Conceptualization of an Urban Travel Behavior Model to Mitigate Air Pollution for Sustainable Environmental Development in Malaysia

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Abstract

Purpose
Global issues on the environment such as climate change, air pollution, and carbon monoxide emission are the major concerns in any part of the world. The present study aims at constructing a conceptual framework for travel behavior performance of a commuter and it is expected to mitigate air pollution from vehicle emission and to promote smart mobility on road.

Design/methodology/approach
From the extensive literature review, the conceptual framework for travel behavior performance of a commuter has been developed and is supported by Theory of Interpersonal Behavior whose functions are attitude, social factor, affect and habit. In particular, in the present article, attitude is conceptualized by four predictors namely confidence in driving, green environment, social responsibility and deviation in driving. The social factor is characterized by subjective norm, social status, and digitalization. Affect factor is conceptualized by accidents and damages, road infrastructure and weather conditions. The mental block in following the ancestor’s way of owning a personal vehicle is the predictor for the habit.

Findings
Road traffic is one of the main contributors to environmental damages. Notably, vehicle emissions are on the rise every year due to the increase of reliance on vehicles and there is no alternative to this issue. Although Malaysia has the well-organized infrastructure with effective digitalized technology on road for the transport system, there is severe traffic congestion in Klang Valley, Kuala Lumpur, because of lack of travel plan behavior during peak hours. If the predictors constructed in the proposed conceptual framework are given the highest importance by the road commuters, then there will be much relief to traffic congestion on road.

Research limitations/implications
Since, the present study focuses on the conceptualization of an urban travel behavior model, and also highlights the synchronization of the proposed framework with the management theory, the results are expected only after the primary survey based on the cross-sectional study will be conducted.

Originality/value
The identification of the suitable predictors for the urban travel behavior model towards travel behavior performance of a commuter is the real novelty of this study. Further, the variables in the
proposed framework and the Theory of Interpersonal Behavior have been synchronized with operational definitions which are the original contributions of the present study, which will definitely enhance the sustainable environmental development for the society as a whole.

**Keywords**— Urban Travel Behavior; Road Traffic Policies/Regulations; Mental Block; Green Environment; Digitalization

1. **Introduction**

Road traffic congestion leads to loss of productivity, waste of fuel, time, skin problems and respiratory diseases is almost occurring in a day-to-day affair. Due to large number of vehicles in Klang Valley (data.gov.my, 2016), Malaysia, a single minor accident could stall up the entire lane to a minimum of 20 minutes. Idle engine, emissions, and noise are causing the degradation of green environment and health of the road commuters. Causes of road traffic congestion can be the over usage of a personal vehicle in travelling, weak first-mile and last-mile connectivity of public transport for road commuters, cycling and walking. The motivation for the study is caused by increase of carbon dioxide (CO2) emission, increase of road deaths and crashes, lack of travel planning, waste of money, time and fuel, lack of real-time data for urban travel behavior and smart mobility models. Road traffic congestion was envisioned by the Malaysia government. The government formulated National Key Result Areas – Urban Public Transport (NKRA-UPT) in 2010 (Performance Management & Delivery Unit, 2017). And the result of implementing NKRA-UPT is total of 20% shift of modal transport and is expected to continue to increase with the newly built Mass Rapid Transit (MRT) and upgrading and expansion of existing Keretapi Tanah Melayu (KTM) and Light Rail Transit (LRT). The occurrence of accidents could be high since there are many vehicles on the road. Consequently, road traffic congestion could happen due to fatal behavior while driving on road, not properly maintaining vehicles, lack of better road infrastructure, not abiding by traffic laws and bad weather conditions. The significance of the study is the contributions towards the growth of knowledge in travel behavior based on psychological theory. The present study will provide identification of predictors for intention to follow road discipline and expected travel behavior performance of road commuters.

2. **Literature Review**

Different travel behaviors of road commuters are the causes of road traffic congestion in Malaysia. Road rage, aggression driving and anger travel are behaviors that have a significant relationship with loss of vehicle control and crash related conditions especially among young drivers in Malaysia (Sullman, Stephens, & Yong, 2015). The harmful effect from vehicle
emissions from a large number of vehicles indicated that the lacking of attitudinal change among Malaysian exists and households use their vehicles for many objectives (Zailani, Iranmanesh, Masron, & Chan, 2016). Public transport serves to provide convenience and benefits for elderly (Wong, Szeto, Yang, Li, & Wong, 2018), social activities (Chowdhury, Hadas, Gonzalez, & Schot, 2018) and more importantly is reducing vehicle emissions. There is a difference between male and female in abiding by traffic rules. While driving, males are perceived to be more violating traffic, due to confident in driving and risks taking (Mohamad, 2018). According to Gianfranchi, Spoto and Tagliabue (2017), males have higher violation score than females whereas females are prone to error driving. There are types of monsoon in Malaysia which contribute to road traffic congestion namely northeast monsoon (NEM) and southwest monsoon (SWM) which is from November to February and May to August respectively. It is inevitable that road traffic congestion happens most of the time especially due to torrential rain (Guo et al, 2018). Other than traffic flow being affected, damages to the road could happen causing more congestion. Steg (2003) remarked that personal vehicles could offer comfortability, convenience, speed, independence, reliability and flexibility. Thus, a greater number of road commuters are using personal vehicles and has become a habit. According to Egmond & Bruel (2007), Theory of Interpersonal Behavior (TIB) can be used to predict the intention of a person to perform a behavior or not. Table 1 provides the conceptualization of the constructs in the proposed framework supported by TIB:

**Table 1. Conceptualization of the constructs as per Theory of Interpersonal Behavior**

<table>
<thead>
<tr>
<th>No</th>
<th>TIB Variables</th>
<th>Description</th>
<th>Constructs in the framework</th>
<th>Synchronization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Attitude</td>
<td>Systematic</td>
<td>Confidence in Driving</td>
<td>If road commuters are confident in driving they have to adhere to traffic laws which converge in safety concerns to commuters and others driving in the road.</td>
</tr>
<tr>
<td>2</td>
<td>Orderly</td>
<td>Green Environment</td>
<td></td>
<td>If travel commuters are travelling less frequently, walk/cycling for short distance and use public transports they can preserve green environment in order.</td>
</tr>
<tr>
<td>3</td>
<td>Principles</td>
<td>Social Responsibility</td>
<td></td>
<td>If road commuters are socially responsible towards understanding and abiding to rules while on road then they are highly principled.</td>
</tr>
<tr>
<td>4</td>
<td>Discipline</td>
<td>No Deviation in Driving</td>
<td></td>
<td>If road commuters do not deviate particularly with no alcohol consumption, no cigarette smoking, no mobile messaging/chatting while driving then their behavior is normal with perfect road travel discipline.</td>
</tr>
<tr>
<td>5</td>
<td>Social Factors</td>
<td>Influence of others</td>
<td>Subjective Norms</td>
<td>Those commuters driving on road should not be influenced by relatives/friends/colleagues suggestions.</td>
</tr>
<tr>
<td>No.</td>
<td>Social Dignity</td>
<td>Social Status</td>
<td>Commuters while driving should seek for their own safety and comforts and not to have luxury vehicle to show off for social status.</td>
<td></td>
</tr>
<tr>
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<td>--------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Technology Advancement</td>
<td>Digitalization</td>
<td>Industry evolution 4.0 to road infrastructures then they are planning ahead.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Affect Road Violation</td>
<td>Accident and Damages</td>
<td>Real time data and sophisticated digitalization using remote sensing of urban travel model will avoid road violation which will control accidents and ultimately reduces damages.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Basic Needs</td>
<td>Road Infrastructure</td>
<td>Infrastructure development should be given utmost important for avoiding traffic congestion.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Compromise Weather</td>
<td></td>
<td>Under unforeseen circumstance bad weather may create traffic congestion and is unavoidable. Commuters have to find alternative routes for travel purposes.</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Habit Mind Wandering</td>
<td>Mental Block</td>
<td>There needs to be some change of thoughts in the mental block in following the family ancestor methods of owning personal vehicles in order to safeguard environment.</td>
<td></td>
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### 2.1 Attitude

Attitude can be used as a consumer recognized value to behavior (Halstead, 1999) to predict future behavior (Triandis, 1979). Jiménez-Mejias et al, (2014) argued that male driving style is associated with confidence in driving, seeking greater intensity of exposure and risky driving while female drivers tend to maximize the braking and keep more distance between the cars in front (Li, Yan, Wu, Radwan, & Zhang, 2016). Moreover, the male driver will overtake other vehicles even in short distances (Lyu, Cao, Wu, Xu, & Xie, 2018). Female drivers are prone to errors while male drivers have a high score for intention to violate rules and laws (Gianfranchi et al, 2017). The demand for fossil fuel and energy increase due to urbanization and economic growth in Malaysia (Bekhet & Othman, 2017). Thus, one of the reasons for the increase in vehicle emission affects the green environment. Three approaches were identified, namely, social responsibility, environmental protection and economic progress, could achieve a sustainable green environment (Chow & Chen, 2009). Deviation from driving safely include drink driving (Watling, Hooijer, Armstrong, & Watling, 2018), distracted driving (Chen, Wu, Zhong, Lyu, & Huang, 2015), effect of different personality driving, texting while driving (Preece, Watson, Kaye, & Fleiter, 2018), driving with discourtesy with stress (Scott-Parker, Jones, Rune, & Tucker, 2018) and driving under negative emotions (Shen, Ge, Qu, Sun, & Zhang, 2018). Surprisingly, drivers are aggressive even they feel cautious while driving on road (Eboli, Mazzulla, & Pungillo, 2017). There are four dimensions of attitude of road commuters and are discussed in detail in the following sections.
2.1.1 Confidence in Driving

After review of literature, males and females display varied driving behaviors and styles. Furthermore, high or low in confidence while driving can determine the intention of drivers if they intend to violate the law or abide to it. According to McKenna (2018), drivers with high confidence tend to violate traffic rules and regulations after surveying thousands of new drivers. Behavior, such as low concentration, hostility towards other drivers, as well as neglecting warning and speed limit signs, can contribute to road traffic accidents. Confidence in driving is about driving styles, violation of traffic laws, and discrimination among other drivers, especially elderly drivers. This shows that concern for other road commuters can be further reminded and improved. Hence, this study hypothesizes that:

H1a: Confidence in driving has a positive influence on travel behavior performance of road commuters.

2.1.2 Green Environment

As the number of vehicles and vehicle emission have escalated, climate change is an issue in Malaysia. The three approaches to achieve sustainability of green environment are environmental protection, social responsibility, and economic progress (Chow & Chen, 2009). Thus, by taking climate change into account, explicit concerns for being environmental-friendly should be tended to immediately. Environmental concerns from personal attitudes and household behaviors signify concern and practice in preserving the environment (Alcock et al, 2017). Nevertheless, accessibility for motorcycles and foot lane should be made available or maintained in order to increase active travel, instead of using personal vehicles for travelling purpose (Măirean & Havârneanu, 2018). This leads to the following hypothesis:

H1b: Green environment has a positive influence on travel behavior performance of road commuters.

2.1.3 Social Responsibility

According to Geng, Long, Chen and Li (2017), age, gender, income level, car ownership, attitude towards government policy measures, and travel distance are influential in performing green travel behavior. Notably, older and high-income groups are more reliant on cars, thus against government policy measures. On the other hand, medium age and income are in line with government policy measures, whereas young and low-income groups are more reluctant and forced in their behavior to use non-car travel modes, and the fourth group (medium age and high income) hold swing attitudes towards government policy measures. Creation of apps that display exposure to level of air pollution due to their own travel behaviors and comparison to previous travel behavior may influence people to have the intention to change (Haddad & de Nazelle,
2018). Road commuters should have social responsibility, such as understanding and abiding to the traffic rules. According to af-Wåhlberg, Dorn, and Kline (2011), drivers who do not abide to traffic rules, such as absence of advance travel planning, double parking, and not parking in yellow box, may lead to accidents and penalties. Hence, this study hypothesizes:

H1c: Social responsibility has a positive influence on travel behavior performance of road commuters.

2.1.4 Deviation in Driving

Unusual way of driving is what identified as abnormal driving. Abnormal driving includes texting while driving, drink-and-driving and distracted driving. Those who text while driving are more likely to exhibit other risky behavior and more immune to traffic risks (Preece et al, 2018). As for drink-and-driving, it is associated with fatal accidents (Chen & Jou, 2018). Additionally, the four categories for distracted driving are watching roadside, talking, under the influence of drowsiness, and drinking (Chen, Wu, Zhong, Lyu, & Huang, 2015). Drivers should have concerns for the safety of the others and their own while travelling. Penalizing offenders is insufficient, as more should be done at the same time given that the consequences of impair driving are costly and life threatening. Thus, this study proposes the following hypothesis:

H1d: Deviation in driving has a positive influence on travel behavior performance of road commuters.

2.2 Social Factors

Having network and social interactions are crucial in modern mobility (Dugundji et al, 2011). The importance of walking and cycling for commuters who are physically inactive should be recognized (Keall, Chapman, Shaw, Abrahamse, & Howden-Chapman, 2018) through social influence. Subjective norm is identified as of whether an individual would exhibit the same behavior if peers are pressuring that individual to (Wan, Shen, & Choi, 2017). This works the same way when deciding to purchase a car or not (Belgiawan, Schmöcker, Abou-Zeid, Walker, & Fujii, 2017). For youths, factors such as independence, car usage frequency, affective and income level are influential in purchasing a car or not. Among male and female as household heads, travel behavior in a household is interchangeably influential (Kroesen, 2015). According to Choo & Mokhtarian (2004), status seeker is one of the four lifestyles in their work. Other lifestyles being community/family-oriented, frustrated factor and workaholic. Owning a sporty and branded vehicle in Malaysia usually is a sign of richness, having a high-income level, fame or social status in modern society. A GPS device that monitor road condition system and road traffic in Klang Valley can be implemented to improve or regulate the traffic when necessary.
(Lei, Mohamed, & Claudel, 2018). However, utilization of electronic board that displays information about traffic flow on the roadside will have a negative effect on driving behavior and traffic safety (Mollu, Cornu, Brijs, Pirdavani, & Brijs, 2018). Social Factors (Kang, Jayaraman, Soh, & Wong, 2018), which influences the travel behavior performance of road commuters have three dimensions and are elaborated below:

### 2.2.1 Subjective Norms

A number of subjective norms are exhibited when people are on the road, such as texting while driving. Making and answering phone calls with handheld devices are a norm, while using hands-free mobile phone does not guarantee greater safety when compared to hand-held devices (Lipovac, Đerić, Tešić, Andrić, & Marić, 2017). Subjective and descriptive norms are able to increase one’s green travel intent even when they do not hold high environmental responsibility (Ru, Wang, Chen, & Yan, 2018). Hence, their attitude, knowledge, and beliefs can influence the effectiveness of the enforcement of distracted driving law. As such, this study proposes the following hypothesis:

**H2a:** Subjective norms have a positive influence on travel behavior performance of road commuters.

### 2.2.2 Social Status

Social statuses are usually expressed through specific patterns of consumption and behaviors (Van Acker, Goodwin, & Witlox, 2016). These patterns are shaped by beliefs, attitude, and interests. Hence, social statuses are simply not only shaped by speed, price, and comfort. In this case, personal aim for having a high value vehicle due to the desire for high esteem can be noted (Kusuma, 2015). Apart from perceptions, preference on vehicles that enhances self-image and esteem comes under the influence of several factors, such as internet marketing, influence from family members on purchase, customer satisfaction, and loyalty (Kusuma, 2015). Being able to quick enough gain ideas and feedback from the internet from potential customers, as well as personalised care and after sales service with vehicle brand, shows that the internet is important in communication and marketing strategies amongst vehicle manufacturers. More importantly, customer satisfaction and loyalty to vehicle brands encourage returning customers. Additionally, there is increment in vehicle purchase from women as well (Kusuma, 2015). Hence, this study hypothesises the following:

**H2b:** Social status has a positive influence on travel behavior performance of road commuters.

### 2.2.3 Digitalization

In making use of advanced sophisticated technology, a GPS device that can monitor traffic and road condition system may be applied by the relevant authorities to regulate road traffic in Klang
Valley, especially during peak hours (Lei et al, 2018). However, high utilisation of advance technology might not be the best case. Rahman, Wirasinghe, and Kattan (2013) claimed that the next bus arrival time made available at bus stops is the most sought after for bus riders. This should encourage people to change their mode of transport for the betterment. As for Light Rail Transit (LRT), the next arrival time has the interest of less frequent riders, but not frequent riders. The industry revolution 4 looks for real time data, automation & integration in every walks of life and therefore the digitalization is mandatory in controlling road traffic. The usage of advance technology and real-time data is crucial in mitigating emissions from vehicles. Hence, this study posits the following:

H2c: Digitalization has a positive influence on travel behavior performance of road commuters.

2.3 Affect
Affect has been considered as emotion (Triandis, 1977). At times, emotion will disrupt and cloud our judgement (Preece et al., 2018) with changes from the past (Pfister & Bohm, 2008) during the process of making decisions. Not to mention during peak hours, travel behavior is certainly different from normal hours and will affect life satisfaction and emotional well-being (Friman, Gärling, Ettema, & Olsson, 2017). In Mann, García-Rada, Hornuf and Tafurt, (2016), internal and legal sanctions could reduce road traffic crimes. The feeling of guilt has the strongest effect on reducing road traffic crimes and if not, legal sanctions will do the work. However, social sanctions do not reduce road traffic crimes but have an influence on road commuters to engage in violation of traffic rules and laws. More mobility from personal vehicle indicates that there will be more air pollutions and climate change (Gilmore & Patwardhan, 2016). Air pollutions also have an effect on agriculture productions (Shindell et al., 2011). While road agencies or authorities are maintaining road lane or road infrastructure, travel behavior performance of drivers will be affected due to diversion of routes (Hartmann & Ling, 2016). Furthermore, good road infrastructure will lead to the reduction of air pollution (Van Acker et al., 2016), the increase of firms’ output through efficient transport systems (Barzin, D’Costa, & Graham, 2018) and increase of cycling activities (Hull & O’Holleran, 2014) among least physically active commuters (Panter, Heinen, Mackett, & Ogilvie, 2016). Reinvestment in cycling infrastructure, pedestrianization of town centers and public transport are considered as encouragement for a change of mode of travel from the workplace of home (Van Acker et al., 2016) that will reduce carbon dioxide from vehicle emissions (Banister, 2008). In terms of individual travel behavior, the different daily temperature has a lesser impact than the different monthly temperature in the long term whereas different temperatures and daily winds are more influential in the short term.
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(Liu et al, 2015). Heavy rainfall is a threat to the safety of road commuter (Preece et al, 2018) as the drivers should slow down during adverse weather (Wang, Liang, & Evans, 2017).

2.3.1 Accidents and Damages

As there is no age limit for vehicles in Malaysia, it is more alarming and dangerous for human wellbeing. According to Tanishita and van Wee (2017), speed and speed variation are strongly believed to be the reasons for high rates of traffic accidents. There are two high probabilities for the occurrence of accidents. First, accidents happen when speed is reduced from 110 to 85 km/h, and second, increase in speed from 65 to 95 km/h. Plus, more accidents tend to occur during sunny days, instead of cloudy weather. More accidents mean more costs, such as repair cost, cost of time or even life-threatening costs. Hence, the study hypothesizes the following:

H3a: Accident and damages have a negative influence on travel behavior performance of road commuters.

2.3.2 Road Infrastructure

Reinvestment in public transportation, cycling infrastructure, and pedestrianization of town canters have been reconsidered as mobility management that encourage change in travel behavior from home or workplace (Van Acker et al, 2016). In order for people to change mode of transport, road infrastructures for cycling and walking must be made available (Panter et al, 2016). With that, this study proposes the following:

H3b: Road infrastructure has a positive influence on travel behavior performance of road commuters.

2.3.3 Weather Conditions

Weather is hard to predict and this can affect travel plan. According to Tao, Corcoran, Rowe, & Hickman (2018), real-time weather information, as well as traffic and time of day, should be considered when monitoring the demand of buses. This indicates that the adjustment of transit time should be changed accordingly to heavy rain or high temperatures. Furthermore, transit operators may upgrade bus stops to shelter passengers from heavy rain to increase ridership in case of decrease in ridership. It has been observed that warm, dry, calm, and sunny, but not scorching hot weather, can stimulate active travel (Böcker, Dijst, & Faber, 2016). Road traffic accidents due to jumping red lights, speeding, and neglecting seatbelts are mostly attributed to other drivers (Rasool et al, 2015), not to mention that it could be far more devastating during rainfall in Malaysia. Hence, this study hypothesises as follows:

H3c: Weather has a negative influence on travel behavior performance of road commuters.
2.4 Habit
Habit and behavior are related (Triandis, 1979). When the intention is repeated continuously and so as the later exhibited behavior, that experience will become a habit. Ouellette & Wood (1998) supported this statement by mentioning that strength of habit is from repeated behavior, therefore it is a predictor of a behavior. It is highly correlated between intention, habits and behavior with dominance from habits over behavioral outcomes (Gardner, Abraham, Lally, & de Brujin, 2012). Mind wandering is preventing drivers from focusing on driving (Burdett, Charlton, & Starkey, 2018) and it occurs when drivers are in a comfortable or familiar environment. According to Qu et al, (2015), emotional driving, aggressive driving, drunk driving and risky driving are all correlated with mind wandering. Additionally, when minds are wandering, male drivers exhibit driving behavior that are riskier and exhibit more emotions.

2.4.1 Mental Block
Mind wandering has been positively correlated with drunk driving, emotional driving, risky driving, and aggressive driving (Qu et al, 2015). Male drivers are found to be riskier and exhibit more negative emotional driving behavior, when compared to female drivers upon mind wandering. There are also issues concerning lights that are glaring and getting the attention of drivers while on road with high chances of creating accidents (Yellappan et al, 2016). Bright lights within a certain range can affect a driver’s vision. Factors of forgiveness and unforgiveness while on road have a role in decreasing the intensity of adverse driving from young drivers (Bumgarner, 2015). Hence, conflicts between driving and non-driving activities can decrease based on the level of forgiveness from ourselves, others, and during unforeseen situations. With that, the following hypothesis is proposed:

H4: Habit factor (Mental Block) of road commuters has a negative influence on travel behavior performance of road commuters.

2.5 Intention to follow Road Discipline
Firstly, in Theory of Planned Behavior (TPB) by Ajzen (1991) recognize that intention is a predictor of behavior. TPB also remarked that only with motivation then only behaviors will be performed. However, scholars also argued that intention may not materialized into behavior sometimes (Webb & Sheeran, 2006). According to Moutinho (1987), intention is an antecedent to behavior that is caused by beliefs about outcome, wherein normative beliefs are provided by social and situational factors. In fact, a lot of similarities have been noted between this explanation and TIB initiated by Triandis (1977) due to the reason that belief about outcome may influence one’s attitude to perform a behavior (Kang, Jayaraman, Soh Keng Lin, & Wai Peng Wong, 2019), while normative beliefs can influence one’s subjective norms to perform a
behavior. Intention to follow road discipline is an intention, thus, can be understood in the same dimension. As such, this study proposes the following hypotheses:

H5 (a-j): Intention to follow road discipline mediates the relationship between independent variables and travel behavior performance of road commuters.

2.6 Road Traffic Policies/Regulations

Kaffashi et al. (2016) asserted that Malaysians are eager to minimize their car usage if innovative transport policy is implemented. Policies, such as appropriate pricing and efficient public transport, could shift the mode of transport from personal vehicles to public transport as much as 70%. The respondents in their study opined that they were willing to pay up to 175% of their hourly wages to have efficient public transport. The government should take some initiatives to implement new policies. However, several steps are involved before decision makers can make decisions from researchers based on studies. Hence, the study hypothesizes the following:

H6a: Road traffic policies/ regulations. Moderate the relationship between Intention to follow road discipline and travel behavior performance of road commuters.

3.0 Construction of a conceptual research framework

Figure 1 illustrates the conceptual research framework based on the Theory of Interpersonal Behavior (TIB) proposed by Egmond and Bruel (2007). The original constructs retained in the research framework are attitude, social factors, affect, and habit. The constructs in attitude (Confidence in driving, green environment, social responsibility and deviation in driving), social factors (subjective norms, social status and digitalization), and affect (accident and damages, road infrastructure and weather) have direct effects on the dependent variable, which is travel behavior performance of road commuters. Second, habit (mental block) also has a direct effect on the dependent variable because habit is the frequency of past behavior. Hence, repetitive behavior could be exhibited given the circumstances are favorable. Intention to follow road discipline will mediate the relationship between independent and dependent variables, while the moderating variable is road traffic policies/ regulations.
The Theory of Interpersonal Behavior (TIB) by Egmond and Bruel (2007) supports the proposed conceptual research framework provided in Figure 1. The conceptualization of the predictors considered in the present study is synchronized with the TIB in Table 1 below:

4. Discussions and novelty of the framework

The present study proposes a conceptual research framework that suggests predictors to avoid road accidents, to abide to road laws, to promote change of transport mode, and to have a pollution-free healthier life. Only through more reliance on public transportation, discipline while driving on the road, and proper care on health and well-being will generate effective behavioral changes. Physical or health well-being achieves higher score from active travel (walking and cycling), when compared to travelling by vehicles (Ettema et al, 2015). Certain factors, such as accessibility, availability of seats, cleanliness, and safety for public transport, should be given focus to consider good alternative to personal vehicle travel (Ettema et al, 2015). The opportunity to involve in multitasking while on road is considered as another attractive important characteristic of travel plan behavior. The society will benefit from the awareness towards the predictors embedded in the framework, having the intent to perform the behavior desired in this study, and implementation of innovative road traffic policies/regulations. The study outcomes will be useful in developing government policies for the transportation sector in the globe. Convenience, flexibility, no benefits of using public transport, and active travel have...
been perceived as values for personal vehicle users and they have to think of environment protection in the long-run and sustainability of travel system on road. The present study seeks to address the issue of low ridership of public transport and active travel as the short-term concern, whereas the long term concern focuses on health and climatic changes which may be addressed if utilization of public transport increases. Ultimately, the purpose of this study is to provide valuable information to overcome road traffic congestion and air pollution by promoting smart mobility in Klang Valley, Malaysia. The theory applied in this study is based on TIB by Triandis (1977). The study focuses on materializing road commuters’ intentions that stem from various factors to the desired behavior in travel plan.

5. Conclusions

Air pollution is the perineal problem in the globe and is predominantly due to road transport.

The present study proposed a conceptual framework for travel behavior model which is applicable to any road infrastructure set-up. The study provides information dissemination on the travel behavior of road commuters. The proposed framework in the present study is supported by the Theory of Interpersonal Behavior (TIB). TIB constructs are operationalized in the context of the study with several relevant dimensions for each variable. The conceptual research framework aimed to expand knowledge in the travel industry with the application of the theory. Abide by traffic laws, a healthier life without air pollution, avoiding road accidents, less frequent travel plan, normal driving, and change of mode of transportation are what the conceptual research framework talks about in this study. In achieving this, road commuters may rely more on public transportation, care for fellow human being, driving with discipline, not influenced by others in rash driving and less frequent travel will definitely smoothen air pollution. For long-run sustainable road traffic system one has to plan for alternative toll system with remote sensing, smart infrastructure with double fly over, strict enforcements on deviation in road regulations policies, sharing system in vehicles, and pre-planned travel visits will be the remedial measures to reduce traffic congestion and protect environment.

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Qu, W., Ge, Y., Xiong, Y., Carciofo, R., Zhao, W., & Zhang, K. (2015). The relationship
between mind wandering and dangerous driving behavior among Chinese drivers. *Safety
Prevalence and behavioral risk factors associated with road traffic accidents among medical
students of Arabian Gulf University in Bahrain. *International Journal of Medical Science*


Title of Manuscript: Conceptualization of an Urban Travel Behavior Model to Mitigate Air Pollution for Sustainable Environmental Development in Malaysia
Manuscript ID Number: MEQ-03-2019-0070

<table>
<thead>
<tr>
<th>No.</th>
<th>Comments of reviewer-1</th>
<th>Response to comments of reviewer-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The article contains many jargons (repeated sentences).</td>
<td>Thank you very much for your valuable comments and suggestions. In the revised version, the repeated sentences and jargons were removed.</td>
</tr>
<tr>
<td>2.</td>
<td>a) Many grammar mistakes for examples:</td>
<td>As per the reviewer’s valid comments, all the required corrections were carried out in the revised version of the article.</td>
</tr>
<tr>
<td></td>
<td>b) Page 3 line 1: vehicles indicated…….. please correct to indicate</td>
<td>a) Thorough professional editing for English vocabulary and grammar have been carried out to improve the quality of the research article.</td>
</tr>
</tbody>
</table>
|     | c) Page 3 line 28: According to Egmond & Bruel Please start with Theory of interpersonal behavior.……….. (Egmond and Bruel, 2007). | b) **Page 3, Section 2.0, Line 4; Revised Line** *(Old: Page 3, Section 2.0, Line 1)*  
The harmful effect of vehicle emissions from a large number of vehicles indicate that the lack of attitudinal change among some Malaysian citizens do exist (Zailani, Imanmanesh, Masron, & Chan, 2016). |
|     | d) In table 1 Second column….TIB variable                                             | c) **Page 4, Section 2.1, Line 14** *(Old: Page 3, Section 2.1, Line 10)*  
For a sustainable green environment, three approaches were identified, namely; social-responsibility, environmental-protection, and economic-progress (Chow & Chen, 2016). Four dimensions of the construct ‘attitude’ of road commuters are discussed in the following sections. |
|     | e) Page 4 attitude Line 10.                                                            | d) **Page 4, Section 2.1.1, Line 1** *(Old: Page 5, Section 2.1.1, Line 1)*  
Males and females display different driving behaviors and styles (Jiménez-Mejías et al, 2014; Li, Yan, Wu, Radwan, & Zhang, 2016). |
|     | Three approaches were identified…………namely social. Please rewritten as Social, responsibility, environmental protection…………. | e) **Page 4, Section 2.1.2, Line 1** *(Additional amendments)*  
As the number of vehicles and vehicle emission have been escalating, climate |
change is a predominant issue in Malaysia. Thus taking climate change into account, specific concern for being environmental-friendly should be given at most priority. Environmental concerns from personal attitudes and household behaviors signify the importance of protecting the environment (Alcock et al, 2017).

g) Page 4, Section 2.1.2, Line 2 (Old: Page 4, Section 2.1, Line 10)
The repeated sentence was removed now.

Page 5, Section 2.1.3, Line 13 (Additional amendments)
On the other hand, training and qualification mechanism should be in force for taxi drivers to avoid aggressive travel behavior and violation of road traffic rules and regulations (Vahedi et al, 2018).

Page 5, Section 2.1.4, Line 4 (Additional amendments)
There are three aspects of driving with discourtesy as per Scott-Parker et al. (2018), namely, impolite behavior (deliberate anger and intimidation), driving context (malfunction of vehicles features, driving on holidays, road infrastructure features and driving in unknown locations) and behavior from other road users (merging, tailgating, and drug use).

h) Page 6, Section 2.2.1, Line 2 (Old: Page 7, Section 2.2.1, Line 2)
Calling and replying phone calls with or without hand-held devices do not guarantee safety while driving (Lipovac et al, 2017).

Page 9, Section 2.3.1, Line 4 (Additional amendments)
Accidents can happen when speed is reduced suddenly from 110 to 85 km/hour, for example, or increasing the speed from 65 to 95 km/hour. Also, more accidents tend to occur during sunny days, instead of cloudy weather which results in more costs, such as repair cost, cost of time, or even life-threatening costs (Tanishita & van Wee, 2017).

c) Page 11, Section 3.0, Line 1 (Old: Page 3, Section 2.0, Line 28)
Figure 1 illustrates the conceptual research framework supported by the Theory of Interpersonal Behavior (TIB) proposed by Egmond and Bruel (2007). The constructs of TIB in the research framework are attitude, social factors, affect, and habit. The sub-constructs for each independent variable (predictor) have been identified rationally to provide novelty to the conceptual framework. The totality of the framework considered in this study is seldom available in the literature, and hence, the present research is timely. The real novelty of this study is to investigate the cause and effect relationships of the predictors in the path diagram of Figure 1.

### i) Page 11, Section 3.0, Line 7 (Old: Page 11, Section 3.0, Line 3)

The sentence describes the exogenous and endogenous variables in the conceptual framework of Figure 1, and therefore, it is included.

### d) Page 12, Section 3.0, Table 1 (Old: Page 3, Section 2.0, Table 1)

Revised now.

### 3. Additional Questions:

<table>
<thead>
<tr>
<th>&lt;b&gt;1. Originality: &lt;/b&gt;</th>
<th>Does the paper contain new and significant information adequate to justify publication?: Yes This article aims to construct a framework for travel behavior performance of a commuter and it is consequences on air quality.</th>
</tr>
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<tbody>
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<td>Thank you very much.</td>
<td></td>
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<tr>
<th>&lt;b&gt;2. Relationship to Literature: &lt;/b&gt;</th>
<th>Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?: Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional literature is provided for most of the predictors of the research framework are as follows:</td>
<td></td>
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<tr>
<td><strong>Page 5, Section 2.1.3, Line 13</strong></td>
<td>On the other hand, training and qualification mechanism should be in force for taxi drivers to avoid aggressive travel behavior and violation of road traffic rules and regulations (Vahedi et al, 2018).</td>
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<tr>
<td>Page 5, Section 2.1.4, Line 4</td>
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<td>There are three aspects of driving with discourtesy as per Scott-Parker et al. (2018), namely, impolite behavior (deliberate anger and intimidation), driving context (malfunction of vehicles features, driving on holidays, road infrastructure features and driving in unknown locations) and behavior from other road users (merging, tailgating, and drug use).</td>
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<td>Stark, Berger, and Hössinger (2018) have pointed out that reflection, action, and intervention of information sources may influence on the intention of a person to optimize travel plan on the road.</td>
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<th>Page 8, Section 2.3, Line 3</th>
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<tr>
<td>Evidence of research from Russel (1980) suggests that in the affective dimensions, variables are highly interrelated in a systematic way. The affective dimensions fall in a circular order: pleasure (0°), excitement (45°), arousal (90°), distress (135°), displeasure (180°), depression (225°), sleepiness (270°) and relaxation (315°).</td>
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Furthermore, positive and negative affect are different depending on the swings in mind (Diener & Emmons, 1985). This study also indicates that the longer the time of thinking process, the clearer the type of emotions.


Notably, older generation feels that they have responsibility for environmental issues, for example, climate change, as compared to the younger generation and through their emotions; this can affect the following generation (Wang et al., 2018).


Regarding environmental damages, light-duty vehicles can contribute to climate change by emitting as much as 209% of carbon emission in different altitude that lacks oxygen and low-pressure concentrations (Wang et al., 2018).

5. **Methodology:** Is the paper's argument built on an appropriate base of theory, concepts or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed appropriate?: it does not contain methodology, as it identify the suitable predictors for urban travel behavior model towards travel behavior performance. This article aims to construct a framework for travel behavior performance of a commuter and it is consequences on air quality. It depends on extensive literature review, however the references are limited. Some more latest references are inserted in the revised version in order to have extensive information on travel behavior model:

| Page 5, Section 2.1.3, Line 13 |
| Page 5, Section 2.1.4, Line 4 |
| Page 6, Section 2.2.1, Line 6 |
| Page 8, Section 2.3, Line 3 |
| Page 8, Section 2.3, Line 6 |
| Page 8, Section 2.3, Line 29 |
| Page 9, Section 2.3.1, Line 7 |

6. **Results:** Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together the other elements of the paper?: Medium, some sentences need to be clarified. The conclusion section has been revised as per the reviewer’s comments

| Page 14, Section 5.0, Line 12 |

The major outcome of the proposed research framework in the present study would be smart mobility on the road, which will ultimately reduce air pollution and carbon emission.

7. **Implications for research, practice and/or society:** Does the paper identify clearly any implications for research, practice and/or society? Does the paper bridge the gap between theory and practice? How can the research be used in practice (economic and commercial impact), in teaching, to influence public policy, in research (contributing to the body of knowledge)? What is the impact upon society (influencing public attitudes, affecting quality of life)? Are these implications consistent with the findings and conclusions of the Thank you very much.
<table>
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<tr>
<th>No.</th>
<th>Comment of reviewers-2</th>
<th>Response to comments of reviewer-2</th>
</tr>
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<tr>
<td>1.</td>
<td>Comments:</td>
<td>The manuscript has been revised for further quality improvements.</td>
</tr>
<tr>
<td></td>
<td>In this paper, the conceptual framework for travel behavior performance of a commuter has been developed by referencing the Theory of Interpersonal Behavior whose functions are attitude, social factor, affect and habit. It is a solid study and the topic is really important in understanding commuter’s psychological states toward sustainable travel behavior. However, I think there are some flaws to be settled to improve the manuscript.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Why the author(s) use the Digitalization as a keyword? Is it the critical content or innovation in the paper?</td>
<td>Thank you very much for your valid comments.</td>
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<td></td>
<td>We have removed the digitalization from the keyword section.</td>
<td></td>
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<tr>
<td>3.</td>
<td>The novelty/originality shall be further justified in Introduction by highlighting that the manuscript contains sufficient contributions to the new body of knowledge.</td>
<td><strong>Page 1, Abstract (Originality/value), Line 1</strong> The identification of the suitable predictors for the urban travel behavior model towards travel behavior performance of a commuter is the real novelty of the present study. In addition, the cause and effect relationships of different</td>
</tr>
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</table>
The present study provides the appropriate predictors for intention to follow road discipline and consequently, the expected travel behavior performance of road commuters. Thus, in the present study, a holistic research framework has been constructed for urban travel behavior model, which can be customized for any developing country in a broader sense to the art of social science research.

Figure 1 illustrates the conceptual research framework supported by the Theory of Interpersonal Behavior (TIB) proposed by Egmond and Bruel (2007). The constructs of TIB in the research framework are attitude, social factors, affect, and habit. The sub-constructs for each independent variable (predictor) have been identified rationally to provide novelty to the conceptual framework. The totality of the framework considered in this study is seldom available in the literature, and hence, the present research is timely. The real novelty of this study is to investigate the cause and effect relationships of the predictors in the path diagram of Figure 1.

The conceptualization of the predictors considered in the present study is synchronized with the variables of TIB as in Table 1.

4. I suggested that the author(s) give more descriptions to the Theory of Interpersonal Behavior (TIB). I remembered that the TIB owns a complete path model.

More descriptions to Theory of Interpersonal Behaviour (TIB) has been added:

Theory of Interpersonal Behavior (TIB) can be used to predict the intention of a person to perform a behavior or not (Egmond and Bruel, 2007). TIB states that the intention of a person to exhibit a behavior is under the influence of
four components, which are attitude (cognition), social factors, affect, and habit (Triandis, 1977). Attitude (cognition) is about the psychological perceived value or consequences of the action. There are three dimensions in social factors, namely, social norms, social role, and self-concept. A social norm is an influence from society to individual to believe that certain behavior is viewed as appropriate. The social role implies that a person holds a set of behavior that is appropriate for his/her roles in society, whereas self-concept is the idea of who he or she is. Affect is the state of the emotion during the thought of exhibiting the behavior. Habit is the frequency of past behavior where repetition in performing the same behavior has been practiced in day-to-day routine life. The constructs of TIB are elaborated in the sections below:


5. The author(s) mentioned in the Abstract that the identification of predictors and the synchronization of the predictors and the TIB are two novelties in the paper. However, to the best of my knowledge, most of these predictors as well as the TIB have already been introduced and empirically proofed by many literatures on the topic of travel psychology and behavior. So I think the real novelty of this study may be to reveal the mutual relations (e.g. the path directions) among different predictors in the proposed framework. But it is a pity that this study has not demonstrated this novelty by empirical research. I hope the author(s) would improve the manuscript by adding a questionnaire or an experimental study rather than leaving it as the research limitations.

You are absolutely correct that the real novelty of this study is to reveal the mutual relations (e.g. the path directions) among different predictors in the proposed framework.

The questionnaire can be obtained from the email: jayaraman.krishnaswamy@taylors.edu.my. The questionnaire is not included in the article due to the size restriction of the article.

6. In my opinion, the variable of Weather is belongs to For the predictor “affect” the original dimensions are considered as per Russel
a situational factor that directly influenced people’s travel behavior rather than an antecedent variable of Affect.

In a word, I am looking forward to the improved manuscript after some revision work.

(1980), Diener & Emmons (1985), Wang et al. (2018) which excludes the sub-dimensions defined in the earlier version of the article (including the factor weather):

Page 8, Section 2.3, Line 3
Evidence of research from Russel (1980) suggests that in the affective dimensions, variables are highly interrelated in a systematic way. The affective dimensions fall in a circular order: pleasure (0°), excitement (45°), arousal (90°), distress (135°), displeasure (180°), depression (225°), sleepiness (270°) and relaxation (315°).


Page 8, Section 2.3, Line 6
Furthermore, positive and negative affect are different depending on the swings in mind (Diener & Emmons, 1985). This study also indicates that the longer the time of thinking process, the clearer the type of emotions.


Page 8, Section 2.3, Line 29
Notably, older generation feels that they have responsibility for environmental issues, for example, climate change, as compared to the younger generation and through their emotions; this can affect the following generation (Wang et al, 2018).


7. **Additional Questions:**
   - **1. Originality:** Does the paper contain new and significant information adequate to justify publication?: Yes.

   Thank you very much.

8. **2. Relationship to Literature:** Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?: Yes.

   Thank you very much.

9. **3. Methodology:** Is the paper's argument built on an appropriate base of theory, concepts or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed appropriate?: Some revision work is required.

   The revised article takes care of 1) some latest research articles 2) practical and theoretical contributions 3) substantiating the discussion part of the earlier version:

   **Page 5, Section 2.1.3, Line 13**
   
   On the other hand, training and qualification mechanism should be in force for taxi drivers to avoid aggressive travel behavior and violation of road traffic rules and regulations (Vahedi et al, 2018).


   **Page 5, Section 2.1.4, Line 4**

   There are three aspects of driving with discourtesy as per Scott-Parker et al. (2018), namely, impolite behavior (deliberate anger and intimidation), driving context (malfunction of vehicles features, driving on holidays, road infrastructure features and driving in unknown locations) and behavior from
Stark, Berger, and Hössinger (2018) have pointed out that reflection, action, and intervention of information sources may influence on the intention of a person to optimize travel plan on the road.


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**Page 9, Section 2.3.1, Line 7**
Regarding environmental damages, light-duty vehicles can contribute to climate change by emitting as much as 209% of carbon emission in different altitude that lacks oxygen and low-pressure concentrations (Wang et al, 2018).


10. **4. Results:** Are results presented clearly and analysed appropriately? Do the conclusions

Thank you very much.
5. Implications for research, practice and/or society: Does the paper identify clearly any implications for research, practice and/or society? Does the paper bridge the gap between theory and practice? How can the research be used in practice (economic and commercial impact), in teaching, to influence public policy, in research (contributing to the body of knowledge)? What is the impact upon society (influencing public attitudes, affecting quality of life)? Are these implications consistent with the findings and conclusions of the paper?: Some revision work is required.

Section 3.0, Page 11, Line 1
Figure 1 illustrates the conceptual research framework supported by the Theory of Interpersonal Behavior (TIB) proposed by Egmond and Bruel (2007). The constructs of TIB in the research framework are attitude, social factors, affect, and habit. The sub-constructs for each independent variable (predictor) have been identified rationally to provide novelty to the conceptual framework. The totality of the framework considered in this study is seldom available in the literature, and hence, the present research is timely. The real novelty of this study is to investigate the cause and effect relationships of the predictors in the path diagram of Figure 1.

Section 5.0, Page 14, Line 12
The major outcome of the proposed research framework in the present study would be smart mobility on the road, which will ultimately reduce air pollution and carbon emission.

6. Quality of Communication: Does the paper clearly express its case, measured against the technical language of the fields and the expected knowledge of the journal's readership? Has attention been paid to the clarity of expression and readability, such as sentence structure, jargon use, acronyms, etc.: Yes.

Thank you very much.
1. **Comments:**
The described study is relevant to area of Environmental studies. The authors did work to validate their hypothesis. Also, the results are presented in a coherent manner. However, to avoid grammatical and typographical errors, the paper needs to be proof read before the manuscript can proceed to publishing. The manuscript needs a minor revision.

Thorough professional editing for English vocabulary and grammar has been carried out to improve the quality of the research article.

**Page 3, Section 2.0, Line 4** (Old: Page 3, Section 2.0, Line 1)
The harmful effect of vehicle emissions from a large number of vehicles indicate that the lack of attitudinal change among some Malaysians citizens is present (Zailani, Iranmanesh, Masron, & Chan, 2016).

**Page 4, Section 2.1, Line 14** (Old: Page 3, Section 2.1, Line 10)
For a sustainable green environment, three approaches were identified, namely; social-responsibility, environmental-protection, and economic-progress (Chow & Chen, 2016). Four dimensions of the construct ‘attitude’ of road commuters are discussed in the following sections.

**Page 4, Section 2.1.1, Line 1** (Old: Page 5, Section 2.1.1, Line 1)
As mentioned, males and females display different driving behaviors and styles (Jiménez-Mejías et al, 2014; Li, Yan, Wu, Radwan, & Zhang, 2016).

**Page 4, Section 2.1.2, Line 1** (Additional amendments)
As the number of vehicles and vehicle emission has been escalating, climate change is a predominant issue in Malaysia. Thus taking climate change into account, specific concern for being environmental-friendly should be given at most priority. Environmental concerns from personal attitudes and household behaviors signify the importance of protecting the environment (Alcock et al, 2017).

**Page 4, Section 2.1.2, Line 2** (Old: Page 4, Section 2.1, Line 10)
Has removed repeated sentence start with “The three approaches to achieve sustainability of green environment are environmental protection, social responsibility, and economic progress (Chow & Chen, 2009)” from the text.

**Page 5, Section 2.1.3, Line 13** (Additional amendments)
On the other hand, training and qualification mechanism should be in force for taxi drivers to avoid aggressive travel behavior and violation of road traffic rules and regulations (Vahedi et al, 2018).

Page 5, Section 2.1.4, Line 4 (Additional amendments)
There are three aspects of driving with discourtesy as per Scott-Parker et al. (2018), namely, impolite behavior (deliberate anger and intimidation), driving context (malfunction of vehicles features, driving on holidays, road infrastructure features and driving in unknown locations) and behavior from other road users (merging, tailgating, and drug use).

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Page 9, Section 2.3.1, Line 4 (Additional amendments)
Accidents can happen when speed is reduced suddenly from 110 to 85 km/hour, for example, or increasing the speed from 65 to 95 km/hour. Also, more accidents tend to occur during sunny days, instead of cloudy weather which results in more costs, such as repair cost, cost of time, or even life-threatening costs (Tanishita & van Wee (2017).

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2. The described study is relevant to area of Environmental studies. The authors did work to validate their hypothesis. Also, the results are presented in a coherent manner. However, to avoid grammatical and typographical errors, the paper needs to be proof read before the manuscript can proceed to publishing. The manuscript needs a minor revision.

Page 11, Section 3.0, Line 7 (Old: Page 11, Section 3.0, Line 3)
The sentence describes the exogenous and endogenous variables in the conceptual framework, and therefore, it is included.

Page 12, Section 3.0, Table 1 (Old: Page 3, Section 2.0, Table 1)
Edited TIB variables to TIB variable.

Page 3, Section 2.0, Line 4 (Old: Page 3, Section 2.0, Line 1)
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Page 4, Section 2.1, Line 14 (Old: Page 3, Section 2.1, Line 10)
Thorough professional editing for English vocabulary and grammar has been carried out to improve the quality of the research article.

Page 4, Section 2.1.1, Line 1 (Old: Page 5, Section 2.1.1, Line 1)
Page 4, Section 2.1.2, Line 1 (Page 6, Section 2.1.2, Line 1)
Page 4, Section 2.1.2, Line 2 (Old: Page 4, Section 2.1, Line 10)
Page 5, Section 2.1.3, Line 13 (Amendments on newly inserted content)
Page 5, Section 2.1.4, Line 4 (Amendments on newly inserted content)
Page 6, Section 2.2.1, Line 2 (Old: Page 7, Section 2.2.1, Line 2)
Page 9, Section 2.3.1, Line 4 (Old: Page 9, Section 2.3.1, Line 2)
Page 11, Section 3.0, Line 1 (Old: Page 3, Section 2.0, Line 28)
Page 11, Section 3.0, Line 7 (Old: Page 11, Section 3.0, Line 3)
Page 12, Section 3.0, Table 1 (Old: Page 3, Section 2.0, Table 1)

Page 5, Section 2.1.3, Line 13
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Furthermore, positive and negative affect are different depending on the
swings in mind (Diener & Emmons, 1985). This study also indicates that the
longer the time of thinking process, the clearer the type of emotions.

Diener, E., & Emmons, R. A. (1985). The independence of positive and
negative affect. *Journal of Personality and Social Psychology, 47*,
1117.

**Page 8, Section 2.3, Line 29**
Notably, older generation feels that they have responsibility for environmental
issues, for example, climate change, as compared to the younger generation
and through their emotions; this can affect the following generation (Wang et
al, 2018).

Emotions predict policy support: Why it matters how people feel about
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</table>

4. **Relationship to Literature:** Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?: Yes, the paper demonstrates an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources. No noticeable significant work ignored.

5. **Methodology:** Is the paper's argument built on an appropriate base of theory, concepts or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed appropriate?: Yes. These questions are well addressed.

6. **Results:** Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together the other elements of the paper?: Yes, the results are adequately presented and the study is also well concluded.

7. **Implications for research, practice and/or society:** Does the paper identify clearly any
implications for research, practice and/or society? Does the paper bridge the gap between theory and practice? How can the research be used in practice (economic and commercial impact), in teaching, to influence public policy, in research (contributing to the body of knowledge)? What is the impact upon society (influencing public attitudes, affecting quality of life)? Are these implications consistent with the findings and conclusions of the paper?: The paper identified clearly implications for research, practice and/or society by providing mitigation measures for air pollution. As a modelling study, the paper bridged the gap between theory and practice, while implications are consistent with the findings and conclusions of the paper.

8. <b>6. Quality of Communication: </b>Does the paper clearly express its case, measured against the technical language of the fields and the expected knowledge of the journal's readership? Has attention been paid to the clarity of expression and readability, such as sentence structure, jargon use, acronyms, etc.: The questions are adequately addressed, but the paper needs further proof reading to avoid grammatical and typographical errors.

Proofreading is now done in the revised version.

<table>
<thead>
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1. In addition to the comments from the above reviewers, please also pay attention to some of the following aspects while improving the quality of your manuscript:

An updated and complete literature review should be conducted. The relevance to Management of Environmental Quality should be enhanced with the considerations of scope and readership of the Journal.

The revised article takes care of 1) some latest research articles 2) practical and theoretical contributions and 3) substantiating the discussion part of the earlier version, keeping in mind the scope of journal “Management of Environmental Quality”.

Page 5, Section 2.1.3, Line 13
On the other hand, training and qualification mechanism should be in force for taxi drivers to avoid aggressive travel behavior and violation of road traffic rules and regulations (Vahedi et al, 2018).


Page 5, Section 2.1.4, Line 4
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Page 6, Section 2.2.1, Line 6
Stark, Berger, and Hössinger (2018) have pointed out that reflection, action, and intervention of information sources may influence on the intention of a person to optimize travel plan on the road.

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**Page 8, Section 2.3, Line 6**
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**Page 8, Section 2.3, Line 29**
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Page 4, Section 2.1.2, Line 2 (Old: Page 4, Section 2.1, Line 10)
Has removed repeated sentence start with “The three approaches to achieve sustainability of green environment are environmental protection, social responsibility, and economic progress (Chow & Chen, 2009)” from the text.

Page 5, Section 2.1.3, Line 13 (Additional amendments)
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Figure 1 illustrates the conceptual research framework supported by the Theory of Interpersonal Behavior (TIB) proposed by Egmond and Bruel (2007). The constructs of TIB in the research framework are attitude, social factors, affect, and habit. The sub-constructs for each independent variable (predictor) have been identified rationally to provide novelty to the conceptual framework. The totality of the framework considered in this study is seldom available in the literature, and hence, the present research is timely. The real novelty of this study is to investigate the cause and effect relationships of the predictors in the path diagram of Figure 1.

**Page 11, Section 3.0, Line 7** (Old: Page 11, Section 3.0, Line 3)
The sentence describes the exogenous and endogenous variables in the conceptual framework, and therefore, it is included.

**Page 12, Section 3.0, Table 1** (Old: Page 3, Section 2.0, Table 1)
Edited TIB variables to TIB variable.

**Page 1, Abstract (Originality/value), Line 1**
The identification of the suitable predictors for the urban travel behavior model towards travel behavior performance of a commuter is the real novelty of the present study. In addition, the cause and effect relationships of different predictors in terms of path directions of the proposed research framework are the highlights of the study.
The present study provides the appropriate predictors for intention to follow road discipline and consequently, the expected travel behavior performance of road commuters. Thus, in the present study, a holistic research framework has been constructed for urban travel behavior model, which can be customized for any developing country in a broader sense to the art of social science research.

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The conceptualization of the predictors considered in the present study is synchronized with the variables of TIB as in Table 1.

Articles should be between 7000 and 9000 words in length. This includes all text including figures, tables, references and appendices (280 words for each figure or table).

The revised article is well within the stipulated words prescribed by the journal guidelines.
Conceptualization of an Urban Travel Behavior Model to Mitigate Air Pollution for Sustainable Environmental Development in Malaysia

Abstract

Purpose

Global issues on the environment, such as climate change, air pollution, and carbon monoxide emission are the primary concerns in any part of the world. The present study aims at constructing a conceptual framework for travel behavior performance of a commuter, and it is expected to mitigate air pollution from vehicle emission and to promote smart mobility on the road.

Design/methodology/approach

From the extensive literature review, the conceptual framework for travel behavior performance of a commuter has been developed and is supported by the Theory of Interpersonal Behavior whose functions are attitude, social factor, affect and habit. In particular, in the present article, attitude is conceptualized by four predictors, namely confidence in driving, green environment, social responsibility, and deviation in driving. The social factor is characterized by subjective norms, social status, and digitalization. Affect factor is conceptualized by accidents and damages, road infrastructure, and weather conditions. The mental block in following the ancestor’s way of owning a personal vehicle is the predictor for the habit.

Findings

One of the main contributors to environmental damages is road traffic. Notably, vehicle emissions are on the rise every year due to the increase of reliance on vehicles, and there is no alternative to this issue. Although Malaysia has the well-organized infrastructure with effective digitalized technology on the road for the transport system, there is severe traffic congestion in Klang Valley, Kuala Lumpur, because of lack of travel plan behavior during peak hours. If the road commuters give the predictors constructed in the proposed conceptual framework the highest importance, then there will be much relief to traffic congestion on the road.

Research limitations/implications

Since, the present study focuses on the conceptualization of an urban travel behavior model, and also highlights the synchronization of the proposed framework with the management theory, the results are expected only after the primary survey based on the cross-sectional study will be conducted.

Originality/value

The identification of the suitable predictors for the urban travel behavior model towards travel behavior performance of a commuter is the real novelty of the present study. In addition, the cause and effect relationships of different predictors in terms of path directions of the proposed research
framework are value add of the study. Further, the predictors in the proposed framework and the Theory of Interpersonal Behavior have been synchronized with operational definitions which are the original contributions of the present study, which will definitely enhance the sustainable environmental development for the society as a whole.

**Keywords**— Urban *Travel Behavior; Road Traffic Policies/Regulations; Mental Block; Green Environment*

1. Introduction

Road traffic congestion leads to loss of productivity, waste of fuel, time, skin problems, and respiratory diseases are almost occurring in a day-to-day affair. Due to a large number of vehicles in Klang Valley (data.gov.my, 2016), Malaysia, a single minor accident could stall up the entire lane to a minimum of 20 minutes. Idle engine, emissions, and noise are causing the degradation of green environment and health of the road commuters. Causes of road traffic congestion can be the over usage of a personal vehicle in traveling, weak first-mile and last-mile connectivity of public transport for road commuters, cycling and walking. The motivation for the study is caused by increase of carbon dioxide (CO2) emission, an increase of road deaths and crashes, lack of travel planning, waste of money, time and fuel, lack of real-time data for urban travel behavior and smart mobility models. The Malaysia government envisioned road traffic congestion. The government formulated National Key Result Areas – Urban Public Transport (NKRA-UPT) in 2010 (Malaysian Administrative Modernisation and Management Planning Unit, 2018). Moreover, the result of implementing NKRA-UPT is total of 20% shift of modal transport and is expected to continue to increase with the newly built Mass Rapid Transit (MRT) and upgrading and expansion of existing Keretapi Tanah Melayu (KTM) and Light Rail Transit (LRT). The occurrence of accidents could be high since there are many vehicles on the road. Consequently, road traffic congestion could happen due to fatal behavior while driving on the road, not properly maintaining vehicles, lack of better road infrastructure, not abiding by traffic laws and adverse weather conditions. The significance of the study is the contributions to the growth of knowledge in travel behavior based on psychological theory. The present study provides the appropriate predictors for intention to follow road discipline and consequently, the expected travel behavior performance of road commuters. Thus, in the present study, a holistic research framework has been constructed for urban travel behavior model, which can be customized for any developing country in a broader sense to the art of social science research.
2.0 Literature Review

Different travel behaviors of road commuters are the causes of road traffic congestion in Malaysia. Road rage, aggression driving and anger travel are behaviors that have a significant relationship with loss of vehicle control and crash-related conditions especially among young drivers in Malaysia (Sullman, Stephens, & Yong, 2015). The harmful effect of vehicle emissions from a large number of vehicles indicate that the lack of attitudinal change among some Malaysian citizens do exist (Zailani, Iranmanesh, Masron, & Chan, 2016). Public transport serves to provide convenience and benefits for elderly (Wong, Szeto, Yang, Li, & Wong, 2018), social activities (Chowdhury, Hadas, Gonzalez, & Schot, 2018) and more importantly is reducing vehicle emissions. There is a difference between male and female in abiding by traffic rules. While driving, males are perceived to be more violating traffic, due to confident in driving and risks taking (Mohamad, 2018). According to Gianfranchi, Spoto, and Tagliabue (2017), males have higher violation score than females, whereas females are prone to error driving. There are types of monsoon in Malaysia, which contribute to road traffic congestion, namely northeast monsoon (NEM) and the southwest monsoon (SWM) which is from November to February and May to August respectively. Road traffic congestion inevitably happens most of the time, mainly due to torrential rain (Guo et al, 2018). Other than traffic flow being affected, damages to the road could happen to cause more congestion. Steg (2003) remarked that personal vehicles could offer comfortability, convenience, speed, independence, reliability, and flexibility. Thus, a higher number of road commuters are using personal vehicles and has become a habit.

Theory of Interpersonal Behavior (TIB) can be used to predict the intention of a person to perform a behavior or not (Egmond and Bruel, 2007). TIB states that the intention of a person to exhibit a behavior is under the influence of four components, which are attitude (cognition), social factors, affect, and habit (Triandis, 1977). Attitude (cognition) is about the psychological perceived value or consequences of the action. There are three dimensions in social factors, namely, social norms, social role, and self-concept. A social norm is an influence from society to individual to believe that certain behavior is viewed as appropriate. The social role implies that a person holds a set of behavior that is appropriate for his/her roles in society, whereas self-concept is the idea of who he or she is. Affect is the state of the emotion during the thought of exhibiting the behavior. Habit is the frequency of past behavior where repetition in performing the same behavior has been practiced in day-to-day routine life. The constructs of TIB are elaborated in the sections below:
2.1 Attitude

Attitude can be used as a consumer recognized value to behavior (Halstead, 1999) to predict future behavior (Triandis, 1979). Jiménez-Mejías et al. (2014) argued that male driving style is associated with confidence in driving, seeking greater intensity of exposure and risky driving while female drivers tend to maximize the braking and keep more distance between the cars in front (Li, Yan, Wu, Radwan, & Zhang, 2016). Moreover, the male driver will overtake other vehicles even in short distances (Lyu, Cao, Wu, Xu, & Xie, 2018). Female drivers are prone to errors while male drivers have a high score for intention to violate rules and laws (Gianfranchi et al, 2017). The demand for fossil fuel and energy increase due to urbanization and economic growth in Malaysia (Bekhet & Othman, 2017). Deviation from driving safely include drink driving (Watling, Hooijer, Armstrong, & Watling, 2018), distracted driving (Chen, Wu, Zhong, Lyu, & Huang, 2015), effect of different personality driving, texting while driving (Preece, Watson, Kaye, & Fleiter, 2018), driving with discourtesy with stress (Scott-Parker, Jones, Rune, & Tucker, 2018) and driving under negative emotions (Shen, Ge, Qu, Sun, & Zhang, 2018). Surprisingly, drivers are aggressive even they feel cautious while driving on the road (Eboli, Mazzulla, & Pungillo, 2017). For a sustainable green environment, three approaches were identified, namely; social-responsibility, environmental-protection, and economic-progress (Chow & Chen, 2016). Four dimensions of the construct ‘attitude’ of road commuters are discussed in the following sections.

2.1.1 Confidence in Driving

Males and females display different driving behaviors and styles (Jiménez-Mejías et al, 2014; Li, Yan, Wu, Radwan, & Zhang, 2016). Furthermore, high or low in confidence while driving can determine the intention of drivers if they intend to violate the law or abide by it. According to Mckenna (2018), drivers with high confidence tend to violate traffic rules and regulations. Behavior, such as low concentration, hostility towards other drivers, as well as neglecting warning and speed limit signs, can contribute to road traffic accidents. Confidence in driving is about driving styles, violation of traffic laws, and discrimination among other drivers, especially elderly drivers. This shows that concern for other road commuters can be further reminded and improved. Hence, this study hypothesizes that:

H1a: Confidence in driving has a positive influence on travel behavior performance of road commuters.

2.1.2 Green Environment

As the number of vehicles and vehicle emission have been escalating, climate change is a predominant issue in Malaysia. Thus taking climate change into account, specific concern for being...
Environmental-friendly should be given at most priority. Environmental concerns from personal attitudes and household behaviors signify the importance of protecting the environment (Alcock et al., 2017). Nevertheless, accessibility for motorcycles in foot lane should be made available to increase active travel on the road (Măirean & Havârneanu, 2018). This leads to the following hypothesis:

H1b: Green environment has a positive influence on travel behavior performance of road commuters.

2.1.3 Social Responsibility

According to Geng, Long, Chen, and Li (2017), age, gender, income level, car ownership, attitude towards government policy measures, and travel distance are influential in performing green travel behavior. Notably, older and high-income groups are more reliant on cars, thus against government policy measures. On the other hand, medium age and income are in line with government policy measures, whereas young and low-income groups are more reluctant and forced in their behavior to use non-car travel modes, and the fourth group (medium age and high income) hold swing attitudes towards government policy measures. Creation of apps that display exposure to a level of air pollution due to their travel behaviors and comparison to previous travel behavior may influence people to have the intention to change (Haddad & de Nazelle, 2018). Road commuters should have a social responsibility, such as understanding and abiding by the traffic rules. According to af-Wåhlberg, Dorn, and Kline (2011), drivers who do not abide by traffic rules, such as the absence of advance travel planning, double parking, and not parking in the yellow box, may lead to accidents and penalties. On the other hand, training and qualification mechanism should be in force for taxi drivers to avoid aggressive travel behavior and violation of road traffic rules and regulations (Vahedi et al., 2018). Hence, this study hypothesizes that:

H1c: Social responsibility has a positive influence on travel behavior performance of road commuters.

2.1.4 Deviation in Driving

The unusual way of driving is what identified as abnormal driving. Abnormal driving includes texting while driving, drink-and-driving, and distracted driving. Those who text while driving are more likely to exhibit other risky behavior and more immune to traffic risks (Preece et al., 2018). As for drink-and-driving, it is associated with fatal accidents (Chen & Jou, 2018). There are three aspects of driving with discourtesy as per Scott-Parker et al. (2018), namely, impolite behavior (deliberate anger and intimidation), driving context (malfunction of vehicles features, driving on holidays, road infrastructure features and driving in unknown locations) and behavior from other road users (merging, tailgating, and drug use). Additionally, the four categories for distracted driving
are watching roadside, talking, under the influence of drowsiness, and drinking (Chen, Wu, Zhong, Lyu, & Huang, 2015). Drivers should have concerns about the safety of the others and their own while traveling. Penalizing offenders is insufficient, as more should be done at the same time, given that the consequences of impair driving are costly and life-threatening. Thus, this study proposes the following hypothesis:

H1d: Deviation in driving has a positive influence on travel behavior performance of road commuters.

### 2.2 Social Factors

Having network and social interactions are crucial in modern mobility (Dugundji et al, 2011). The importance of walking and cycling for commuters who are physically inactive should be recognized (Keall, Chapman, Shaw, Abrahamse, & Howden-Chapman, 2018) through social influence. Subjective norm is identified as of whether an individual would exhibit the same behavior if peers are pressuring that individual to (Wan, Shen, & Choi, 2017). This works the same way when deciding to purchase a car or not (Belgianw, Schmöcker, Abou-Zeid, Walker, & Fujii, 2017). For youths, factors such as independence, car usage frequency, affective, and income level are influential in purchasing a car or not. Among male and female as household heads, travel behavior in a household is interchangeably influential (Kroesen, 2015). According to Choo & Mokhtarian (2004), a status seeker is one of the four lifestyles in their work. Other lifestyles being community/family-oriented, frustrating factor, and workaholic. Owning a sporty and branded vehicle in Malaysia usually is a sign of richness, having a high-income level, fame, or social status in modern society. A GPS device that monitor road condition system and road traffic in Klang Valley can be implemented to improve or regulate the traffic when necessary (Lei, Mohamed, & Claudel, 2018). However, utilization of electronic board that displays information about traffic flow on the roadside will have a negative effect on driving behavior and traffic safety (Mollu, Cornu, Brijs, Pirdavani, & Brijs, 2018). Social Factors (Kang, Jayaraman, Soh, & Wong, 2018), which influences the travel behavior performance of road commuters have three dimensions and are elaborated below:

#### 2.2.1 Subjective Norms

Several subjective norms are exhibited when people are on the road, such as texting while driving. Calling and replying phone calls with or without hand-held devices do not guarantee safety while driving (Lipovac et al, 2017). Subjective and descriptive norms can increase one’s green travel intent even when they do not hold high environmental responsibility (Ru, Wang, Chen, & Yan, 2018). Hence, their attitude, knowledge, and beliefs can influence the effectiveness of the enforcement of distracted driving law. Stark, Berger, and Hössinger (2018) have pointed out that reflection, action,
and intervention of information sources may influence on the intention of a person to optimize travel plan on the road. Hence, this study proposes the hypothesis that:

H2a: Subjective norm has a positive influence on travel behavior performance of road commuters.

2.2.2 Social Status

Social statuses are usually expressed through specific patterns of consumption and behaviors (Van Acker, Goodwin, & Witlox, 2016). Beliefs, attitude, and interests shape these patterns. Hence, social statuses are not only shaped by speed, price, and comfort. In this case, the personal aim of having a high-value vehicle due to the desire for high esteem can be noted (Kusuma, 2015). Apart from perceptions, preference on vehicles that enhances self-image and esteem comes under the influence of several factors, such as internet marketing, influence from family members on the purchase, customer satisfaction, and loyalty (Kusuma, 2015). Being able to quick enough gain ideas and feedback from the internet from potential customers, as well as personalized care and after-sales service with vehicle brand, shows that the internet is important in communication and marketing strategies amongst vehicle manufacturers. More importantly, customer satisfaction and loyalty to vehicle brands encourage returning customers. Additionally, there is an increment in vehicle purchase from women as well (Kusuma, 2015). Hence, this study hypothesizes the following:

H2b: Social status has a positive influence on travel behavior performance of road commuters.

2.2.3 Digitalization

In making use of advanced, sophisticated technology, a GPS device that can monitor traffic and road condition system may be applied by the relevant authorities to regulate road traffic in Klang Valley, especially during peak hours (Lei et al, 2018). However, the high utilization of advanced technology might not be the best case. Rahman, Wirasinghe, and Kattan (2013) claimed that the next bus arrival time made available at bus stops is the most sought after for bus riders. This should encourage people to change their mode of transport for the betterment. As for Light Rail Transit (LRT), the next arrival time has the interest of less frequent riders, but not regular riders. The industry revolution 4 looks for real-time data, automation & integration in every walks of life, and therefore, the digitalization is mandatory in controlling road traffic. The usage of advanced technology and real-time data is crucial in mitigating emissions from vehicles. Hence, this study posits the following:

H2c: Digitalization has a positive influence on travel behavior performance of road commuters.
2.3 Affect

Affect has been considered as emotion (Triandis, 1977). At times, emotion will disrupt and cloud individual judgment (Preece et al, 2018) with changes from the past (Pfister & Bohm, 2008) during the process of making decisions. Evidence of research from Russel (1980) suggests that in the affective dimensions, variables are highly interrelated in a systematic way. The affective dimensions fall in a circular order: pleasure (0°), excitement (45°), arousal (90°), distress (135°), displeasure (180°), depression (225°), sleepiness (270°) and relaxation (315°). Furthermore, positive and negative affect are different depending on the swings in mind (Diener & Emmons, 1985). This study also indicates that the longer the time of thinking process, the clearer the type of emotions. Not to mention during peak hours, travel behavior is certainly different from normal hours and will affect life satisfaction and emotional well-being (Friman, Gärling, Ettema, & Olsson, 2017). In Mann, Garcia-Rada, Hornuf, and Tafurt, (2016), internal and legal sanctions could reduce road traffic crimes. The feeling of guilt has the strongest effect on reducing road traffic crimes, and if not, legal sanctions will do the work. However, social sanctions do not reduce road traffic crimes but influence road commuters to engage in violation of traffic rules and laws. More mobility from personal vehicle indicates that there will be more air pollutions and climate change (Gilmore & Patwardhan, 2016). Air pollutions also affect agriculture productions (Shindell et al, 2011). While road agencies or authorities are maintaining road lane or road infrastructure, travel behavior performance of drivers will be affected due to the diversion of routes (Hartmann & Ling, 2016). Furthermore, good road infrastructure will lead to the reduction of air pollution (Van Acker et al., 2016), the increase of firms’ output through efficient transport systems (Barzin, D’Costa, & Graham, 2018) and increase of cycling activities (Hull & O’Holleran, 2014) among least physically active commuters (Panter, Heinen, Mackett, & Ogilvie, 2016). Reinvestment in cycling infrastructure, pedestrianization of town centers and public transport are considered as an encouragement for a change of mode of travel from the workplace or home (Van Acker et al, 2016) that will reduce carbon dioxide from vehicle emissions (Banister, 2008). In terms of individual travel behavior, the different daily temperature has a lesser impact than the different monthly temperature in the long term whereas different temperatures and daily winds are more influential in the short term (Liu et al, 2015). Heavy rainfall is a threat to the safety of road commuter (Preece et al, 2018) as the drivers should slow down during adverse weather (Wang, Liang, & Evans, 2017). Notably, older generation feels that they have responsibility for environmental issues, for example, climate change, as compared to the younger generation and through their emotions; this can affect the following generation (Wang et al, 2018).
2.3.1 Accidents and Damages

As there is no age limit for vehicles in Malaysia, it is more alarming and dangerous for human wellbeing. According to Tanishita and van Wee (2017), speed and speed variation are strongly believed to be the reasons for high rates of traffic accidents. There are two high probabilities for the occurrence of accidents. Accidents can happen when speed is reduced suddenly from 110 to 85 km/hour, for example, or increasing the speed from 65 to 95 km/hour. Also, more accidents tend to occur during sunny days, instead of cloudy weather which results in more costs, such as repair cost, cost of time, or even life-threatening costs (Tanishita & van Wee, 2017). Regarding environmental damages, light-duty vehicles can contribute to climate change by emitting as much as 209% of carbon emission in different altitude that lacks oxygen and low-pressure concentrations (Wang et al, 2018). Hence, the study hypothesizes the following:

H3a: Accidents and damages have a negative influence on travel behavior performance of road commuters.

2.3.2 Road Infrastructure

Reinvestment in public transportation, cycling infrastructure, and pedestrianization of town centers have been reconsidered as mobility management that encourages change in travel behavior from home or workplace (Van Acker et al, 2016). In order for people to change the mode of transport, road infrastructures for cycling and walking must be made available (Panter et al, 2016). With that, this study proposes the following:

H3b: Road infrastructure has a positive influence on travel behavior performance of road commuters.

2.3.3 Weather Conditions

Weather is hard to predict, and this can affect the travel plan. According to Tao, Corcoran, Rowe, & Hickman (2018), real-time weather information, as well as traffic and time of day, should be considered when monitoring the demand for buses. This also indicates that the adjustment of transit time should be changed accordingly to heavy rain or high temperatures. Furthermore, transit operators may upgrade bus stops to shelter passengers from heavy rain to increase ridership in case of a decrease in ridership. It has been observed that warm, dry, calm, and sunny, but not scorching hot weather, can stimulate active travel (Böcker, Dijst, & Faber, 2016). Road traffic accidents due to jumping red lights, speeding, and neglecting seatbelts are mostly attributed to other drivers (Rasool et al, 2015), not to mention that it could be far more devastating during rainfall in Malaysia. Hence, this study hypothesizes as follows:

H3c: Weather has a negative influence on travel behavior performance of road commuters.
2.4 Habit
Habit and behavior are related (Triandis, 1979). When the intention is repeated continuously and so as the later exhibited behavior, that experience will become a habit. Ouellette & Wood (1998) supported this statement by mentioning that the strength of habit is from repeated behavior; therefore, it is a predictor of behavior. It is highly correlated between intention, habits, and behavior with dominance from habits over behavioral outcomes (Gardner, Abraham, Lally, & de Bruijn, 2012). Mind wandering is preventing drivers from focusing on driving (Burdett, Charlton, & Starkey, 2018), and it occurs when drivers are in a comfortable or familiar environment. According to Qu et al. (2015), emotional driving, aggressive driving, drunk driving, and risky driving are all correlated with mind wandering. Additionally, when minds are wandering, male drivers exhibit driving behavior that is riskier and exhibits more emotions.

2.4.1 Mental Block
Mind wandering has been positively correlated with drunk driving, emotional driving, risky driving, and aggressive driving (Qu et al, 2015). Male drivers are found to be riskier and exhibit more negative emotional driving behavior when compared to female drivers upon mind wandering. There are also issues concerning lights that are glaring and getting the attention of drivers while on the road with high chances of creating accidents (Yellappan et al, 2016). Bright lights within a certain range can affect a driver’s vision. Factors of forgiveness and unforgiveness while on the road have a role in decreasing the intensity of adverse driving from young drivers (Bumgarner, 2015). Hence, conflicts between driving and non-driving activities can decrease based on the level of forgiveness from ourselves, others, and during unforeseen situations. With that, the following hypothesis is proposed:

H4: Habit factor (Mental Block) of road commuters has a negative influence on travel behavior performance of road commuters.

2.5 Intention to follow Road Discipline
Firstly, in the Theory of Planned Behavior (TPB) by Ajzen (1991) recognize that intention is a predictor of behavior. TPB also remarked that only with motivation, then only behaviors will be performed. However, scholars also argued that intention might not materialize into behavior sometimes (Webb & Sheeran, 2006). According to Moutinho (1987), the intention is an antecedent to behavior that is caused by beliefs about the outcome, whereas social and situational factors provided by normative beliefs. In fact, a lot of similarities have been noted between this explanation and TIB initiated by Triandis (1977) due to the reason that belief about outcome may influence one’s attitude to performing a behavior (Kang, Jayaraman, Soh Keng Lin, & Wai Peng Wong, 2019), while normative beliefs can influence one’s subjective norms to perform a behavior. Intention to
follow road discipline is an intention; thus, it can be understood in the same dimension. As such, this study proposes the following hypotheses:

H5 (a-j): Intention to follow road discipline mediates the relationship between independent variables and travel behavior performance of road commuters.

2.6 Road Traffic Policies/Regulations

Kaffashi et al. (2016) asserted that Malaysians are eager to minimize their car usage if innovative transport policy is implemented. Policies, such as proper pricing and efficient public transport, could shift the mode of transport from personal vehicles to public transport as much as 70%. The respondents in their study opined that they were willing to pay up to 175% of their hourly wages to have efficient public transport. The government should take some initiatives to implement new policies. However, several steps are involved before decision-makers can make decisions from researchers based on studies. Hence, the study hypothesizes the following:

H6: Road traffic policies/ regulations. Moderate the relationship between Intention to follow road discipline and travel behavior performance of road commuters.

3.0 Construction of a conceptual research framework

Figure 1 illustrates the conceptual research framework supported by the Theory of Interpersonal Behavior (TIB) proposed by Egmond and Bruel (2007). The constructs of TIB in the research framework are attitude, social factors, affect, and habit. The sub-constructs for each independent variable (predictor) have been identified rationally to provide novelty to the conceptual framework. The totality of the framework considered in this study is seldom available in the literature, and hence, the present research is timely. The real novelty of this study is to investigate the cause and effect relationships of the predictors in the path diagram of Figure 1. The constructs in attitude (Confidence in driving, green environment, social responsibility and deviation in driving), social factors (subjective norms, social status and digitalization), and affect (accident and damages, road infrastructure and weather) have direct effects on the dependent variable, which is travel behavior performance of road commuters. Second, habit (mental block) also has a direct effect on the dependent variable because habit is the frequency of past behavior. Hence, repetitive behavior could be exhibited, given that the circumstances are favorable. Intention to follow road discipline will mediate the relationship between independent and dependent variables, while the moderating variable is road traffic policies/ regulations.
Figure 1. Proposed Conceptual Research Framework

The conceptualization of the predictors considered in the present study is synchronized with the variables of TIB as in Table 1.

Table 1. Conceptualization of the constructs as per Theory of Interpersonal Behavior

<table>
<thead>
<tr>
<th>No</th>
<th>TIB variable</th>
<th>Description</th>
<th>Constructs in the framework</th>
<th>Synchronization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Attitude</td>
<td>Systematic</td>
<td>Confidence in Driving</td>
<td>If road commuters are confident in driving, they have to adhere to traffic laws which converge in safety concerns to commuters and others driving in the road.</td>
</tr>
<tr>
<td>2</td>
<td>Orderly</td>
<td>Green Environment</td>
<td>Social Responsibility</td>
<td>If travel commuters are traveling less frequently, walk/cycling for short distance, and use public transports, they can preserve the green environment in order.</td>
</tr>
<tr>
<td>3</td>
<td>Principles</td>
<td>Social Responsibility</td>
<td></td>
<td>If road commuters are socially responsible for understanding and abiding by rules while on the road, then they are highly principled.</td>
</tr>
<tr>
<td>4</td>
<td>Discipline</td>
<td>No Deviation in Driving</td>
<td></td>
<td>If road commuters do not deviate, particularly with no alcohol consumption, no cigarette smoking, no mobile messaging/chatting while driving; then their behavior is normal with perfect road travel discipline.</td>
</tr>
<tr>
<td>5</td>
<td>Social Factors</td>
<td>Influence of others</td>
<td>Subjective Norms</td>
<td>Relatives/friends/colleagues suggestions should not influence those commuters driving on the road.</td>
</tr>
</tbody>
</table>
6 Social Dignity | Social Status | Commuters while driving should seek for their safety and comforts and not have a luxury vehicle to show off for social status.
7 Technology Advancement | Digitalization | Industry evolution 4.0 to road infrastructures then they are planning ahead.
8 Affect | Road Violation | Accident and Damages | Real-time data and sophisticated digitalization using remote sensing of urban travel model will avoid road violation, which will control accidents and ultimately reduces damages.
9 Basic Needs | Road Infrastructure | Infrastructure development should be given utmost importance for avoiding traffic congestion.
10 Compromise | Weather | Under the unforeseen circumstance, bad weather may create traffic congestion and is unavoidable. Commuters have to find alternative routes for travel purposes.
11 Habit | Mind Wandering | Mental Block | There needs to be some change of thoughts in the mental block in following the family ancestor methods of owning personal vehicles in order to safeguard the environment.

4. Discussions and novelty of the framework
The present study proposes a conceptual research framework that suggests predictors avoid road accidents, to abide by road laws, to promote a change of transport mode, and to have a pollution-free healthier life. Only through more reliance on public transportation, discipline while driving on the road, and proper care on health and well-being will generate effective behavioral changes. Physical or health well-being achieves a higher score from active travel (walking and cycling) when compared to traveling by vehicles (Ettema et al, 2015). Certain factors, such as accessibility, availability of seats, cleanliness, and safety for public transport, should be given focus to consider an enjoyable alternative to personal vehicle travel (Ettema et al, 2015). The opportunity to involve in multitasking while on the road is considered as another crucial attractive characteristic of travel plan behavior. The society will benefit from the awareness towards the predictors embedded in the framework, having the intent to perform the behavior desired in this study, and implementation of innovative road traffic policies/regulations. The study outcomes will be useful in developing government policies for the transportation sector in the globe. Convenience, flexibility, no benefits of using public transport, and active travel have been perceived as values for personal vehicle users, and they have to think of environment protection in the long-run and sustainability of travel system on the road. The present study seeks to address the issue of low ridership of public transport and active travel as the short-term concern, whereas the long-term concern focuses on health and
climatic changes which may be addressed if utilization of public transport increases. Ultimately, the purpose of this study is to provide valuable information to overcome road traffic congestion and air pollution by promoting smart mobility in Klang Valley, Malaysia. The theory applied in this study is based on TIB by Triandis (1977). The study focuses on materializing road commuters’ intentions that stem from various factors to the desired behavior in travel plan.

5. Conclusions

Air pollution is a perineal problem in the globe and is predominantly due to road transport. The present study proposed a conceptual framework for travel behavior model, which applies to any road infrastructure set-up. The study provides information dissemination on the travel behavior of road commuters. The proposed framework in the present study is supported by the Theory of Interpersonal Behavior (TIB). TIB constructs are operationalized in the context of the study with several relevant dimensions for each variable. The conceptual research framework aimed to expand knowledge in the travel industry with the application of the theory. Abide by traffic laws, a healthier life without air pollution, avoiding road accidents, less frequent travel plan, normal driving, and change of mode of transportation are what the conceptual research framework talks about in this study. In achieving this, road commuters may rely more on public transportation, care for the fellow human beings, driving with discipline, not influenced by others in reckless driving and less frequent travel will smoothen air pollution. The major outcome of the proposed research framework in the present study would be smart mobility on the road, which will ultimately reduce air pollution and carbon emission. For long-run sustainable road traffic system, one has to plan for alternative toll system with remote sensing, smart infrastructure with double flyovers, strict enforcement on deviation in road regulations policies, sharing system in vehicles, and pre-planned travel visits will be the remedial measures to reduce traffic congestion and protect the environment.

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Kang, A. S., Jayaraman, K., Soh, K.-L., & Wong, W. P. (2019). Convenience, flexible service, and commute impedance as the predictors of drivers’ intention to switch and behavioral readiness to


Conceptualization of an Urban Travel Behavior Model to Mitigate Air Pollution 
for Sustainable Environmental Development in Malaysia

Abstract

Purpose
Global issues on the environment, such as climate change, air pollution, and carbon monoxide 
emission are the primary concerns in any part of the world. The present study aims at constructing a 
conceptual framework for travel behavior performance of a commuter, and it is expected to mitigate 
air pollution from vehicle emission and to promote smart mobility on the road.

Design/methodology/approach
From the extensive literature review, the conceptual framework for travel behavior performance of a 
commuter has been developed and is supported by the Theory of Interpersonal Behavior, whose 
functions are attitude, social factor, affect and habit. In the present article, attitude is conceptualized 
by four predictors, namely confidence in driving, green environment, social responsibility, and 
deviation in driving. The social factor is characterized by subjective norms, social status, and 
digitalization. Affect factor is conceptualized by accidents and damages, road infrastructure, and 
weather conditions. The mental block in following the ancestor’s way of owning a personal vehicle 
is the predictor for the habit.

Findings
One of the major contributors to environmental damages is road traffic. Notably, vehicle emissions 
are on the rise every year due to the increase of reliance on vehicles, and there is no alternative to 
this issue. Although Malaysia has the well-organized infrastructure with effective digitalized 
technology on the road for the transport system, there is severe traffic congestion in Klang Valley, 
Kuala Lumpur, because of lack of travel plan behavior during peak hours. If the road commuters 
give the predictors constructed in the proposed conceptual framework the highest importance, then 
there will be much relief to traffic congestion on the road.

Research limitations
Since, the present study focuses on the conceptualization of an urban travel behavior model, and also 
highlights the synchronization of the proposed framework with the management theory, the results 
are expected only after the primary survey based on the cross-sectional study will be conducted.

Originality value
The identification of the suitable predictors for the urban travel behavior model towards travel 
behavior performance of a commuter is the real novelty of the present study. Also, the cause and 
effect relationships of different predictors in terms of path directions of the proposed research

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framework are the highlights of the study. Further, the predictors in the proposed framework and the Theory of Interpersonal Behavior have been synchronized with operational definitions which are the original contributions of the present study, which will enhance the sustainable environmental development for the society as a whole.

**Keywords**— Urban Travel Behavior; Road Traffic Policies/Regulations; Mental Block; Green Environment; **Malaysia**

### 1.0 Introduction

Road traffic congestion leads to loss of productivity, waste of fuel, time, skin problems, and respiratory diseases are almost occurring in a day-to-day affair. Due to a large number of vehicles in Klang Valley (data.gov.my, 2016), Malaysia, a single minor accident could stall up the entire lane to a minimum of 20 minutes. Idle engine, emissions, and noise are causing the degradation of green environment and health of the road commuters. Causes of road traffic congestion can be the over usage of a personal vehicle in traveling, weak first-mile and last-mile connectivity of public transport for road commuters, less cycling and literally no walking on road. The motivation for the study is caused by increase of carbon dioxide (CO2) emission, an increase of road deaths and crashes, lack of travel planning, waste of money, time and fuel, lack of real-time data for urban travel behavior and smart mobility models. The Malaysia government formulated National Key Result Areas – Urban Public Transport (NKRA-UPT) in 2010 (Malaysian Administrative Modernisation and Management Planning Unit, 2018). Moreover, the result of implementing NKRA-UPT is of 20% shift of modal transport and is expected to continue to increase with the newly built Mass Rapid Transit (MRT) and upgrading and expansion of existing Keretapi Tanah Melayu (KTM) and Light Rail Transit (LRT). The occurrence of accidents could be high since there are many vehicles on the road. Consequently, road traffic congestion could happen due to fatal behavior while driving on the road, not properly maintaining vehicles, lack of better road infrastructure, not abiding by traffic laws and adverse weather conditions (Leow, Jayaraman & Asirvatham, 2018). The significance of the study is the contributions to the growth of knowledge in travel behavior based on psychological theory. The present study provides the appropriate predictors for intention to follow road discipline and consequently, the expected travel behavior performance of road commuters. Thus, in the present study, a holistic research framework has been constructed for urban travel behavior model, which can be customized for any developing country in a broader sense to the art of social science research.
2.0 Literature Review

Different travel behaviors of road commuters are the causes of road traffic congestion in Malaysia. Road rage, aggression driving and anger travel are behaviors that have a significant relationship with loss of vehicle control and crash-related conditions especially among young drivers in Malaysia (Sullman, Stephens & Yong, 2015). The harmful effect of vehicle emissions from a large number of vehicles indicates that the lack of attitudinal change among some Malaysians citizens is present (Zailani et al., 2016). Public transport serves to provide convenience and benefits for elderly (Wong, Szeto, Yang, Li & Wong, 2018), social activities (Chowdhury et al., 2018) and more importantly is reducing vehicle emissions. There is a difference between male and female in abiding by traffic rules. While driving, males are perceived to be more violating traffic, due to confident in driving and risks taking (Mohamad, 2018). According to Gianfranchi, Spoto and Tagliabue (2017), males have higher violation score than females, whereas females are prone to error driving. There are types of monsoon in Malaysia, which contribute to road traffic congestion, namely northeast monsoon (NEM) and the southwest monsoon (SWM) which is from November to February and May to August respectively in every year. Road traffic congestion inevitably happens most of the time, mainly due to torrential rain (Guo et al., 2018). Other than traffic flow being affected, damages to the road could happen to cause more congestion. Steg (2003) remarked that personal vehicles could offer comfortability, convenience, speed, independence, reliability, and flexibility. Thus, a higher number of road commuters are using personal vehicles and has become a regular habit.

Theory of Interpersonal Behavior (TIB) can be used to predict the intention of a person to perform a behavior or not (Egmond & Bruel, 2007). TIB states that the intention of a person to exhibit a behavior is under the influence of four components, which are attitude (cognition), social factors, affect, and habit (Triandis, 1977). Attitude is about the psychological perceived value or consequences of the action. There are three dimensions in social factors, namely, social norms, social role, and self-concept. A social norm is an influence from society to individual to believe that particular behavior is viewed as appropriate. The social role implies that a person holds a set of behavior that is appropriate for his/her roles in society, whereas self-concept is the idea of who he or she is. Affect is the state of the emotion during the thought of exhibiting the behavior. Habit is the frequency of past behavior where repetition in performing the same behavior has been practiced in day-to-day routine life. The constructs of TIB are elaborated in the sections below:
2.1 Attitude

Attitude can be used as a consumer recognized value to behavior (Halstead, 1999) to predict future behavior (Triandis, 1979). Jiménez-Mejías et al. (2014) argued that male driving style is associated with confidence in driving, seeking greater intensity of exposure and risky driving while female drivers tend to maximize the braking and keep more distance between the cars in front (Li et al., 2016). Moreover, the male driver will overtake other vehicles even in short distances (Lyu et al., 2018). Female drivers are prone to errors while male drivers have a high score for intention to violate rules and laws (Gianfranchi et al., 2017). The demand for fossil fuel and energy increase due to urbanization and economic growth in Malaysia (Bekhet & Othman, 2017). Deviation from driving safely include drink driving (Watling et al., 2018), distracted driving (Chen et al., 2015), effect of different personality driving, texting while driving (Preece et al., 2018), driving with discourtesy with stress (Scott-Parker et al., 2018) and driving under negative emotions (Shen et al., 2018). Surprisingly, drivers are aggressive even they feel cautious while driving on the road (Eboli, Mazzulla & Pungillo, 2017). For a sustainable green environment, three approaches were identified, namely; social-responsibility, environmental protection, and economic-progress (Chow & Chen, 2016). Four dimensions of the construct ‘attitude’ of road commuters are discussed in the following sections.

2.1.1 Confidence in Driving

As mentioned, males and females display different driving behaviors and styles (Jiménez-Mejías et al., 2014; Li et al., 2016). Furthermore, high or low in confidence while driving can determine the intention of drivers if they intend to violate the law or abide by it. According to Mckenna (2018), drivers with high confidence tend to violate traffic rules and regulations. Behavior, such as low concentration, hostility towards other drivers, as well as neglecting warning and speed limit signs, can contribute to road traffic accidents. Confidence in driving is about driving styles, violation of traffic laws, and discrimination among other drivers, especially elderly drivers. This shows that concern for other road commuters can be further reminded and improved. Hence, this study hypothesizes that:

H1a: Confidence in driving has a positive influence on travel behavior performance of road commuters.

2.1.2 Green Environment

As the number of vehicles and vehicle emission has been escalating, climate change is a prevalent issue in Malaysia. Thus, taking climate change into account, specific concern for being
environmental-friendly should be given at most priority. Environmental concerns from personal attitudes and household behaviors signify the importance of protecting the environment (Alcock et al., 2017). Nevertheless, accessibility for motorcycles in foot lane should be made available to increase active travel on the road (Măirean & Havârneanu, 2018). This leads to the following hypothesis:

H1b: Green environment has a positive influence on travel behavior performance of road commuters.

2.1.3 Social Responsibility

According to Geng et al. (2017), age, gender, income level, car ownership, attitude towards government policy measures, and travel distance are influential in performing green travel behavior. Notably, older and high-income groups are more reliant on cars, thus against government policy measures. On the other hand, middle age and average income group are in line with government policy measures, whereas young and low-income groups are more reluctant and forced in their behavior to use non-car travel modes, and the fourth group (middle age and high income) hold swing attitudes towards government policy measures (Geng et al., 2017). Creation of apps that display exposure to a level of air pollution due to travel behaviors and comparison to previous travel behavior may influence people to have the intention to change (Haddad & de Nazelle, 2018). Road commuters should have a social responsibility, such as understanding and abiding by the traffic rules. According to af-Wåhlberg, Dorn and Kline (2011), drivers who do not abide by traffic rules, such as the absence of advance travel planning, double parking, and not parking in the yellow box, may lead to accidents and penalties. On the other hand, training and qualification mechanism should be in force for taxi drivers to avoid aggressive travel behavior and violation of road traffic rules and regulations (Vahedi et al., 2018). Hence, this study hypothesizes that:

H1c: Social responsibility has a positive influence on travel behavior performance of road commuters.

2.1.4 Deviation in Driving

The unusual way of driving is what identified as abnormal driving. Abnormal driving includes texting while driving, drink-and-driving, and distracted driving. Those who text while driving are more likely to exhibit other risky behavior and more immune to traffic risks (Preece et al., 2018). As for drink-and-driving, it is associated with fatal accidents (Chen & Jou, 2018). There are three aspects of driving with discourtesy as per Scott-Parker et al. (2018), namely, impolite behavior (deliberate anger and intimidation), driving context (malfunction of vehicles features, driving on holidays, road infrastructure features and driving in unknown locations) and behavior from other road users (merging, tailgating, and drug use). Additionally, the four categories for distracted driving
are watching roadside, talking, under the influence of drowsiness, and drinking (Chen et al., 2015). Drivers should have concerns about the safety of the others and their own while traveling. Penalizing offenders is insufficient, as more should be done at the same time, given that the consequences of impair driving are costly and life-threatening. Thus, this study proposes the following hypothesis:

H1d: *Deviation in driving has a positive influence on travel behavior performance of road commuters.*

2.2 Social Factors

Having network and social interactions are crucial in modern mobility (Dugundji et al, 2011). The importance of walking and cycling for commuters who are physically inactive should be recognized (Keall et al., 2018) through social influence. Subjective norm is identified as of whether an individual would exhibit the same behavior if peers are pressuring that individual (Wan, Shen & Choi, 2017). This works the same way when deciding to purchase a car or not (Belgiawan et al., 2017). For youths, factors such as independence, car usage frequency, affective, and income level are influential in purchasing a car or not. Among male and female as household heads, travel behavior in a household is interchangeably influential (Kroesen, 2015). According to Choo and Mokhtarian (2004), a status seeker is one of the four lifestyles in their work. Other lifestyles being community/family-oriented, frustrating factor, and workaholic. Owning a sporty and branded vehicle in Malaysia usually is a sign of richness, having a high-income level, fame, or social status in modern society. A GPS device that monitor road condition system and the road traffic in Klang Valley can be implemented to improve or regulate the traffic when necessary (Lei, Mohamed & Claudel, 2018). However, utilization of electronic board that displays information about traffic flow on the roadside will have a negative effect on driving behavior and traffic safety (Mollu et al., 2018). Social Factors (Kang et al., 2019), which influences the travel behavior performance of road commuters have three dimensions and are elaborated below:

2.2.1 Subjective Norms

Several subjective norms are exhibited when people are *driving* on the road, such as texting while driving. Calling and replying phone calls with or without hand-held devices do not guarantee safety while driving (Lipovac et al., 2017). Subjective and descriptive norms can increase *ones* green travel intent even when they do not hold high environmental responsibility (Ru et al., 2018). Hence, their attitude, knowledge, and beliefs can influence the effectiveness of the enforcement of distracted driving law. Stark, Berger, and Hössinger (2018) have pointed out that reflection, action, and intervention of information sources may influence on the intention of a person to optimize travel plan on the road. Hence, this study proposes the hypothesis that:
H2a: Subjective norm has a positive influence on travel behavior performance of road commuters.

2.2.2 Social Status

Social status is usually expressed through specific patterns of consumption and behaviors (Van Acker, Goodwin & Witlox, 2016). Beliefs, attitude, and interests shape these patterns. Hence, social status is not shaped by speed, price, and comfort. In this case, the personal aim of having a high-value vehicle due to the desire for high esteem can be noted (Kusuma, 2015). Apart from perceptions, preference on vehicles that enhances self-image and esteem comes under the influence of several factors, such as internet marketing, influence from family members on the purchase, customer satisfaction, and loyalty (Kusuma, 2015). Being able to quick enough gain ideas and feedback from the internet from potential customers, as well as personalized care and after-sales service with vehicle brand, shows that the internet is important in communication and marketing strategies amongst vehicle manufacturers. More importantly, customer satisfaction and loyalty to vehicle brands encourage returning customers. Additionally, there is an increment in vehicle purchase from women as well (Kusuma, 2015). Hence, this study hypothesizes the following:

H2b: Social status has a positive influence on travel behavior performance of road commuters.

2.2.3 Digitalization

In making use of advanced, sophisticated technology like a GPS device that can monitor traffic and road condition system may be applied by the relevant authorities to regulate road especially during peak hours (Lei et al., 2018). However, the high utilization of advanced technology might not be the best case. Rahman, Wirasinghe and Kattan (2013) claimed that the next bus arrival time should be made available at bus stops is the most sought-after for bus riders. This should encourage people to change their mode of transport for the betterment. As for Light Rail Transit (LRT), the next arrival time has the interest of less frequent riders, but not regular riders. The industry revolution-4 looks for real-time data, automation and integration in every walks of life, and therefore, the digitalization is mandatory in controlling road traffic. The usage of advanced technology and real-time data is crucial in mitigating emissions from vehicles. Hence, this study posits the following:

H2c: Digitalization has a positive influence on travel behavior performance of road commuters.

2.3 Affect

Affect has been considered as emotion (Triandis, 1977). At times, emotion will disrupt and cloud individual judgment (Preece et al., 2018) with changes from the past (Pfister & Bohm, 2008) during the process of making decisions. Evidence of research from Russel (1980) suggests that in the affective dimensions, variables are highly interrelated in a systematic way. The affective dimensions fall in a circular order: pleasure (0°), excitement (45°), arousal (90°), distress (135°), displeasure
(180°), depression (225°), sleepiness (270°) and relaxation (315°). Furthermore, positive and negative affect are different depending on the swings in mind (Diener & Emmons, 1985). This study also indicates that the longer the time of thinking process, the clearer the type of emotions. Not to mention during peak hours, travel behavior is certainly different from normal hours and will affect life satisfaction and emotional well-being (Friman et al., 2017). In Mann et al. (2016), internal and legal sanctions could reduce road traffic crimes. The feeling of guilt has the strongest effect on reducing road traffic crimes, and if not, legal sanctions will do the work. However, social sanctions do not reduce road traffic crimes but influence road commuters to engage in violation of traffic rules and laws. More mobility from personal vehicle indicates that there will be more air pollutions and climate change (Gilmore & Patwardhan, 2016). Air pollutions also affect agriculture productions (Shindell et al., 2011). While road agencies or authorities are maintaining road lane or road infrastructure, travel behavior performance of drivers will be affected due to the diversion of routes (Hartmann & Ling, 2016). Furthermore, good road infrastructure will lead to the reduction of air pollution (Van Acker et al., 2016), the increase of firms’ output through efficient transport systems (Barzin, D’Costa & Graham, 2018) and increase of cycling activities (Hull & O’Holleran, 2014) among least physically active commuters (Panter et al., 2016). Reinvestment in cycling infrastructure, pedestrianization of town centers and public transport are considered as an encouragement for a change of mode of travel from the workplace or home (Van Acker et al., 2016) that will reduce carbon dioxide from vehicle emissions (Banister, 2008). In terms of individual travel behavior, the different daily temperature has a lesser impact than the different monthly temperature in the long term whereas different temperatures and daily winds are more influential in the short term (Liu et al., 2015). Heavy rainfall is a threat to the safety of road commuter (Preece et al., 2018) as the drivers should slow down during adverse weather (Wang, Liang & Evans, 2017). Notably, older generation feels that they have responsibility for environmental issues, for example, climate change, as compared to the younger generation and through their emotions; this can affect the following generation (Wang et al., 2018).

2.3.1 Accidents and Damages
As there is no age limit restriction for vehicles in Malaysia, it is more alarming and dangerous for human wellbeing. According to Tanishita and van Wee (2017), speed and speed variation are strongly believed to be the reasons for high rates of traffic accidents. There are two high probabilities for the occurrence of accidents. Accidents can happen when speed is reduced suddenly from 110 to 85 km/hour, for example, or increasing the speed from 65 to 95 km/hour. Also, more accidents tend to occur during sunny days, instead of cloudy weather which results in more costs, such as repair cost, cost of time, or even life-threatening costs (Tanishita & van Wee, 2017).
Regarding environmental damages, light-duty vehicles can contribute to climate change by emitting as much as 209% of carbon emission in different altitude that lacks oxygen and low-pressure concentrations (Wang et al., 2018). Hence, the study hypothesizes the following:

H3a: Accidents and damages have a negative influence on travel behavior performance of road commuters.

2.3.2 Road Infrastructure

Reinvestment in public transportation, cycling infrastructure, and pedestrianization of town centers have to be reconsidered as mobility management that encourages change in travel behavior from home to workplace (Van Acker et al., 2016). In order for people to change the mode of transport, road infrastructures for cycling and walking must be made available (Panter et al., 2016). With that, this study proposes the following:

H3b: Road infrastructure has a positive influence on travel behavior performance of road commuters.

2.3.3 Weather Conditions

Weather is hard to predict, and this can affect the travel plan. According to Tao et al. (2018), real-time weather information, as well as traffic and time of day, should be considered when monitoring the demand for buses. This also indicates that the adjustment of transit time should be changed accordingly to heavy rain or high temperatures. Furthermore, transit operators may upgrade bus stops to shelter passengers from heavy rain to increase ridership in case of a decrease in ridership. It has been observed that warm, dry, calm, and sunny, but not scorching hot weather, can stimulate active travel (Böcker, Dijst & Faber, 2016). Road traffic accidents due to jumping red lights, speeding, and neglecting seatbelts are mostly attributed to other drivers (Rasool et al., 2015), not to mention that it could be far more devastating during rainfall. Hence, this study hypothesizes as follows:

H3c: Weather has a negative influence on travel behavior performance of road commuters.

2.4 Habit

Habit and behavior are related (Triandis, 1979). When the intention is repeated continuously and so as the later exhibited behavior, that experience will become a habit. Ouellette and Wood (1998) supported this statement by mentioning that the strength of habit is from repeated behavior; therefore, it is a predictor of behavior. It is highly correlated between intention, habits, and behavior with dominance from habits over behavioral outcomes (Gardner et al., 2012). Mind-wandering is preventing drivers from focusing on driving (Burdett, Charlton & Starkey, 2018), and it occurs when drivers are in a comfortable or familiar environment. According to Qu et al. (2015), emotional
driving, aggressive driving, drunk driving, and risky driving are all correlated with mind wandering. Additionally, when minds are wandering, male drivers exhibit driving behavior that is riskier and exhibits more emotions.

### 2.4.1 Mental Block

Mind-wandering has been positively correlated with drunk driving, emotional driving, risky driving, and aggressive driving (Qu et al., 2015). Male drivers are found to be riskier and exhibit more negative emotional driving behavior when compared to female drivers upon mind wandering. There are also issues concerning lights that are glaring and getting the attention of drivers while on the road with high chances of creating accidents (Yellappan et al., 2016). Bright lights within a certain range can affect a driver’s vision. Factors of forgiveness and unforgiveness while on the road have a role in decreasing the intensity of adverse driving from young drivers (Bumgarner, 2015). Hence, conflicts between driving and non-driving activities can decrease based on the level of forgiveness from ourselves, others, and during unforeseen situations. With that, the following hypothesis is proposed:

**H4:** Habit factor (Mental Block) of road commuters has a negative influence on travel behavior performance of road commuters.

### 2.5 Intention to follow Road Discipline

Firstly, in the Theory of Planned Behavior (TPB) by Ajzen (1991) recognize that intention is a predictor of behavior. TPB also remarked that only with motivation, then only behaviors will be performed. However, scholars also argued that intention might not materialize into behavior sometimes (Webb & Sheeran, 2006). According to Moutinho (1987), the intention is an antecedent to behavior that is caused by beliefs about the outcome, whereas social and situational factors provided by normative beliefs. In fact, a lot of similarities have been noted between this explanation and TIB initiated by Triandis (1977) due to the reason that belief about outcome may influence one’s attitude to perform a behavior (Kang et al., 2019), while normative beliefs can influence one’s subjective norms to perform a behavior. Intention to follow road discipline is an intention; thus, it can be understood in the same dimension. As such, this study proposes the following hypotheses:

**H5 (a-j): Intention to follow road discipline mediates the relationship between independent variable (Attitude, Social Factors, Affect and Habit) and travel behavior performance of road commuters.**

### 2.6 Road Traffic Policies/Regulations

Kaffashi et al. (2016) asserted that Malaysians are eager to minimize their car usage if innovative transport policy is implemented. Policies, such as proper pricing and efficient public transport, could shift the mode of transport from personal vehicles to public transport to the extent of 70%. The
respondents in this study opined that they were willing to pay up to 175% of their hourly wages to have efficient public transport. The government should take some initiatives to implement new policies. However, several steps are involved before decision-makers can make decisions from research studies. Hence, the study hypothesizes the following:

H6: Road traffic policies/ regulations moderates the relationship between Intention to follow road discipline and travel behavior performance of road commuters.

3.0 Construction of a conceptual research framework

Figure 1 illustrates the conceptual research framework supported by the Theory of Interpersonal Behavior (TIB) proposed by Egmond and Bruel (2007). The constructs of TIB in the research framework are attitude, social factors, affect, and habit. The sub-constructs for each independent variable (predictor) have been identified rationally to provide novelty to the conceptual framework. The totality of the framework considered in this study is seldom available in the literature, and hence, the present research is timely. The real novelty of this study is to investigate the cause and effect relationships of the predictors in the path diagram of Figure 1. The constructs in attitude (Confidence in driving, green environment, social responsibility and deviation in driving), social factors (subjective norms, social status and digitalization), and affect (accident and damages, road infrastructure and weather) have direct effects on the travel behavior performance of road commuters. Habit (mental block) also has a direct effect on the travel behavior performance of road commuters because habit is the frequency of past behavior. Hence, repetitive behavior could be exhibited, given that the circumstances are favorable. Intention to follow road discipline will mediate the relationship between independent and dependent variables, while the moderating variable is road traffic policies/ regulations.
The conceptualization of the predictors considered in the present study is synchronized with the variables of TIB as in Table 1.

**Table 1.** Conceptualization of the constructs as per Theory of Interpersonal Behavior

<table>
<thead>
<tr>
<th>No</th>
<th>TIB variable</th>
<th>Description</th>
<th>Constructs in the framework</th>
<th>Synchronization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Systematic</td>
<td>Confidence in Driving</td>
<td>If road commuters are confident in driving, they have to adhere to traffic laws which converge in safety concerns to commuters and others driving on the road.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Orderly</td>
<td>Green Environment</td>
<td>If travel commuters are traveling less frequently, walk/cycling for short distance, and use public transports, they can preserve the green environment in order.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Attitude</td>
<td>Principles</td>
<td>Social Responsibility</td>
<td>If road commuters are socially responsible for understanding and abiding by rules while on the road, they are highly principled.</td>
</tr>
<tr>
<td>4</td>
<td>Discipline</td>
<td>No Deviation in Driving</td>
<td>If road commuters do not deviate, particularly with no alcohol consumption, no cigarette smoking, no mobile messaging/chatting while driving; then their behavior is normal with perfect road travel discipline.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Social Factors</td>
<td>Influence of others</td>
<td>Subjective Norms</td>
<td>Relatives/friends/colleagues suggestions should not influence those commuters driving on the road.</td>
</tr>
</tbody>
</table>
Commuters while driving should seek for their safety and comforts and not have a luxury vehicle to show off for social status.

Application of artificial intelligence (AI) with real-time data (Industry Revolution-4) to be implemented for digitalization.

Real-time data and sophisticated digitalization using remote sensing of urban travel model will avoid road violation, which will control accidents and ultimately reduces damages.

Infrastructure development should be given utmost importance for avoiding traffic congestion.

Under the unforeseen circumstance, bad weather may create traffic congestion and is unavoidable. Commuters have to find alternative routes for travel purposes.

There needs to be some change of thoughts in the mental block in following the family ancestor methods of owning personal vehicles in order to safeguard the environment.

4.0 Discussions and novelty of the framework

The present study proposes a conceptual research framework that suggests predictors to avoid road accidents, to abide by road laws, to promote a change of transport mode, and to have a pollution-free healthier life. Only through more reliance on public transportation, discipline while driving on the road, and proper care on health and well-being will generate effective behavioral changes. Physical or health well-being achieves a higher score from active travel (walking and cycling) when compared to traveling by vehicles (Ettema et al., 2015). Certain factors, such as accessibility, availability of seats, cleanliness, and safety for public transport, should be given focus to be considered an enjoyable alternative to personal vehicle travel (Ettema et al., 2015). The opportunity to involve in multi-tasking while on the road is considered as another crucial attractive characteristic of travel plan behavior. The society will benefit from the awareness towards the predictors embedded in the framework, having the intent to perform the behavior desired in this study, and implementation of innovative road traffic policies/regulations. The study outcomes will be useful in developing government policies for the transportation sector in the globe. Convenience, flexibility, no benefits of using public transport, and active travel have been perceived as values for personal vehicle users, and they have to think of environment protection in the long-run and sustainability of travel system on the road. The present study seeks to address the issue of low ridership of public transport and active travel as the short-term concern, whereas the long-term concern focuses on...
health and climatic changes which may be addressed if utilization of public transport increases. Ultimately, the purpose of this study is to provide valuable information to overcome road traffic congestion and air pollution by promoting smart mobility in Klang Valley, Malaysia. The theory applied in this study is based on TIB by Triandis (1977). The study focuses on materializing road commuters’ intentions that stem from various factors to the desired behavior in travel plan.

5.0 Conclusions

Air pollution is a perennial problem in the globe and is predominantly due to road transport. The present study proposed a conceptual framework for travel behavior model, which applies to any road infrastructure set-up. The study provides information dissemination on the travel behavior of road commuters. The proposed framework in the present study is supported by the Theory of Interpersonal Behavior (TIB). TIB constructs are operationalized in the context of the study with several relevant dimensions for each variable. The framework aimed to expand knowledge in the travel industry with the application of the theory. Abide by traffic laws, a healthier life without air pollution, avoiding road accidents, less frequent travel plan, normal driving, and change of mode of transportation are what the conceptual research framework talks about in this study. In achieving this, road commuters may rely more on public transportation, care for the fellow human beings, driving with discipline, not influenced by others in reckless driving and less frequent travel will smoothen air pollution. The significant outcome of the proposed research framework in the present study would be smart mobility on the road, which will ultimately reduce air pollution and carbon emission. For long-run sustainable road traffic system, one has to plan for alternative toll system with remote sensing, smart infrastructure with double flyovers, strict enforcement on deviation in road regulations policies, sharing system in vehicles, and pre-planned travel visits will be the remedial measures to reduce traffic congestion and protect the environment.

Acknowledgment

The authors are highly thankful to the reviewers and the editor for their valuable comments and suggestions which are definitely enhanced the quality of the present article.

References


Liu, C., Susilo, Y. O., & Karlström, A. (2015). Investigating the impacts of weather variability on...


Scott-Parker, B., Jones, C. M., Rune, K., & Tucker, J. (2018). A qualitative exploration of driving
stress and driving discourtesy. *Accident Analysis and Prevention, 118*, 38–53.


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<th>Response to comments of reviewer (1)</th>
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<td>1</td>
<td>Comments: The paper addressed issues that are germane with respect to aerial pollution and mitigation. The paper is publishable in MEQ and journals of similar settings subject to adequate response to the issues raised.</td>
<td>Thank you very much for your valuable comments and suggestions. In the revised version, professional editing has been carried out now.</td>
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<td>2</td>
<td>Additional Questions: &lt;b&gt;1. Originality: &lt;/b&gt;Does the paper contain new and significant information adequate to justify publication?: Yes, the paper contains new and significant information adequate to justify publication</td>
<td>Thank you very much.</td>
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<td>3</td>
<td>&lt;b&gt;2. Relationship to Literature: &lt;/b&gt;Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?: Yes, the paper demonstrates an adequate understanding of the relevant literature in the field and cites an appropriate range of literature sources. I doubt if any significant work is ignored</td>
<td>Thank you very much.</td>
</tr>
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<td>4</td>
<td>&lt;b&gt;3. Methodology: &lt;/b&gt;Is the paper's argument built on an appropriate base of theory, concepts or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed appropriate?: Yes, the paper's argument is built on an appropriate base of theory and concept. The work</td>
<td>Thank you very much.</td>
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</table>
was well designed and procedures used are appropriate.

| 5. | <b>4. Results: </b>Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together the other elements of the paper?: Yes, the results of the study are presented clearly and analysed appropriately, the conclusions were adequately tie together the other elements of the paper. | Thank you very much. |
| 6. | <b>5. Implications for research, practice and/or society: </b>Does the paper identify clearly any implications for research, practice and/or society? Does the paper bridge the gap between theory and practice? How can the research be used in practice (economic and commercial impact), in teaching, to influence public policy, in research (contributing to the body of knowledge)? What is the impact upon society (influencing public attitudes, affecting quality of life)? Are these implications consistent with the findings and conclusions of the paper?: The paper addressed the relevant issues adequately. | Thank you very much. |
| 7. | <b>6. Quality of Communication: </b>Does the paper clearly express its case, measured against the technical language of the fields and the expected knowledge of the journal's readership? Has attention been paid to the clarity of expression and readability, such as sentence structure, jargon use, acronyms, etc.: The paper needs to be formatted and proof read well for typographical and grammatical errors, even though I passive the errors are few. | Proof reading, editing, and formatting were carried out to ensure the readability of the present research article. The following amendments were made in the revised manuscript. |

1) **Page 1, Abstract (Findings), Line 1** (Old: Page 1, Abstract (Findings), Line 1)  
Edited “main” to “major”.

2) **Page 1, Abstract (Originality value), Heading** (Old: Page 1, Abstract (Originality/value), Line 2)
<table>
<thead>
<tr>
<th>Removed the “/” between Originality and value.</th>
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| **3) Page 1, Abstract (Originality value), Line 2** (Old: Page 1, Abstract (Originality/value), Line 2)  
Edited “In addition” to “Also”.  
**4) Page 2, Keywords, Line 2** (Old: Page 2, Keywords, Line 2)  
Edited “Digitalization” to “Malaysia”.  
**5) Page 3, Section 1.0, Line 7** (Old: Page 3, Section 1.0, Line 7)  
Added “less” cycling.  
**6) Page 3, Section 1.0, Line 7** (Old: Page 3, Section 1.0, Line 7)  
Added: “literally no” walking “on road”.  
**7) Page 3, Section 2.0, Line 5** (Old: Page 3, Section 2.0, Line 5)  
Edited “indicate” to “indicates”.  
**8) Page 3, Section 2.0, Line 14** (Old: Page 3, Section 2.0, Line 14)  
Added: respectively “in every year”.  
**9) Page 3, Section 2.0, Line 19** (Old: Page 3, Section 2.0, Line 19)  
Added: become a “regular” habit.  
**10) Page 3, Section 2.0, Line 26** (Old: Page 3, Section 2.0, Line 26)  
Edited “certain” to “particular”.  
**11) Page 4, Section 2.1.2, Line 1** (Old: Page 4, Section 2.1.2, Line 2)  
Edited “predominant” to “prevalent”.
<p>|</p>
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<th>Page</th>
<th>Section</th>
<th>Old</th>
<th>Added</th>
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<td>2.1.3, 4</td>
<td>Page 5, Section 2.1.3, Line 4</td>
<td>Added: “middle” age and “average” income “group”.</td>
</tr>
<tr>
<td>5</td>
<td>2.1.3, 6</td>
<td>Page 5, Section 2.1.3, Line 6</td>
<td>Added: (“middle” age and high income).</td>
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<td>2.2, 12</td>
<td>Page 6, Section 2.2, Line 13</td>
<td>Inserted “the” road traffic in.</td>
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<td>6</td>
<td>2.2.1, 1</td>
<td>Page 6, Section 2.2.1, Line 1</td>
<td>Added: “driving” on the road.</td>
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<td>6</td>
<td>2.2.1, 3</td>
<td>Page 6, Section 2.2.1, Line 3</td>
<td>Edited “one’s” to “ones”</td>
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<td>7</td>
<td>2.2.2, 1</td>
<td>Page 6, Section 2.2.2, Line 1</td>
<td>Edited “statuses” to “status is”</td>
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<td>Edited “statuses” to “status is”</td>
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<td>7</td>
<td>2.2.3, 1</td>
<td>Page 7, Section 2.2.3, Line 1</td>
<td>Removed “,” and inserted “like” a GPS.</td>
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<td>Inserted “should be” made available.</td>
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</table>
23) Page 8, Section 2.3.1, Line 1 (Old: Page 8, Section 2.3.1, Line 1)
   Added: no age limit “restriction”.

24) Page 9, Section 2.3.2, Line 2 (Old: Page 9, Section 2.3.2, Line 2)
   Edited “been” to “to be”.

25) Page 9, Section 2.3.2, Line (Old: Page 9, Section 2.3.2, Line 3)
   Edited “or” to “to”.

26) Page 10, Section 2.4, Line 5 (Old: Page 10, Section 2.4, Line 6)
   Edited “Mind wandering” to “Mind-wandering”.

27) Page 10, Section 2.4.1, Line 1 (Old: Page 10, Section 2.4.1, Line 1)
   Edited “Mind wandering” to “Mind-wandering”.

28) Page 10, Section 2.5, Line 8 (Old: Page 10, Section 2.5, Line 8)
   Edited “performing” to “perform”.

29) Page 10, Section 2.5, Hypothesis 5 (a-j) (Old: Page 10, Section 2.5,
   Hypothesis 5 (a-j))
   Added: independent variable “(Attitude, Social Factors, Affect and Habit)”.

30) Page 10, Section 2.6, Line 3 (Old: Page 10, Section 2.6, Line 3)
   Edited “as much as” to “to the extent of”.

31) Page 11, Section 2.6, Line 4 (Old: Page 11, Section 2.6, Line 4)
   Edited “their” to “this”.

32) Page 11, Section 2.6, Line 7 (Old: Page 11, Section 2.6, Line 7)
   Edited “researchers based” to “research”.

Edited “&” to “and”.
33) Page 11, Section 2.6, Hypothesis 6 (Old: Page 11, Section 2.6, Hypothesis 6)
Edited “moderate” to “moderates”.

34) Page 11, Section 3.0, Line 10 (Old: Page 11, Section 3.0, Line 10)
Edited “dependent variable” to “travel behavior performance of road commuters”.

35) Page 11, Section 3.0, Line 11 (Old: Page 11, Section 3.0, Line 12)
Edited “dependent variable” to “travel behavior performance of road commuters”.

36) Page 12, Section 3.0, Figure 1 (Old: Page 11, Section 3.0, Figure 1)
Inserted bracket for H5 (a-j) in the proposed conceptual research framework.

37) Page 12, Table 1, Column 1 for Synchronization, Line 4 (Old: Page 12, Table 1, Column 2 for Synchronization, Line 4)
Edited “in” to “on”.

38) Page 13, Table 1, Column 7 for Synchronization (Old: Page 13, Table 1, Column 7 for Synchronization)
Edited the whole text to “Application of artificial intelligence (AI) with real-time data (Industry Revolution-4) to be implemented for digitalization”.

39) Page 13, Section 4.0, Line 1 (Old: Page 13, Section 4.0, Line 1)
Added: predictors “to” avoid.

40) Page 13, Section 4.0, Line 7 (Old: Page 13, Section 4.0, Line 7)
Added: given focus to “be considered”.

41) Page 13, Section 4.0, Line 9 (Old: Page 13, Section 4.0, Line 9)
Edited “multitasking” to “multi-tasking”.
<p>| | |</p>
<table>
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<td><strong>42) Page 14, Section 5.0, Line 12</strong> (Old: Page 14, Section 5.0, Line 12)</td>
<td>Edited “major to “significant”.</td>
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Title of Manuscript: Conceptualization of an Urban Travel Behavior Model to Mitigate Air Pollution for Sustainable Environmental Development in Malaysia

Manuscript ID Number: MEQ-03-2019-0070

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<th>Comments of the reviewer</th>
<th>Response to comments of reviewer</th>
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<td>1.</td>
<td>Comments: The finds of the paper were communicated well. The paper is easy to read and understand. But there is still room for improvement.</td>
<td>Thank you very much for your nice words and comments. In the revised version, Section 4.0 has been enhanced further to improve the quality of the revised research article.</td>
</tr>
<tr>
<td>2.</td>
<td>Additional Questions: 1. Originality: Does the paper contain new and significant information adequate to justify publication?: The manuscript consists of significant information adequate to justify publication, though not new but improved.</td>
<td>Thank You Very Much.</td>
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<td>3.</td>
<td>2. Relationship to Literature: Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?: Yes, the paper demonstrates an adequate understanding of the relevant literature in the field and cites an appropriate range of literature sources. There is no significant work ignored.</td>
<td>Thank You Very Much.</td>
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<td>4.</td>
<td>3. Methodology: Is the paper's argument built on an appropriate base of theory, concepts or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed appropriate?: The paper's argument is significantly built on appropriate theory and the research is well</td>
<td>Thank You Very Much.</td>
</tr>
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</table>
4. Results: Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together the other elements of the paper?: Yes, the results presented are clearly and analysed appropriately and the conclusion adequately ties together the other elements of the paper.

Thank You Very Much.

5. Implications for research, practice and/or society: Does the paper identify clearly any implications for research, practice and/or society? Does the paper bridge the gap between theory and practice? How can the research be used in practice (economic and commercial impact), in teaching, to influence public policy, in research (contributing to the body of knowledge)? What is the impact upon society (influencing public attitudes, affecting quality of life)? Are these implications consistent with the findings and conclusions of the paper?: The present study constructed a conceptual framework for travel behavior performance of commuter which is expected to mitigate air pollution from vehicle emission and to promote smart mobility on road. The implications consistent with the findings and conclusions of the paper.

Thank You Very Much.

6. Quality of Communication: Does the paper clearly express its case, measured against the technical language of the fields and the expected knowledge of the journal's readership? Has attention been paid to the clarity of expression and readability, such as sentence structure, jargon use, acronyms, etc.: Interestingly, Theory of Interpersonal Behavior (TIB) developed by Triandis (1977) supports the proposed conceptual framework in the present article. The one-to-one mapping between the factors of the framework and the attributes of...
The finds of the paper were communicated well. But there is still room for improvement. The theory is synchronized elaborately to make the framework more realistic for commuters on the road and in turn it is timely to conceptualize the Urban Travel Behavior Model (UTBM) for developing countries. Furthermore, country like Malaysia has severe traffic congestion during peak hours and the remedial activities to avoid traffic congestion on road is described at length in the present article.


2) Page 14, Section 4.0, Line 7 (Old: Page 13, Section 4.0, Line 3)
Edited “a” to “of”.

3) Page 14, Section 4.0, Line 2 (Amendments on newly inserted word)
Inserted “also” to the text.

4) Page 14, Section 4.0, Line 8 (Additional amendments)
Furthermore, the study focuses on potential predictors which lead to road commuters’ travel intentions to actual behavior performance to promote smart mobility on road.
Conceptualization of an Urban Travel Behavior Model to Mitigate Air Pollution for Sustainable Environmental Development in Malaysia

Abstract

Purpose

Global issues on the environment, such as climate change, air pollution, and carbon monoxide emission are the primary concerns in any part of the world. The present study aims at constructing a conceptual framework for travel behavior performance of a commuter, and it is expected to mitigate air pollution from vehicle emission and to promote smart mobility on the road.

Design/methodology/approach

From the extensive literature review, the conceptual framework for travel behavior performance of a commuter has been developed and is supported by the Theory of Interpersonal Behavior, whose functions are attitude, social factor, affect and habit. In the present article, attitude is conceptualized by four predictors, namely confidence in driving, green environment, social responsibility, and deviation in driving. The social factor is characterized by subjective norms, social status, and digitalization. Affect factor is conceptualized by accidents and damages, road infrastructure, and weather conditions. The mental block in following the ancestor’s way of owning a personal vehicle is the predictor for the habit.

Findings

One of the major contributors to environmental damages is road traffic. Notably, vehicle emissions are on the rise every year due to the increase of reliance on vehicles, and there is no alternative to this issue. Although Malaysia has the well-organized infrastructure with effective digitalized technology on the road for the transport system, there is severe traffic congestion in Klang Valley, Kuala Lumpur, because of lack of travel plan behavior during peak hours. If the road commuters give the predictors constructed in the proposed conceptual framework the highest importance, then there will be much relief to traffic congestion on the road.

Research limitations

Since, the present study focuses on the conceptualization of an urban travel behavior model, and also highlights the synchronization of the proposed framework with the management theory, the results are expected only after the primary survey based on the cross-sectional study will be conducted.

Originality value

The identification of the suitable predictors for the urban travel behavior model towards travel behavior performance of a commuter is the real novelty of the present study. Also, the cause and effect relationships of different predictors in terms of path directions of the proposed research framework

This research is sponsored by Taylor’s University Flagship Research, Project Code: TUFR/2017/004/01, Budget Code: 320201-SR21-429-C31, and the authors are highly thankful to Taylor’s University, Selangor, Malaysia.
are the highlights of the study. Further, the predictors in the proposed framework and the Theory of Interpersonal Behavior have been synchronized with operational definitions which are the original contributions of the present study, which will enhance the sustainable environmental development for the society as a whole.

**Keywords**— Urban *Travel Behavior; Road Traffic Policies/Regulations; Mental Block; Green Environment; Malaysia*

**1.0 Introduction**

Road traffic congestion leads to loss of productivity, waste of fuel, time, skin problems, and respiratory diseases are almost occurring in a day-to-day affair. Due to a large number of vehicles in Klang Valley (data.gov.my, 2016), Malaysia, a single minor accident could stall up the entire lane to a minimum of 20 minutes. Idle engine, emissions, and noise are causing the degradation of green environment and health of the road commuters. Causes of road traffic congestion can be the over usage of a personal vehicle in traveling, weak first-mile and last-mile connectivity of public transport for road commuters, less cycling and literally no walking on road. The motivation for the study is caused by increase of carbon dioxide (CO2) emission, an increase of road deaths and crashes, lack of travel planning, waste of money, time and fuel, lack of real-time data for urban travel behavior and smart mobility models. The Malaysia government formulated National Key Result Areas–Urban Public Transport (NKRA-UPT) in 2010 (Malaysian Administrative Modernisation and Management Planning Unit, 2018). Moreover, the result of implementing NKRA-UPT is of 20% shift of modal transport and is expected to continue to increase with the newly built Mass Rapid Transit (MRT) and upgrading and expansion of existing Keretapi Tanah Melayu (KTM) and Light Rail Transit (LRT). The occurrence of accidents could be high since there are many vehicles on the road. Consequently, road traffic congestion could happen due to fatal behavior while driving on the road, not properly maintaining vehicles, lack of better road infrastructure, not abiding by traffic laws and adverse weather conditions (Leow, Jayaraman & Asirvatham, 2018). The significance of the study is the contributions to the growth of knowledge in travel behavior based on psychological theory. The present study provides the appropriate predictors for intention to follow road discipline and consequently, the expected travel behavior performance of road commuters. Thus, in the present study, a holistic research framework has been constructed for urban travel behavior model, which can be customized for any developing country in a broader sense to the art of social science research.
2.0 Literature Review

Different travel behaviors of road commuters are the causes of road traffic congestion in Malaysia. Road rage, aggression driving and anger travel are behaviors that have a significant relationship with loss of vehicle control and crash-related conditions especially among young drivers in Malaysia (Sullman, Stephens & Yong, 2015). The harmful effect of vehicle emissions from a large number of vehicles indicates that the lack of attitudinal change among some Malaysians citizens is present (Zailani et al., 2016). Public transport serves to provide convenience and benefits for elderly (Wong, Szeto, Yang, Li & Wong, 2018), social activities (Chowdhury et al., 2018) and more importantly is reducing vehicle emissions. There is a difference between male and female in abiding by traffic rules. While driving, males are perceived to be more violating traffic, due to confident in driving and risks taking (Mohamad, 2018). According to Gianfranchi, Spoto and Tagliahue (2017), males have higher violation score than females, whereas females are prone to error driving. There are types of monsoon in Malaysia, which contribute to road traffic congestion, namely northeast monsoon (NEM) and the southwest monsoon (SWM) which is from November to February and May to August respectively in every year. Road traffic congestion inevitably happens most of the time, mainly due to torrential rain (Guo et al., 2018). Other than traffic flow being affected, damages to the road could happen to cause more congestion. Steg (2003) remarked that personal vehicles could offer comfortability, convenience, speed, independence, reliability, and flexibility. Thus, a higher number of road commuters are using personal vehicles and has become a regular habit.

Theory of Interpersonal Behavior (TIB) can be used to predict the intention of a person to perform a behavior or not (Egmond & Bruel, 2007). TIB states that the intention of a person to exhibit a behavior is under the influence of four components, which are attitude (cognition), social factors, affect, and habit (Triandis, 1977). Attitude is about the psychological perceived value or consequences of the action. There are three dimensions in social factors, namely, social norms, social role, and self-concept. A social norm is an influence from society to individual to believe that particular behavior is viewed as appropriate. The social role implies that a person holds a set of behavior that is appropriate for his/her roles in society, whereas self-concept is the idea of who he or she is. Affect is the state of the emotion during the thought of exhibiting the behavior. Habit is the frequency of past behavior where repetition in performing the same behavior has been practiced in day-to-day routine life. The constructs of TIB are elaborated in the sections below:
2.1 Attitude

Attitude can be used as a consumer recognized value to behavior (Halstead, 1999) to predict future behavior (Triandis, 1979). Jiménez-Mejías et al. (2014) argued that male driving style is associated with confidence in driving, seeking greater intensity of exposure and risky driving while female drivers tend to maximize the braking and keep more distance between the cars in front (Li et al., 2016). Moreover, the male driver will overtake other vehicles even in short distances (Lyu et al., 2018). Female drivers are prone to errors while male drivers have a high score for intention to violate rules and laws (Gianfranchi et al., 2017). The demand for fossil fuel and energy increase due to urbanization and economic growth in Malaysia (Bekhet & Othman, 2017). Deviation from driving safely include drink driving (Watling et al., 2018), distracted driving (Chen et al., 2015), effect of different personality driving, texting while driving (Preece et al., 2018), driving with discourtesy with stress (Scott-Parker et al., 2018) and driving under negative emotions (Shen et al., 2018). Surprisingly, drivers are aggressive even they feel cautious while driving on the road (Eboli, Mazzulla & Pungillo, 2017). For a sustainable green environment, three approaches were identified, namely; social-responsibility, environmental protection, and economic-progress (Chow & Chen, 2016). Four dimensions of the construct ‘attitude’ of road commuters are discussed in the following sections.

2.1.1 Confidence in Driving

As mentioned, males and females display different driving behaviors and styles (Jiménez-Mejias et al., 2014; Li et al., 2016). Furthermore, high or low in confidence while driving can determine the intention of drivers if they intend to violate the law or abide by it. According to Mckenna (2018), drivers with high confidence tend to violate traffic rules and regulations. Behavior, such as low concentration, hostility towards other drivers, as well as neglecting warning and speed limit signs, can contribute to road traffic accidents. Confidence in driving is about driving styles, violation of traffic laws, and discrimination among other drivers, especially elderly drivers. This shows that concern for other road commuters can be further reminded and improved. Hence, this study hypothesizes that:

H1a: Confidence in driving has a positive influence on travel behavior performance of road commuters.

2.1.2 Green Environment

As the number of vehicles and vehicle emission has been escalating, climate change is a prevalent issue in Malaysia. Thus, taking climate change into account, specific concern for being environmental-friendly should be given at most priority. Environmental concerns from personal attitudes and household behaviors signify the importance of protecting the environment (Alcock et al., 2017).
Nevertheless, accessibility for motorcycles in foot lane should be made available to increase active
travel on the road (Măirean & Havărneanu, 2018). This leads to the following hypothesis:

**H1b:** Green environment has a positive influence on travel behavior performance of road
commuters.

### 2.1.3 Social Responsibility

According to Geng et al. (2017), age, gender, income level, car ownership, attitude towards
government policy measures, and travel distance are influential in performing green travel behavior.
Notably, older and high-income groups are more reliant on cars, thus against government policy
measures. On the other hand, middle age and average income group are in line with government policy
measures, whereas young and low-income groups are more reluctant and forced in their behavior to
use non-car travel modes, and the fourth group (middle age and high income) hold swing attitudes
towards government policy measures (Geng et al., 2017). Creation of apps that display exposure to a
level of air pollution due to travel behaviors and comparison to previous travel behavior may influence
people to have the intention to change (Haddad & de Nazelle, 2018). Road commuters should have a
social responsibility, such as understanding and abiding by the traffic rules. According to af-Wählberg,
Dorn and Kline (2011), drivers who do not abide by traffic rules, such as the absence of advance travel
planning, double parking, and not parking in the yellow box, may lead to accidents and penalties. On
the other hand, training and qualification mechanism should be in force for taxi drivers to avoid
aggressive travel behavior and violation of road traffic rules and regulations (Vahedi et al., 2018).
Hence, this study hypothesizes that:

**H1c:** Social responsibility has a positive influence on travel behavior performance of road
commuters.

### 2.1.4 Deviation in Driving

The unusual way of driving is what identified as abnormal driving. Abnormal driving includes texting
while driving, drink-and-driving, and distracted driving. Those who text while driving are more likely
to exhibit other risky behavior and more immune to traffic risks (Preece et al., 2018). As for drink-
and-driving, it is associated with fatal accidents (Chen & Jou, 2018). There are three aspects of driving
with discourtesy as per Scott-Parker et al. (2018), namely, impolite behavior (deliberate anger and
intimidation), driving context (malfuction of vehicles features, driving on holidays, road
infrastructure features and driving in unknown locations) and behavior from other road users (merging,
tailgating, and drug use). Additionally, the four categories for distracted driving are watching roadside,
talking, under the influence of drowsiness, and drinking (Chen et al., 2015). Drivers should have
concerns about the safety of the others and their own while traveling. Penalizing offenders is
insufficient, as more should be done at the same time, given that the consequences of impair driving are costly and life-threatening. Thus, this study proposes the following hypothesis:

**H1d:** *Deviation in driving has a positive influence on travel behavior performance of road commuters.*

### 2.2 Social Factors

Having network and social interactions are crucial in modern mobility (Dugundji et al., 2011). The importance of walking and cycling for commuters who are physically inactive should be recognized (Keall et al., 2018) through social influence. Subjective norm is identified as of whether an individual would exhibit the same behavior if peers are pressuring that individual (Wan, Shen & Choi, 2017). This works the same way when deciding to purchase a car or not (Belgiawan et al., 2017). For youths, factors such as independence, car usage frequency, affective, and income level are influential in purchasing a car or not. Among male and female as household heads, travel behavior in a household is interchangeably influential (Kroesen, 2015). According to Choo and Mokhtarian (2004), a status seeker is one of the four lifestyles in their work. Other lifestyles being community/family-oriented, frustrating factor, and workaholic. Owning a sporty and branded vehicle in Malaysia usually is a sign of richness, having a high-income level, fame, or social status in modern society. A GPS device that monitor road condition system and the road traffic in Klang Valley can be implemented to improve or regulate the traffic when necessary (Lei, Mohamed & Claudel, 2018). However, utilization of electronic board that displays information about traffic flow on the roadside will have a negative effect on driving behavior and traffic safety (Mollu et al., 2018). Social Factors (Kang et al., 2019), which influences the travel behavior performance of road commuters have three dimensions and are elaborated below:

**2.2.1 Subjective Norms**

Several subjective norms are exhibited when people are driving on the road, such as texting while driving. Calling and replying phone calls with or without hand-held devices do not guarantee safety while driving (Lipovac et al., 2017). Subjective and descriptive norms can increase ones green travel intent even when they do not hold high environmental responsibility (Ru et al., 2018). Hence, their attitude, knowledge, and beliefs can influence the effectiveness of the enforcement of distracted driving law. Stark, Berger, and Hössinger (2018) have pointed out that reflection, action, and intervention of information sources may influence on the intention of a person to optimize travel plan on the road. Hence, this study proposes the hypothesis that:

**H2a:** *Subjective norm has a positive influence on travel behavior performance of road commuters.*

**2.2.2 Social Status**
Social status is usually expressed through specific patterns of consumption and behaviors (Van Acker, Goodwin & Witlox, 2016). Beliefs, attitude, and interests shape these patterns. Hence, social status is not shaped by speed, price, and comfort. In this case, the personal aim of having a high-value vehicle due to the desire for high esteem can be noted (Kusuma, 2015). Apart from perceptions, preference on vehicles that enhances self-image and esteem comes under the influence of several factors, such as internet marketing, influence from family members on the purchase, customer satisfaction, and loyalty (Kusuma, 2015). Being able to quickly gain ideas and feedback from the internet from potential customers, as well as personalized care and after-sales service with vehicle brand, shows that the internet is important in communication and marketing strategies amongst vehicle manufacturers. More importantly, customer satisfaction and loyalty to vehicle brands encourage returning customers. Additionally, there is an increment in vehicle purchase from women as well (Kusuma, 2015). Hence, this study hypothesizes the following:

**H2b:** Social status has a positive influence on travel behavior performance of road commuters.

### 2.2.3 Digitalization

In making use of advanced, sophisticated technology like a GPS device that can monitor traffic and road condition system may be applied by the relevant authorities to regulate road especially during peak hours (Lei et al., 2018). However, the high utilization of advanced technology might not be the best case. Rahman, Wirasinghe and Kattan (2013) claimed that the next bus arrival time should be made available at bus stops is the most sought-after for bus riders. This should encourage people to change their mode of transport for the betterment. As for Light Rail Transit (LRT), the next arrival time has the interest of less frequent riders, but not regular riders. The industry revolution-4 looks for real-time data, automation and integration in every walk of life, and therefore, the digitalization is mandatory in controlling road traffic. The usage of advanced technology and real-time data is crucial in mitigating emissions from vehicles. Hence, this study posits the following:

**H2c:** Digitalization has a positive influence on travel behavior performance of road commuters.

### 2.3 Affect

Affect has been considered as emotion (Triandis, 1977). At times, emotion will disrupt and cloud individual judgment (Preece et al., 2018) with changes from the past (Pfister & Bohm, 2008) during the process of making decisions. Evidence of research from Russel (1980) suggests that in the affective dimensions, variables are highly interrelated in a systematic way. The affective dimensions fall in a circular order: pleasure (0°), excitement (45°), arousal (90°), distress (135°), displeasure (180°), depression (225°), sleepiness (270°) and relaxation (315°). Furthermore, positive and negative affect are different depending on the swings in mind (Diener & Emmons, 1985). This study also indicates
that the longer the time of thinking process, the clearer the type of emotions. Not to mention during peak hours, travel behavior is certainly different from normal hours and will affect life satisfaction and emotional well-being (Friman et al., 2017). In Mann et al. (2016), internal and legal sanctions could reduce road traffic crimes. The feeling of guilt has the strongest effect on reducing road traffic crimes, and if not, legal sanctions will do the work. However, social sanctions do not reduce road traffic crimes but influence road commuters to engage in violation of traffic rules and laws. More mobility from personal vehicle indicates that there will be more air pollutions and climate change (Gilmore & Patwardhan, 2016). Air pollutions also affect agriculture productions (Shindell et al., 2011). While road agencies or authorities are maintaining road lane or road infrastructure, travel behavior performance of drivers will be affected due to the diversion of routes (Hartmann & Ling, 2016). Furthermore, good road infrastructure will lead to the reduction of air pollution (Van Acker et al., 2016), the increase of firms’ output through efficient transport systems (Barzin, D’Costa & Graham, 2018) and increase of cycling activities (Hull & O’Holleran, 2014) among least physically active commuters (Panter et al., 2016). Reinvestment in cycling infrastructure, pedestrianization of town centers and public transport are considered as an encouragement for a change of mode of travel from the workplace or home (Van Acker et al., 2016) that will reduce carbon dioxide from vehicle emissions (Banister, 2008). In terms of individual travel behavior, the different daily temperature has a lesser impact than the different monthly temperature in the long term whereas different temperatures and daily winds are more influential in the short term (Liu et al., 2015). Heavy rainfall is a threat to the safety of road commuter (Preece et al., 2018) as the drivers should slow down during adverse weather (Wang, Liang & Evans, 2017). Notably, older generation feels that they have responsibility for environmental issues, for example, climate change, as compared to the younger generation and through their emotions; this can affect the following generation (Wang et al., 2018).

2.3.1 Accidents and Damages

As there is no age limit restriction for vehicles in Malaysia, it is more alarming and dangerous for human wellbeing. According to Tanishita and van Wee (2017), speed and speed variation are strongly believed to be the reasons for high rates of traffic accidents. There are two high probabilities for the occurrence of accidents. Accidents can happen when speed is reduced suddenly from 110 to 85 km/hour, for example, or increasing the speed from 65 to 95 km/hour. Also, more accidents tend to occur during sunny days, instead of cloudy weather which results in more costs, such as repair cost, cost of time, or even life-threatening costs (Tanishita & van Wee, 2017). Regarding environmental damages, light-duty vehicles can contribute to climate change by emitting as much as 209% of carbon emission in different altitude that lacks oxygen and low-pressure concentrations (Wang et al., 2018). Hence, the study hypothesizes the following:
**H3a:** Accidents and damages have a negative influence on travel behavior performance of road commuters.

### 2.3.2 Road Infrastructure

Reinvestment in public transportation, cycling infrastructure, and pedestrianization of town centers have to be reconsidered as mobility management that encourages change in travel behavior from home to workplace (Van Acker et al., 2016). In order for people to change the mode of transport, road infrastructures for cycling and walking must be made available (Panter et al., 2016). With that, this study proposes the following:

**H3b:** Road infrastructure has a positive influence on travel behavior performance of road commuters.

### 2.3.3 Weather Conditions

Weather is hard to predict, and this can affect the travel plan. According to Tao et al. (2018), real-time weather information, as well as traffic and time of day, should be considered when monitoring the demand for buses. This also indicates that the adjustment of transit time should be changed accordingly to heavy rain or high temperatures. Furthermore, transit operators may upgrade bus stops to shelter passengers from heavy rain to increase ridership in case of a decrease in ridership. It has been observed that warm, dry, calm, and sunny, but not scorching hot weather, can stimulate active travel (Böcker, Dijst & Faber, 2016). Road traffic accidents due to jumping red lights, speeding, and neglecting seatbelts are mostly attributed to other drivers (Rasool et al., 2015), not to mention that it could be far more devastating during rainfall. Hence, this study hypothesizes as follows:

**H3c:** Weather has a negative influence on travel behavior performance of road commuters.

### 2.4 Habit

Habit and behavior are related (Triandis, 1979). When the intention is repeated continuously and so as the later exhibited behavior, that experience will become a habit. Ouellette and Wood (1998) supported this statement by mentioning that the strength of habit is from repeated behavior; therefore, it is a predictor of behavior. It is highly correlated between intention, habits, and behavior with dominance from habits over behavioral outcomes (Gardner et al., 2012). Mind-wandering is preventing drivers from focusing on driving (Burdett, Charlton & Starkey, 2018), and it occurs when drivers are in a comfortable or familiar environment. According to Qu et al. (2015), emotional driving, aggressive driving, drunk driving, and risky driving are all correlated with mind wandering. Additionally, when minds are wandering, male drivers exhibit driving behavior that is riskier and exhibits more emotions.

#### 2.4.1 Mental Block
Mind-wandering has been positively correlated with drunk driving, emotional driving, risky driving, and aggressive driving (Qu et al., 2015). Male drivers are found to be riskier and exhibit more negative emotional driving behavior when compared to female drivers upon mind wandering. There are also issues concerning lights that are glaring and getting the attention of drivers while on the road with high chances of creating accidents (Yellappan et al., 2016). Bright lights within a certain range can affect a driver’s vision. Factors of forgiveness and unforgiveness while on the road have a role in decreasing the intensity of adverse driving from young drivers (Bumgarner, 2015). Hence, conflicts between driving and non-driving activities can decrease based on the level of forgiveness from ourselves, others, and during unforeseen situations. With that, the following hypothesis is proposed:

**H4**: Habit factor (Mental Block) of road commuters has a negative influence on travel behavior performance of road commuters.

### 2.5 Intention to follow Road Discipline

Firstly, in the Theory of Planned Behavior (TPB) by Ajzen (1991) recognize that intention is a predictor of behavior. TPB also remarked that only with motivation, then only behaviors will be performed. However, scholars also argued that intention might not materialize into behavior sometimes (Webb & Sheeran, 2006). According to Moutinho (1987), the intention is an antecedent to behavior that is caused by beliefs about the outcome, whereas social and situational factors provided by normative beliefs. In fact, a lot of similarities have been noted between this explanation and TIB initiated by Triandis (1977) due to the reason that belief about outcome may influence one’s attitude to perform a behavior (Kang et al., 2019), while normative beliefs can influence one’s subjective norms to perform a behavior. Intention to follow road discipline is an intention; thus, it can be understood in the same dimension. As such, this study proposes the following hypotheses:

**H5 (a-j)**: Intention to follow road discipline mediates the relationship between independent variable (Attitude, Social Factors, Affect and Habit) and travel behavior performance of road commuters.

### 2.6 Road Traffic Policies/Regulations

Kaffashi et al. (2016) asserted that Malaysians are eager to minimize their car usage if innovative transport policy is implemented. Policies, such as proper pricing and efficient public transport, could shift the mode of transport from personal vehicles to public transport to the extent of 70%. The respondents in this study opined that they were willing to pay up to 175% of their hourly wages to have efficient public transport. The government should take some initiatives to implement new policies. However, several steps are involved before decision-makers can make decisions from research studies. Hence, the study hypothesizes the following:
**H6:** Road traffic policies/regulations moderates the relationship between Intention to follow road discipline and travel behavior performance of road commuters.

### 3.0 Construction of a conceptual research framework

Figure 1 illustrates the conceptual research framework supported by the Theory of Interpersonal Behavior (TIB) proposed by Egmond and Bruel (2007). The constructs of TIB in the research framework are attitude, social factors, affect, and habit. The sub-constructs for each independent variable (predictor) have been identified rationally to provide novelty to the conceptual framework. The totality of the framework considered in this study is seldom available in the literature, and hence, the present research is timely. The real novelty of this study is to investigate the cause and effect relationships of the predictors in the path diagram of Figure 1. The constructs in attitude (Confidence in driving, green environment, social responsibility and deviation in driving), social factors (subjective norms, social status and digitalization), and affect (accident and damages, road infrastructure and weather) have direct effects on the travel behavior performance of road commuters. Habit (mental block) also has a direct effect on the travel behavior performance of road commuters because habit is the frequency of past behavior. Hence, repetitive behavior could be exhibited, given that the circumstances are favorable. Intention to follow road discipline will mediate the relationship between independent and dependent variables, while the moderating variable is road traffic policies/ regulations.
The conceptualization of the predictors considered in the present study is synchronized with the variables of TIB as in Table 1.

**Table 1. Conceptualization of the constructs as per Theory of Interpersonal Behavior**

<table>
<thead>
<tr>
<th>No.</th>
<th>TIB Variable</th>
<th>Description</th>
<th>Constructs in the framework</th>
<th>Synchronization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Systematic</td>
<td>Confidence in Driving</td>
<td>If road commuters are confident in driving, they have to adhere to traffic laws which converge in safety concerns to commuters and others driving on the road.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Orderly</td>
<td>Green Environment</td>
<td>If travel commuters are traveling less frequently, walk/cycling for short distance, and use public transports, they can preserve the green environment in order.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Attitude</td>
<td>Principles</td>
<td>Social Responsibility</td>
<td>If road commuters are socially responsible for understanding and abiding by rules while on the road, they are highly principled.</td>
</tr>
<tr>
<td>4</td>
<td>Discipline</td>
<td>No Deviation in Driving</td>
<td>If road commuters do not deviate, particularly with no alcohol consumption, no cigarette smoking, no mobile messaging/chatting while driving; then their behavior is normal with perfect road travel discipline.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Social Factors</td>
<td>Influence of others</td>
<td>Subjective Norms</td>
<td>Relatives/friends/colleagues suggestions should not influence those commuters driving on the road.</td>
</tr>
<tr>
<td>6</td>
<td>Social Dignity</td>
<td>Social Status</td>
<td>Commuters while driving should seek for their safety and comforts and not have a luxury vehicle to show off for social status.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Technology Advancement</td>
<td>Digitalization</td>
<td>Application of artificial intelligence (AI) with real-time data (Industry Revolution-4) to be implemented for digitalization.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Affect</td>
<td>Road Violation</td>
<td>Accident and Damages</td>
<td>Real-time data and sophisticated digitalization using remote sensing of urban travel model will avoid road violation, which will control accidents and ultimately reduces damages.</td>
</tr>
<tr>
<td>9</td>
<td>Basic Needs</td>
<td>Road Infrastructure</td>
<td>Infrastructure development should be given utmost importance for avoiding traffic congestion.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Compromise</td>
<td>Weather</td>
<td>Under the unforeseen circumstance, bad weather may create traffic congestion and is unavoidable. Commuters have to find alternative routes for travel purposes.</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Habit</td>
<td>Mind Wandering</td>
<td>Mental Block</td>
<td>There needs to be some change of thoughts in the mental block in following the family ancestor methods of owning personal vehicles in order to safeguard the environment.</td>
</tr>
</tbody>
</table>
4.0 Discussions and novelty of the framework

Interestingly, Theory of Interpersonal Behavior (TIB) developed by Triandis (1977) supports the proposed conceptual framework in the present article. The one-to-one mapping between the factors of the framework and the attributes of the theory is synchronized (Table 1) elaborately to make the framework more realistic for commuters on the road and in turn it is timely to conceptualize the Urban Travel Behavior Model (UTBM) for developing countries. Furthermore, country like Malaysia has severe traffic congestion during peak hours and the remedial activities to avoid traffic congestion on the road is described at length in the present article. With the proposes of conceptual research framework that suggests predictors to avoid road accidents, to abide by road laws, to promote a change of transport mode, and to have a pollution-free healthier life. Only through more reliance on public transportation, discipline while driving on the road, and proper care on health and well-being will generate effective behavioral changes. Physical or health well-being achieves a higher score from active travel (walking and cycling) when compared to traveling by vehicles (Ettema et al., 2015). Certain factors, such as accessibility, availability of seats, cleanliness, and safety for public transport, should be given focus to be considered an enjoyable alternative to personal vehicle travel (Ettema et al., 2015). The opportunity to involve in multi-tasking while on the road is considered as another crucial attractive characteristic of travel plan behavior. The society will benefit from the awareness towards the predictors embedded in the framework, having the intent to perform the behavior desired in this study, and implementation of innovative road traffic policies/regulations. The study outcomes will also be useful in developing government policies for the transportation sector in the globe. Convenience, flexibility, no benefits of using public transport, and active travel have been perceived as values for personal vehicle users, and they have to think of environment protection in the long-run and sustainability of travel system on the road. The present study also seeks to address the issue of low ridership of public transport and active travel as the short-term concern, whereas the long-term concern focuses on health and climatic changes which may be addressed if utilization of public transport increases. Furthermore, the study focuses on potential predictors which lead to road commuters’ travel intentions to actual behavior performance to promote smart mobility on road.

5.0 Conclusions

Air pollution is a perineal problem in the globe and is predominantly due to road transport. The present study proposed a conceptual framework for travel behavior model, which applies to any road infrastructure set-up. The study provides information dissemination on the travel behavior of road commuters. The proposed framework in the present study is supported by the Theory of Interpersonal Behavior (TIB). TIB constructs are operationalized in the context of the study with several relevant
dimensions for each variable. The framework aimed to expand knowledge in the travel industry with the application of the theory. Abide by traffic laws, a healthier life without air pollution, avoiding road accidents, less frequent travel plan, normal driving, and change of mode of transportation are what the conceptual research framework talks about in this study. In achieving this, road commuters may rely more on public transportation, care for the fellow human beings, driving with discipline, not influenced by others in reckless driving and less frequent travel will smoothen air pollution. The significant outcome of the proposed research framework in the present study would be smart mobility on the road, which will ultimately reduce air pollution and carbon emission. For long-run sustainable road traffic system, one has to plan for alternative toll system with remote sensing, smart infrastructure with double flyovers, strict enforcement on deviation in road regulations policies, sharing system in vehicles, and pre-planned travel visits will be the remedial measures to reduce traffic congestion and protect the environment.

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### Comments of the reviewer

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<th>No.</th>
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<th>Response to comments of reviewer</th>
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<td>1.</td>
<td>Comments: This is a very good paper publishable in MEQ. The authors should proof-read well for possible errors.</td>
<td>Thank you very much for your valuable comments and suggestions. Proof-read and amendments were carried out to improve the quality of the research article.</td>
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<td>1) <strong>Page 1, Section Abstract (Purpose), Line 2</strong> (Additional amendment) Added a comma.</td>
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<td>2) <strong>Page 1, Section Abstract (Purpose), Line 3</strong> (Additional amendment) Inserted “the”.</td>
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<td>3) <strong>Page 1, Section Abstract (Design/methodology/approach), Line 1</strong> (Additional amendment) Inserted “the”.</td>
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<td>4) <strong>Page 1, Section Abstract (Findings), Line 3</strong> (Old: Page 1, Section Abstract (Findings), Line 3) Edited “the” to “a”.</td>
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<td>5) <strong>Page 1, Section Abstract (Findings), Line 3</strong> (Additional amendment) Inserted “a”.</td>
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17) **Page 3, Section 2.0, Line 2** (Additional amendment)  
Added a comma.

18) **Page 3, Section 2.0, Line 3** (Additional amendment)  
Added a comma.

19) **Page 3, Section 2.0, Line 6** (Additional amendment)  
Inserted “the”

20) **Page 3, Section 2.0, Line 7** (Additional amendment)  
Added a comma.

21) **Page 3, Section 2.0, Line 8** (Additional amendment)  
Added a comma.

22) **Page 3, Section 2.0, Line 8** (Old: Page 3, Section 2.0, Line 8)  
Edited “male” to males”.

23) **Page 3, Section 2.0, Line 8** (Old: Page 3, Section 2.0, Line 8)  
Edited “female” to “females”.

24) **Page 3, Section 2.0, Line 10** (Additional amendment)  
Added a comma.

25) **Page 3, Section 2.0, Line 11** (Old: Page 3, Section 2.0, Line 11)  
Edited “score” to “scores”.

26) **Page 3, Section 2.0, Line 25** (Old: Page 3, Section 2.0, Line 25)  
Edited “role” to roles”.

27) **Page 3, Section 2.0, Line 25** (Old: Page 3, Section 2.0, Line 25)  
Edited “individual” to “individuals”
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<td>Page 4, Section 2.1.1 in H1a, Line 1</td>
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<td>Page 6, Section 2.2, Line 7</td>
<td>(Old: Page 6, Section 2.2, Line 7) Edited “female” to “females”.</td>
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39) Page 6, Section 2.2, Line 10 (Old: Page 6, Section 2.2, Line 10) Edited “factor” to “factors”

40) Page 6, Section 2.2, Line 12 (Old: Page 6, Section 2.2, Line 12) Edited “monitor” to “monitors”

41) Page 6, Section 2.2, Line 12 (Additional amendment) Inserted “the”.

42) Page 6, Section 2.2, Line 14 (Additional amendment) Inserted “the”.

43) Page 6, Section 2.2, Line 14 (Additional amendment) Inserted “the”.

44) Page 6, Section 2.2, Line 17 (Additional amendment) Inserted “to”.

45) Page 6, Section 2.2.1, Line 3 (Old: Page 6, Section 2.2.1, Line 3) Edited “ones” to “the”.

46) Page 6, Section 2.2.1, Line 3 (Additional amendment) Inserted “of road commuters”.

47) Page 7, Section 2.2.1 in H2a, Line 1 (Additional amendment) Inserted “the”.

48) Page 7, Section 2.2.2, Line 2 (Old: Page 7, Section 2.2.2, Line 2) Edited “attitude” to “attitudes”.

49) Page 7, Section 2.2.2, Line 9 (Old: Page 7, Section 2.2.2, Line 9) Edited “brand” to brands”. 

50) Page 7, Section 2.2.2, Line 9 (Additional amendment) Inserted “the”.

51) Page 7, Section 2.2.2, Line 9 (Additional amendment) Inserted “of road commuters”.

52) Page 7, Section 2.2.2, Line 9 (Additional amendment) Inserted “the”.

53) Page 7, Section 2.2.2, Line 9 (Additional amendment) Inserted “of road commuters”.

54) Page 7, Section 2.2.2, Line 9 (Additional amendment) Inserted “the”.

55) Page 7, Section 2.2.2, Line 9 (Additional amendment) Inserted “of road commuters”.

56) Page 7, Section 2.2.2, Line 9 (Additional amendment) Inserted “the”.

57) Page 7, Section 2.2.2, Line 9 (Additional amendment) Inserted “of road commuters”.

58) Page 7, Section 2.2.2, Line 9 (Additional amendment) Inserted “the”.

59) Page 7, Section 2.2.2, Line 9 (Additional amendment) Inserted “of road commuters”.

60) Page 7, Section 2.2.2, Line 9 (Additional amendment) Inserted “the”. 

61) Page 7, Section 2.2.2, Line 9 (Additional amendment) Inserted “of road commuters”.

62) Page 7, Section 2.2.2, Line 9 (Additional amendment) Inserted “the”.
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61) Page 9, Section 2.3.3 in H3c, Line 1 (Additional amendment) Inserted “the”.

62) Page 10, Section 2.5 in H5 (a-j), Line 1 (Additional amendment) Inserted “the”.

63) Page 10, Section 2.5 in H5 (a-j), Line 2 (Old: Page 10, Section 2.5, Line 2) Edited “variable” to ‘variables”.

64) Page 10, Section 2.5 in H5 (a-j), Line 2 (Additional amendment) Added a comma.

65) Page 11, Section 2.6 in H6, Line 1 (Additional amendment) Inserted “the”.

66) Page 11, Section 3.0, Line 9 (Additional amendment) Added a comma.

67) Page 12, Section 3.0, Line 2 (Additional amendment) Added a comma.

68) Page 12, Table 1 – No. 1 Synchronization, Line 2 (Old: Page 12, Table 1 – No 1. Synchronization, Line 2) Edited “which” to “that”.

69) Page 12, Table 1 – No. 2 Synchronization, Line 2 (Old: Page 12, Table 1, No 2. Synchronization, Line 2) Edited “distance” to “distances”.
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<td><strong>70</strong></td>
<td><strong>Page 12, Table 1 – No. 5 Synchronization, Line 2</strong> (Additional amendment)</td>
<td>Inserted a right single quotation mark.</td>
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<td><strong>Page 13, Table 1 – No. 6 Synchronization, Line 1</strong> (Additional amendment)</td>
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<td><strong>Page 13, Section 4.0, Line 5</strong> (Additional amendment)</td>
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79) **Page 13, Section 4.0, Line 6** (Additional amendment)
Added a comma.

80) **Page 13, Section 4.0, Line 8** (Old: Page 13, Section 4.0, Line 8)
Removed “to”.

81) **Page 13, Section 4.0, Line 17** (Old: Page 13, Section 4.0, Line 17)
Edited “towards” to “of”.

82) **Page 14, Section 4.0, Line 3** (Old: Page 14, Section 4.0, Line 3)
Edited “in” to “around”.

83) **Page 14, Section 4.0, Line 5** (Old: Page 14, Section 4.0, Line 5)
Edited “system” to “systems”.

84) **Page 14, Section 4.0, Line 7** (Additional amendment)
Added a comma.

85) **Page 14, Section 4.0, Line 9** (Old: Page 14, Section 4.0, Line 9)
Edited “which” to “that”.

86) **Page 14, Section 5.0, Line 2** (Additional amendment)
Inserted “the”.

88) **Page 14, Section 5.0, Line 10** (Old: Page 14, Section 5.0, Line 10)
Removed “the”.

89) **Page 14, Section 5.0, Line 11** (Additional amendment)
Added a comma.

90) **Page 14, Acknowledgement, Line 2** (Additional amendment)
Added a comma.
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<td>&lt;b&gt;2. Relationship to Literature: &lt;/b&gt; Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?: Yes, he paper demonstrates adequate understanding of the relevant literature in the field and cites appropriate ranges of literature sources. No significant work ignored.</td>
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<td>&lt;b&gt;3. Methodology: &lt;/b&gt; Is the paper's argument built on an appropriate base of theory, concepts or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed appropriate?: The paper’s argument is built on an appropriate base of theory and concepts, while the methods employed are appropriate.</td>
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<td>&lt;b&gt;4. Results: &lt;/b&gt; Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together the other elements of the paper?: The results are presented clearly and analysed appropriately and the conclusions adequately tie together the other elements of the paper.</td>
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<td>Thank You Very Much.</td>
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6. **Implications for research, practice and/or society:** Does the paper identify clearly any implications for research, practice and/or society? Does the paper bridge the gap between theory and practice? How can the research be used in practice (economic and commercial impact), in teaching, to influence public policy, in research (contributing to the body of knowledge)? What is the impact upon society (influencing public attitudes, affecting quality of life)? Are these implications consistent with the findings and conclusions of the paper? Yes, the paper identifies clearly some implications for research, practice and/or society and it bridges the gap between theory and practice. The implications are consistent with the findings and conclusion of the paper.

7. **Quality of Communication:** Does the paper clearly express its case, measured against the technical language of the fields and the expected knowledge of the journal's readership? Has attention been paid to the clarity of expression and readability, such as sentence structure, jargon use, acronyms, etc.? The paper clearly express its case, measured against the technical language of the fields and the expected knowledge of the journal’s readership, while attention was paid to the clarity of expression and readability.

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Thank You Very Much.
Conceptualization of an Urban Travel Behavior Model to Mitigate Air Pollution
for Sustainable Environmental Development in Malaysia

Abstract

Purpose

Global issues on the environment, such as climate change, air pollution, and carbon monoxide emission, are the primary concerns in any part of the world. The present study aims at constructing a conceptual framework for the travel behavior performance of a commuter, and it is expected to mitigate air pollution from vehicle emission and to promote smart mobility on the road.

Design/methodology/approach

From the extensive literature review, the conceptual framework for the travel behavior performance of a commuter has been developed and is supported by the Theory of Interpersonal Behavior, whose functions are attitude, social factor, affect and habit. In the present article, attitude is conceptualized by four predictors, namely confidence in driving, green environment, social responsibility, and deviation in driving. The social factor is characterized by subjective norms, social status, and digitalization. Affect factor is conceptualized by accidents and damages, road infrastructure, and weather conditions. The mental block in following the ancestor’s way of owning a personal vehicle is the predictor for the habit.

Findings

One of the major contributors to environmental damages is road traffic. Notably, vehicle emissions are on the rise every year due to the increase of reliance on vehicles, and there is no alternative to this issue. Although Malaysia has a well-organized infrastructure with effective digitalized technology on the road for the transport system, there is severe traffic congestion in Klang Valley, Kuala Lumpur, because of a lack of travel plan behavior during peak hours. If the road commuters give the predictors constructed in the proposed conceptual framework the highest importance, then there will be much relief to traffic congestion on the road.

Research limitations

Since, the present study focuses on the conceptualization of an urban travel behavior model, and also highlights the synchronization of the proposed framework with the management theory, the results are expected after the primary survey based on the cross-sectional study will be conducted.

Originality value

The identification of the suitable predictors for the urban travel behavior model towards the travel behavior performance of a commuter is the real novelty of the present study. Also, the cause and effect relationships of different predictors in terms of path directions of the proposed research

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framework are the highlights of the study. Further, the predictors in the proposed framework and the Theory of Interpersonal Behavior have been synchronized with operational definitions, which are the original contributions of the present study, which will enhance the sustainable environmental development for the society as a whole.

**Keywords**— Urban Travel Behavior; Road Traffic Policies/Regulations; Mental Block; Green Environment; Malaysia

### 1.0 Introduction

Road traffic congestion leads to loss of productivity, waste of fuel, time, skin problems, and respiratory diseases are almost occurring in a day-to-day affair. Due to a large number of vehicles in Klang Valley (data.gov.my, 2016), Malaysia, a single minor accident could stall up the entire lane to a minimum of 20 minutes. Idle engine, emissions, and noise are causing the degradation of the green environment and health of the road commuters. Causes of road traffic congestion can be the over usage of a personal vehicle in traveling, weak first-mile and last-mile connectivity of public transport for road commuters, less cycling, and no walking on the road. The motivation for the study is caused by the increase of carbon dioxide (CO2) emission, an increase of road deaths and crashes, lack of travel planning, waste of money, time and fuel, lack of real-time data for urban travel behavior and smart mobility models. The Malaysia government formulated National Key Result Areas – Urban Public Transport (NKRA-UPT) in 2010 (Malaysian Administrative Modernisation and Management Planning Unit, 2018). Moreover, the result of implementing NKRA-UPT is of 20% shift of modal transport and is expected to continue to increase with the newly built Mass Rapid Transit (MRT) and upgrading and expansion of existing Keretapi Tanah Melayu (KTM) and Light Rail Transit (LRT). The occurrence of accidents could be high since there are many vehicles on the road. Consequently, road traffic congestion could happen due to fatal behavior while driving on the road, not properly maintaining vehicles, lack of better road infrastructure, not abiding by traffic laws, and adverse weather conditions (Leow, Jayaraman & Asirvatham, 2018). The significance of the study is the contributions to the growth of knowledge in travel behavior based on psychological theory. The present study provides the appropriate predictors for intention to follow road discipline and, consequently, the expected travel behavior performance of road commuters. Thus, in the present study, a holistic research framework has been constructed for the urban travel behavior model, which can be customized for any developing country in a broader sense to the art of social science research.
2.0 Literature Review

Different travel behaviors of road commuters are the causes of road traffic congestion in Malaysia. Road rage, aggression driving, and anger travel are behaviors that have a significant relationship with loss of vehicle control and crash-related conditions, especially among young drivers in Malaysia (Sullman, Stephens & Yong, 2015). The harmful effect of vehicle emissions from a large number of vehicles indicates that the lack of attitudinal change among some Malaysians citizens is present (Zailani et al., 2016). Public transport serves to provide convenience and benefits for the elderly (Wong, Szeto, Yang, Li & Wong, 2018), social activities (Chowdhury et al., 2018) and more importantly, is reducing vehicle emissions. There is a difference between males and females in abiding by traffic rules. While driving, males are perceived to be more violating traffic, due to confident in driving and risks taking (Mohamad, 2018). According to Gianfranchi, Spoto, and Tagliabue (2017), males have higher violation scores than females, whereas females are prone to error driving. There are types of monsoon in Malaysia, which contribute to road traffic congestion, namely northeast monsoon (NEM) and the southwest monsoon (SWM) which is from November to February and May to August respectively in every year. Road traffic congestion inevitably happens most of the time, mainly due to torrential rain (Guo et al., 2018). Other than traffic flow being affected, damages to the road could happen to cause more congestion. Steg (2003) remarked that personal vehicles could offer comfortability, convenience, speed, independence, reliability, and flexibility. Thus, a higher number of road commuters are using personal vehicles and has become a regular habit.

Theory of Interpersonal Behavior (TIB) can be used to predict the intention of a person to perform a behavior or not (Egmond & Bruel, 2007). TIB states that the intention of a person to exhibit a behavior is under the influence of four components, which are attitude (cognition), social factors, affect, and habit (Triandis, 1977). Attitude is about the psychological perceived value or consequences of the action. There are three dimensions in social factors, namely, social norms, social roles, and self-concept. A social norm is an influence from society to individuals to believe that particular behavior is viewed as appropriate. The social role implies that a person holds a set of behavior that is appropriate for his/her roles in society, whereas self-concept is the idea of who he or she is. Affect is the state of the emotion during the thought of exhibiting the behavior. Habit is the frequency of past behavior where repetition in performing the same behavior has been practiced in day-to-day routine life. The constructs of TIB are elaborated in the sections below:
2.1 Attitude

Attitude can be used as a consumer recognized value to behavior (Halstead, 1999) to predict future behavior (Triandis, 1979). Jiménez-Mejías et al. (2014) argued that male driving style is associated with confidence in driving, seeking greater intensity of exposure and risky driving while female drivers tend to maximize the braking and keep more distance between the cars in front (Li et al., 2016). Moreover, the male driver will overtake other vehicles even in short distances (Lyu et al., 2018). Female drivers are prone to errors, while male drivers have a high score for intention to violate rules and laws (Gianfranchi et al., 2017). The demand for fossil fuel and energy increase due to urbanization and economic growth in Malaysia (Bekhet & Othman, 2017). Deviation from driving safely include drink driving (Watling et al., 2018), distracted driving (Chen et al., 2015), effect of different personality driving, texting while driving (Preece et al., 2018), driving with discourtesy with stress (Scott-Parker et al., 2018) and driving under negative emotions (Shen et al., 2018). Surprisingly, drivers are aggressive even they feel cautious while driving on the road (Eboli, Mazzulla & Pungillo, 2017). For a sustainable green environment, three approaches were identified, namely; social-responsibility, environmental protection, and economic-progress (Chow & Chen, 2016). Four dimensions of the construct ‘attitude’ of road commuters are discussed in the following sections.

2.1.1 Confidence in Driving

As mentioned, males and females display different driving behaviors and styles (Jiménez-Mejías et al., 2014; Li et al., 2016). Furthermore, high or low in confidence while driving can determine the intention of drivers if they intend to violate the law or abide by it. According to Mckenna (2018), drivers with high confidence tend to violate traffic rules and regulations. Behavior, such as low concentration, hostility towards other drivers, as well as neglecting warning and speed limit signs, can contribute to road traffic accidents. Confidence in driving is about driving styles, violation of traffic laws, and discrimination among other drivers, especially elderly drivers. This shows that concern for other road commuters can be further reminded and improved. Hence, this study hypothesizes that:

H1a: Confidence in driving has a positive influence on the travel behavior performance of road commuters.

2.1.2 Green Environment

As the number of vehicles and vehicle emissions has been escalating, climate change is a prevalent issue in Malaysia. Thus, taking climate change into account, specific concern for being environmental-friendly should be given at most priority. Environmental concerns from personal
attitudes and household behaviors signify the importance of protecting the environment (Alcock et al., 2017). Nevertheless, accessibility for motorcycles in foot lanes should be made available to increase active travel on the road (Măirean & Havârneanu, 2018). This leads to the following hypothesis:

H1b: Green environment has a positive influence on travel behavior performance of road commuters.

2.1.3 Social Responsibility

According to Geng et al. (2017), age, gender, income level, car ownership, attitude towards government policy measures, and travel distance are influential in performing green travel behavior. Notably, older and high-income groups are more reliant on cars, thus against government policy measures. On the other hand, middle age and average income group are in line with government policy measures, whereas young and low-income groups are more reluctant and forced in their behavior to use non-car travel modes, and the fourth group (middle age and high income) hold swing attitudes towards government policy measures (Geng et al., 2017). The creation of apps that display exposure to a level of air pollution due to travel behaviors and comparison to previous travel behavior may influence people to have the intention to change (Haddad & de Nazelle, 2018). Road commuters should have a social responsibility, such as understanding and abiding by the traffic rules. According to Wåhlberg, Dorn, and Kline (2011), drivers who do not abide by traffic rules, such as the absence of advance travel planning, double parking, and not parking in the yellow box, may lead to accidents and penalties. On the other hand, training and qualification mechanism should be in force for taxi drivers to avoid aggressive travel behavior and violation of road traffic rules and regulations (Vahedi et al., 2018). Hence, this study hypothesizes that:

H1c: Social responsibility has a positive influence on travel behavior performance of road commuters.

2.1.4 Deviation in Driving

The unusual way of driving is what identified as abnormal driving. Abnormal driving includes texting while driving, drink-and-driving, and distracted driving. Those who text while driving are more likely to exhibit other risky behavior and more immune to traffic risks (Preece et al., 2018). As for drink-and-driving, it is associated with fatal accidents (Chen & Jou, 2018). There are three aspects of driving with discourtesy as per Scott-Parker et al. (2018), namely, impolite behavior (deliberate anger and intimidation), driving context (malfuction of vehicles features, driving on holidays, road infrastructure features and driving in unknown locations) and behavior from other road users (merging, tailgating, and drug use). Additionally, the four categories for distracted driving are watching roadside, talking, under the influence of drowsiness, and drinking (Chen et al., 2015).
Drivers should have concerns about the safety of the others and their own while traveling. Penalizing offenders is insufficient, as more should be done at the same time, given that the consequences of impair driving are costly and life-threatening. Thus, this study proposes the following hypothesis:

H1d: *Deviation in driving has a positive influence on the travel behavior performance of road commuters.*

### 2.2 Social Factors

Having network and social interactions are crucial in modern mobility (Dugundji et al., 2011). The importance of walking and cycling for commuters who are physically inactive should be recognized (Keall et al., 2018) through social influence. Subjective norm is identified as of whether an individual would exhibit the same behavior if peers are pressuring that individual (Wan, Shen & Choi, 2017). This works the same way when deciding to purchase a car or not (Belgiawan et al., 2017). For youths, factors such as independence, car usage frequency, affective, and income level are influential in purchasing a car or not. Among males and females as household heads, travel behavior in a household is interchangeably influential (Kroesen, 2015). According to Choo and Mokhtarian (2004), a status seeker is one of the four lifestyles in their work. Other lifestyles being community/family-oriented, frustrating factors, and workaholic. Owning a sporty and branded vehicle in Malaysia usually is a sign of richness, having a high-income level, fame, or social status in modern society. A GPS device that monitors the road condition system and the road traffic in Klang Valley can be implemented to improve or regulate the traffic when necessary (Lei, Mohamed & Claudel, 2018). However, the utilization of the electronic board that displays information about traffic flow on the roadside will have a negative effect on driving behavior and traffic safety (Mollu et al., 2018). Social Factors (Kang et al., 2019), which influences the travel behavior performance of road commuters to have three dimensions and are elaborated below:

#### 2.2.1 Subjective Norms

Several subjective norms are exhibited when people are driving on the road, such as texting while driving. Calling and replying phone calls with or without hand-held devices do not guarantee safety while driving (Lipovac et al., 2017). Subjective and descriptive norms can increase the green travel intent of road commuters even when they do not hold high environmental responsibility (Ru et al., 2018). Hence, their attitude, knowledge, and beliefs can influence the effectiveness of the enforcement of distracted driving law. Stark, Berger, and Hössinger (2018) have pointed out that reflection, action, and intervention of information sources may influence on the intention of a person to optimize travel plan on the road. Hence, this study proposes the hypothesis that:
H2a: Subjective norm has a positive influence on the travel behavior performance of road commuters.

2.2.2 Social Status
Social status is usually expressed through specific patterns of consumption and behaviors (Van Acker, Goodwin & Witlox, 2016). Beliefs, attitudes, and interests shape these patterns. Hence, social status is not shaped by speed, price, and comfort. In this case, the personal aim of having a high-value vehicle due to the desire for high esteem can be noted (Kusuma, 2015). Apart from perceptions, preference on vehicles that enhances self-image and esteem comes under the influence of several factors, such as internet marketing, influence from family members on the purchase, customer satisfaction, and loyalty (Kusuma, 2015). Being able to quick enough gain ideas and feedback from the internet from potential customers, as well as personalized care and after-sales service with vehicle brands, shows that the internet is important in communication and marketing strategies amongst vehicle manufacturers. More importantly, customer satisfaction and loyalty to vehicle brands encourage returning customers. Additionally, there is an increment in vehicle purchase from women as well (Kusuma, 2015). Hence, this study hypothesizes the following: H2b: Social status has a positive influence on the travel behavior performance of road commuters.

2.2.3 Digitalization
In making use of advanced, sophisticated technology like a GPS device that can monitor traffic and road condition systems may be applied by the relevant authorities to regulate road, especially during peak hours (Lei et al., 2018). However, the high utilization of advanced technology might not be the best case. Rahman, Wirasinghe, and Kattan (2013) claimed that the next bus arrival time should be made available at bus stops is the most sought-after for bus riders. This should encourage people to change their mode of transport for the betterment. As for Light Rail Transit (LRT), the next arrival time has the interest of less frequent riders, but not regular riders. The industry revolution-4 looks for real-time data, automation, and integration in every walk of life, and therefore, the digitalization is mandatory in controlling road traffic. The usage of advanced technology and real-time data is crucial in mitigating emissions from vehicles. Hence, this study posits the following: H2c: Digitalization has a positive influence on the travel behavior performance of road commuters.

2.3 Affect
Affect has been considered as emotion (Triandis, 1977). At times, emotion will disrupt and cloud individual judgment (Preece et al., 2018) with changes from the past (Pfister & Bohm, 2008) during the process of making decisions. Evidence of research from Russel (1980) suggests that in the affective dimensions, variables are highly interrelated in a systematic way. The affective dimensions
fall in a circular order: pleasure (0°), excitement (45°), arousal (90°), distress (135°), displeasure (180°), depression (225°), sleepiness (270°) and relaxation (315°). Furthermore, positive and negative affect are different depending on the swings in mind (Diener & Emmons, 1985). This study also indicates that the longer the time of thinking process, the clearer the type of emotions. Not to mention during peak hours, travel behavior is certainly different from normal hours and will affect life satisfaction and emotional well-being (Friman et al., 2017). In Mann et al. (2016), internal and legal sanctions could reduce road traffic crimes. The feeling of guilt has the strongest effect on reducing road traffic crimes, and if not, legal sanctions will do the work. However, social sanctions do not reduce road traffic crimes but influence road commuters to engage in violation of traffic rules and laws. More mobility from personal vehicles indicates that there will be more airpollutions and climate change (Gilmore & Patwardhan, 2016). Air pollutions also affect agriculture productions (Shindell et al., 2011). While road agencies or authorities are maintaining road lane or road infrastructure, travel behavior performance of drivers will be affected due to the diversion of routes (Hartmann & Ling, 2016). Furthermore, good road infrastructure will lead to the reduction of air pollution (Van Acker et al., 2016), the increase of firms’ output through efficient transport systems (Barzin, D’Costa & Graham, 2018) and increase of cycling activities (Hull & O’Holleran, 2014) among least physically active commuters (Panter et al., 2016). Reinvestment in cycling infrastructure, pedestrianization of town centers and public transport are considered as an encouragement for a change of mode of travel from the workplace or home (Van Acker et al., 2016) that will reduce carbon dioxide from vehicle emissions (Banister, 2008). In terms of individual travel behavior, the different daily temperature has a lesser impact than the different monthly temperature in the long term whereas different temperatures and daily winds are more influential in the short term (Liu et al., 2015). Heavy rainfall is a threat to the safety of road commuter (Preece et al., 2018) as the drivers should slow down during adverse weather (Wang, Liang & Evans, 2017). Notably, the older generation feels that they have responsibility for environmental issues, for example, climate change, as compared to the younger generation and through their emotions; this can affect the following generation (Wang et al., 2018).

2.3.1 Accidents and Damages

As there is no age limit restriction for vehicles in Malaysia, it is more alarming and dangerous for human wellbeing. According to Tanishita and van Wee (2017), speed and speed variation are strongly believed to be the reasons for high rates of traffic accidents. There are two high probabilities for the occurrence of accidents. Accidents can happen when speed is reduced suddenly from 110 to 85 km/hour, for example, or increasing the speed from 65 to 95 km/hour. Also, more accidents tend to occur during sunny days instead of cloudy weather, which results in more costs,
such as repair cost, cost of time, or even life-threatening costs (Tanishita & van Wee, 2017). Regarding environmental damages, light-duty vehicles can contribute to climate change by emitting as much as 209% of carbon emission in different altitude that lacks oxygen and low-pressure concentrations (Wang et al., 2018). Hence, the study hypothesizes the following:

H3a: Accidents and damages have a negative influence on travel behavior performance of road commuters.

2.3.2 Road Infrastructure

Reinvestment in public transportation, cycling infrastructure, and pedestrianization of town centers have to be reconsidered as mobility management that encourages change in travel behavior from home to the workplace (Van Acker et al., 2016). In order for people to change the mode of transport, road infrastructures for cycling and walking must be made available (Panter et al., 2016). With that, this study proposes the following:

H3b: Road infrastructure has a positive influence on travel behavior performance of road commuters.

2.3.3 Weather Conditions

Weather is hard to predict, and this can affect the travel plan. According to Tao et al. (2018), real-time weather information, as well as traffic and time of day, should be considered when monitoring the demand for buses. This also indicates that the adjustment of transit time should be changed accordingly to heavy rain or high temperatures. Furthermore, transit operators may upgrade bus stops to shelter passengers from heavy rain to increase ridership in case of a decrease in ridership. It has been observed that warm, dry, calm, and sunny, but not scorching hot weather, can stimulate active travel (Böcker, Dijst & Faber, 2016). Road traffic accidents due to jumping red lights, speeding, and neglecting seatbelts are mostly attributed to other drivers (Rasool et al., 2015), not to mention that it could be far more devastating during rainfall. Hence, this study hypothesizes as follows:

H3c: Weather has a negative influence on the travel behavior performance of road commuters.

2.4 Habit

Habit and behavior are related (Triandis, 1979). When the intention is repeated continuously and so as the later exhibited behavior, that experience will become a habit. Ouellette and Wood (1998) supported this statement by mentioning that the strength of habit is from repeated behavior; therefore, it is a predictor of behavior. It is highly correlated between intention, habits, and behavior with dominance from habits over behavioral outcomes (Gardner et al., 2012). Mind-wandering is preventing drivers from focusing on driving (Burdett, Charlton & Starkey, 2018), and it occurs when
drivers are in a comfortable or familiar environment. According to Qu et al. (2015), emotional driving, aggressive driving, drunk driving, and risky driving are all correlated with mind wandering. Additionally, when minds are wandering, male drivers exhibit driving behavior that is riskier and exhibits more emotions.

### 2.4.1 Mental Block

Mind-wandering has been positively correlated with drunk driving, emotional driving, risky driving, and aggressive driving (Qu et al., 2015). Male drivers are found to be riskier and exhibit more negative emotional driving behavior when compared to female drivers upon mind wandering. There are also issues concerning lights that are glaring and getting the attention of drivers while on the road with high chances of creating accidents (Yellappan et al., 2016). Bright lights within a certain range can affect a driver’s vision. Factors of forgiveness and unforgiveness while on the road have a role in decreasing the intensity of adverse driving from young drivers (Bumgarner, 2015). Hence, conflicts between driving and non-driving activities can decrease based on the level of forgiveness from ourselves, others, and during unforeseen situations. With that, the following hypothesis is proposed:

**H4:** Habit factor (Mental Block) of road commuters has a negative influence on travel behavior performance of road commuters.

### 2.5 Intention to follow Road Discipline

Firstly, in the Theory of Planned Behavior (TPB) by Ajzen (1991) recognize that intention is a predictor of behavior. TPB also remarked that only with motivation, then only behaviors will be performed. However, scholars also argued that intention might not materialize into behavior sometimes (Webb & Sheeran, 2006). According to Moutinho (1987), the intention is an antecedent to behavior that is caused by beliefs about the outcome, whereas social and situational factors provided by normative beliefs. In fact, a lot of similarities have been noted between this explanation and TIB initiated by Triandis (1977) due to the reason that belief about outcome may influence one’s attitude to perform a behavior (Kang et al., 2019), while normative beliefs can influence one’s subjective norms to perform a behavior. Intention to follow road discipline is an intention; thus, it can be understood in the same dimension. As such, this study proposes the following hypotheses:

**H5 (a-j):** Intention to follow road discipline mediates the relationship between the independent variables (Attitude, Social Factors, Affect, and Habit) and travel behavior performance of road commuters.

### 2.6 Road Traffic Policies/Regulations

Kaffashi et al. (2016) asserted that Malaysians are eager to minimize their car usage if innovative transport policy is implemented. Policies, such as proper pricing and efficient public transport, could
shift the mode of transport from personal vehicles to public transport to the extent of 70%. The respondents in this study opined that they were willing to pay up to 175% of their hourly wages to have efficient public transport. The government should take some initiatives to implement new policies. However, several steps are involved before decision-makers can make decisions from research studies. Hence, the study hypothesizes the following:

H6: Road traffic policies/ regulations moderates the relationship between Intention to follow road discipline and travel behavior performance of road commuters.

3.0 Construction of a conceptual research framework

Figure 1 illustrates the conceptual research framework supported by the Theory of Interpersonal Behavior (TIB) proposed by Egmond and Bruel (2007). The constructs of TIB in the research framework are attitude, social factors, affect, and habit. The sub-constructs for each independent variable (predictor) have been identified rationally to provide novelty to the conceptual framework. The totality of the framework considered in this study is seldom available in the literature, and hence, the present research is timely. The real novelty of this study is to investigate the cause and effect relationships of the predictors in the path diagram of Figure 1. The constructs in attitude (Confidence in driving, green environment, social responsibility and deviation in driving), social factors (subjective norms, social status, and digitalization), and affect (accident and damages, road infrastructure and weather) have direct effects on the travel behavior performance of road commuters. Habit (mental block) also has a direct effect on the travel behavior performance of road commuters because habit is the frequency of past behavior. Hence, repetitive behavior could be exhibited, given that the circumstances are favorable. Intention to follow road discipline will mediate the relationship between independent and dependent variables, while the moderating variable is road traffic policies/ regulations.
Figure 1. Proposed Conceptual Research Framework

The conceptualization of the predictors considered in the present study is synchronized with the variables of TIB\textsuperscript{1} as in Table 1.

<table>
<thead>
<tr>
<th>No</th>
<th>TIB variable</th>
<th>Description</th>
<th>Constructs in the framework</th>
<th>Synchronization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TIB variable</td>
<td>Systematic</td>
<td>Confidence in Driving</td>
<td>If road commuters are confident in driving, they have to adhere to traffic laws that converge in safety concerns to commuters and others driving on the road.</td>
</tr>
<tr>
<td>2</td>
<td>Orderly</td>
<td>Green Environment</td>
<td>If travel commuters are traveling less frequently, walk/cycling for short distances, and use public transports, they can preserve the green environment in order.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Attitude</td>
<td>Principles</td>
<td>Social Responsibility</td>
<td>If road commuters are socially responsible for understanding and abiding by rules while on the road, they are highly principled.</td>
</tr>
<tr>
<td>4</td>
<td>Discipline</td>
<td>No Deviation in Driving</td>
<td>If road commuters do not deviate, particularly with no alcohol consumption, no cigarette smoking, no mobile messaging/chatting while driving; then their behavior is normal with perfect road travel discipline.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Social Factors</td>
<td>Influence of others</td>
<td>Subjective Norms</td>
<td>Relatives/friends/colleagues' suggestions should not influence those commuters driving on the road.</td>
</tr>
<tr>
<td>6</td>
<td>Social Dignity</td>
<td>Social Status</td>
<td>Commuters, while driving, should seek their safety and comforts and not have a luxury vehicle to show off for social status.</td>
<td></td>
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<td>---</td>
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<td></td>
</tr>
<tr>
<td>7</td>
<td>Technology Advancement</td>
<td>Digitalization</td>
<td>Application of artificial intelligence (AI) with real-time data (Industry Revolution-4) to be implemented for digitalization.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Affect</td>
<td>Road Violation</td>
<td>Accident and Damages</td>
<td>Real-time data and sophisticated digitalization using remote sensing of urban travel model will avoid road violation, which will control accidents and ultimately reduces damages.</td>
</tr>
<tr>
<td>9</td>
<td>Basic Needs</td>
<td>Road Infrastructure</td>
<td>Infrastructure development should be given the utmost importance for avoiding traffic congestion.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Compromise</td>
<td>Weather</td>
<td>Under the unforeseen circumstance, bad weather may create traffic congestion and is unavoidable. Commuters have to find alternative routes for travel purposes.</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Habit</td>
<td>Mind Wandering</td>
<td>Mental Block</td>
<td>There needs to be some change of thoughts in the mental block in following the family ancestor methods of owning personal vehicles in order to safeguard the environment.</td>
</tr>
</tbody>
</table>

### 4.0 Discussions and novelty of the framework

Interestingly, the Theory of Interpersonal Behavior (TIB) developed by Triandis (1977) supports the proposed conceptual framework in the present article. The one-to-one mapping between the factors of the framework and the attributes of the theory is synchronized elaborately to make the framework more realistic for commuters on the road, and in turn, it is timely to conceptualize the Urban Travel Behavior Model (UTBM) for developing countries. Furthermore, a country like Malaysia has severe traffic congestion during peak hours and the remedial activities to avoid traffic congestion on the road is described at length in the present article. With the proposes of conceptual research framework that suggests predictors avoid road accidents, to abide by road laws, to promote a change of transport mode, and to have a pollution-free healthier life. Only through more reliance on public transportation, discipline while driving on the road, and proper care on health and well-being will generate effective behavioral changes. Physical or health well-being achieves a higher score from active travel (walking and cycling) when compared to traveling by vehicles (Ettema et al., 2015). Certain factors, such as accessibility, availability of seats, cleanliness, and safety for public transport, should be given focus to be considered an enjoyable alternative to personal vehicle travel (Ettema et al., 2015). The opportunity to involve in multi-tasking while on the road is considered as another crucial attractive characteristic of travel plan behavior. The society will benefit from the awareness of the predictors embedded in the framework, having the intent to perform the behavior.
desired in this study, and implementation of innovative road traffic policies/regulations. The study outcomes will also be useful in developing government policies for the transportation sector around the globe. Convenience, flexibility, no benefits of using public transport, and active travel have been perceived as values for personal vehicle users, and they have to think of environment protection in the long-run and sustainability of travel systems on the road. The present study also seeks to address the issue of low ridership of public transport and active travel as the short-term concern, whereas the long-term concern focuses on health and climatic changes, which may be addressed if utilization of public transport increases. Furthermore, the study focuses on potential predictors that lead to road commuters’ travel intentions to actual behavior performance to promote smart mobility on the road.

5.0 Conclusions
Air pollution is a perineal problem in the globe and is predominantly due to road transport. The present study proposed a conceptual framework for the travel behavior model, which applies to any road infrastructure set-up. The study provides information dissemination on the travel behavior of road commuters. The proposed framework in the present study is supported by the Theory of Interpersonal Behavior (TIB). TIB constructs are operationalized in the context of the study with several relevant dimensions for each variable. The framework aimed to expand knowledge in the travel industry with the application of the theory. Abide by traffic laws, a healthier life without air pollution, avoiding road accidents, less frequent travel plan, normal driving, and change of mode of transportation are what the conceptual research framework talks about in this study. In achieving this, road commuters may rely more on public transportation, care for fellow human beings, driving with discipline, not influenced by others in reckless driving, and less frequent travel will smoothen air pollution. The significant outcome of the proposed research framework in the present study would be smart mobility on the road, which will ultimately reduce air pollution and carbon emission. For long-run sustainable road traffic system, one has to plan for alternative toll system with remote sensing, smart infrastructure with double flyovers, strict enforcement on deviation in road regulations policies, sharing system in vehicles, and pre-planned travel visits will be the remedial measures to reduce traffic congestion and protect the environment.

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