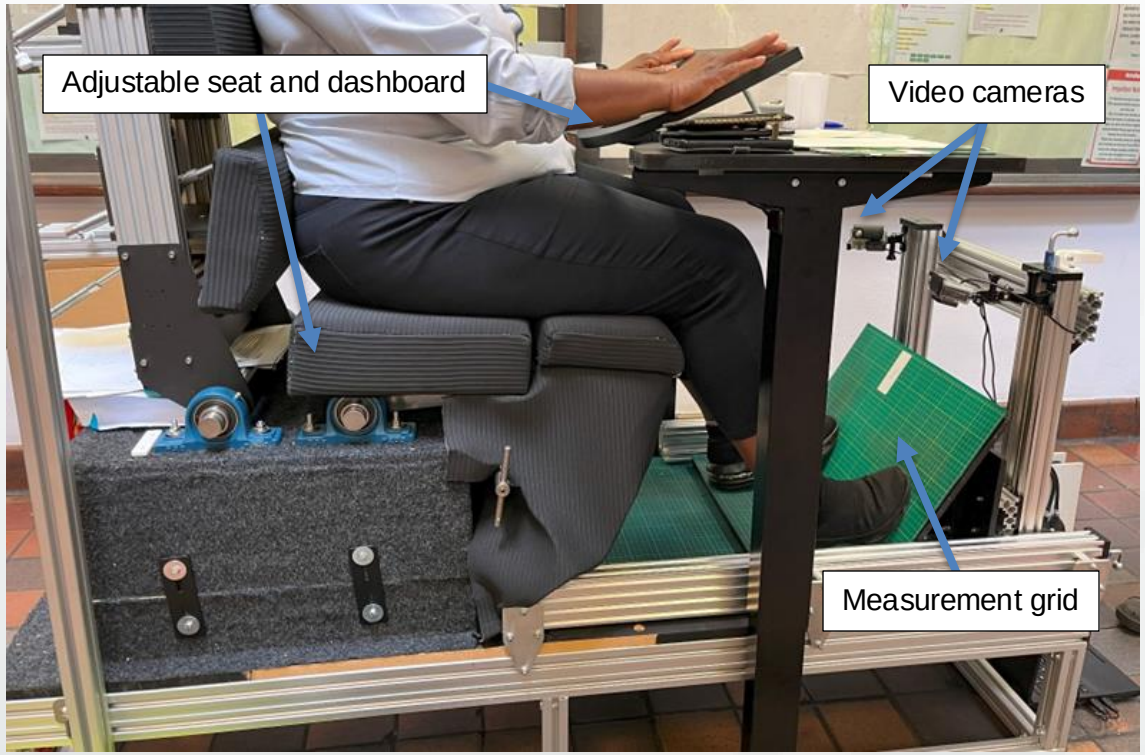


Accelerator pedal

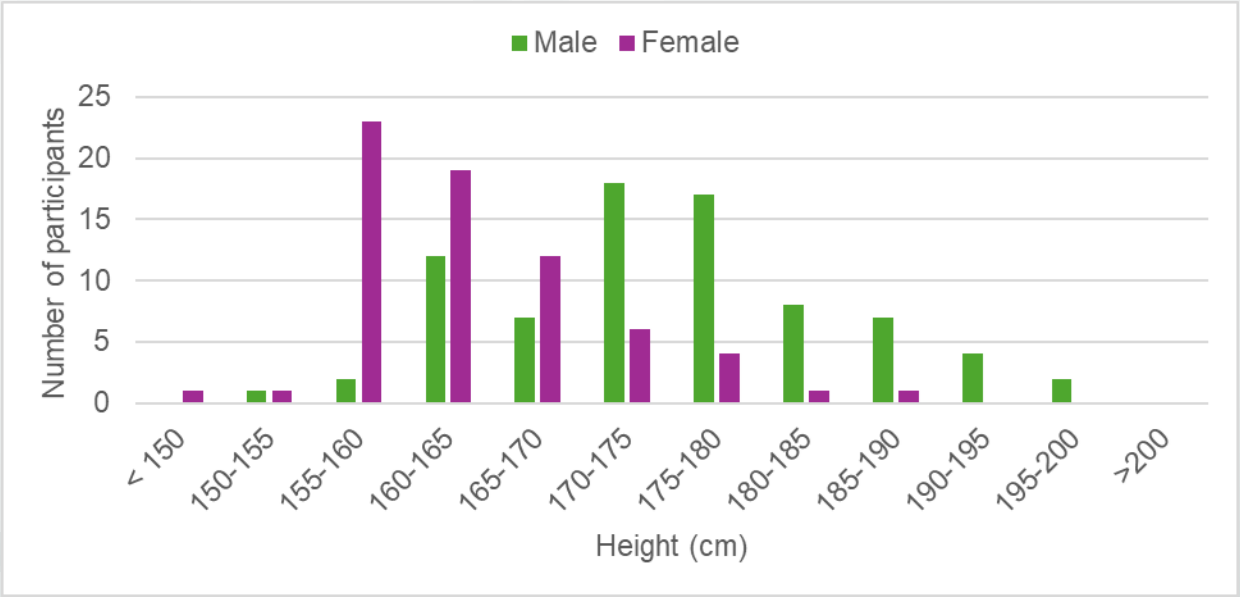


Over 99% of brake applications are very gentle

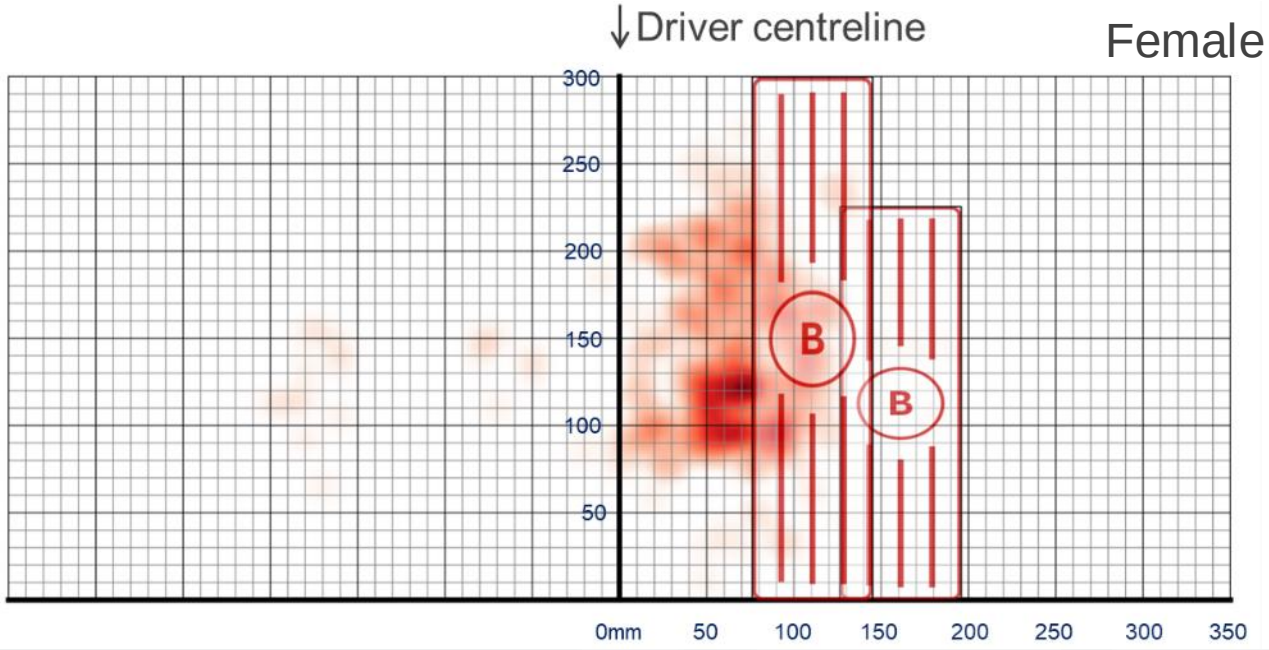
Driver expectation of pedal position

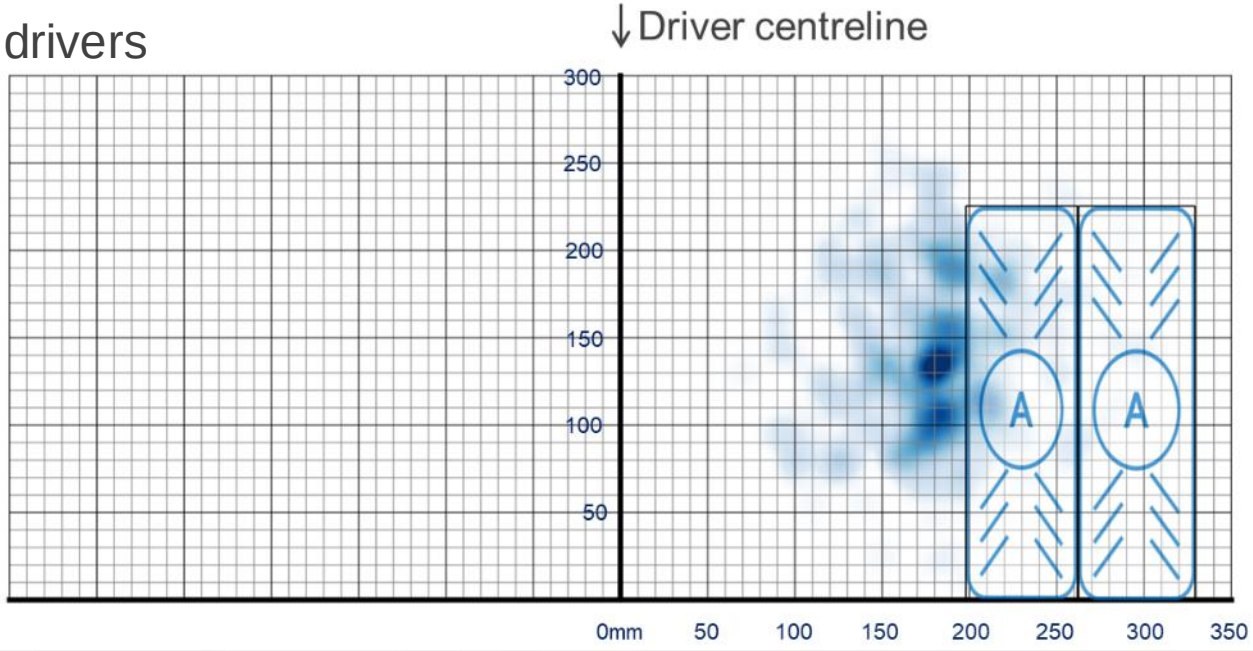


146 drivers
68 females & 78 males

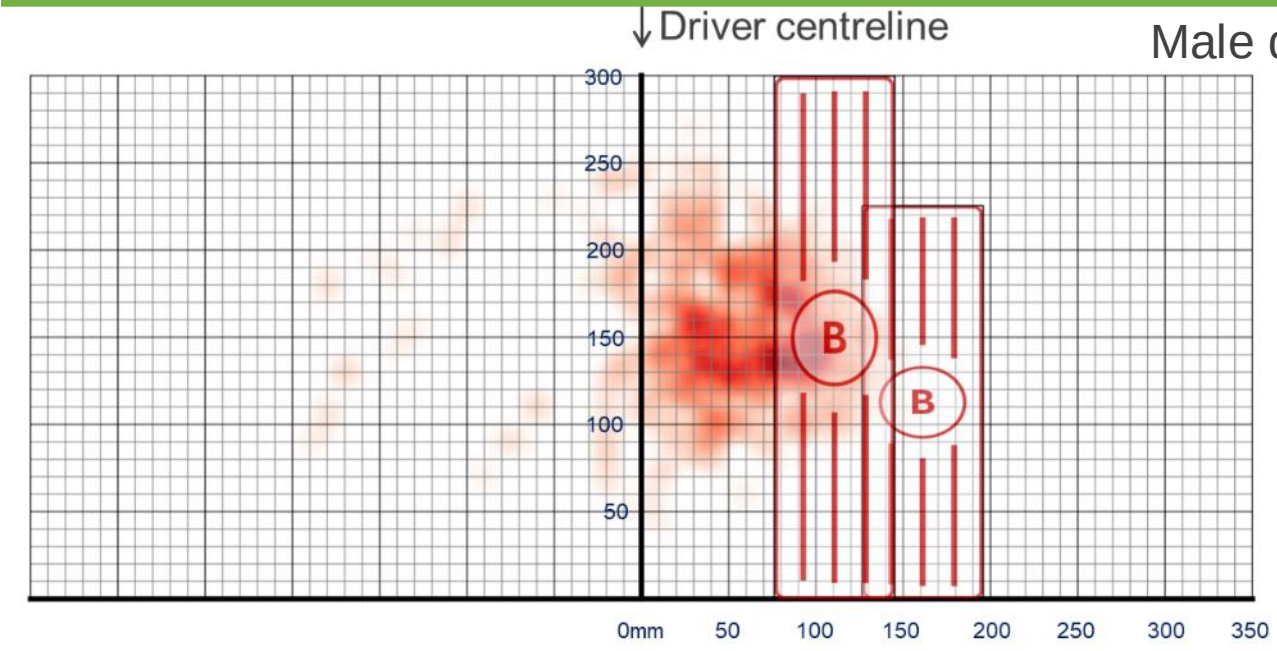


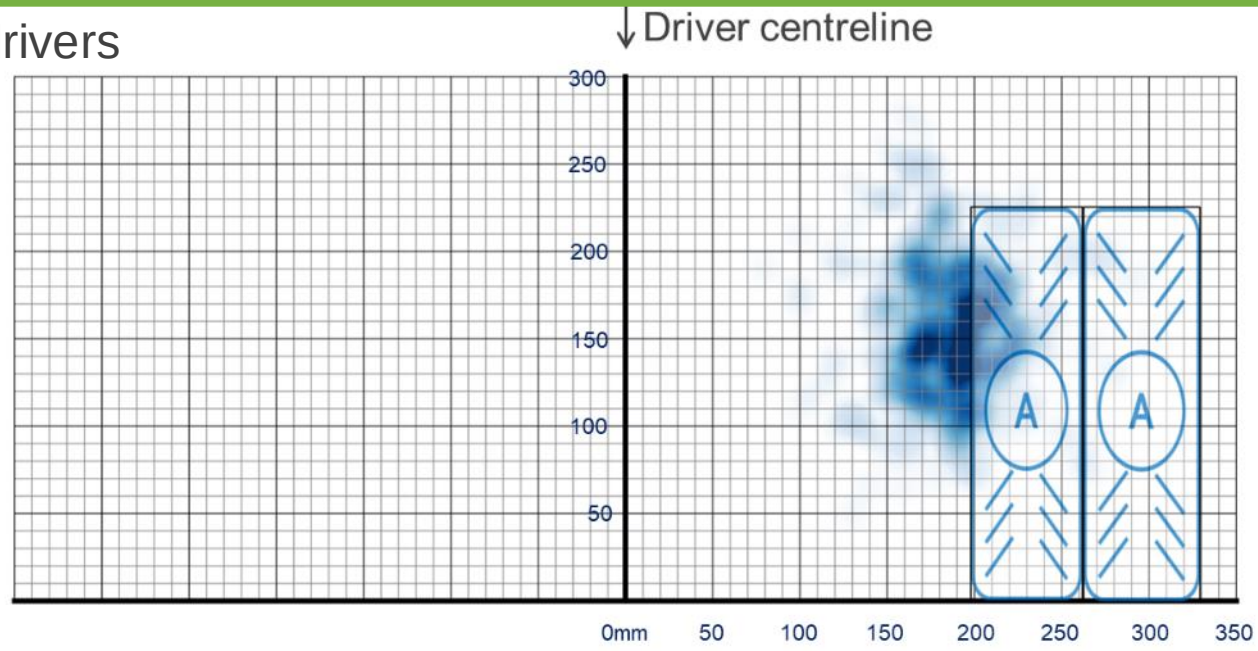
Female drivers





Male drivers





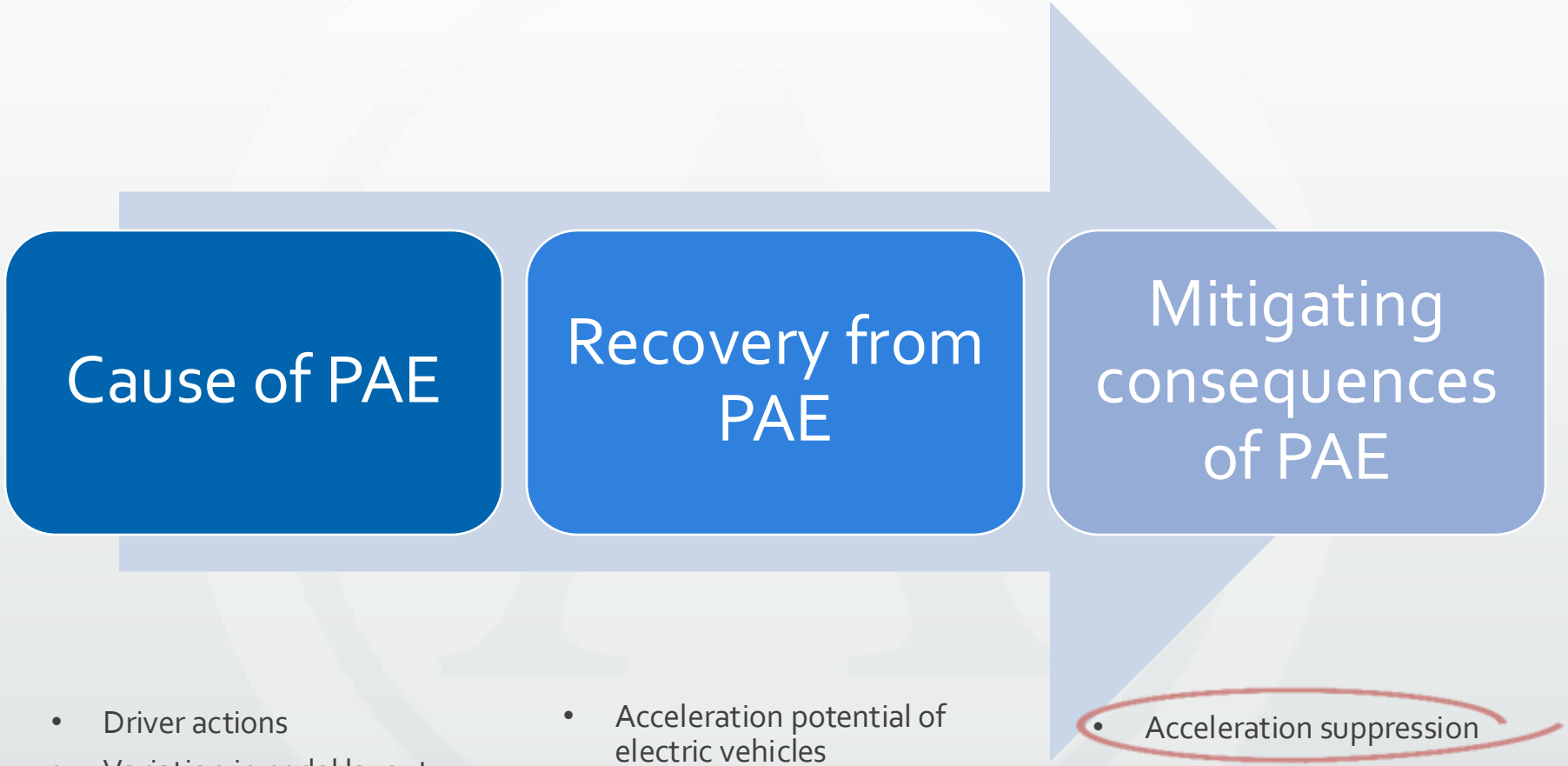
Pedal layout - summary

- Some variation in pedal position evident across buses
- Some potential to reduce variation by using recommended values in ISO 16121

- Pedals likely feel very similar for the majority of day-to-day driving
- Could improve differentiation by using different pedal types

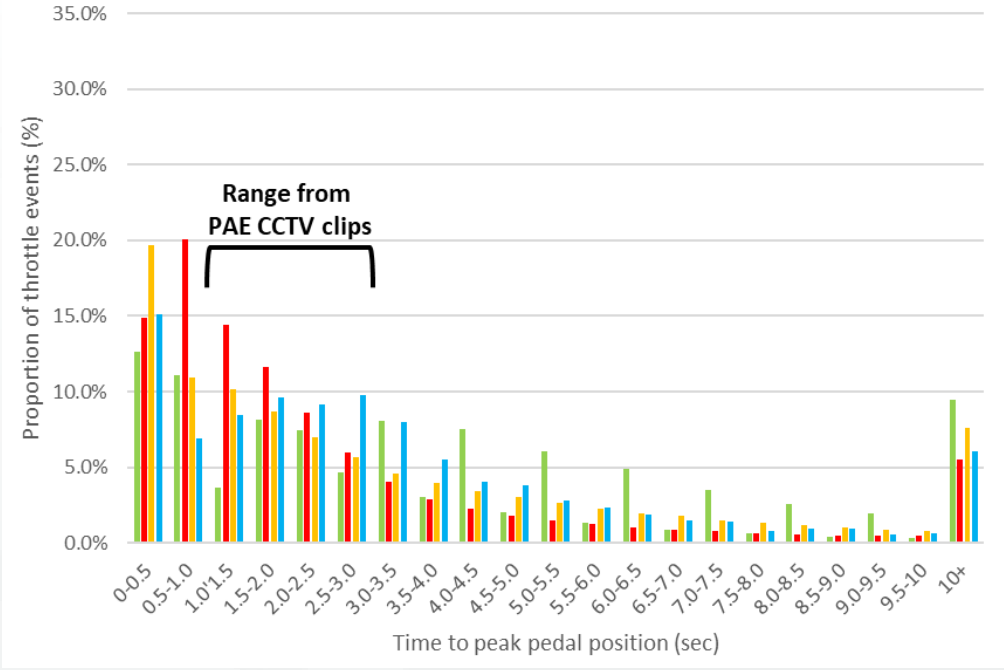
- Various options currently under consideration by TfL

Characterising the problem



Acceleration suppression

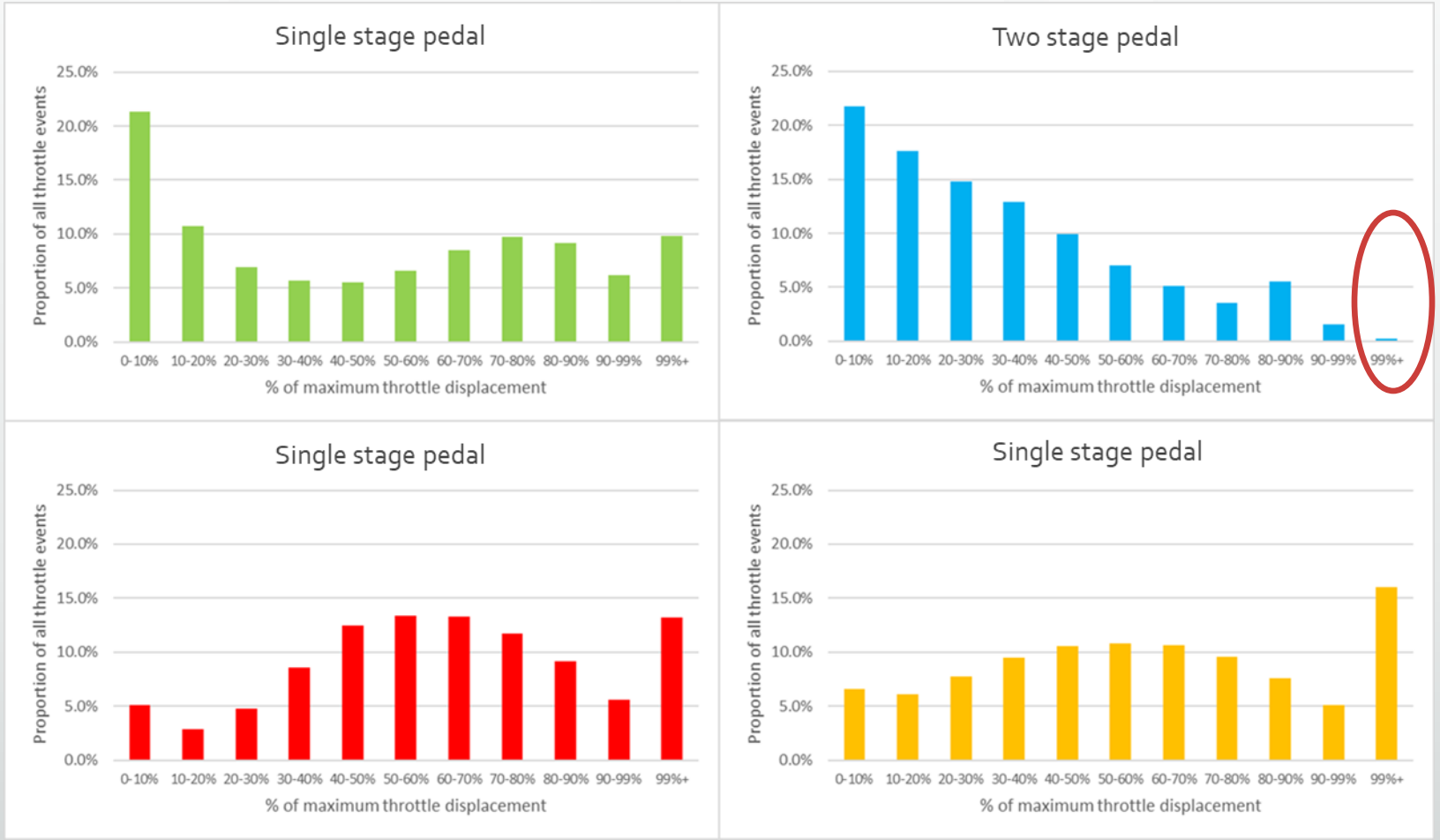
- How best to detect a PAE incident?
- Pedal speed
  - CCTV footage shows relatively slow pedal application
  - Considerable overlap to distribution for normal driving



- Pedal force
  - CCTV shows drivers often "standing" or "squirming" on the accelerator pedal, thinking it's the brake

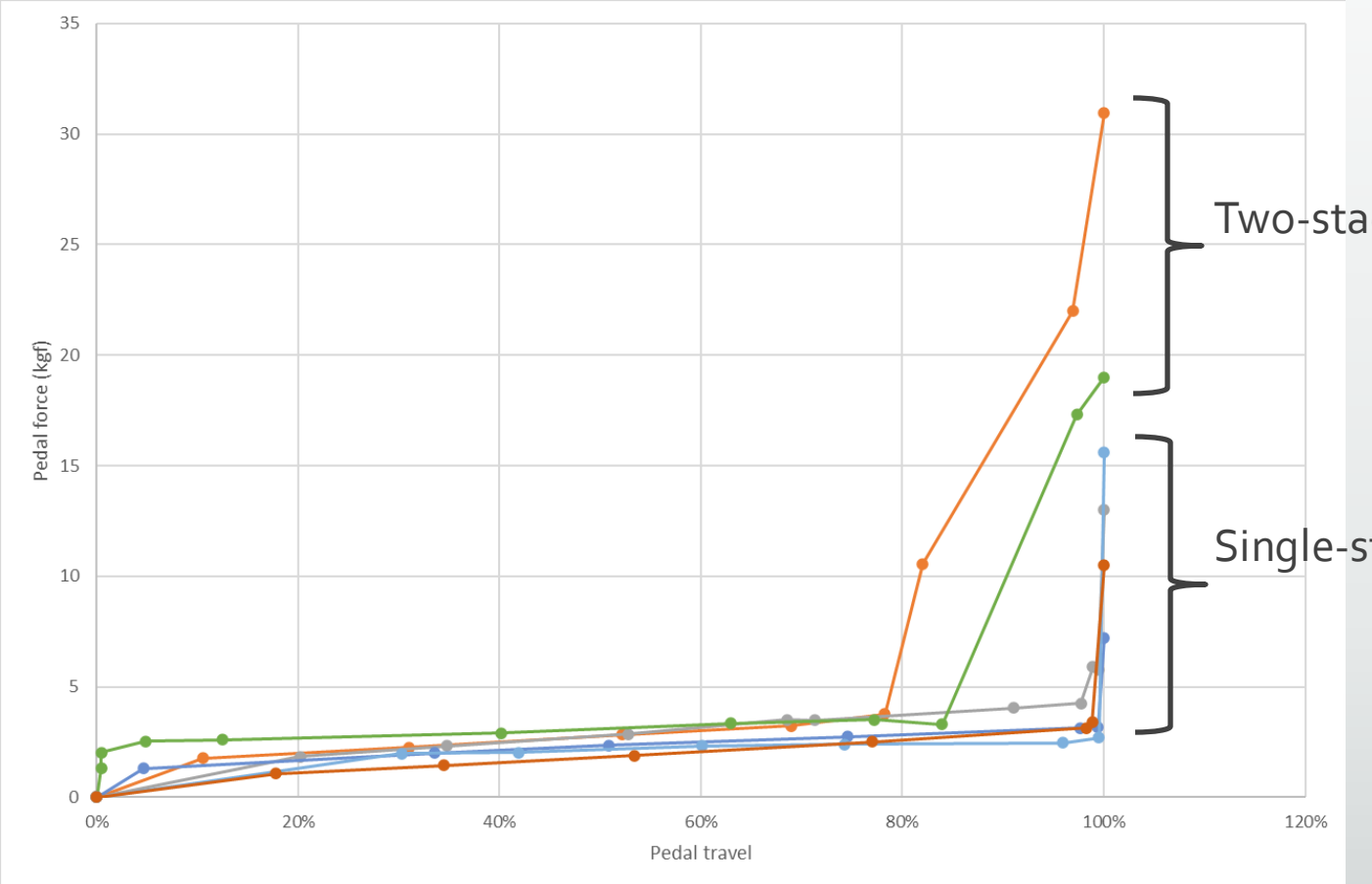
Acceleration suppression

- Pedal data highlighted far fewer full throttle events for buses with two-stage accelerator pedal



Acceleration suppression

- Buses with two-stage pedal require more force to reach 100% displacement



Acceleration suppression

- If drivers press the accelerator pedal hard during PAE, but rarely press hard during normal driving…
- Can the second stage of the accelerator pedal travel be used to activate an acceleration suppression system and stop prolonged PAE events?
- Initial trial underway to investigate further.

High level trial plan

1. 10 buses - Configure telematics & calibrate pedals
2. Gather data with current pedal layout (~1 month)
   Collect CCTV footage of full throttle events
3. Modify spring stiffness (replace spring or change pre-load)
4. Gather data with modified spring(s) (~1 month)
   Collect CCTV footage of full throttle events
5. Decide next steps: More data? Wider rollout? Address any technical issues

Stakeholder engagement

Thank you

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