

Understanding the Factors Influencing Public Transport Mode Choice Behavior of Vietnamese Motorcyclists

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Abstract: *Many previous studies evaluated modal choices of car and public transport users. In contrast, there are very few studies on modal choice in motorcycle dominant countries like Vietnam. Thus, this paper reviews studies on travel mode choice to identify factors influencing mode choice in Vietnam. Most of the frameworks in previous studies divide boundaries between different levels such as the utility function, social-ecological system, socio-demographics, and psychology. These frameworks also list objective factors (gender, age, ethnicity, etc.) and subjective factors (attitudes, subjective norms, perceived behavioural control, etc.) within each level but rarely provide the interactions among them. Therefore, this study discusses the challenges in the travel mode choice and attempts to introduce a model linking objective factors and subjective factors in understanding the modal choices of the Vietnamese population.*

Keywords: *Travel mode choice, modal shift, motorcyclist, TPB, EFA*

1. Introduction

Most people are interested in performing private trips to participate in activities instead of using public transport or emerging shared mobility services. Compared to other transport alternatives, this travel mode is generally perceived as more convenient, comfortable and promotes accessibility for supporting busy lifestyles. This travel mode is more attractive for individuals and is perceived as symbolic or reflects a person's identity (Steg, 2005; Redman et al., 2013). Those without private, mobility become more disadvantaged and even socially isolated because the infrastructure of public buildings and workplaces are relocated to suit private mobility users (Steg, Can Public Transport Compete With The Private Car?, 2003). Previous studies have identified many factors influencing commuters' mode choice for different travel modes due to the differences in living conditions and land use from country to country (Washbrook et al., 2006; Kim & Ulfarsson, 2008; Eriksson et al., 2010; Stanton et al., 2013). However, these studies have mainly focused on car users, while just a few studies have attempted to understand factors influencing motorcycle users. This can lead to a lack of understanding of the transport situation of some regions, especially in Asia, which was significantly different from the Western world with typical features of a higher proportion of motorbike users (United Nations, Road Safety Performance Review Viet Nam, 2018). Among the leading 20 countries with a high number of motorcycles per 1000 population, 7 of them come from the Southeast Asia region, which are Vietnam, Malaysia, Indonesia, Thailand, Lao, Cambodia (Laksanakit, 2014). Taiwan, a state in East Asia, also has a very high motorcycle usage (0.65 motorcycles per person

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on average) (Chang & Lai, Using travel socialization and underlying motivations to better understand motorcycle usage in Taiwan, 2015). The lower purchase and operating costs and the small size and high maneuverability enabling the user to operate the motorcycle on the road and parking even under poor traffic conditions can explain the rise of motorcycles in Asia (Kepaptsoglou et al., 2011). Previous studies on motorcycle use have mostly focused on traffic safety (Gkritza, 2009; Kepaptsoglou et al., 2011; Le & Trinh, 2016), economic factors (Burge et al., 2008; Chang & Wu, 2008; Chen & Lai, 2011; Kepaptsoglou et al., 2011; Le & Trinh, 2016), and social demographic analyses (Sheikh et al., 2006; Abdullah et al., 2007; Satiennam et al., 2016; Le & Trinh, 2016; Nguyen et al., 2018). Although motorcycle ownership and usage are considered important factors in developing traffic and transport safety plans and transport policies in high motorcycle usage areas, this travel mode still has been examined at a much lower level.

In Vietnam, a country in the Southeast Asia region, public transport is not a new concept, and Vietnamese people used the first type of public transport since France dominated them in the 1880s (Tran Q. Q., 2011; Thu Hang, 2016). In May 1890, the Société foncière de l'Indochine asked the colonial government for permission to set up a tramway system called Usine de la Société des tramways électriques de L'Indochine (Tran Q. Q., 2011; Thu Hang, 2016). During the French colonial period, each train had two or three train cars and run on 5 routes (total of 30 km long). In the first decades of the nineteenth century, the tramway system was almost one of the symbols of old Hanoi, the capital of Vietnam, and also the main means of transportation of the Hanoi area. On June 1st, 1955, Usine de la Société des tramways électriques de L'Indochine stopped working after the French failed in Indochina and the company was dissolved in 1962 (Tran Q. Q., 2011; Thu Hang, 2016). Since 1968, the tramway system has been restored and developed to become an important public transport of the city, serving more than 30 million passengers a year (Tran Q. Q., 2011; Thu Hang, 2016). Until the late 1980s, bicycles and tramways remained familiar means of the capital's people (Tran Q. Q., 2011; Thu Hang, 2016). In 1991, since the last road was shut down, motorbikes gradually flooded Hanoi and other main cities of Vietnam, along with urbanization, socio-economic development, and a rising population. These cities are faced with the urgency of the urban traffic crisis (Tran Q. Q., 2011; Thu Hang, 2016). Since 2001, the bus system has been reorganized and was expected to be an alternative to private vehicles (Tran Q. Q., 2011; Thu Hang, 2016). Indeed, the development of safe, convenient, and sustainable public transport plays an important role in decreasing private motorized trips (Bhourri et al., 2015). To develop sustainable public transport, a good understanding of the factors influencing the travel mode choice of Vietnamese people is required. In this regard, this paper analyzes data collected from December 2020 to February 2021 from 618 Vietnamese motorcycle users to find factors influencing the intention to use public transport.

2. Literature review

Public transport, which includes bus, bus rapid transit (BRT), metros, tramway, etc., is an alternative to private vehicles and has many advantages such as high capacity, price, not affected by congestion, etc. (Profillidis & Botzoris, 2018). Public transport plays an important role in ensuring access to activities and services in urban and crowded areas as well as contributes to the mitigation of global and local environmental and social problems through a decrease of private mobility trips and carbon footprint (Daniels & Mulley, 2013; Stanton et al., 2013; Dirgahayani, 2013). Better quality of public transportation is believed to address issues related to public transport share, congestion, air pollution, and climate change impact (Dirgahayani, 2013). Many factors affect public transport use, including costs, physical accessibility, attitudes, etc., which relate to the capacity and motivation of public transport use (Andreassen, 1995; Kitamura et al., 1997; Parkany et al., 2004; Steg, 2005; Beirão & Cabral,

2007; Abdullah et al., 2007; Domarchi et al., 2008; Chen & Chao, 2011; Daniels & Mulley, 2013; Satiennam et al., 2016). This section reviews the prior studies that investigated factors influencing public transport mode choice. Considered explanatory variables can be broadly divided into (i) mode characteristics (Andreassen, 1995; Hensher et al., 2003; Washbrook et al., 2006; Beirão & Cabral, 2007), (ii) demographic and socio-economic characteristics (Morikawa et al., 2003; Sheikh et al., 2006; Abdullah et al., 2007; Satiennam et al., 2016), and (iii) psychological characteristics (Kitamura et al., 1997; Parkany et al., 2004; Steg, 2005; Beirão & Cabral, 2007; Domarchi et al., 2008; Murray et al., 2010).

2.1. Mode characteristics

Transport mode characteristics are the extrinsic motivation factors (e.g., public transport service quality and accessibility) that affect individuals' travel mode choice. Early studies on public transport mode choice focused on measuring service quality's efficiency, effectiveness, and availability. Results from previous studies indicated that travel time, travel cost, service reliability, frequency, seat availability, station facilities, and the number of transfers are the highly ranked attributes for service quality (Andreassen, 1995; Rietveld, 2005; Washbrook et al., 2006; Redman et al., 2013). For most of the journeys related to work and school activities, travel time and travel cost are the most influencing factors (Washbrook et al., 2006; Kim & Ulfarsson, 2008; Beirão & Cabral, 2007). Indeed, commuters want to feel in control when travelling and this means short waiting times and a fast journey (Beirão & Cabral, 2007). In addition, lower fares would increase commuters' perceptions of public transport quality affecting their satisfaction with this mode choice (Andreassen, 1995; Hensher et al., 2003).

2.2. Demographic and Socio-economic characteristics

Previous studies have indicated a significant influence of demographic and socio-economic characteristics on commuters' behavior (Morikawa et al., 2003; Sheikh et al., 2006; Abdullah et al., 2007; Leong & Mohd. Sadullah, 2007; Satiennam et al., 2016). Demographic variables such as age, gender, and household composition were found to be good explanatory variables in understanding commuters' behavior (Morikawa et al., 2003; Sheikh et al., 2006; Abuhamoud et al., 2011). Indeed, in the case of the same services quality, elderly people were more willing to use public transport (Abdullah et al., 2007). One study in Nagoya, Japan's fourth-largest incorporated city, also found a strong preference for private vehicle dependency among adults (aged 18 and above), while the older (aged 65 and above) prefer public transport (Morikawa et al., 2003). Also, most of the households with younger members in medium-sized European cities were more mobile and had a higher expenditure on transportation, both private and public (Nolan, 2001; Santos et al., 2013). Public transport is not a convenient mode of transport for households with younger members, as it typically entails walking to and from a station and waiting, on top of the actual journey, which entails a number of stops and sometimes a detour relative to the final destination (Santos et al., 2013). In Malaysia, apart from extrinsic motivation factors (such as travel time, travel cost, age, and gender), car ownership and household income are also significant factors influencing an individual's mode choice (Abdullah et al., 2007). In developing countries, an increase in household income makes private mobility a more affordable means of transport, and young commuters perceive this travel mode as status symbols causing a high private mobility share (Steg, 2005; Chang & Lai, 2015; Satiennam et al., 2016). Gender is also an influencing factor for mode choice behavior. Male commuters prefer private mobility as they seem to place a high premium on symbolic aspects compared to their counterpart (Steg, Car use: lust and must. Instrumental, symbolic and affective motives for car use, 2005).

2.3. Psychological characteristics

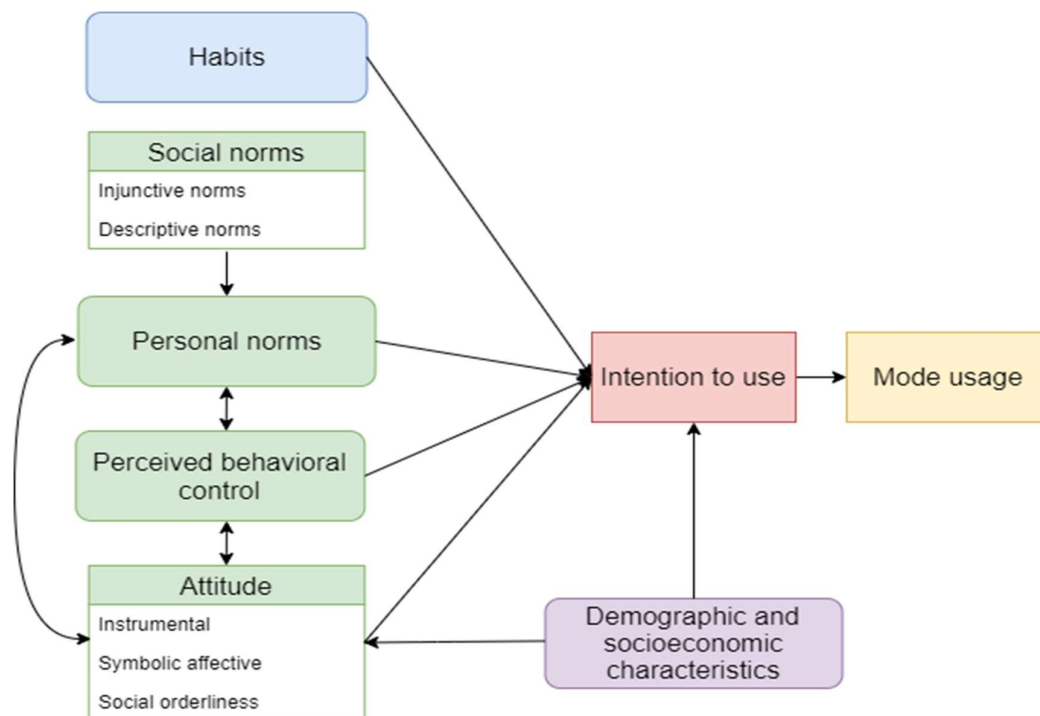
Psychological factors are the intrinsic motivation factors that represent an inner state that affects individuals’ travel mode choice. Psychological factors include behavioral intention to use a specific travel mode, which results from a mental function that immediately yields antecedents to mode choice behavior. Intention is one of the best indicators for predicting and studying human behavior, especially if the behavior is difficult to observe (Krueger, Jr & Brazeal, 1994; Yurtkoru et al., 2014). The theory of reasoned action (TRA) (Fishbein & Ajzen, 1975) is frequently used for studying behavioral intention in addition to the theory of planned behavior (TPB) (Ajzen, 1991). Theory of planned behavior (Ajzen, 1991), developed from TRA (Fishbein & Ajzen, 1975), assumes that an individual’s behavior can be predicted by understanding intrinsic motivation factors that influence behavior (Ajzen, 1991). There are three determinants of behavioral intention in the model: attitudes, subjective norms, and perceived behavioral control (PBC). Indeed, many studies in the field of travel behavior have applied TPB theory as a framework in understanding human decision-making processes (Betsch et al., 1998; Heath & Gifford, 2002; Bamberg et al., 2003; Chen et al., 2004; Steg, 2005; Haustein & Hunecke, 2007; Haustein et al., 2009; Murray et al., 2010; Chen & Chao, 2011; Olsson et al., 2018). This theory has been modified over the years and added more variables to enhance its prediction in travel choice behavior. Table 1 summarizes the most prominent physical characteristic, demographic, socio-economic, and psychological factors that affect the utilization of public transport. The relationships among these factors are shown in Figure 1.

Mode characteristics	Travel time	(Hensher, Stopher, & Bullock, 2003; Andreassen, 1995; Rietveld, 2005; Beirão & Cabral, 2007; Redman, Friman, Garling, & Hartig, 2013; Satiennam, Jaensirisak, Satiennam, & Detsdamrong, 2016)
	Travel cost	
	Service reliability	
	Frequency	
	Seat availability	
	Number of transfers	
	Station facilities	
Demographic and Socio-economic characteristics	Age	(Nolan, 2001; Morikawa, et al., 2003; Sheikh, Umar, Habshah, & Kassim, 2006; Abdullah, Ismail, & Rahmat, 2007; Santos, Maoh, Potoglou, & Brunn, 2013)
	Gender	
	Household composition	(Steg, Car use: lust and must. Instrumental, symbolic and affective motives for car use, 2005; Abdullah, Ismail, & Rahmat, 2007; Tran, Zhang, & Fujiwara, 2014; Chang & Lai, Using travel socialization and underlying motivations to better understand motorcycle usage in Taiwan, 2015; Vu, 2015; Satiennam, Jaensirisak, Satiennam, & Detsdamrong, 2016)
	Car ownership	
Income		
Psychological characteristics	Attitude	(Murray, Walton, & Thomas, 2010; Wong, Chung, & Huang, 2010; Chen & Chao, Habitual or reasoned? Using the theory of planned behavior, technology acceptance model, and habit to examine switching intentions toward public transit, 2011; Chen & Chen, Speeding for fun? Exploring the speeding behavior of riders of heavy motorcycles using the theory of planned behavior and psychological flow theory, 2011; Habib, Tian, & Zaman, 2011; Van & Fujii, 2011; Le & Trinh, 2016)

	Habitual	(Ronis, Yates, & Kirscht, 1989; Betsch, Fiedler, & Brinkmann, 1998; Chen, Gärling, & Kitamura, 2004; Johansson, 2006; Haustein, Klöckner, & Blöbaum, Car use of young adults: The role of travel socialization, 2009; Lin & Chang, 2010; Chang & Lai, Using travel socialization and underlying motivations to better understand motorcycle usage in Taiwan, 2015; Vu, 2015)
	Social norms	(Heath & Gifford, 2002; Borsari & Carey, 2003; Steg, Car use: lust and must. Instrumental, symbolic and affective motives for car use, 2005; Lapinski & Rimal, 2005; Hardecker, et al., 2009; Olsson, Huck, & Friman, 2018)
	Perceived behavioral control	(Heath & Gifford, 2002; Bamberg, Ajzen, & Schmidt, Choice of Travel Mode in the Theory of Planned Behavior: The Roles of Past Behavior, Habit, and Reasoned Action, 2003; Haustein & Hunecke, Reduced Use of Environmentally Friendly Modes of Transportation Caused by Perceived Mobility Necessities: An Extension of the Theory of Planned Behavior, 2007; Chen & Chao, Habitual or reasoned? Using the theory of planned behavior, technology acceptance model, and habit to examine switching intentions toward public transit, 2011; Chen & Lai, The effects of rational and habitual factors on mode choice behaviors in a motorcycle-dependent region: Evidence from Taiwan Ching-Fu, 2011)

Table 1 : Factors influencing public transport mode choice

Figure 1 : Conceptual model



3. Methodology and result

3.1. Data source and scale

More than eight hundred questionnaires were sent to Vietnamese motorcyclists in Danang city, a class-1 municipality, the largest city in the central of Vietnam, and the fifth-largest city by population. The questionnaire consists of an introduction with questions such as travel route, travel mode, distance, cost per trip, etc. Next, the respondent was asked to rate 32 statements on a 7-point Likert scale (Likert-1 totally disagree, and Likert-7 totally agree). To have accurate data, the authors asked the respondents to rate the statements based on the situation before the Covid-19 pandemic. Finally, the respondents were asked to answer several demographic and socio-economic questions.

3.2. Result

Because of the COVID-19 pandemic and subsequent lockdown periods, most questionnaires were sent to employees at Da Nang Administrative Centre, members of the Facebook group of Danang, people interested in urban management, and university of economic students. After data cleaning, the authors retained survey data from 618 respondents (Table 2), of which 437 from female motorcyclists (70.7 percent), followed by 181 male motorcyclists (29.3 percent). 368 respondents use a motorcycle for a school trip (59.5 percent), and 250 respondents use a motorcycle for a work trip (40.5 percent). The age of respondents is ranged from below 20 years old to above 50 years old.

Gender		Most frequency trip		Age	
Male	181	School	368	< 20 years old	161
				21 - < 30 years old	337
Female	437	Work	250	30 - < 40 years old	69
				40 - < 50 years old	37
				> 50 years old	14
Total	618	Total	618	Total	618

Table 2: Descriptive statistics of Danang motocylists

3.3. Exploratory Factor Analysis results (EFA)

The Kaiser-Meyer-Olkin (KMO) and Bartlett test results show that the data are eligible for exploratory factor analysis, with its KMO value equal to 0.876. The authors conduct an exploratory factor analysis with varimax rotation, and the results are shown in Table 3. EFA was used to define the factor structure based on the answers which correspond to attributes. Firstly, the factor analysis condition was checked to see if it is satisfied through the correlation matrix. Then, the KMO test was applied to test the sample size adequacy with a condition between 0.5 and 1 for factor analysis (Kaiser, 1974). In addition, Bartlett’s Test of Sphere (BTS) value was at a large enough one, and the BTS was significant at a low level of significance (< 0.01) (Bartlett, 1954). For factor extraction, the primary factoring method was conducted, and the results suggested a six-factor solution. The items with less than 0.5 value of factor loadings or items that are cross-loaded were excluded one at a time, and the analysis was started again (Hair et al., 2010). The total explained variance was ranked at a quite high level of 71 percent compared to the proposed threshold of 60 percent (Hinkin, 2005). Also, the instruments’ reliability was checked with Cronbach’s alpha test. As a result, the estimated coefficient for the six factors was over 0.70, which is acceptable (Hair et al., 2010). Therefore, the EFA results met the reliability requirements and demonstrated high internal consistency (Hair et al., 2010).

The result shows that all items of social norm, perceived behavioral control, and habitual factors are closely related. Of the five items of the instrumental attitude factor, item AI3 is discarded due to its low factor loading. Of the five items of the social orderliness attitude factor, item AO4 is discarded due to its low factor loading. Of the eleven items of the symbolic/affective attitude factor, items ASA3, 4, 9, and 10 are discarded due to their low factor loadings. As shown in Table 3, the Cronbach's alpha value supports the separation of 4 original factors: attitude, social norm, perceived behavior control, and habitual into six factors: (i) instrumental attitude, (ii) social orderliness attitude, (iii) symbolic/affective attitude, (iv) social norm, (v) perceived behavior control, and (vi) habits. This result is consistent with previous studies applied TPB theory (Kitamura et al., 1997; Steg, 2005; Beirão & Cabral, 2007; Steg & Brussel, 2009; Chen & Chao, 2011; Van & Fujii, 2011; Chen & Chen, 2011).

Kaiser-Meyer-Olkin Measure: 0.876				Factor loading						Cronbach's alpha	Factor average	
Factor	Item	Average	Extraction	1	2	3	4	5	6			
Symbolic/Affective	ASA5	2.46	.840	.898							0.872	2.917
	ASA6	2.44	.800	.874								
	ASA2	2.39	.548	.716								
	ASA11	3.45	.590	.675								
	ASA8	3.24	.639	.639								
	ASA7	3.09	.541	.636								
Social orderliness	AO2	4.69	.865		.918						0.877	4.505
	AO1	4.55	.831		.898							
	AO5	4.75	.760		.840							
	AO3	4.04	.547		.595							
Habits	HA3	2.34	.797			.863					0.865	2.384
	HA4	2.30	.793			.856						
	HA1	2.28	.733			.811						
	HA2	2.62	.568			.741						
Instrumental	AI1	3.72	.790				.869				0.873	3.671
	AI2	3.29	.794				.853					
	AI4	4.06	.724				.763					
	AI5	3.60	.680				.748					
Social norms	SIN1	4.16	.779					.849			0.770	3.789
	SDN1	3.35	.701					.701				
	PN1	3.86	.639					.659				
Perceived behavioral control	PBC2	3.75	.831							.905	0.735	3.651
	PBC1	3.55	.778							.828		

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Table 3: Analysis of factors to explore relationship quality scale

Previous studies in western countries measure attitude by assessing the service quality, such as being flexible, saving time, cost sensitivity, or as the intention to use alternative transportation modes (Parkany et al., 2004; Beirão & Cabral, 2007). They also admitted that attitudes toward mode choice are formulated from *instrumental*, *symbolic* and *affective motives* (Steg, Can Public Transport Compete With The Private Car?, 2003; Steg, Car use: lust and must. Instrumental, symbolic and affective motives for car use, 2005; Gatersleben, 2007). The instrumental aspect mainly refers to the utility benefits of using travel modes. Symbolic aspects are related to the expression of personal and social identity, while affective motives refer to commuters' feelings (Steg, Can Public Transport Compete With The Private Car?, 2003; Steg, Car use: lust and must. Instrumental, symbolic and affective motives for car use, 2005). However, many studies also found a strong relationship between symbolic and affective factors

and concluded that there is no clear distinction between them (Hiscock et al., 2002; Steg, 2003; Steg, 2005; Gatersleben, 2007; Van & Fujii, 2011). Both instrumental and symbolic/affective are scored very low in Vietnam as Vietnamese people perceive public transport as an inconvenient travel mode and not attractive in terms of cost. The low score in symbolic/affective attitude component reflects that Vietnamese motorcyclists do not want to use public transport because they can be socially misclassified. In addition, the condition of traffic in the Southeast Asia region is different, with typical features of a higher proportion of motorbike users (United Nations, Road Safety Performance Review Viet Nam, 2018). Because of these special conditions, there is another type of attitude factor influencing Vietnamese motorcyclists named *social orderliness*, which is related to safety, quietness, environmental friendliness, altruism, etc. (Van & Fujii, 2011). The social orderliness attitude's score is high, which means that Vietnamese people perceive public transport as an environment-friendly and safe travel mode, but they still not willing to shift to this travel mode.

4. Conclusion

This study attempts to explore factors influencing public transport travel mode choice behavior of Vietnamese motorcyclists. The results are consistent with previous studies on psychological factors. They show that the attitudes toward public transport travel mode are formulated from three components, namely instrumental attitude, symbolic/affective attitude, and social orderliness attitude. Even though Vietnamese people do believe that public transport is an environmentally friendly travel mode, but because of their own value, they still prefer to use a motorcycle, which is more convenient and cheap in terms of cost. Despite the theoretical and practical implications, there are still some cautions due to the study's limitations. First, our future studies need to apply a behavioral change model based on the State model of Self-Regulated Behavioral Change (SSBC) to investigate the modal shift toward public transport (Bamberg, Changing environmentally harmful behaviors: A stage model of self-regulated behavioral change, 2013). To evaluate the capability of Vietnamese commuters to switch from private vehicles to public transport, it is necessary to evaluate both intrinsic and extrinsic motivation factors influencing travel mode choice. Second, there are also very few studies on modal shift that apply the behavioral change to study the changing process of commuters' behavior toward pro-environmental travel mode, especially in the case of modal shift from motorcycle to public transport. Therefore, there is a need to indicate how the interaction of these factors may lead to behavioral and environmental changes. Third, previous studies have identified many factors influencing commuter's mode choice for public transport and motorcycle, but few studies have attempted to understand factors influencing motorcycle mode choice of Southeast Asian commuters. There is an urgent need to consider such aspects as living conditions and land use in Southeast Asia are significantly different from the Western world with typical features of a higher proportion of motorcycle riders (United Nations, Demographic Yearbook, 2017). Fourth, there is a need to study the impact of cultural and socio-demographic factors on public transport mode choice of Southeast Asian commuters as there is a difference in public transport symbolism cities between the global south and global north (Ashmore et al., 2019).

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