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Perceptions and attitudes towards micro e-scooters in Singapore

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Being a dissertation submitted to the faculty of The Built Environment as part of the requirements for the award of the MSc Transport and City Planning at University College London: I declare that this dissertation is entirely my own work and that ideas, data and images, as well as direct quotations, drawn from elsewhere are identified and referenced.

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Contents

1. Abstract

With the potential of micro-mobility devices such as e-scooters in replacing car-based trips and reducing congestion, many cities have sought to promote the use of these devices. However, studies on the perceived risks and comfort level when sharing paths/spaces with users of micro-mobility devices remain relatively under-researched. Therefore, the overall aim of this research is to advance an understanding on the perceptions/attitudes towards the use of micro e-scooters in Singapore in order to support transport policy design. Specifically, this research will identify the perceived safety issues posed by e-scooters; assess whether the public is supportive of the ban on e-scooters; and examine what are the predictors that may determine the likelihood of one supporting the ban. This will be done through a literature review on perceived safety issues regarding micro-mobility devices as well as pedestrians' attitudes towards other devices when sharing spaces, coupled with collection and analysis of empirical data via an online survey (participated by 310 respondents) on attitudes towards e-scooters in Singapore. The findings from this research show that the majority of respondents perceive e-scooters as dangerous and a burden to pedestrians. However, the level of experience/familiarity with the use of these devices has an effect on one's perceptions towards e-scooters. Bulk of respondents are in favour of the ban, with some personal characteristics such as "age group", "having a personal negative incident with an e-scooter", as well as subjective norms i.e. "having family/close friend(s)" are found to have an effect on the level of support for the ban. This dissertation thus argues that the government urgently needs to embark on measures to minimise conflict between competing users and mitigate intimidating behaviours by e-scooter riders, in order to transform largely negative public sentiment towards e-scooters, especially in light of the influence of media on one's perceptions/attitudes.

2. Introduction

"An alternative to motor vehicles" has been found to be a commonly-cited motivation behind the use of e-bikes in many studies such as by Johnson & Rose (2013); MacArthur et al. (2014); and Popovich et al. (2014), as cited by Fishman and Cherry (2016). It is thus not surprising that many cities have sought to promote the adoption of e-bikes and other micro-mobility devices (such as e-scooters) as a transport solution to reduce pollution and congestion problems.

However, with the increasing proliferation in the use of e-bikes and e-scooters in many cities, safety concerns pertaining to the use of these devices have cropped up. On that note, there seems to be some difficulty amongst existing literature in examining the objective safety risks posed by these devices (perhaps due to lack of data). Further, there seems to be no consensus from existing studies on whether users of such devices exhibit more risky and reckless behaviour as compared to cyclists (of conventional bicycles). For instance, a study by Zhang and Wu (2013) found that that there was a higher likelihood that e-biker riders may run red-lights as compared to cyclists. In contrast, a study by Schepers et al. (2014) concluded that there was no significant difference in safety outcomes between e-bike riders and cyclists in the Netherlands.

Objective safety concerns aside, an increasingly important yet relatively "under-researched" area is pedestrians' perceived risks and comfort level when sharing paths/spaces with users of micro-mobility devices. Based on Ajzen (1991)'s theory of planned behaviour, one can perhaps allude to the importance of perceived social norms in affecting decision-making - taking up micro-mobility in this context. This suggests that the attitudes and perceptions of the general public towards the use of micro-mobility devices (as socially desirable/undesirable) have an impact on the social acceptance, promotion and correspondingly the adoption of these devices in a harmonious manner within the community. This issue on potential conflict between users of micro-mobility devices and pedestrians is perhaps best illustrated in the case of Singapore. Unlike other cities where e-scooters can only be ridden on the roads, it is legal to ride e-scooters on footpaths (sidewalks) in Singapore. Despite regulations put in place to enhance the safety of pedestrians, mounting public anger and perceived safety concerns among the general public towards e-scooter riders eventually led to the government banning the use of e-scooters from footpaths.

2.1 Research Focus

To the best of the knowledge of the author, there is limited research on perceived/subjective risks (from the perspective of pedestrians) towards micro-mobility devices, although it is a field of growing importance. Safety studies of the same nature in the land transport field are largely contained to the domain between motorists and cyclists/pedestrians. Further, while there have been much literature on understanding the attitudes and motivations behind purchasing and using a micro-mobility device such as an e-bike, perceptions and attitudes of pedestrians towards sharing spaces with these devices remain largely under-researched, with the closest (and related) literature mainly stemmed from Jacob and Schreyer (1980)'s theory of recreation conflict in the context of examining conflict between hikers and mountain bikers along nature trails. In addition, in the context of Singapore, the Land Transport Authority (LTA) have previously conducted a survey[1] in 2015 to gauge the general public's willingness to share footpaths (amongst others) with micro-mobility device users as part of a public consultation exercise to guide policy formulation. However, as the survey was positioned then to examine the general sentiment of the public towards micro-mobility users when the use (and popularity) of such devices was still at its infancy, it did not (and was unlikely able to accurately) examine the underlying attitudes and perceptions of the general public towards the use of these devices.

The overall aim of this research is thus to advance an understanding on the perceptions and attitudes towards the use of micro e-scooters in Singapore to support transport policy design. Within the context of e-scooters in Singapore, the specific objectives of this research are to:

i. Examine the attitudes among the general public towards micro e-scooters (and riders);
ii. Identify the perceived safety issues (by pedestrians) posed by the use of micro e-scooters;
iii. Assess whether the public is generally supportive of the ban on the use of micro e-scooters; and
iv. Examine what are the predictors (e.g. personal characteristics) towards determining the likelihood of one supporting the ban.

This research will depend on a review of relevant literature and the collection of empirical data through an online survey. The survey will be targeted at Singapore residents in the different age groups.

1 Please refer to **Annex A** for the results of the survey conducted by LTA in 2015.

Table 1 Expected timescales for this dissertation proposal.

Dissertation Activity	Duration (weeks)	Month
Clarify Aim/Objectives	2	Early June – Mid June
Literature Review	2	Mid June - End June
Research Methods	2	Early July – Mid July
Data Collection	3	Mid July – Early August
Findings	2	Early August – Mid August
Conclusion	2	Mid August – End August

It is worthwhile to note that there has been neither a study nor poll conducted prior to and after the ban to examine whether Singaporeans and residents are supportive of the ban, as well as their perceptions and attitudes towards micro e-scooters (and riders). Moreover, the limited research on this field can be attributed to the situation where most overseas cities have only just recently experienced the use of such devices via e-scooter sharing in the past 1-2 years, and on a very limited pilot scale. Therefore, there is value in examining the above which can help provide the necessary insights to influence subsequent transport policies regarding the future use of micro e-scooters in Singapore. In addition, this research may hopefully trigger a re-think on the possible interventions to the built environment that may be needed in order to better create a better balance between the concerns and needs of both pedestrians and e-scooter riders, such that they co-exist in a harmonious and sustainable manner.

3. Literature Review

This Literature Review will first start off with a definition on what devices are considered as micro-mobility before briefly touching on the motivations behind the growing demand of such devices in order to provide some context. The Review will then proceed to examine the safety issues as well as the area of perceived/subjective risks with regards to e-bikes, and finally study the factors that may influence perceptions and attitudes towards e-bikes. With the regards to the research objectives (appended below), this Literature Review will therefore provide an overarching study on the main issues pertaining to objectives (i) and (ii). In addition, this Review will inform the possible predictors pertaining to objective (iv), which will then be further investigated via an empirical study.

i. Examine the attitudes among the general public towards micro e-scooters (and riders);
ii. Identify the perceived safety issues (by pedestrians) posed by the use of micro e-scooters;

iii. Assess whether the public is generally supportive of the ban on the use of micro e-scooters; and
iv. Examine what are the predictors (e.g. personal characteristics) towards determining the likelihood of one supporting the ban.

For the purpose of this research study, this paper shall adopt ITDP (2020)'s definition of micro-mobility which 'refers to a range of small, lightweight devices operating at speeds typically below 25km/h and are ideal for trips up to 10km'. Based on this definition and for the scope of this study, e-scooters and e-bikes shall thus be considered as micro-mobility devices.

3.1 Safety concerns and behavioural issues of e-bike riders

Much research found that key motivations behind using or purchasing an e-bike include the ability to ride faster and at longer distances and with less physical exertion (relative to a bicycle) due to the higher operating speed of an e-bike, hence enabling one to overcome the barriers traditionally associated with the take-up of cycling. insurmountable (Fishman & Cherry, 2016; Heinen, van Wee & Maat, 2010). In addition, the potential to replace car-based/motor vehicle trips is another driver behind the demand for e-bikes especially in cities where the capital and maintenance costs of an e-bike are significantly lower than a car or motorcycle (Fishman & Cherry, 2016), as can be seen in Chinese cities where there are around 200 million e-bikes on the streets (Shepard, 2016).

Intuitively, one may argue that an e-bike is likely to be more dangerous than a bicycle (and may result in more accidents) given the former's higher operating speed and faster acceleration. While the higher performance of e-bikes is a primary motivation for purchasing/using one, there is little empirical evidence that attributes the difference in speed capacity between an e-bike and a bicycle to a possible difference in accident rates (between the two devices). Cherry and He (2010); Lin et al. (2008); Yang et al. (2014) found that e-bike riders travel at a speed of at least 40% higher than bicycles, while another study found that e-bike riders actually travelled slower on average than cyclists on shared paths (Nielsen, T., Palmatier, S. M. & Proffitt. A. (2019)). Further, some studies have suggested that riders actually feel safer using an e-bike relative to a traditional bicycle. For instance, respondents in a North American survey stated that the faster operating speed of an e-bike allow them to improve self-balance, clear an intersection more easily as well as avoid crashes (MacArthur et al., 2018). Self-assessment reports of greater confidence as a rider due to the use of e-bike were similarly found in a Boulder

County's study (Nielsen, Palmatier & Proffitt, 2019). Still, there has been little evidence that the increased risk perception of e-bike rider actually leads to safer riding behaviour.

In fact, there has been little consensus within existing literature on whether the use of e-bikes generate worse safety outcomes as compared to traditional bicycles. Ma et al. (2019) noted that the number of the number of e-bike accidents is about eight times more than accidents involving bicycles based on 2015 statistics from Traffic Management Bureau of Ministry of Public Security. The situation is even more pronounced in Jiangsu Province where the number of accidents involving e-bikes contributed to about 70% of the total number of accidents in the first half of 2016 (Ma et al., 2019). However, this trend is seemingly not replicated in other cities (as compared to Chinese cities). For instance, a study in Netherlands by Schepers et al. (2014) using data from Emergency Department concluded that there was no significant difference in safety outcomes between e-bike riders and cyclists. Regarding the difference in conclusions drawn from the above-mentioned studies, it may be worthwhile to consider the influence of environmental factor specific to a city such as infrastructural characteristics, types and level of enforcement, which may have an impact on riding behaviour and traffic accidents.

Beyond safety outcomes, other studies have attempted to examine differences in risk behaviour between e-bike riders and cyclists, but have arrived at different conclusions. For instance, Langford, Chen, and Cherry (2015) found no differences between the two groups in terms of red-light violations. This is slightly corroborated by Bai et al. (2013), as cited by Fishman and Cherry (2016), who did a study through video analytics at traffic intersections and found that only slightly more e-bike riders as compared to cyclists ran red-lights. In contrast, Zhang and Wu (2013) observed that there was a higher likelihood (1.8 times) that e-bike riders would commit the violation (as compared to cyclists).

The above perhaps suggests that the behaviour amongst e-bike riders may not be homogenous, and that there may be another dimension to it. On that note, many studies have determined that there is a relationship between personal characteristics with different risk behaviour and safety attitudes. For instance, Wu, Yao and Zhang (2011) observed that there was a higher probability that the youths and middle-aged e-bike riders would run a red-light as compared to riders that were much older. This could perhaps be attributed to a more risk-adverse attitude adopted by older riders. This trend of risk-taking behaviour among youths does not pertain solely to e-bike riders and can similarly be observed among motorcyclists - Reeder et al. (1999), as cited by Clarke et al. (2004), found that motorcyclists aged below 25 years accounted for more

than 2/3 of all motorcycle accident fatalities in New Zealand. While risk behaviour may contribute to traffic accidents and fatalities, reaction ability as found by Fu (2016) and Ma et al. (2019) may be a factor too. Gogola (2018) observed that the majority of e-bike riders in Germany who were seriously injured and died in accidents were riders who were 65 years and older. One can perhaps thus draw linkages with Ma et al. (2019) finding that reaction ability may decline with age and hence compromising riding judgement and responsiveness to the external environment, increasing the possibility of being involved in an accident.

Many studies concur that gender has an impact on risk behaviour and probability of traffic accidents. For example, Wu, Yao and Zhang (2011) through the use of survey data concluded that male riders are more likely to commit a red-light violation. This observation that females tend to perceive greater risks (as compared to males) has also been illustrated in different domains by previous research such as by Brody (1984); Gutteling and Wiegman (1993), as cited by Garbarino and Strahilevitz (2004). In addition, gender differences also have an impact on safety outcomes.

Yao and Wu (2012); Guo et al. (2017) found that there was a higher likelihood that male e-bike riders would get into a traffic collision. If one considers Wang et al. (2017) 's finding that there was a higher probability that male e-bike riders were at fault (as compared to female riders) in collisions, and Truong et al. (2016)'s insight that there was lower incidence of mobile phone use (during riding) by female e-bike riders as compared to male riders in Hanoi (as cited by Ma et al. (2019)), this may plausibly suggest that certain risk behaviours are more often exhibited by males which may have resulted in higher accident rates involving males. However, it is difficult to determine such a relationship at this juncture due to lack of empirical evidence and hence more studies (in other cities) examining the difference between genders in attitudes towards risk and safety perceptions are needed.

Besides age and gender, riding experience may have an effect on the likelihood of being involved in an accident. In a study on e-bike riders in Ningbo (a Chinese city at the east coast), Guo et. al (2017) found that e-bike riders with greater riding experience (i.e. more than 3 years of experience) have a lower likelihood of being involved in a traffic collision. This observation is perhaps intuitively in concurrence with Sanders (2015)'s suggestion that higher cycling frequency may result in greater awareness of potential traffic dangers, hence lowers the likelihood of being involved in a collision. However, Guo et. al (2017) found that the trend

decreases over time and attributed it to complacency (as one becomes familiarised with the use of e-bike after using it for long periods of time).

3.2 Pedestrians' attitudes towards other devices when sharing spaces

A 2015 survey conducted by LTA showed that only 34% of respondents were willing to share footpaths with e-bikes and other motorised devices (e.g. e-scooters), while 54% were not in favour (LTA, 2016). While the survey may have provided a broad indication of the general sentiment (then) towards the sharing of paths with the use of such devices, it neither provided any insights on the possible factors such personal characteristics that may have an impact on perceptions and attitudes. To date, this remains a relatively under-researched area in the context of micro-mobility. A survey conducted by Bernhoft and Carstensen (2008) in Denmark examining the attitudes of pedestrians towards cyclists found that significantly more seniors (aged 70 years and above), as compared to younger respondents, perceived sharing paths as dangerous in the presence of other cyclists. Kang and Fricker (2016) found that males are more likely to be willing and open to sharing paths with bicycles as compared to females and suggested that this could be perhaps be attributed to the larger frame of males. In addition, Kang and Fricker (2016) suggested that married individuals are likely less tolerant of sharing spaces with cyclists as compared to single respondents as the former may have greater family commitments and obligations. Still, there is insufficient research to corroborate on the above.

Besides the above-mentioned personal characteristics, direct experience through personal encounters with cyclists and riders motorised micro-mobility devices may influence (pedestrians') perceptions. Conflict-related literature (originating from Jacob and Schreyer (1980)'s theory of recreational conflict) suggest that that most instances of conflict due to goal interference are asymmetrical in nature (Nielsen, T., Palmatier, S. M. & Proffitt. A. (2019)). On that note, a pedestrian may form (or reinforced his/her) negative perception towards an e-bike rider after directly experiencing a negative encounter with a rider (e.g. being cut off by an e-bike rider or nearly collided with one) on a footpath. This is supported by a self-assessment survey studying conflict between pedestrians and cyclists on campus by Gkekas, Bigazzi and Gill (2020) which found that respondents who have experienced at least one instance of a near collision with a cyclist reported higher safety concerns. Nevertheless, recreational conflict model does not adequately explain why pedestrians may view other path users negatively in the absence of a personal negative encounter with one. A survey by Mcleod (2015) on pedestrians' attitudes towards e-bikes in North America revealed that the lack of shared values was a key contributor behind the negative perceptions towards these devices. This finding resonates with

the Social Values conflict model which theorises that different norms/values of different user groups can result in conflict (even in the absence of a negative direct interaction) (Park & Open Space, 2019). Nevertheless, there is perhaps some common ground between Social Values conflict model and recreational conflict - Jacob and Schreyer (1980) suggested that the lack of tolerance towards diverse lifestyles in part due to attaching stereotypical social labels to other user groups may contribute to higher likelihood of conflict.

Further, perceptions towards new or unfamiliar technologies may be influenced or even heightened (intentionally or unintentionally) by the media especially when one does not have any direct experience/interaction with it (McCluskey, Kalaitzandonakes & Swinnen, 2016). In addition, McCluskey and Swinnen (2004) suggested that more weight and attention (of readers) tend to be given to negative news. This coupled with consumers' lack of attention span in processing increasing amount of information (especially towards benefits of new technologies as compared to its risks) (McCluskey, Kalaitzandonakes & Swinnen, 2015), and considering the reality that news tend to be demand-driven (McCluskey, Kalaitzandonakes & Swinnen, 2016), the media in highlighting the dangers and risks of micro-mobility devices such as e-bikes may play a part in influencing public option. Further, as suggested by Goddard et al. (2019), this can be exacerbated by news reports on accidents involving victims of vulnerable groups such as young children and the elderly, which naturally may receive significant coverage. Still, the influence by media on one's perception and attitudes can be negated to a certain degree by one's direct experience and familiarity with the issue (or the e-bike in this context) as suggested by Happer and Philoa (2013).

3.3 Summary and Emerging Issues

While there has been extensive literature examining the motivations behind the use and purchase of e-bikes as well as its benefits, the above Literature Review shows that the study on behavourial issues of micro-mobility riders (focusing on e-bikes) and perceptions of pedestrians towards the use of these devices remains relatively under-researched. Despite some studies (through self-reporting) suggesting that users of e-bikes actually feel safer using one relative to a bicycle, there is still a lack of consensus on whether motorised micro-mobility devices such as e-bikes generates worse safety outcomes as compared to traditional bicycles. In addition, while the studies on risk behaviours have shed some light on the impact of personal characteristics such as gender and age on riding behaviours of e-bike riders, these studies are predominantly skewed towards Chinese cities (probably due to the availability of a large sample size), and

hence it is difficult to conclude that these findings may be applicable to riders in other overseas cities as well.

Further, as highlighted in the Literature Review, there is limited literature examining the perceptions and attitudes of pedestrians towards micro-mobility devices, especially in the context of sharing spaces. Most related research in this area have largely been confined to examining the interaction and conflict between cyclists and motorists. Still, recreation conflict model and social values conflict model, despite not being widely applied to the context of micro-mobility, provide a glimpse of insights in understanding the possible underlying reasons why some individuals (with or without a personal experience/interaction) may form a negative perception towards sharing paths with micro-mobility devices. In the context of e-scooters, many cities have grappled with the challenge of introducing measures that not only minimise the safety risks associated with the use of these devices, but also managing public sentiment. In addition, studies highlighted in this Review have shown that media reports of collisions especially involving vulnerable victims such as the young and elderly have the potential to shift public opinion. For instance, there was great outrage and resulted in renewed calls for tougher action against e-scooter riders in Singapore following news report of the death of an elderly cyclist due to a collision with an e-scooter rider (Wong, 2019). A ban on e-scooters on footpaths by the Singapore government followed soon after, although there has only been one fatality from collisions with e-scooter riders. This research thus seeks to address the above gaps by providing an exploratory analysis on the attitudes among the general public towards e-scooters (and riders), as well as investigate if factors such as personal characteristics, experience, news reports etc. have an impact on these perceptions. These will be covered by empirical research. More details will be covered under the next section: Research methods.

4. Research Methods

The empirical study seeks to address the following research objectives:

i. Examine the attitudes among the general public towards micro e-scooters (and riders);
ii. Identify the perceived safety issues (by pedestrians) posed by the use of micro e-scooters;
iii. Assess whether the public is generally supportive of the ban on the use of micro e-scooters; and

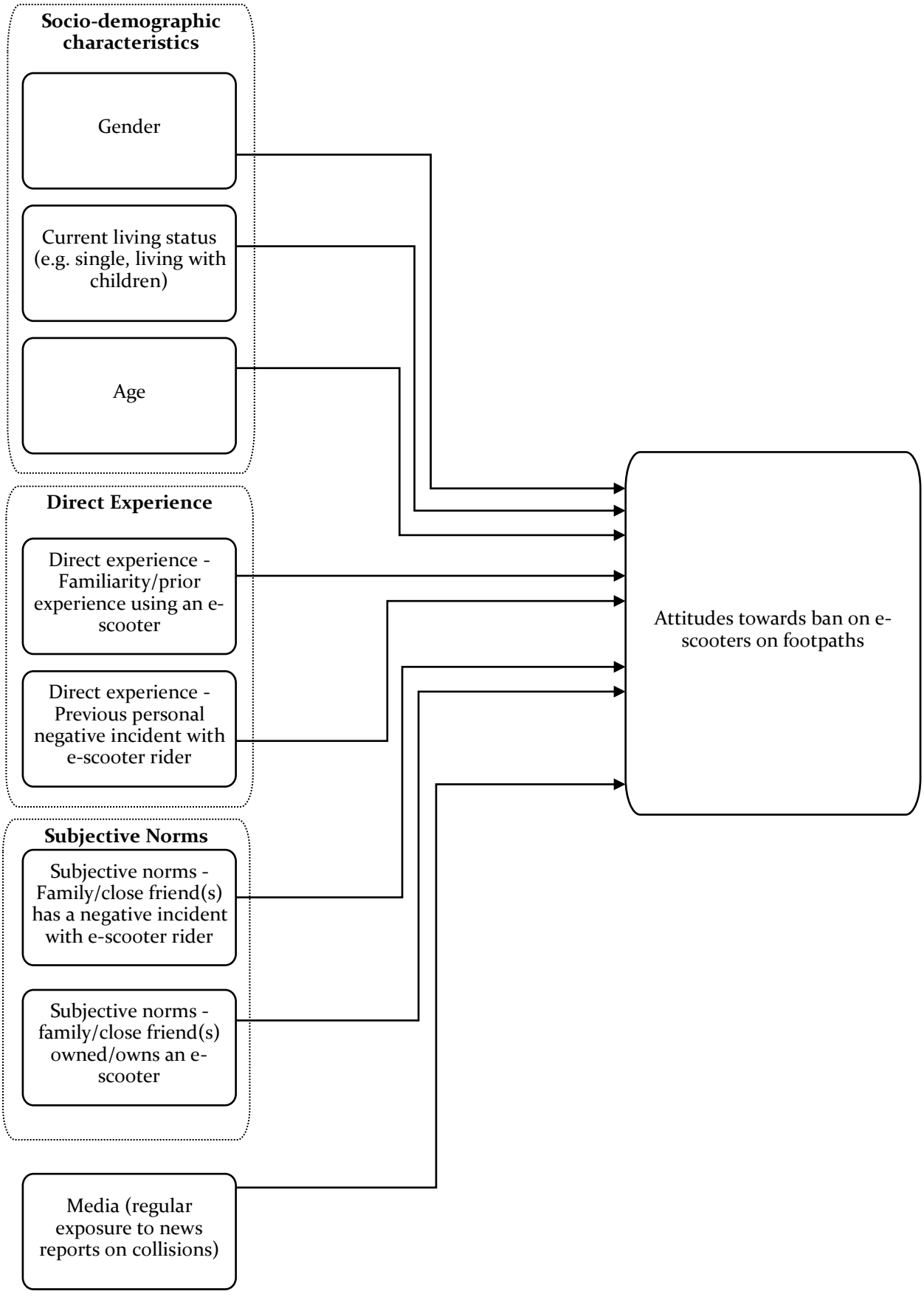
iv. Examine what are the predictors (e.g. personal characteristics) towards determining the likelihood of one supporting the ban.

This was done through primary data collection via conducting an online survey in Singapore in which respondents (users and non-users of e-scooters) were randomly targeted. This research method was selected as there was neither a study nor poll conducted prior to and/or after the ban to examine whether Singaporeans and residents are supportive of the ban, as well as their perceptions and attitudes towards e-scooters (and riders). Convenience sampling was used for the online survey given that there was no specific expertise or contextual experience required in answering the survey questions.

To address research objective (i), the survey instrument included questions on potential factors (such as e-scooter riding very closely to him/her, e-scooter rider was speeding etc.) that caused the respondent to feel threatened for his/her personal safety. In addition, mirroring the questions in Gkekas, Bigazzi and Gill (2020)'s survey on conflict between pedestrians and cyclists on campus, respondents were also asked to retrospectively self-assess contributing factors that resulted in previously experienced incidents with e-scooter riders. The survey adopted Gkekas, Bigazzi and Gill (2020)'s definition of incidents – 'when someone "fell to avoid contact, caused someone to fall, or made contact with a pedestrian, cyclist, skateboarder, motor vehicle, or non-moving permanent object (e.g., structure, ground)'. To examine the attitudes (and intensity) towards e-scooters i.e. research objective (ii), respondents were asked to rate on a 5-point Likert scale the extent to which they agreed to a series of statements such as "I like riding an e-scooter", "E-scooters are dangerous", "E-scooters are a burden to pedestrians", "E-scooters reduce congestion" etc. Similarly, in order to address research objective (iii), respondents were asked on a 5-point Likert scale the extent on which they were supportive of the ban of e-scooters on footpaths.

The Literature Review have identified various factors (such as personal characteristics) that may have an impact on pedestrians' attitudes towards potential conflict with other devices. The impact of these factors on predicting the attitudes towards supporting the ban of e-scooters (as shown in **Figure 1**) were tested via chi-square and ordinal logistic regression in addressing research objective (iv).

Figure 1


Socio-demographic characteristics
Gender
Current living status (e.g. single, living with children)
Age
Direct Experience
Direct experience - Familiarity/prior experience using an e-scooter
Direct experience - Previous personal negative incident with e-scooter rider
Subjective Norms
Subjective norms - Family/close friend(s) has a negative incident with e-scooter rider
Subjective norms - family/close friend(s) owned/owns an e-scooter
Media (regular exposure to news reports on collisions)
Attitudes towards ban on e-scooters on footpaths

Respondents were asked to indicate their gender, the age group they belonged to, as well as their current status (e.g. whether they are single, have child(ren) etc). To examine whether respondents have familiarity or prior experience handling an e-scooter, they were asked on the frequency (on average) they have used an e-scooter in the past two years. Questions on whether respondents have directly experienced a negative incident with an e-scooter rider and/or their close friends/ family have a prior negative incident with one were included. In addition, to determine the influence of media on perceptions, respondents were asked if they regularly came across/read news reports on collisions between pedestrians and e-scooter riders in the past two years. The responses to the above predictors were coded as follows:

Table 2: Variable Descriptions

Independent Variable	**Descriptions**
Gender	1 if male, 0 if female
Age	1 if 21-30, 2 if 31-40, 3 if 41-50, 4 if 51 and above
Status	0 if other, 1 if single, 2 if single parent, 3 if living with partner, 4 if living with partner and child(ren)
Direct experience – familiarity with using an e-scooter	How often have you used an e-scooter in the past two years on average? 0 if Not at all, 1 if Less than once a month, 2 if 1-4 times a month, 3 if 1-3 times a week, 4 if More than 3 times a week
Direct experience-previous personal negative incident with e-scooter rider	Have you experienced any incident with an e-scooter rider in the past 2 years? 1 if Yes, 0 if No
Subjective Norms-Family/close friends has a negative incident with e-scooter rider	Do you know of a family member/close friend that have experienced any incident with an e- scooter rider in the past 2 years? 1 if Yes, 0 if No
Subjective Norms-Family/close friends owned/owns an e-scooter	How many family members/close friends do you know of that owns or previously owned an e- scooter? 0 if None, 1 if 1-5, 2 if More than 5
Media	Have you regularly come across/read news reports on collisions between pedestrians and e- scooter riders in the past 2 years? 1 if Yes, 0 if No
Dependent Variable	**Descriptions**
Ban	To what extent do you support this ban? 1 if Not supportive at all, 2 if Not supportive, 3 if Neutral, 4 if Supportive, 5 if Very Supportive

4.1 Research Ethics

There are no ethical concerns as the survey was anonymous. In addition, the only personal information collected were a) age group; b) gender; and c) marital status which are necessary to examine possible differences in attitudes between demographic groups. Moreover, the survey did not require respondents to reveal any sensitive information or any other identifiable information.

5. Empirical Results

In total, 310 respondents completed the online survey. Please refer to **Table 3** below for more details.

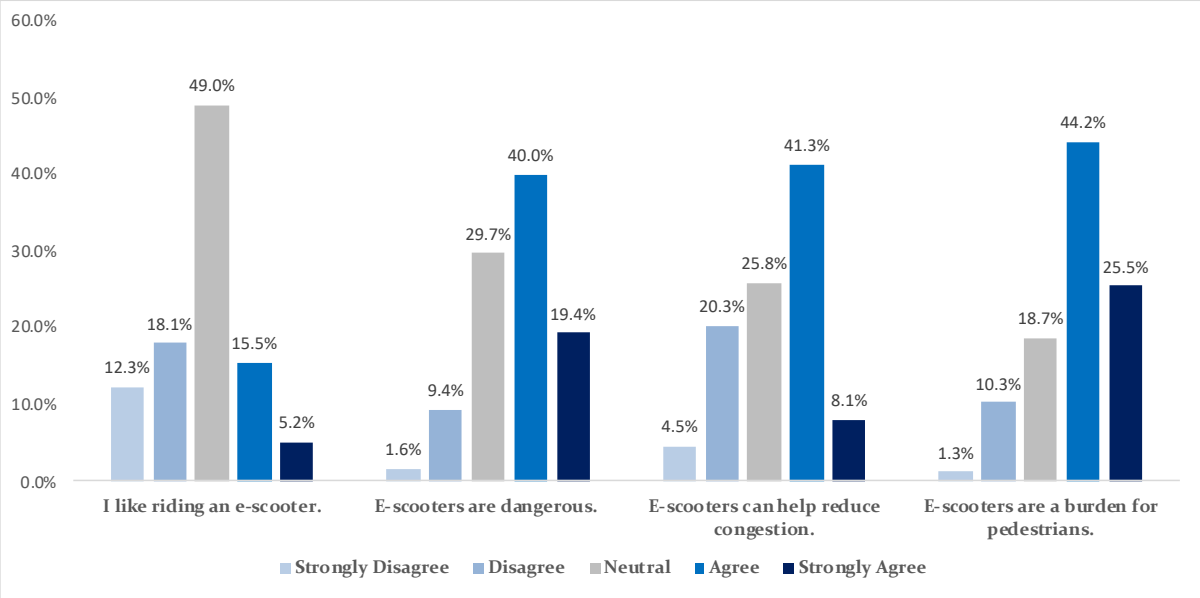
Table 3: Descriptive characteristics of survey respondents (*N*=310)

Variable	Percentage
Female	52.6%
Age group	
21-30	22.6%
31-40	39.0%
41-50	20.0%
>50	18.4%
Current living status	
Single	33.9%
Single parent	1.9%
Living with partner	22.9%
Living with partner and child(ren)	38.1%
Others	3.2%

5.1 Attitudes towards e-scooters

With reference to **Table 4** below which examines attitudes towards e-scooters, respondents were asked to what extent they agreed with statements regarding e-scooters. In summary, 20.7% of respondents liked riding an e-scooter, with the majority (49.0%) were neutral. 59.4% of respondents were of the view that e-scooters were dangerous while only 11.0% disagreed. 49.4% of respondents were of the view that e-scooters could reduce congestion while 24.8% of respondents opposed. Lastly, 69.7% of respondents were of the view that e-scooters were a burden for pedestrians while only 11.6% disagreed.

Table 4: Attitudes towards e-scooters



Next, this study examined if there was a difference in the attitudes towards e-scooters (indicated in **Table 4**) amongst regular users and non-users. With reference to **Table 5**, all respondents who used an e-scooter at least 1-4 times a month indicated they liked riding an e-scooter. Further, Pearson chi-square test indicated that there was a relationship between the level of familiarity with using an e-scooter and positive attitudes towards riding one.

Table 5: Distribution of respondents according to direct experience (familiarity with using an e-scooter) and attitudes towards riding an e-scooter.

	Do you agree with this statement? **I like riding an e-scooter.**				
Direct experience – familiarity with using an e-scooter	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Not at all	38 (16.0%)	55 (23.2%)	121 (51.1%)	17 (7.2%)	6 (2.5%)
Less than once a month	0 (0.0%)	1 (2.3%)	22 (51.2%)	18 (41.9%)	2 (4.7%)
1-4 times a month	0 (0.0%)	0 (0.0%)	6 (37.5%)	7 (43.8%)	3 (18.8%)
1-3 times a week	0 (0.0%)	0 (0.0%)	1 (16.7%)	4 (66.7%)	1 (16.7%)
More than 3 times a week	0 (0.0%)	0 (0.0%)	2 (25.0%)	2 (25.0%)	4 (50.0%)

Note: The Pearson chi-square test indicates that the respondents are not randomly distributed according to their direct experience (familiarity with using an e-scooter) and their attitudes towards riding an e-scooter (Pearson chi-square = 119.776; df = 16, p = 0.000).

64.5% of respondents who have not used an e-scooter in the last 2 years were of the view that e-scooters were dangerous (**Table 4**). As indicated in **Table 6**, the proportion of respondents who held similar perceptions declined as level of usage increased. In addition, Pearson chi-

square test indicates that level of usage has an impact on perceptions towards e-scooters being dangerous. The same trend can be observed regarding perceptions towards e-scooters being a burden for pedestrians, as seen in **Table 7**.

Table 6: Distribution of respondents according to direct experience (familiarity with using an e-scooter) and perceptions of e-scooters being dangerous

	Do you agree with this statement? **E-scooters are dangerous.**				
Direct experience – familiarity with using an e-scooter	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Not at all	4 (1.7%)	17 (7.2%)	63 (26.6%)	98 (41.4%)	55 (23.2%)
Less than once a month	1 (2.3%)	4 (9.3%)	19 (44.2%)	16 (37.2%)	3 (7.0%)
1-4 times a month	0 (0.0%)	2 (12.5%)	8 (50.0%)	6 (37.5%)	0 (0.0%)
1-3 times a week	0 (0.0%)	4 (66.7%)	0 (0.0%)	2 (33.3%)	0 (0.0%)
More than 3 times a week	0 (0.0%)	2 (25.0%)	2 (25.0%)	2 (25.0%)	2 (25.0%)

Note: The Pearson chi-square test indicates that the respondents are not randomly distributed according to their direct experience (familiarity with using an e-scooter) and their perceptions on e-scooters being dangerous (Pearson chi- square = 43.488; df = 16, p = 0.000).

Table 7: Distribution of respondents according to direct experience (familiarity with using an e-scooter) and perceptions of e-scooters being a burden for pedestrians

	Do you agree with this statement? **E-scooters are a burden for pedestrians.**				
Direct experience – familiarity with using an e-scooter	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Not at all	2 (0.8%)	18 (7.6%)	39 (16.5%)	107 (45.1%)	71 (30.0%)
Less than once a month	0 (0.0%)	8 (18.6%)	11 (25.6%)	19 (44.2%)	5 (11.6%)
1-4 times a month	0 (0.0%)	2 (12.5%)	6 (37.5%)	7 (43.8%)	1 (6.3%)
1-3 times a week	1 (16.7%)	3 (50.0%)	0 (0.0%)	2 (33.3%)	0 (0.0%)
More than 3 times a week	1 (12.5%)	1 (12.5%)	2 (25.0%)	2 (25.0%)	2 (25.0%)

Note: The Pearson chi-square test indicates that the respondents are not randomly distributed according to their direct experience (familiarity with using an e-scooter) and perceptions on e-scooters being a burden for pedestrians (Pearson chi- square = 49.608; df = 16, p = 0.000).

41.8% of respondents who had no prior experience using an e-scooter were of the view that that e-scooters could reduce congestion (**Table 4**). As seen in **Table 8**, the proportion of respondents who held similar views broadly increased with the level of experience in using an e-scooter. In addition, Pearson chi-square test indicates that the level of e-scooter usage has an influence on one's perceptions of e-scooters being able to reduce congestion.

Table 8: Distribution of respondents according to direct experience (familiarity with using an e-scooter) and perceptions of e-scooters being able to reduce congestion

	Do you agree with this statement? **E-scooters can reduce congestion**				
Direct experience – familiarity with using an e-scooter	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Not at all	14 (5.9%)	59 (24.9%)	68 (28.7%)	85 (35.9%)	14 (5.9%)
Less than once a month	0 (0.0%)	2 (4.7%)	7 (16.3%)	27 (62.8%)	0 (0.0%)
1-4 times a month	0 (0.0%)	2 (12.5%)	3 (18.8%)	9 (56.3%)	0 (0.0%)
1-3 times a week	0 (0.0%)	0 (0.0%)	0 (0.0%)	5 (83.3%)	0 (0.0%)
More than 3 times a week	0 (0.0%)	0 (0.0%)	2 (25.0%)	2 (25.0%)	0 (0.0%)

Note: The Pearson chi-square test indicates that the respondents are not randomly distributed according to their direct experience (familiarity with using an e-scooter) and their perceptions on e-scooters being able to reduce congestion (Pearson chi- square = 55.291; df = 16, p = 0.000).

With reference to **Table 9** below, there is a relationship between knowing a family member/close friend(s) who owns/owned an e-scooter and the level of usage with one.

Table 9: Distribution of respondents according to subjective norms - e-scooter ownership by family/close friend(s) and direct experience (familiarity with using an e-scooter)

	Direct experience - familiarity with using an e-scooter				
Subjective norms – e-scooter ownership by family/close friend(s)	Not at all	Less than once a month	1-4 times a month	1-3 times a week	More than 3 times a week
None	131 (93.6%)	9 (6.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
1-5	101 (66.9%)	26 (17.2%)	13 (8.6%)	4 (2.6%)	7 (4.6%)
More than 5	5 (26.3%)	8 (42.1%)	3 (15.8%)	2 (10.5%)	1 (5.3%)

Note: The Pearson chi-square test indicates that the respondents are not randomly distributed according to e-scooter ownership by family/close friend(s) and direct experience (familiarity with using an e-scooter) (Pearson chi- square = 62.979; df = 8, p = 0.000).

5.2 Comfort level and perceived safety issues

79.6% of respondents indicated that they felt threatened for their personal safety when walking on footpaths due to e-scooter riders. Amongst these respondents, 83.0% of them have not experienced an incident with an e-scooter rider in the past 2 years. Pearson chi-square test concludes that there is indeed an association between personal negative interaction and attitudes towards feeling threatened for their personal safety.

Table 10: Distribution of respondents according to direct experience - previous personal negative interaction with e-scooter and attitudes towards feeling threatened for their personal safety

	Have you ever felt threatened for your personal safety when walking on footpaths due to e-scooter riders?	
Direct experience-previous personal negative interaction with e-scooter rider	No	Yes
No	62 (26.2%)	205 (86.5%)
Yes	1 (2.3%)	42 (97.7%)

Note: The Pearson chi-square test indicates that the respondents are not randomly distributed according to direct experience - previous personal negative interaction with e-scooter) and attitudes towards feeling threatened for their personal safety (Pearson chi- square = 9.986, df=1, p = 0.002).

Please see **Tables 11** and **12** respectively for a) reasons resulting in respondents feeling threatened; and b) factors that they believed to have contributed to this incident for each party involved.

Table 11: Actions by e-scooter riders that were threatening

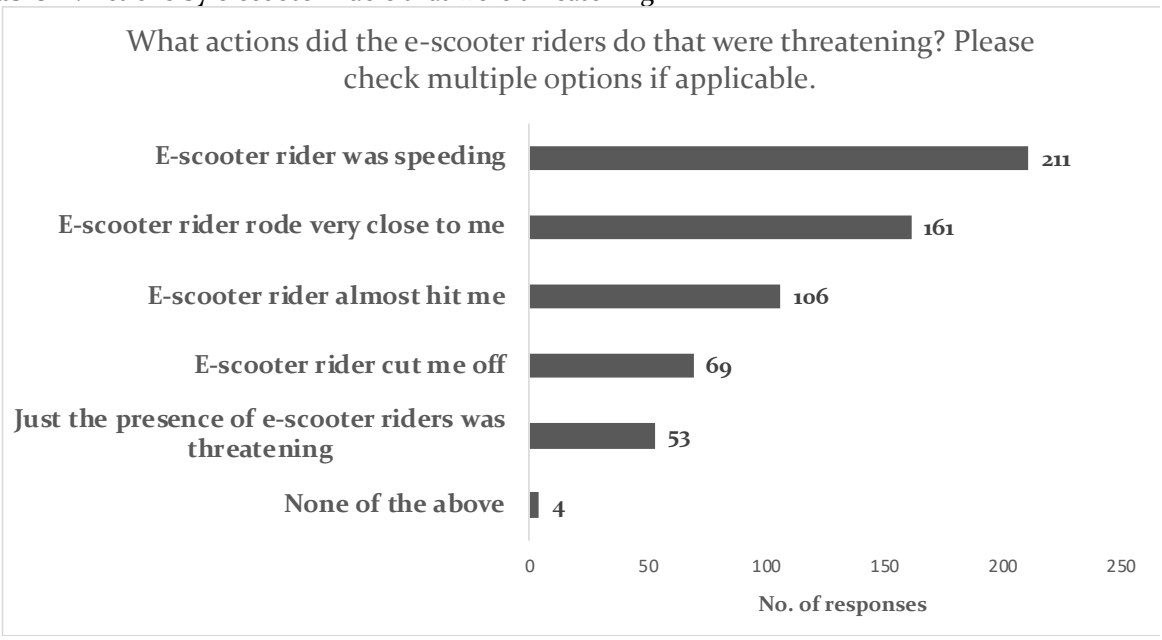
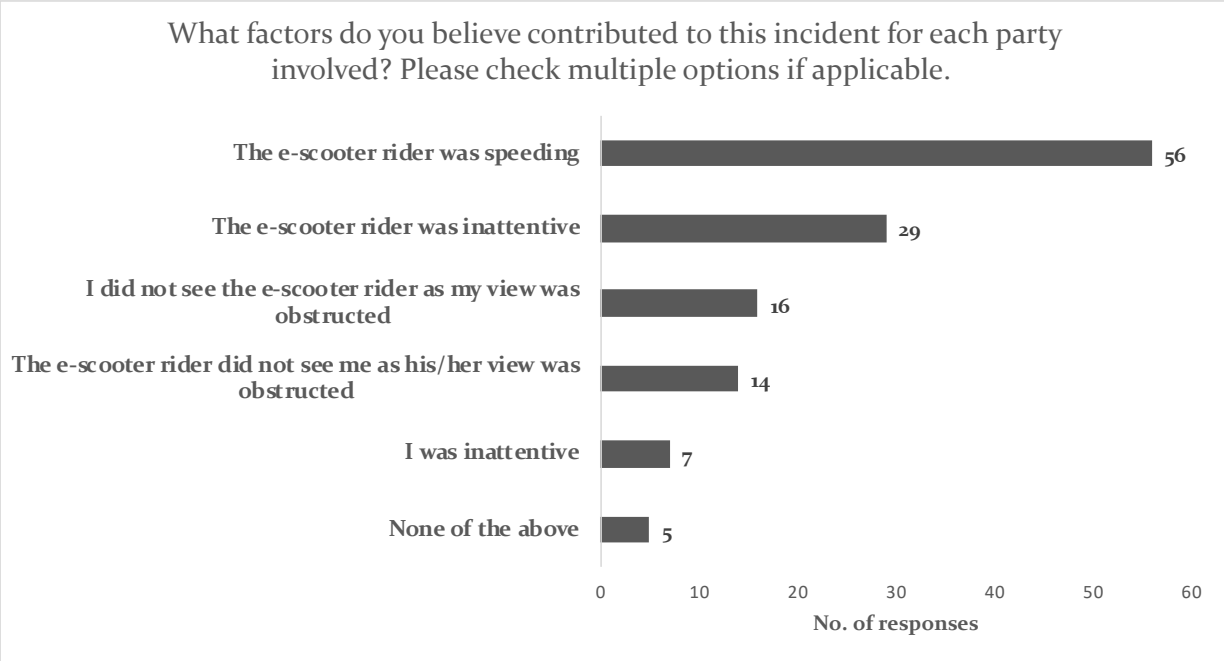


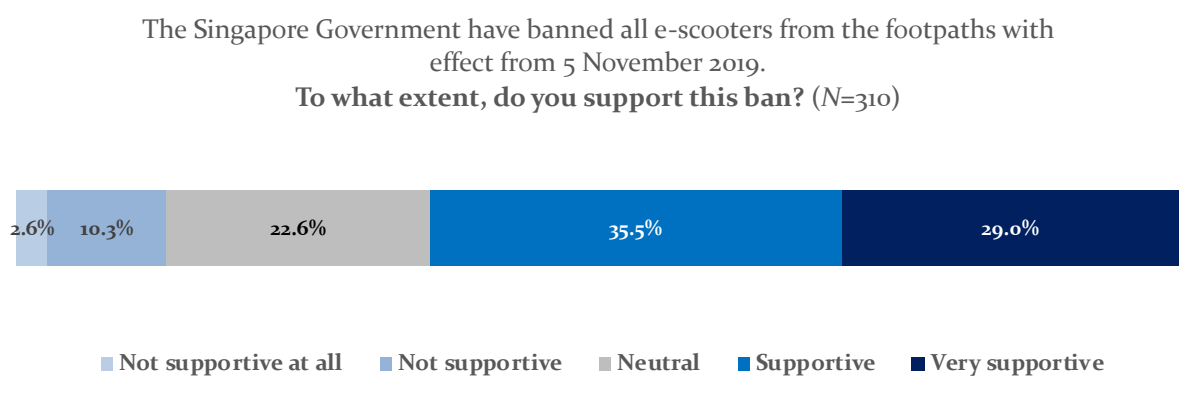
Table 12: Self-reported factors that contributed to the incident



5.3 Attitudes towards ban and predictor variables

Please see **Table 13** below for respondents' attitudes towards the ban.

Table 13: Level of support for the ban



Tables 14.1 – 14.8 show the distribution of respondents according to each predictor variable (shown in **Figure 1**) and the level of support for ban. In summary, only the variables, "current living status" and "subjective norms-family/close friend(s) has a negative incident with e-scooter rider" do not have an effect with the level of support for the ban.

Table 14.1: Distribution of respondents according to gender and level of support for ban

	Support for ban				
Gender					
	Not supportive at all	Not supportive	Neutral	Supportive	Very supportive
Female	4 (2.5%)	12 (7.4%)	46 (28.2%)	61 (37.4%)	40 (24.5%)
Male	4 (2.7%)	20 (13.6%)	24 (16.3%)	49 (33.3%)	50 (34.0%)

Note: The Pearson chi-square test indicates that the respondents are not randomly distributed according to gender and level of support for ban (Pearson chi-square = 10.537, df=4, p = 0.032).

Table 14.2 Distribution of respondents according to age group and level of support for ban

	Support for ban				
Age group					
	Not supportive at all	Not supportive	Neutral	Supportive	Very supportive
21-30	2 (2.9%)	10 (14.3%)	30 (42.9%)	21 (30.0%)	7 (10.0%)
31-40	5 (4.1%)	14 (11.6%)	19 (15.7%)	42 (34.7%)	41 (33.9%)
41-50	1 (1.6%)	5 (8.1%)	11 (17.7%)	25 (40.3%)	20 (32.3%)
>50	0 (0.0%)	3 (5.3%)	10 (17.5%)	22 (38.6%)	22 (38.6%)

Note: The Pearson chi-square test indicates that the respondents are not randomly distributed according to age group and level of support for ban (Pearson chi- square = 35.288, df=12, p = 0.000).

Table 14.3 Distribution of respondents according to current living status and level of support for ban

	Support for ban				
Current living status					
	Not supportive at all	Not supportive	Neutral	Supportive	Very supportive
Single	0 (0.0%)	0 (0.0%)	2 (20.0%)	5 (50.0%)	3 (30.0%)
Single parent	2 (1.9%)	14 (13.3%)	32 (30.5%)	33 (31.4%)	24 (22.9%)
Living with partner	0 (0.0%)	1 (16.7%)	0 (0.0%)	5 (83.3%)	0 (0.0%)
Living with partner and child(ren)	2 (2.8%)	6 (8.5%)	13 (18.3%)	21 (29.6%)	29 (40.8%)
Other	4 (3.4%)	11 (9.3%)	23 (19.5%)	46 (39.0%)	34 (28.8%)

Note: The Pearson chi-square test indicates that the respondents are randomly distributed according to age group and level of support for ban (Pearson chi- square = 21.408, df=16, p = 0.163).

Table 14.4: Distribution of respondents according to direct experience - familiarity with using an e-scooter) and level of support for ban

	Support for ban				
Direct experience - familiarity with using an e-scooter					
	Not supportive at all	Not supportive	Neutral	Supportive	Very supportive
Not at all	3 (1.3%)	19 (8.0%)	49 (20.7%)	85 (35.9%)	81 (34.2%)
Less than once a month	2 (4.7%)	7 (16.3%)	11 (25.6%)	17 (39.5%)	6 (14.0%)
1-4 times a month	1 (6.3%)	2 (12.5%)	5 (31.3%)	6 (37.5%)	2 (12.5%)
1-3 times a week,	0 (0.0%)	2 (33.3%)	3 (50.0%)	1 (16.7%)	0 (0.0%)
More than 3 times a week	2 (25.0%)	2 (25.0%)	2 (25.0%)	1 (12.5%)	1 (12.5%)

Note: The Pearson chi-square test indicates that the respondents are not randomly distributed according to direct experience - familiarity with using an e-scooter and level of support for ban (Pearson chi- square = 41.042, df=16, p = 0.001).

Table 14.5: Distribution of respondents according to direct experience – previous personal negative incident with e-scooter and level of support for ban

	Support for ban				
Direct experience- previous personal negative incident with e-scooter rider					
	Not supportive at all	Not supportive	Neutral	Supportive	Very supportive
No	8 (3.0%)	31 (11.6%)	65 (24.3%)	98 (36.7%)	65 (24.3%)
Yes	0 (0.0%)	1 (2.3%)	5 (11.6%)	12 (27.9%)	25 (58.1%)

Note: The Pearson chi-square test indicates that the respondents are not randomly distributed according to direct experience – previous personal negative incident with e-scooter and level of support for ban (Pearson chi-square = 22.411, df=4, p = 0.000).

Table 14.6: Distribution of respondents according to subjective norms-family/close friends has a negative incident with e-scooter rider and level of support for ban

	Support for ban				
Subjective Norms-Family/close friends has a negative incident with e-scooter rider					
	Not supportive at all	Not supportive	Neutral	Supportive	Very supportive
No	8 (3.2%)	25 (10.0%)	59 (23.7%)	89 (35.7%)	68 (27.3%)
Yes	0 (0.0%)	7 (11.5%)	11 (18.0%)	21 (34.4%)	22 (36.1%)

***Note*:** The Pearson chi-square test indicates that the respondents are randomly distributed according to subjective norms-family/close friend(s) has a negative interaction with e-scooter rider and level of support for ban (Pearson chi-square = 4.071, df=4, p = 0.396).

Table 14.7: Distribution of respondents according to subjective norms - e-scooter ownership by family/close friend(s) and level of support for ban

	Support for ban				
Subjective norms - e-scooter ownership by family/close friend(s)					
	Not supportive at all	Not supportive	Neutral	Supportive	Very supportive
None	1 (0.7%)	13 (9.3%)	23 (16.4%)	50 (35.7%)	53 (37.9%)
1 to 5	6 (4.0%)	15 (9.9%)	40 (26.5%)	56 (37.1%)	34 (22.5%)
More than 5	1 (5.3%)	4 (21.1%)	7 (36.8%)	4 (21.1%)	3 (15.8%)

***Note*:** The Pearson chi-square test indicates that the respondents are not randomly distributed according to subjective norms - e-scooter ownership by family/close friend(s) and level of support for ban (Pearson chi-square = 19.260, df=8, p = 0.014).

Table 14.8: Distribution of respondents according to frequency of exposure to news reports and level of support for ban

	Support for ban				
Media – regular exposure to news reports					
	Not supportive at all	Not supportive	Neutral	Supportive	Very supportive
No	3 (10.0%)	6 (20.0%)	8 (26.7%)	11 (36.7%)	2 (6.7%)
Yes	5 (1.8%)	26 (9.3%)	62 (22.1%)	99 (35.4%)	88 (31.4%)

***Note*:** The Pearson chi-square test indicates that the respondents are not randomly distributed according to frequency of exposure to news reports and level of support for ban (Pearson chi-square = 16.080, df=4, p = 0.003).

5.4 Examining relationship between predictor variable and support for ban via ordinal logistic regression

Upon establishing that only the variables, "current living status" and "subjective norms-family/close friend(s) has a negative incident with e-scooter rider" have no relationship with the level of support for the ban, the remaining six independent variables were preliminarily tested against the level of support for the ban via ordinal logistic regression. However, as observed in **Tables 14.1-14.6**, there were insufficient responses for some of the categories for particular independent variables. Therefore, these independent variables were subsequently dropped from the eventual analysis via ordinal logistic regression and only "Subjective Norms-Family/close friend(s) owned/owns an e-scooter" and "Media" were tested. In addition, the number of categories for the former as well as the dependent variable were reduced by combining adjacent categories. Please see **Figure 2** and **Table 15** for more details.

Figure 2

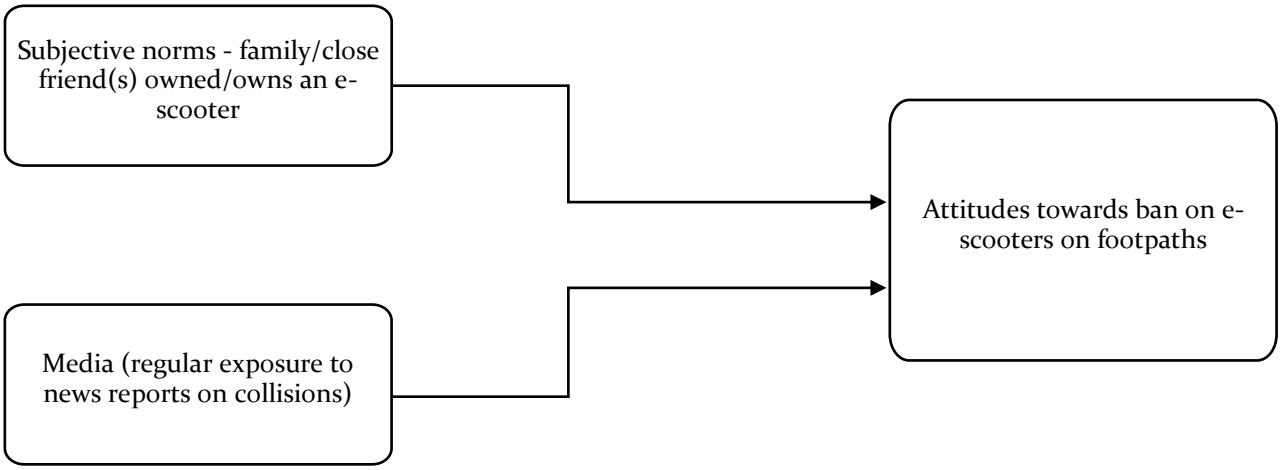


Table 15: Variable Descriptions

Independent Variable	**Descriptions**
Subjective Norms-Family/close friends owned/owns an e-scooter	How many family members/close friends do you know of that owns or previously owned an e- scooter? 0 if None, 1 if 1-5 and/or more than 5
Media	Have you regularly come across/read news reports on collisions between pedestrians and e- scooter riders in the past 2 years? 1 if Yes, 0 if No
Dependent Variable	**Descriptions**
Ban	To what extent do you support this ban?

	1 if Not supportive at all, 1 if Not supportive, 2 if Neutral, 3 if Supportive, 3 if Very Supportive

The results in **Table 16** indicate that not knowing a family/close friend(s) who owns/owned an e-scooter has a significantly positive effect of supporting the ban. Similarly, regularly coming across news reports of collisions has a significantly positive effect of supporting the ban.

Table 16: Results of Ordinal Logistic Regression

	Parameter Estimates		
	Coeff	Std. Error	Sig.
Subjective norms - e-scooter ownership by family/close friend(s)			
None	0.727	0.244	0.003
Yes (at least 1)	0	.	.
Media-regular exposure to news reports on collisions			
No	-1.103	0.365	0.003
Yes	0	.	.

Note: Test of Parallel lines indicate non-significance (p=.588) hence assumption of proportional odds is satisfied

6. Discussion

This chapter will critically reflect on the findings presented in the preceding chapter, Empirical Results in relation to each research objective. This will be done through synthesising the findings with the Literature Review when applicable, as well as discuss possible policy implications/interventions to the built environment needed (in the context of Singapore).

6.1 Attitudes towards e-scooters

The results provide evidence supporting Ajzen (1991)'s Theory of Planned Behaviour and Dill and Voros (2007)'s work where subjective norms and attitudes have an effect on one's behaviour. For instance, as shown in **Table 9**, there is a relationship between "subjective norms-family/close friends owned/owns an e-scooter" and level of usage (of an e-scooter). This corroborates with Dill and Voros (2007)'s finding where the propensity of an individual cycling is likely higher if his/her co-worker(s) cycles as well. In addition, as similarly found by Dill and Voros (2007)'s where having a positive attitude towards cycling has an effect on the propensity of cycling, there appears to be a relationship between usage (of e-scooter) levels and liking (riding) an e-scooter. Lastly, the high proportion of non-users having negative perceptions of e-scooters can perhaps again be explained with Ajzen (1991)'s Theory of Planned Behaviour - negative attitudes towards e-scooters may impact one's propensity to try/use one. Moreover,

considering that e-scooters are relatively a new technology/transport mode, no or limited familiarity with one may result in having greater and pre-conceived safety concerns.

With the exception of "regular" (i.e. those who used an e-scooter more than once per month) e-scooter users' consensus towards the enjoyment of riding an e-scooter, there is no homogeneity amongst them with regards to their attitudes towards the use of e-scooters in other areas. In fact, there is surprisingly muted biasness amongst regular e-scooter riders towards their attitudes on the safety issues pertaining to the use of e-scooters. This perhaps suggests that some of these "regular" users may be captive users who did not have other viable alternatives. It is also plausible that some of the "regular" users may have experienced some extent of cognitive dissonance, and that they perhaps placed higher priority on other factors such as their enjoyment (the physical activity of riding), as well as other factors e.g. the practical convenience of using one due to its higher operating speed (similarly found by Fishman and Cherry (2016); Heinen et al. (2010) regarding motivations behind the use of an e-bike).

In addition, drawing linkages to Sanders (2015)'s suggestion that higher cycling frequency may result in greater awareness of potential traffic dangers, hence reduces the likelihood of being involved in a collision, it is possible that more experienced e-scooter riders may be more adept at using one as well as better able to navigate shared spaces safely (as compared to inexperienced/infrequent users), hence reported lower safety concerns. The next section will discuss the comfort level and perceived safety concerns with regards to the use of e-scooters on footpaths.

6.2 Comfort level and perceived safety issues

The results suggest that respondents who reported that they have personally experienced a negative incident with an e-scooter would likely feel threatened for their personal safety. This seems intuitive as a previous negative incident may result in one being more aware of the safety risks posed by e-scooters. Still, 86.5% of individuals who have not experienced a negative incident with an e-scooter reported that they too felt threatened for the personal safety. This suggests that such attitudes may be attributed to particular intimidating behaviours (of e-scooter riders) although they have not led to an incident.

On that note, "speeding" followed by "riding very close to me" were the two commonly-cited actions that caused discomfort among respondents. While the former is a contravention of the law, the latter is not. In addition, while the latter behaviour may be due to aggressiveness or

lack of graciousness, it could also be a result of the width constraints of the path. Drawing linkages to Jacob and Schreyer (1980)'s theory of recreational conflict which argues that (asymmetrical) goal interference is a key source of conflict, the "intimidating" behaviours indicated in **Table 11** may thus be a source of conflict between pedestrians between e-scooter users even in the absence of a collision. This suggests that transforming public sentiment on e-scooters may require public education as well as interventions to the built environment (e.g. widening of specific paths to enhance a sense of safety and comfort) to minimise instances of the abovementioned behaviours, beyond enforcing on illegal riding behaviours such as speeding.

Speeding was the most commonly-cited factor when respondents were asked to self-assess on the factors that they believed to have contributed to the incident for each party involved. Inferring from a study by Nielsen, T., Palmatier, S. M. and Proffitt. A. (2019), setting speed limits and dedicating resources to enforce them can probably reduce the speed differential between pedestrians and e-scooters, but this could have the unintended effect of shifting the focus (of e-scooter riders) to complying with the speed limit rather than other risky behaviour as well. This is especially problematic given that inattentiveness of e-scooter rider was the second most commonly-cited reason for causing an incident. This suggests that the recently announced ban on the use of mobile phones while riding an e-scooter (Toh, 2020) is a step in the right direction. In addition, a small minority of respondents self-assessed that a lack of attention on their part may have contributed to the incident. Given that minimising safety risks is a shared responsibility between pedestrians and other device users, the above finding lends support to the need for the newly introduced code of conduct for pedestrians to encourage pedestrians to stay alert of their environment and refrain from using their mobile devices when using the paths.

6.3 Attitudes towards ban and predictor variables

64.5% of respondents were in favour of the ban on the use of e-scooters on footpaths. Comparing this result with a 2015 survey conducted by LTA which found that 66% (LTA, 2016) of individuals were not willing to share footpaths with electric/motorised micro-mobility devices, there appears to be little change in public opinion (after five years) with regards to sharing of spaces with these devices. This perhaps suggests that negative attitudes towards e-scooters remain probably due to persisting low comfort levels and safety concerns despite a slew of regulations and measures introduced to enhance safety levels.

Gender

In contrast to Kang and Fricker (2016)'s finding that males were more likely to be willing and open to sharing paths with bicycles as compared to females (and suggested that it could be the larger frame of males), a higher proportion of male respondents (67.3%) were supportive to very supportive of the ban as compared to females (61.9%). Considering that there is only a very small difference between the proportion of males (78.2%) and females (81.0%) who indicated they felt threatened for their personal safety, the differences in level of support may possibly be due to lower tolerance (towards e-scooters) amongst males.

Age

Age was found to have an effect on the level of support for the ban. This resonates with Bernhoft and Carstensen (2008)'s study which found that significantly more seniors (aged 70 years and above), as compared to younger respondents, perceived sharing paths as dangerous in the presence of other cyclists. Older pedestrians may feel more vulnerable to the risks of falls (due to collisions or near-misses) and hence may be more in favour for the ban. Respondents in the 21-30 age group were the most divided with regards to their attitudes towards the ban, despite the overwhelming majority of respondents (74%) in this age group who indicated that they felt threatened for their personal safety when using footpaths. This perhaps suggests that some respondents in this age group may not necessarily agree with the introduction of the ban despite having safety concerns. This can probably be due to a hybrid of reasons (such as perceiving the ban as being too draconian, empathy for individuals who depend on e-scooters for their livelihood etc.), although these are not investigated under the scope of this study.

Current living status

There was little difference in proportion of respondents in favour of the ban amongst respondents who were living with dependents. However, this proportion is comparatively lower for respondents who were single where only 54% were in favour of the ban. However, this study found that there was no relationship between current living status and level of support for the ban and hence one is unable to conclude that married individuals, as compared to singles, are likely less tolerant of sharing spaces with other device users (as found by Kang and Fricker (2016)).

Familiarity/prior experience

This study found that level of prior experience has an effect on the level of support for the ban. If one was to proxy favour of the ban as a lack of tolerance on the use of e-scooters on footpaths, the above findings suggest that the lack of tolerance is perhaps particularly pronounced amongst individuals who have no prior experience using an e-scooter as compared to those who have. One may thus draw linkages to social value conflict model, where there may be a lack of shared values particularly between pedestrians who have not used an e-scooter before and e-scooter riders. On the other hand, regular users may naturally have less support for the ban as it is not in their interests to do so, and especially if they are captive users.

Previous personal negative incident

Table 10 shows that there is an association between having a previous personal negative incident (with an e-scooter rider) and feeling threatened for one's personal safety. This, coupled with the finding that the former similarly has an effect on the level of support for ban, suggests that having previously experienced a negative incident may result in one having strong safety concerns and hence more likely to be in favour of the ban. This corroborates with Gkekas, Bigazzi and Gill (2020)'s study which found that respondents who have experienced at least one instance of a near collision with a cyclist reported higher safety concerns.

Subjective norms - negative incident experienced by family/close friend(s)

The results show that a negative incident experienced by family/close friend(s) has no effect on the level of support for the ban. In addition, an individual is likely to support the ban even in the absence of a negative incident experienced by a family/close friend(s). This can perhaps be due to the existence of negative attitudes and safety concerns towards e-scooters already personally held by the individual (which may be in part due to other variables such as experiencing a negative incident personally). Regarding the 29.5% of respondents who were neutral/or not in favour in of the ban but who knew of family/close friend(s) who was involved in an incident, it could be that the incidents did not result in major injuries which may have otherwise possibly influenced one's tolerance towards e-scooters. This is probable given a study by a local hospital on e-scooter-related injuries which found that only 2.8% of 213 patients treated (from 2017 to 2019) were pedestrians (Kok, 2019).

Subjective norms – ownership of e-scooter by family/close friend(s)

Having family/close friend(s) who owns/owned an e-scooter has an effect on the level of support for the ban. Drawing linkages to Ajzen (1991)'s theory of planned behaviour, perceived subjective norms especially pertaining to the attitudes of family and close friends may hence influence one's perceptions towards the usefulness of e-scooters, which inevitably will be curtailed with the introduction of the ban. In addition, in relation to Jacob and Schreyer (1980), having family/close friends who own e-scooters may result in a non-user to less likely attach stereotypical social labels to e-scooter riders and hence have a greater tolerance towards diverse lifestyles. Lastly, a non-user may also more likely and better able to empathise with users regarding the impact of a ban due to the influence of family/close friends.

Media

The results from the ordinal logistic regression test show that individuals who regularly came across news reports of collisions between pedestrians and e-scooters were more likely to support the ban. This resonates with McCluskey et al. (2016)'s finding on the influence of media on perceptions towards new technologies as well as the possibility of such news reports further heightening (safety) fears with regards to these technologies. A high-profile case (in 2016) of an elderly pedestrian who landed in in coma due to a collision with an e-scooter rider prompted calls for tougher measures against errant e-scooter riders. Moreover, considering that news reports on collisions involving e-scooters seem to generate more public and online discussion as compared to those involving motor vehicles (although the latter have higher accident and fatality rates), this may plausibly be attributed to the public having become more "desensitised" with the latter as compared to e-scooters. Further, there may be an underlying public sentiment that more needs to be done to safeguard the safety of pedestrians. This, perhaps further fuelled by a perception that e-scooters are not essential, could have triggered discussion in the public sphere, and correspondingly resulting in more frequent media coverage.

7. Conclusion

This chapter will summarise the findings as well as cover recommendations, the value this research study has brought to knowledge, limitations to the research as well as potential areas for future research.

7.1 Summary and recommendations

The overall aim of this research is to advance an understanding on the perceptions and attitudes towards the use of micro e-scooters in Singapore to support transport policy design. In summary, this study found that majority of respondents were of the view that e-scooters were dangerous and a burden to pedestrians. In addition, the level of experience/familiarity with the use of these devices has an effect on one's perceptions towards e-scooters. Speeding was the most common "threatening" behaviour shared amongst respondents. Speeding was similarly the top-cited reason when respondents were asked to self-assess on the factors that they believed to have contributed to an incident they had personally experienced. In addition, 64.5% of respondents indicated they were supportive to very supportive of the ban. With the exception of "current living status" and "ownership of e-scooter by family/close friend(s), all other personal characteristics and other factors (such as the influence of media) that were tested were found to have an effect on the level of support for the ban.

Based on the above findings, this study suggests the following recommendations. Firstly, it is clear from the study that majority of respondents have negative attitudes and perceptions towards the safety risks posed by the use of e-scooters. As some of these perceptions likely stem from perceived intimidating behaviour by riders, the government in Singapore may therefore need to regulate these behaviours and/or embark on public education efforts to improve comfort and perceived safety levels for pedestrians. Another probable way to achieve the above is to minimise conflict between competing users by introducing segregated paths. Secondly, to mitigate the risk of accidents, certain design interventions to the built environment (e.g. installation of mirrors at blind-spots, paths markings reminding pedestrians/users to "stop and look" at high-risk spots) are important too and should be considered as part of a comprehensive approach to enhance safety, beyond strict enforcement on reckless and illegal riding behaviour. Further, in view of the influence of media on public opinion, there is hence an urgent need to embark on the above measures. Lastly, one key insight from this study was that familiarity with using an e-scooter has an effect on one's attitudes to the use of such devices. Therefore, if the government's objective is to promote social acceptance on the use of micro-mobility devices,

introduction of an e-scooter sharing system may allow broader and greater access to one, and hence provides the opportunity to transform public perception on the use of such devices.

7.2 Contribution to knowledge

This research has contributed significantly to new knowledge. Firstly, this is the one of the first studies in Singapore (to the author's best knowledge) that has examined the underlying attitudes/perceptions towards e-scooters as well as explore the relationship of personal characteristic and other factors with the above attitudes, beyond studying the willingness of pedestrians to share paths with other micro-mobility devices. Further, the findings (including the synthesis with the Literature Review) and recommendations have enabled a better understanding on the conflict between pedestrians and micro-mobility device users in sharing spaces and thus the insights can contribute to subsequent transport policy considerations regarding the future use of micro e-scooters in Singapore. Moreover, considering that conflict studies between pedestrians and micro-mobility device users remains relatively under-researched, this study has contributed significantly to the foundation of this research field whereby subsequent future research can build on.

7.3 Limitations and further research

This research has provided an exploratory analysis in establishing if there is a relationship between particular variables (such as personal characteristics) and their attitudes towards e-scooters. Further research can thus be carried out for a greater in-depth investigation on the above-mentioned relationship(s). In addition, in relation to Happer and Philoa (2013)'s finding that the influence by media on one's perceptions can be negated to a certain degree by one's direct experience and familiarity with the issue, this study has not examined the possible interactions between these two variables and their effects on attitudes and perceived safety concerns regarding e-scooters, which can be further studied. Also, further research can build on the findings of this study to examine if there are differences in attitudes towards e-scooters of different forms and sizes as some may appear more intimidating than others despite performing specifications e.g. speed. This would be useful in informing future policy decisions on regulating the type/model of devices allowed, which may also be important in the event the government is considering to introduce e-scooter sharing.

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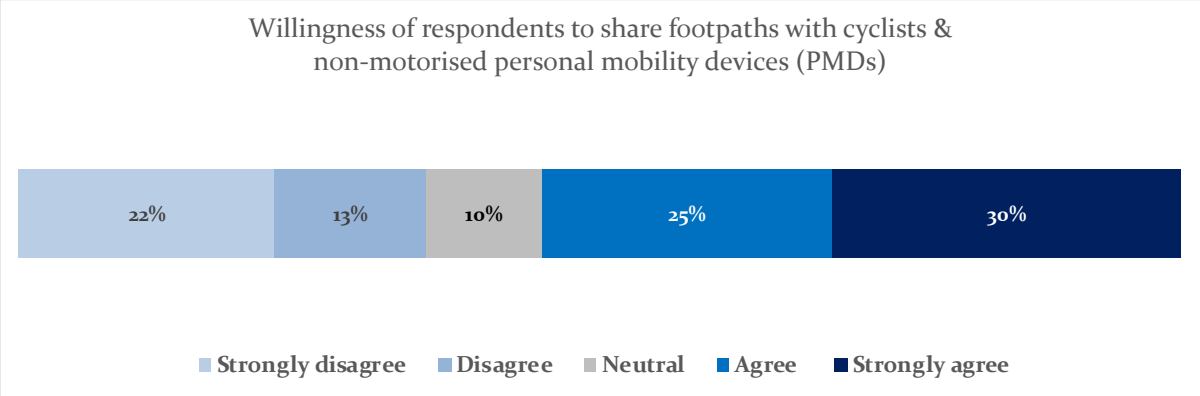
ANNEX A

Key findings from public consultation survey by Land Transport Authority (2015)

Figure 3: Willingness of respondents to share footpaths with cyclists and non-motorised personal mobility devices (PMDs)



Note: Personal mobility devices refer to electric scooters, electric unicycles and electric hoverboards, kick-scooters.

Figure 4: Willingness of respondents to share footpaths with e-bikes and motorised PMDs

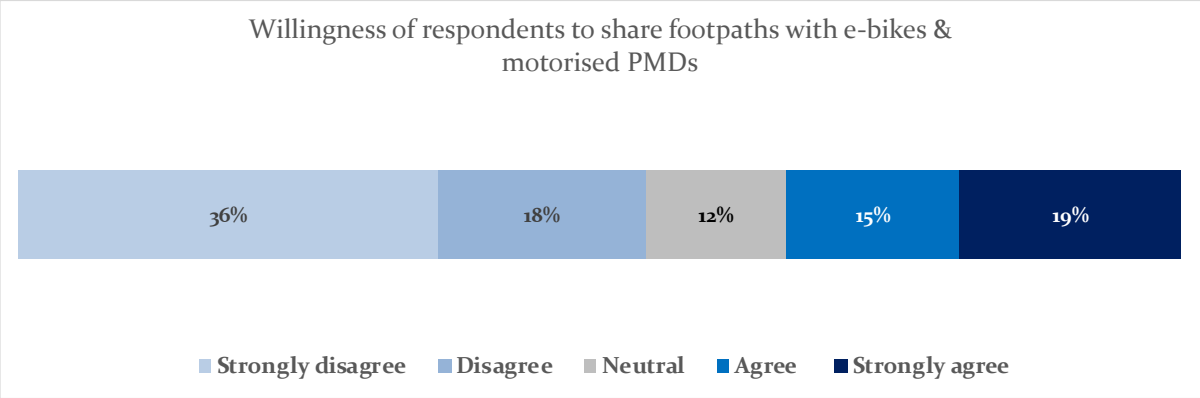
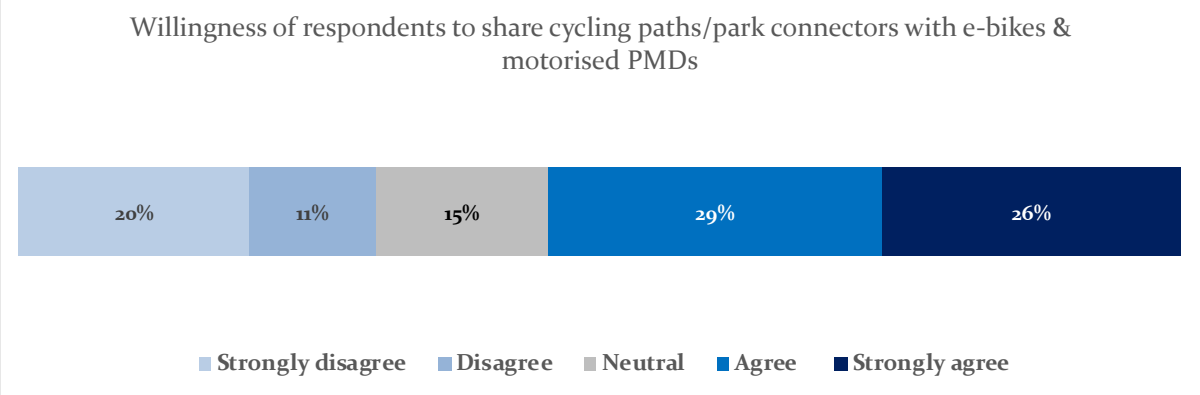


Figure 5: Willingness of respondents to share cycling paths/park connectors with e-bikes and motorised PMDs



ANNEX B

SURVEY FOR STUDENT'S DISSERTATION
UNIVERSITY OF COLLEGE LONDON (UCL)

Q1	**Please indicate your gender.** ▭ Male ▭ Female
Q2	**Please indicate your age group.** ▭ 21 – 30 ▭ 31-40 ▭ 41-50 ▭ 51 and above
Q3	**Please indicate your current status.** ▭ Single ▭ Single Parent ▭ Living with partner ▭ Living with partner and child(ren) ▭ Other
Q4	Do you agree with this statement? **I like riding an e-scooter.** ▭ Strongly Agree ▭ Agree ▭ Neutral ▭ Disagree ▭ Strongly Disagree **E-scooters are dangerous.** ▭ Strongly Agree ▭ Agree ▭ Neutral ▭ Disagree ▭ Strongly Disagree **E-scooters can help reduce congestion.** ▭ Strongly Agree ▭ Agree ▭ Neutral. ▭ Disagree. ▭ Strongly Disagree **E-scooters are a burden for pedestrians.** ▭ Strongly Agree ▭ Agree ▭ Neutral ▭ Disagree ▭ Strongly Disagree
Q5	**How often have you used an e-scooter in the past two years on average?** ▭ Not at all ▭ Less than once a month ▭ 1-4 times a month ▭ 1-3 times a week ▭ More than 3 times a week
Q6	**How many family members/close friends do you know of that owns or previously owned an e-scooter?** ▭ None ▭ 1-5 ▭ More than 5
Q7	**Have you regularly come across/read news reports on collisions between pedestrians and e-scooter riders in the past 2 years?** ▭ YES ▭ NO
Q8	**Have you ever felt threatened for your personal safety when walking on footpaths due to e-scooter riders?** ▭ YES ▭ NO
Q9	If you have answered **NO** to Qn **8,** please skip to Qn **10**.

	What actions did the e-scooter riders did that were threatening? Please check **multiple** options if applicable. **a. E-scooter rider rode very close to me** ☐ **b. E-scooter rider was speeding** ☐ **c. E-scooter rider almost hit me** ☐ **d. E-scooter rider cut me off** ☐ **e. Just the presence of e-scooter riders was threatening** ☐ **f. None of the above** ☐
Q10	**Have you experienced any incident* with an e-scooter rider in the past 2 years?** *Incident is defined as when someone "fell to avoid contact, caused someone to fall, or made contact with a pedestrian, or non-moving permanent object (e.g., structure, ground)"* ☐ YES ☐ NO
Q11	If you have answered **NO** to Qn **10**, please skip to Qn **12**. **What factors do you believe contributed to this incident for each party involved?"** Please check **multiple** options if applicable. **a. I was inattentive** ☐ **b. The e-scooter rider was inattentive** ☐ **c. The e-scooter rider was speeding** ☐ **d. I did not see the e-scooter rider as my view was obstructed** ☐ **e. The e-scooter rider did not see me as his/her view was obstructed** ☐ **f. The e-scooter rider failed to yield the right of way** ☐ **g. None of the above** ☐
Q12	**Do you know of a family member/close friend that have experienced any incident* with an e-scooter rider in the past 2 years?** *Incident is defined as when someone "fell to avoid contact, caused someone to fall, or made contact with a pedestrian, or non-moving permanent object (e.g., structure, ground)"* ☐ YES ☐ NO
Q13	**The Singapore Government have banned all e-scooters from the footpaths with effect from 5 November 2019. To what extent do you support this ban?** ☐ Not supportive at all ☐ Not supportive ☐ Neutral ☐ Supportive ☐ Very Supportive

RISK ASSESSMENT FORM
FIELD / LOCATION WORK

The Approved Code of Practice - Management of Fieldwork should be referred to when completing this form
http://www.ucl.ac.uk/estates/safetynet/guidance/fieldwork/acop.pdf

DEPARTMENT/SECTION
LOCATION(S)
PERSONS COVERED BY THE RISK ASSESSMENT

BRIEF DESCRIPTION OF FIELDWORK

No fieldwork is required. Primary data collection will solely be done via online survey.

Consider, in turn, each hazard (white on black). If **NO** hazard exists select **NO** and move to next hazard section.
If a hazard does exist select **YES** and assess the risks that could arise from that hazard in the risk assessment box.
Where risks are identified that are not adequately controlled they must be brought to the attention of your Departmental Management who should put temporary control measures in place or stop the work. Detail such risks in the final section.

ENVIRONMENT	**The environment always represents a safety hazard. Use space below to identify and assess any risks associated with this hazard**
e.g. location, climate, terrain, neighbourhood, in outside organizations, pollution, animals.	Examples of risk: adverse weather, illness, hypothermia, assault, getting lost. Is the risk high / medium / low ? There will be no interaction with the environment as data collection will solely be done via online survey.

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
	work abroad incorporates Foreign Office advice
	participants have been trained and given all necessary information
	only accredited centres are used for rural field work
	participants will wear appropriate clothing and footwear for the specified environment
	trained leaders accompany the trip
	refuge is available
	work in outside organisations is subject to their having satisfactory H&S procedures in place

	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

EMERGENCIES	**Where emergencies may arise use space below to identify and assess any risks**
e.g. fire, accidents	Examples of risk: loss of property, loss of life

There will be no risk of emergencies as data collection will solely be done via online survey.

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
	participants have registered with LOCATE at http://www.fco.gov.uk/en/travel-and-living-abroad/
	fire fighting equipment is carried on the trip and participants know how to use it
	contact numbers for emergency services are known to all participants
	participants have means of contacting emergency services
	participants have been trained and given all necessary information
	a plan for rescue has been formulated, all parties understand the procedure
	the plan for rescue /emergency has a reciprocal element
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

EQUIPMENT	**Is equipment used?**	**NO**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. clothing, outboard motors.	Examples of risk: inappropriate, failure, insufficient training to use or repair, injury. Is the risk high / medium / low ?		

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
	the departmental written Arrangement for equipment is followed
	participants have been provided with any necessary equipment appropriate for the work
	all equipment has been inspected, before issue, by a competent person
	all users have been advised of correct use
	special equipment is only issued to persons trained in its use by a competent person
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

LONE WORKING	Is lone working a possibility?	YES	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. alone or in isolation *lone interviews.*	Examples of risk: difficult to summon help. Is the risk high / medium / low?		

There is no risk as data collection will solely be done via online survey.

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
	the departmental written Arrangement for lone/out of hours working for field work is followed
	lone or isolated working is not allowed
	location, route and expected time of return of lone workers is logged daily before work commences
	all workers have the means of raising an alarm in the event of an emergency, e.g. phone, flare, whistle
	all workers are fully familiar with emergency procedures
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

ILL HEALTH	The possibility of ill health always represents a safety hazard. Use space below to identify and assess any risks associated with this Hazard.
e.g. accident, illness, personal attack, special personal considerations or vulnerabilities.	Examples of risk: injury, asthma, allergies. Is the risk high / medium / low? There is no risk as data collection will solely be done via online survey.

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
	an appropriate number of trained first-aiders and first aid kits are present on the field trip
	all participants have had the necessary inoculations/ carry appropriate prophylactics
	participants have been advised of the physical demands of the trip and are deemed to be physically suited
	participants have been adequate advice on harmful plants, animals and substances they may encounter
	participants who require medication have advised the leader of this and carry sufficient medication for their needs
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

TRANSPORT	Will transport be required	NO	X	Move to next hazard
		YES		Use space below to identify and assess any risks
e.g. hired vehicles	Examples of risk: accidents arising from lack of maintenance, suitability or training Is the risk high / medium / low?			

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
	only public transport will be used
	the vehicle will be hired from a reputable supplier
	transport must be properly maintained in compliance with relevant national regulations
	drivers comply with UCL Policy on Drivers http://www.ucl.ac.uk/hr/docs/college_drivers.php
	drivers have been trained and hold the appropriate licence
	there will be more than one driver to prevent driver/operator fatigue, and there will be adequate rest periods
	sufficient spare parts carried to meet foreseeable emergencies
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

DEALING WITH THE PUBLIC	Will people be dealing with public	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. interviews, observing	Examples of risk: personal attack, causing offence, being misinterpreted. Is the risk high / medium / low?		

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
	all participants are trained in interviewing techniques
	interviews are contracted out to a third party
	advice and support from local groups has been sought
	participants do not wear clothes that might cause offence or attract unwanted attention
	interviews are conducted at neutral locations or where neither party could be at risk
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

WORKING ON OR NEAR WATER	Will people work on or near water?	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. rivers, marshland, sea.	Examples of risk: drowning, malaria, hepatitis A, parasites. Is the risk high / medium / low?		

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
	lone working on or near water will not be allowed
	coastguard information is understood; all work takes place outside those times when tides could prove a threat
	all participants are competent swimmers
	participants always wear adequate protective equipment, e.g. buoyancy aids, wellingtons
	boat is operated by a competent person

	all boats are equipped with an alternative means of propulsion e.g. oars
	participants have received any appropriate inoculations
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

MANUAL HANDLING (MH)	**Do MH activities take place?**	**NO**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. lifting, carrying, moving large or heavy equipment, physical unsuitability for the task.	Examples of risk: strain, cuts, broken bones. Is the risk high / medium / low?		

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
	the departmental written Arrangement for MH is followed
	the supervisor has attended a MH risk assessment course
	all tasks are within reasonable limits, persons physically unsuited to the MH task are prohibited from such activities
	all persons performing MH tasks are adequately trained
	equipment components will be assembled on site
	any MH task outside the competence of staff will be done by contractors
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

SUBSTANCES	**Will participants work with substances**	**NO**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. plants, chemical, biohazard, waste	Examples of risk: ill health - poisoning, infection, illness, burns, cuts. Is the risk high / medium / low?		
CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**		

	the departmental written Arrangements for dealing with hazardous substances and waste are followed
	all participants are given information, training and protective equipment for hazardous substances they may encounter
	participants who have allergies have advised the leader of this and carry sufficient medication for their needs
	waste is disposed of in a responsible manner
	suitable containers are provided for hazardous waste
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

OTHER HAZARDS	**Have you identified any other hazards?**	**NO**	**If 'No' move to next section** **If 'Yes' use space below to identify and assess any risks**
i.e. any other hazards must be noted and assessed here.	Hazard: Risk: is the risk		
CONTROL MEASURES	**Give details of control measures in place to control the identified risks**		

Have you identified any risks that are not adequately controlled?	**NO**	**X**	**Move to Declaration**
	YES		**Use space below to identify the risk and what action was taken**

Is this project subject to the UCL requirements on the ethics of Non-NHS Human Research? **NO**

If yes, please state your Project ID Number

For more information, please refer to: http://ethics.grad.ucl.ac.uk/

DECLARATION

The work will be reassessed whenever there is a significant change and at least annually. Those participating in the work have read the assessment.

Select the appropriate statement:

☐ I the undersigned have assessed the activity and associated risks and declare that there is no significant residual risk

☐ I the undersigned have assessed the activity and associated risks and declare that the risk will be controlled by the method(s) listed above

NAME OF SUPERVISOR
Dr. Jonas De Vos

FIELDWORK 5 May 2010