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Pedal Error Among Car Drivers: A Review on The Research Approach and Setup

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Abstract – *The movement of the driver's foot from one pedal to another is a blind positioning movement. Variability of driver's foot movement might lead to pedal error or pedal misapplication. In this paper, we reviewed the research focus in the pedal error study, who are the participants involved in the study, what kind of approach or method used to perform the pedal error study, how is the test setup, test condition, and flow of the study, and what are the factors influencing the pedal error accidents. The review searched relevant articles based on five keywords: pedal errors, pedal misapplication, sudden unintended acceleration (SUA), automotive foot pedals, and sudden acceleration accidents. Based on the review, the research focus is focusing on the factors causing the pedal error, understanding the fundamental principles of pedal misapplications, and characteristics of pedal errors among older drivers. The pedal error study has been conducted either using the naturalistic driving, driving simulation, or survey. The pedal error among ASEAN drivers is essential since there is no study related to this topic has been conducted in any ASEAN countries yet.*

Keywords: Pedal error, pedal misapplication, sudden unintended acceleration (SUA), foot pedals

1.0 INTRODUCTION

Motor vehicle accidents are one of the most dominant causes of deaths, disabilities, and hospitalization. According to a report by the Department of Road Safety, Malaysia, there are about 30.2 million vehicles registered in Malaysia for the past 10 years (JKJR, 2019). Two dominant types of vehicles are motorcycles (45.85%) and passenger vehicles (47.36%) from the total number of registered vehicles. Based on a report, from January 2018 to December 2019, a total of 9,355 deaths is recorded from road accidents that occurred in Malaysia (JKJR, 2019). The motorcycle and passenger vehicles user dominates the number of deaths with 84% of the death came from these two groups. Based on research conducted by the Malaysian Institute of Road Safety (MIROS), 80.6% of road accidents occurred due to human error, 13.2% due to road conditions, and only 6.2% of the accidents happened due to vehicular factors (JKJR, 2019).

Even though the causes of accidents identified in Malaysia are quite general, sudden unintended acceleration (SUA) is one of the serious issues which causes injuries and deaths every year on the road. In Malaysia, sudden braking is one of the critical issues highlighted as one of the sources of road accidents. The SUA is an unintended, unexpected, and high-powered acceleration from a stationary or moving condition accompanied by an apparent loss of braking effectiveness (Wu et al., 2014). The unintended acceleration could also happen when a driver intends to press his/her right foot on the brake while shifting from Park (P) to a drive gear (drive (D) or reverse (R)) but ended up stepping on the accelerator pedal (full-throttle acceleration and cause a crash) (Schmidt & Young, 2010). Several authors have considered that pedal error is the major factor of these kinds of accidents (Jonas et al., 2018; Schmidt & Young, 2010). Pedal misapplication events resulting in crashes have been a topic of discussion for decades (Padmanaban et al., 2013). Over the years, there are designers out there trying to develop various combined brake–accelerator pedals in an effort to eliminate the operator's risk of pressing the wrong pedal (Nilsson, 2002).

The literature review conducted searches in the technical peer-reviewed article as well as news in the media. The following keywords are used to determine the articles: pedal errors, pedal misapplication, sudden unintended acceleration, automotive foot pedals, and sudden acceleration incidents. The news in the media searched also used the same keywords and try to find related news within the ASEAN countries especially in Malaysia. The review focused on elaborating several topics related to the research on the pedal error such as the research focus, target group, research approaches and methods used, and the test apparatus or instruments used to perform the study.

2.0 RESEARCH FOCUS AND TARGET GROUP

There are several research areas related to the pedal error study. Research by Wu et al. (2017) in the United States of America (USA) aims to examine the factors which might cause pedal errors. In their study, they look into how the pedal application types related to the foot placement on the pedal. Moreover, the research performed also investigates whether the error is related to the previous foot locations or not. Meanwhile, a study explored the effect of phone conversations and other potential interference on reaction time (RT) in a braking response (Consiglio et al., 2003). A questionnaire survey was conducted among the elderly aged 65 years and above to explore key issues with the driving experiences of older compared with younger drivers (Karali et al., 2017).

Deng et al. (2019) studied the correlation between pedal operations (foot maneuvers) and drivers' workload by using the mechanism of workload on sloped segments of mountainous roads. The study performed naturalistic driving tests on two-lane mountainous roads in China. Another research examined two classes of accidents and their relative frequencies which aimed to understand fundamental principles of pedal misapplications (Schmidt & Young, 2010). The study is performed by reviewing the accident records from the USA National Highway Traffic Safety Administration (NHTSA) accident database for the years from 1979 to 1995. Besides that, Padmanaban et al. (2013) also using police-reported crash data (the year 1994 to 2009) to determine crash characteristics and other contributing factors from the pedal misapplication events. Another research conducted aimed to compare the differences in braking response to vehicle collision between an active human emergency braking (control condition), cruise control (CC), or the adaptive cruise control (ACC) (Jammes et al., 2017a). McGehee et al. (2016) studied the cause(s) of the apparent increase in single-vehicle run-off-road crashed and the decrease in multi-vehicle on-road crashed as vehicles transition from conventional brakes to ABS. Some publications concentrate on the ergonomics topic (sitting position). Horiue et al. (2012) performed a study to determine whether the distance between the pedals is affected by the driver's seating height. The study investigates whether sitting lower or higher affecting the accuracy of stepping on the pedals from the gas pedal to the brake pedal or not.

Meanwhile, there are a few studies that targeted older drivers. Researchers attempted to explore how the older drivers use their accelerator and brake pedals (Transportation, 2013), to assess to what extent specific cognitive functions contribute to pedal errors among older drivers (Freund et al., 2008), to understand pedal usage characteristics of older drivers during on-road driving tasks in an instrumented vehicle (Xi et al., 2018), and to investigate the characteristics of pedal errors by the older drivers relate to sudden unintended acceleration (SUA) incidents (Wu et al., 2014). Several objectives highlighted are to determine whether is the medical status, sex, or anthropometry associated with drivers' foot positions and movements or not. There is also a study that investigated pedal movement trajectories in older drivers during on-road driving in response to variable traffic light conditions (Sharpe et al., 2017).

Numerous studies have attempted to explain the construction of their test setup and apparatus. Tran et al. (2012) introduce two multi-modal driving testbeds (including both a real-world vehicle and a driving simulator) by describing two novel joint audio-visual driving experiments and databases. The setup was built for investigating driver pedal misapplication errors. Another study by Yuda et al. (2020) discussed the development of a simple system consisting of a laptop computer and a three-pedal foot mouse to measure response time (RT), accuracy, and flexibility of pedal application to visual stimuli. The developed system displayed two open circles on the computer display, lighting one of the circles in random order and interval. During the study, the subjects were instructed to press the ipsilateral or contralateral foot pedal, depending on the operation mode, with their right foot as quickly as possible when the circle was lit. Meanwhile, Groeger and Murphy (2020) performed a study to determine whether the simulators validly reflect real-world driving and to what extent do different aspects of driving relate to each other.

The target group (participants) who were involved in several studies related to pedal error are among the young and senior drivers. The research targeted young drivers are in aged between 18 to 27 years old (Consiglio et al., 2003; Groeger & Murphy, 2020). Meanwhile, most of the other studies recruited participants aged between 22 to 65 years old (Deng et al., 2019; Jammes et al., 2017b; McGehee et al., 2016; Mcgehee et al., 2000; Tran et al., 2012; Wu et al., 2014). All studies performed required the participants to have a certified driving license from the authority.

3.0 RESEARCH APPROACH

3.1 Naturalistic Driving

The first research approach to be discussed in this section is the naturalistic driving method. Several researchers performed the pedal error study by performing naturalistic driving. The naturalistic driving study can be defined as a study undertaken to provide insight into driver behavior during everyday trips by recording details of the driver, the vehicle, and the surroundings through unobtrusive data gathering equipment and without experimental control (Barnard et al., 2016). Wu et al. (2017) used event-triggered video recorded during naturalistic driving to experimenting with the factors that might cause pedal errors. The study performed used a palm-sized device integrated with two video cameras (for forward and interior view), two foot-well cameras, a 3-axis accelerometer, Global Positioning System (GPS), two infrared illuminators, and a wireless transmitter. The device was mounted on the windshield behind the rear-view mirror to capture the audio and video inside the vehicle, and video of the outside vehicle. The pedal application types were classified into the wrong pedal, miss, both pedals pressed, and pedal slip.

Another naturalistic driving study is performed by NHTSA. The study was conducted to focus on exploring how older drivers use their accelerators and brake pedals (Transportation, 2013). Firstly, there was an in-clinic assessment to determine the physical functioning, cognition, perceptual-motor abilities, and vision of the participants. Then, the elderly started driving an instrumented vehicle over a 27-mile course. The foot movement study evaluated driving performance was determined by using two different methods. First, the data from vehicle instrumentation, and secondly using the scores from a certified driving rehabilitation specialist (CDRS). NHTSA also performed the driver-vehicle fit study to measure the anthropometric data such as participant's height, upper leg (femur) length, lower leg (tibia) length, foot length, and distance from knee to the ball of the foot when participants sit in their vehicles and the right foot placed on the brake pedal. The recorded anthropometric data is to determine whether the driver's sex or anthropometry are related to driver-vehicle fit.

Deng et al. (2019) also conducted a naturalistic driving study to observe the correlation between pedal operations (foot maneuvers) and drivers' workload and the mechanism of workload on sloped segments of mountainous roads. The naturalistic driving test is performed at three mountain road segments with two-lane mountainous roads located in Fengjie County, Wuxi County, and Yunyang County in Chongqing, China. A 7-seater multi-purpose vehicle (MPV), Toyota HiAce is used for the study. The Forsentek force sensors measured the forces acting on the accelerator and brake pedals, while an electrocardiograph (ECG) was used to record the electrocardiographic signals of the drivers during driving.

Another research performed by McGehee et al. (2016) to examine the pedal foot behavior also used the naturalistic driving approach. The actual test drive took approximately 15 minutes. Each participant is required to complete 3.5 laps of a large, two-lane "figure 8" course at 45 mph on dry pavement (Mcgehee et al., 1998). Meanwhile, Groeger and Murphy (2020) conducted an on-road driving which the participants drove for approximately 30 minutes along a fixed route comprising urban, suburban, and rural stretches of roadway. The driving performance was evaluated by an assessor who noted the type and seriousness of errors committed en route, following the state driver assessment protocol.

A study by Tran et al. (2012) has introduced a real-world driving testbed named LISA-P. The instrumented car was designed with placeholders and wire connections for the installation of multiple cameras and microphones. LISA-P is instrumented with a novel laser-based see-through windshield display where they can display visual feedback to the driver. The auditory feedback is provided using the speakers. The naturalistic driving test experiment was conducted in an empty parking lot. The participants need to drive a simple rectangular course given a set of designed pseudo-random sequences of cues, to brake or accelerate. The cues are presented to the driver visually, by audio, or using both audio and visual simultaneously, in a short time interval between 2 to 4 seconds.

3.2 Driving Simulation

The second approach implemented for the pedal error study is by doing a driving simulation. According to Yadav and Singh (2014), a virtual driving simulator is a device that allows users to feel a life-like experience of driving an actual vehicle within virtual reality. Driving simulation is commonly used to study the interaction of a driver and vehicle for human factor study, vehicle safety research, or the development of new vehicle systems. A study by Tran et al. (2012) has introduced a driving simulator known as LISA-S. The simulator setup comprised of eye/head tracking system FaceLAB, cameras for visual inputs (looking at driver's head, foot, and upper body), microphones for audio inputs, and a skin conductance sensor for physiological signals. The experiment was conducted to investigate the pedal errors.

Another study by Consiglio et al. (2003) used a test setup consists of a chair assumed posture similar to driving, a red lamp that is 5cm in diameter, positioned 2 m from participant's eyes with a visual angle of 1.4 degrees. The research was performed to investigate the effect of phone conversations and other potential interference on reaction time (RT) in a braking response (Consiglio et al., 2003). The participants were requested to release the accelerator pedal and depress the brake pedal as quickly as possible following the activation of a red brake lamp. There are five conditions studied which are control, listening to a radio, conversing with a passenger, conversing using a hand-held phone, and conversing using a hands-free phone. A researcher from the University of Iowa performed a study to determine driver reaction time in crash avoidance in an intersection incursion crash scenario. The experiment was conducted by using Iowa Driving Simulator (IDS) (Mcgehee et al., 1998). They used four multi-synch projectors to create a 190-degree forward field-of-view and a 60-degree rear-view. Meanwhile, Freund et al. (2008) explored the extent to which specific cognitive functions contribute to pedal errors among older drivers. The study was conducted by using the STISIM Driver, which is a driving simulator to evaluate the driving performance among the elderly.

Wu et al. (2014) run a study to investigate the characteristics of pedal errors by younger and older drivers relate to sudden acceleration (SUA) incidents. The study was conducted by using a series of simple visual stimuli (colored filled circles) to examine how the difficulty of the task and foot movement sequences affected the pedal operation (Wu et al., 2014). The Mini-Mental State Examination (MMSE) was tested to screen for cognitive status and designed to assess basic mental functioning. For instance, an individual's ability to recall specific facts, write, calculate numbers and draw. The data analysis, such as computed mean pedal error rate for each subject in each condition was collected. The response time (RT) was calculated from the time of the onset of the visual stimulus to the time when the accelerator or brake pedal was pressed. Meanwhile, Groeger and Murphy (2020) used a driving simulator where the drivers sat in a real vehicle and the controls connected to the STISIM console. The study performed to determine the simulators validly reflect real-world driving. The desktop simulator used three linked PC screens, a Logitech 27 steering wheel, gear lever, accelerator, brake, and clutch pedals. Simulated driving tasks contained free driving, braking task, car-following task, pedestrian obstruction task, vehicle obstruction task, lane-change task, and curve-driving task.

Palmertz et al. (1998) explained that there were two emergency situations presented to the subjects which are controlled braking and emergency braking situation. During this simulation, the foot placement was sampled from the videotape and analyzed twice during the driving simulation. The brake pedal surface is divided into nine different areas to locate the position of the right foot of the participants. A study by Wu et al. (2018) that used an instrumented vehicle secured in a stationary position where the drivers were guided to complete a series of pedal response task. The given task is based on traffic signals that would be shown horizontally with the red light on the left side and the green light on the right side (Wu et al., 2018). The entire foot movement process of the participants was recorded.

3.3 Other Approaches

Hasegawa et al. (2020) explored the simulation test by using the touch number task. It started with the presentation of a yellow traffic signal on the screen. While it was presented, participants were required to perform the touch number task. They were asked to touch the numbers in ascending order quickly and accurately. When the alert tone was presented, they were asked to give priority to the pedal choice response task, look at the front screen and step on either brake pedal for a red traffic signal or accelerator pedal for a green traffic signal. They had to stop the touch number task immediately after the onset of the alert tone.

A few researches have carried out a study to examine two classes of accidents and their relative frequencies, and to understand fundamental principles of pedal misapplications (Schmidt & Young, 2010). The study was initiated by searching the keywords. The subset with more detailed keywords was searched to isolate accidents thought to be caused by pedal misapplications. They have read the remaining narratives to verify that the accident was related to pedal error and reviewed the accidents. The accident narratives were categorized after searching the accident database to characterize NHTSA-defined unintended acceleration episodes. Meanwhile, Wu et al. (2017) think that questionnaire plays a vital role in determining the factors that might cause the pedal errors. It consists of series of questions which are age, gender, education, driving history, and daily driving behavior.

4.0 METHODOLOGICAL APPROACH

Figure 1 shows the location of the camera and sensors placed by several researchers in a car cabin to study the pedal error using the naturalistic driving approach. Table 1 describes the details of the equipment used (camera, sensor, etc.) for the naturalistic driving study performed by several researchers. Most of the researchers placed the camera on the car windshield. The camera recorders are mounted on the windshield behind the rearview mirror (Deng et al., 2019; Transportation, 2013; Wu et al., 2017). A camera that integrated two video cameras was used to capture the audio and video inside the vehicle, and video only outside the vehicle (Wu et al., 2017). A 5 MP in-vehicle camcorder was used by Deng et al. (2019) and a Weldex WDB 5407 SS 1/3” color bullet camera (Transportation, 2013). The other location of the cameras was placed at the foot-well of the driver seat to capture the movement of the feet during the experiment. The cameras used to capture the accelerator, brake pedals, and the heel of the driver were positioned on the underside of the dash (on the driver side) and at the center console (in the driver's footwell) (Transportation, 2013). Similar positions of attaching foot-well cameras were used in the study by Wu et al. (2017). Five cameras were equipped in the study by Tran et al. (2012) for video capture which aimed to capture the driver's upper body, face, foot, and looking forward.

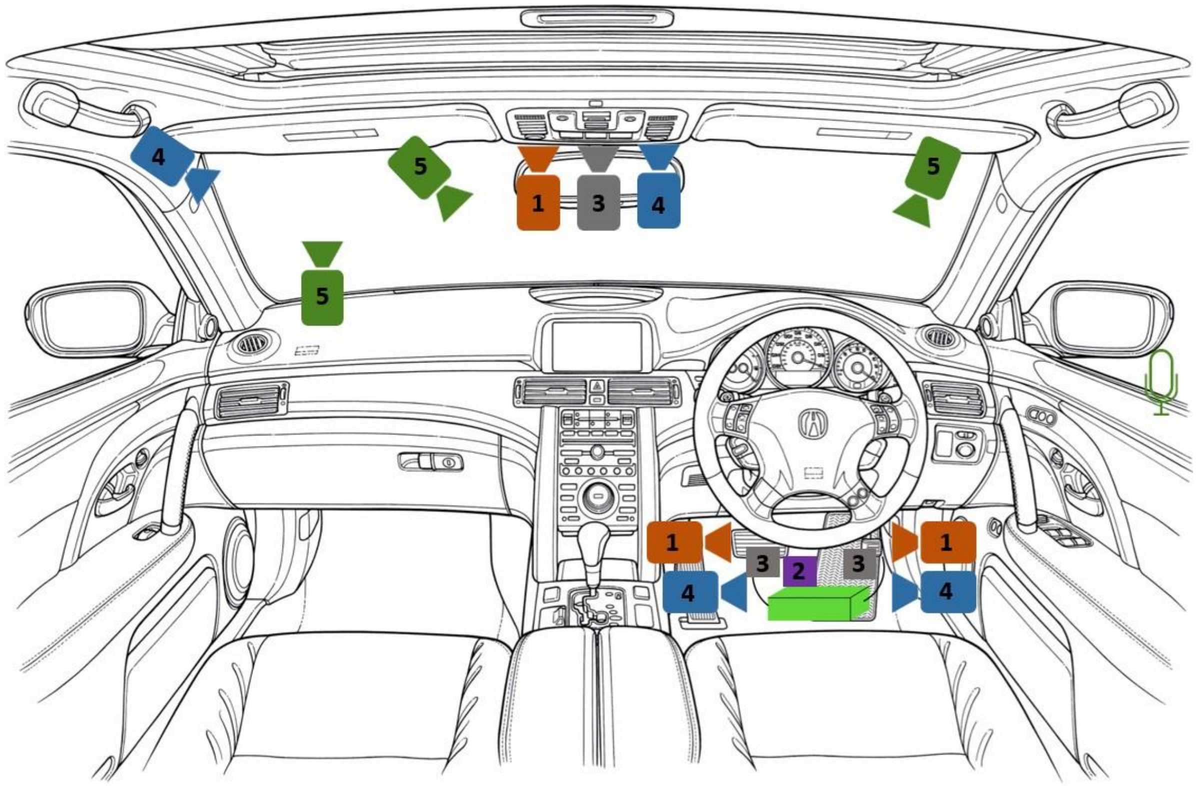

Figure 1: The location of the camera and sensors placed by several researchers inside a car cabin for pedal error study (1) (Wu et al., 2017), (2) (Jammes et al., 2017a) (3) (Deng et al., 2019) (4) (Transportation UD, 2013) (5) (Tran et al., 2012)

Wu et al. (2017) used a three-axis accelerometer in their study. Scaime model K22 compression load cell was fixed under the brake pedal, Scaime model ZF100 articulated support of accelerator pedal, electric contacts that fixed on the accelerator pedal, brake pedal, and vehicle floor in front of the accelerator pedal (Jammes et al., 2017a). Forsentek force sensors, LPMS micro-mechanical, VBOX, and Li Kang electrocardiograph were used by Deng et al. (2019) in their study. A Tekscan F-Socket2 Versa Tek System was used on the pedal and a MatScan System used on the floor (Transportation, 2013). A GPS system was used in both of the studies by Wu et al. (2017) and Transportation (2013). A study by Hasegawa et al. (2020) used Driving Force G29 to measure the pedal choice responses.

Figure 2 shows the location of the camera and sensors placed by several researchers around the driving simulator to study the pedal error using the driving simulation approach. Table 2 describes the details of the equipment used (camera, sensor, etc.) for the driving simulation conducted by several researchers. However, a simulation by Palmertz et al. (1998) used four cameras in the footwell to obtain the top view of the shoe, left side, right side, and rear view including one camera facing the upper part of the subject's body and face.

Table 1: The camera, sensor, or equipment commonly used in the naturalistic driving study

Naturalistic Driving	
Author(s)	**Camera / Sensor / Equipments Used**
(Wu et al., 2017)	• 1 palm-sized device that integrated two video cameras (forward and interior view), 2 foot-well cameras, 1 three-axis accelerometer, GPS, 2 infrared illuminators, 1 wireless transmitter
(Jammes et al., 2017a)	• Compression load cell Scaime model K22 (fixed under the brake pedal), articulated support of accelerator pedal Scaime model ZF100 (connected to a push-pull rod load cell), electric contacts (fixed on accelerator pedal, brake pedal, vehicle floor in front of accelerator pedal, 3 signal outputs fed to a numerical oscilloscope.
(Deng et al., 2019)	• 35MP in-vehicle camcorders (front, right, rear sides of vehicle), Forsentek force sensors (forces acting on accelerator and brake pedals), LPMS micro-mechanical (to record accelerations in lateral, longitudinal and vertical directions, and the driving attitude), VBOX including DGPS with 40cm level performance (to record movement and speed), electrocardiograph (to record ECG signals of the drivers)
(Transportation, 2013)	• 5 Weldex WDB 5407 SS 1/3” color bullet cameras, 1 Tekscan F-Socket2 Versa Tek System (pedals), 1 MatScan System (floor), GPS system
(Tran et al., 2012)	• CAN-Bus (Controller Area Network) (to read speed, acceleration, pedal positions, steering wheel angle), 5 cameras for video capture (2 for driver upper body, 1 for driver face, 1 for driver foot, 1 stereo camera looking forward), 2 microphones for audio capture

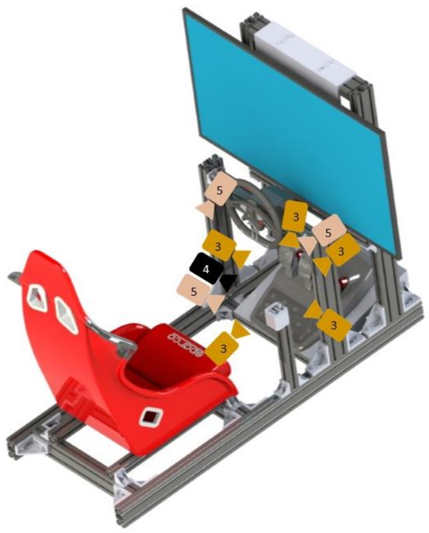

Figure 2: The location of the camera and sensors placed by several researchers on the driving simulator for pedal error study (3) (Palmerts et al., 1998), (4) (Wu et al., 2018), (5) (Tran et al., 2012)

Table 2: The camera, sensor, or equipment commonly used in the driving simulation study

	Simulation
Author(s)	**Camera / Sensor / Equipment Used**
(Groeger & Murphy, 2020)	• Visual environment augmented with active side view mirrors, rear screen on which was back-projected the rearview scene, Desk-Top Simulator: 3 linked PC screens, 1 Logitech27 steering wheel (with turn sign indicators, gear lever, accelerator, brake, clutch pedals), speakers behind or ahead of the driver.
(Hasegawa et al., 2020)	• Apple MacBook Pro (to control pedal choice response) with MATLAB R2017a (Math Works) and Psychophysics Toolbox 3, BenQ, XL2410T (liquid crystal display screen to present the stimuli), Sony, MDR-XD150 headset (to present sound stimuli), Pedal box Logitech, Driving Force G29 (to measure pedal choice responses), Tablet computer, Microsoft Surface Pro 4 with Phyton 2.7 and PsychoPy 2 (to control the touch number task)
(Palmerts et al., 1998)	• 4 cameras in the footwell (top view of shoe, left side, right side, rear view), 1 camera facing the upper part of the body, including subject's face
(Wu et al., 2018)	• Video cameras
(Tran et al., 2012)	• Cameras for visual inputs (looking at driver head, foot and upper body), skin conductance sensor for physiological signals, dedicated (commercial) eye/head tracking system FaceLAB, microphones for audio inputs

5.0 FINDINGS

The review reveals several important findings related to the pedal error study among car drivers. The study by Wu et al. (2017) has found that the driver's foot placement during an event is impacted by the foot location prior to the event. The position is also impacted by the context or environment as well as the driver's seating position in the car. Jammes et al. (2017a) have analyzed the brake reaction time (BRT) and peak braking duration (PBD) were significantly lengthened in the CC/ACC condition compared to the control condition. BRT increased with the age of participants (Jammes et al., 2017a). Consiglio et al. (2003) found that results indicated that conversation, whether conducted in-person or via phone caused response time (RT) to slow, whereas listening to music and radio did not. According to Deng et al. (2019), the brake pedal force is higher than the accelerator pedal force. The pedal force is positively correlated with the heart rate increase (HRI), and the correlation between brake pedal force and HRI is stronger than the accelerator pedal (Deng et al., 2019). According to Transportation (2013), sex did appear to affect foot positioning or variability in foot movement while medical status did not. Drivers who self-selected seat positions provided a good fit had an average functional leg reach that was about three inches longer than that of drivers who had not adjusted their seats properly was shown in driver-vehicle fit analysis (Transportation, 2013). Tran et al. (2012) suggested that factors influencing pedal errors are including driver workload, sequential effect, and cue modality.

McGehee et al. (2016) experimented with the total brake reaction time, time to initial steering, mean time from incursion start to throttle release for Iowa Driving Simulator (IDS) is less than on the test track respectively (Mcgehee et al., 1998). Freund et al. (2008) found that Clock Drawing Test (CDT) is the best predictor of unintended acceleration (UA) unlike MMSE which is a measure of general function that does not predict UA events. Wu et al. (2014) has conducted a study and found that the pedal error rates were significantly higher for the older drivers than younger drivers. Older drivers have demonstrated a longer reaction time compared to younger drivers. The rates of accelerator error were consistently two or three times higher than the rates of brake error in both younger and older drivers (Wu et al., 2014). Hasegawa et al. (2020) also found that the pedal response times of older adults were higher than younger adults. The rates of accelerator error were consistently two or three times higher among the older drivers which is more than the rates of brake error in both younger and older drivers (Hasegawa et al., 2020). Schmidt and Young (2010) have conducted a review that pedal misapplications can occur in other ways than at vehicle start-up. For instance, during a driving cycle when the vehicle has already been shifted from Park to Drive or Reverse, under which conditions the shift interlocks can no longer be effective (Schmidt & Young, 2010).

According to Groeger and Murphy (2020), there is some indication that speed, especially at the higher end, is not well simulated in either simulator, but it is somewhat better in a larger simulator. The performance in the driving simulators was not a strong predictor of performance in the on-road assessment. However, drivers typically ‘parse’ their driving experience, these units of experience, and the operations they require, are likely to be orthogonal to each other. Palmerts et al. (1998) has initiated a study and found that during ‘normal’ driving, most subjects had their left foot on the footrest while all of them had their right foot on the accelerator. A strong tendency in both braking events for men to have their heel more to the left and women more in the air during braking. A study by Wu et al. (2018) has discovered that the variances for the corrected trajectory and direct hit can be segmented into five parts. The first two parts occur at the time the foot is about to touch the pedal (Wu et al., 2018). Meanwhile, the third part was associated with the middle portion, when the foot is already raised from the floor and moving toward the pedal. The fourth part is when the driver starts lifting the foot from the floor, and the last part, which is for the entire pedal application process.

4.0 CONCLUSIONS

Based on the review, we found that researchers attempted to investigate the factors which might cause the pedal error, the correlation between pedal operation and the driver’s workload, and to understand the fundamental principles of pedal misapplications. Moreover, to date, several studies also focusing on the ergonomics topic whether sitting position affecting the accuracy of stepping on the pedal, explore how the elderly use the accelerator and brake pedals, investigate the characteristics of pedal errors by older drivers related to SUA, and the construction of test setup and apparatus for the pedal error study. The participants (target group) who were involved in the pedal error study age ranged between 30 to 65 years old, or even older. Several studies found that the pedal error rates were significantly higher for the older drivers than younger drivers due to the longer reaction time by the elderly. Besides that, the rates of accelerator error were consistently two or three times higher among older drivers. The researchers used either the naturalistic driving, driving simulation or survey method to conduct the pedal error study. The test setup needed is based on the approach used whether an instrumented car or a simulator is used for the study. Several factors identified which influence the pedal error are distraction, interruption, hit by other objects, and avoiding other objects.

Moreover, from the review, there is no study related to the pedal error has been performed in ASEAN countries yet.

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