[LOG 11] LET'S BIKE! THE FACTORS THAT INFLUENCE URBAN CYCLING

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ABSTRACT

Transportation is one of the major carbon-footprint contributors towards country. These emissions are generated from automobiles on traffic, especially during congestion. In Malaysia, traffic congestion remains an issue, especially in developing regions, Penang and Kuala Lumpur which results in massive delays, fuel wastage, monetary losses and environmental pollution. In order to deter these issues, a sustainable transport mode should be promoted which is bicycle. The present study intends to look into the relationship between infrastructural factors and cycling intention. Availability, route planning and accessibility, are the predictor variables and user intention is the criterion variable. The Ajzen's Theory of Planned Behaviour (TPB), will be the underpinning theory in order to understand the intention from the road users. Judgmental sampling method were used and 400 usable data were collected from Penang population through self-administered questionnaire. The findings reveal that relationship between Availability of Public Bike (APB), Route Planning (RP) and Accessibility of cycling-transit integration (ACT) are positively correlated with user's intention to cycle (CCB), and APB was found to have a strongest relationship with user's intention to cycle (CCB) in this study.

Keywords: *bicycling, intention, bicycle infrastructures, Theory of Planned Behaviour, sustainable transport*

INTRODUCTION

Transportation brings significant effects towards our daily activities, despite, it is commonly being view negatively. Transportation is the largest end who contribute towards environment pollution such as global warming towards country (Boye, & Arcand, 2012). Generally, these emissions are generated from the automobiles on traffic, especially during congestion (Zhang, Batterman, & Dion, 2011; Maitra, Sadhukhan, 2013). There is a serious need to reduce the numbers of vehicles on traffic, for the purpose of congestion free and green environment. A general consensus indicating the 'right' urban design would most probably stimulate the use of public transport, resulting in a reduction of cars on traffic (Susilo, Williams, Lindsay, & Dair, 2012). In the world where environmental sustainability, congestion and physical inactivity are significant concerns, cycling present itself as a tenable approach to address these issues.

Investment has been made for the purpose of promoting cycling culture in Penang Island, Malaysia, such as the Bike on Fridays (BoF), however the connection of bicycle network seems to be disjointed which becomes a deterrent on cycling intention (Christopher, 2016). Few notable studies have been conducted on cycling infrastructure and cycling intention (Pucher, Dill, & Handy 2010; Heinen, Maat, & van Wee, 2013; Ariffin, 2016). Findings of these studies have reported that cycling infrastructures are crucial determinants towards cycling intention. Further, most of the research usually focusing on the relationship between behavioural aspect (attitudes, social norms, weather conditions) and cycling intention (Willis, Manaugh, & El-Geneidy, 2013; Lois, Moriano, & Rondinella, 2015; Milkovic, & Stambuk, 2015). Despite, considering both of these aspect, there is limited research conducted in Malaysia context.

Hence, this study intends to look into the relationship between the infrastructural factor and cycling intention in Malaysia. The present study contributes to the research on infrastructural factors and cycling intention in both knowledge and practical aspect. By studying the infrastructural factors in local context, the findings of this study will further reassure whether the infrastructural factors that established from past researches can be generalize in Malaysia. While majority of studies are conducted in western context, little is known on the effects of infrastructural factors on the eastern culture such as Malaysia. The results of this study will enable the city planner in Malaysia to identify the strength and weaknesses of the present infrastructures provided to the users, and make further necessary improvement in order to increase the intention to cycle as well as towards a more sustainable transport system in Malaysia.

LITERATURE REVIEW

Intention

According to Schröder, Stewart and Thagard (2014), intentions have now been concern with a more practical questions, to understand how intention affects people's behaviour in practices such as healthy nutrition and commuting choices. Despite there are numerous debates on what is intentions, however in a broadly speaking, it can be conceived where in some way the mental state linked to phenomena such as decision, desire, and belief (Thinnes-ElkerI'z, Iljll'la, Apostolides, & Kraemers, 2012). The intention can be considered as intentional and unintentional. Intentional intention can be defined as intended to do things on purpose or rationally whereby unintentional intention are not purposely or unaware (Miltenburg, 2011).

Theory Planned Behaviour (TPB) is one the most successful theories that is being used to understand human behaviour (Milakis, 2015). Recently, researchers have been applying TPB in the field transportation, particularly for cycle use (Eriksson. & Forward, 2011; Kaplan, Manca, Nielsen, & Prato, 2015; Fernández-Heredia, Jara-Díaz, & Monzón, 2016). The main concept of this theory is the intention that represent if a person would perform a particular behaviour, how many efforts he or she is willing to invest (Milković, & Štambuk, 2015). Following that, intention is basically being shaped by 3 factors: attitude, subjective norm, and perceived behavioural control (PBC) (Fraser et al., 2010). Among the 3 factors, the present research tends to focus more on PBC instead the other 2 factors, where the questionnaire questions are also designed based on PBC. PBC refers to the perceived ease or difficulty of performing specific behaviour, reflecting past experience, as well as anticipating an obstacle which an individual is

expect to overcome in order to perform that behaviour (de Souza, Sanches, & Ferreira, 2014).

Cycling intention has been intensively discussed in past studies, subject in the area of transportation, health, as well as pro-environmental aspects (Lafaye, & Hill, 2011; Eriksson, et al., 2011; Randal, 2013; Fernández-Heredia, et al., 2016). According to Milković et al., (2015) Ajzen's theory of planned behaviour (TPB) is the most favourable theories applied to predict the cycling intentions. There is significant empirical support indicating TPB are appropriate to predict the cycling intentions. Research has shown that 85% of the variance in intention to use environmental friendly modes of transport is explained by TPB components (subjective norm, attitudes and perceived behavioural control) (Milković et al., 2015).

Perceived behavioural control (PBC) in the case of cycling may refer to the present of obstacles that being considered as barriers in the option of selecting bicycle as a mode of transport (de Souza et al., 2014). According to Kaplan (2015), an easy access to cycle and availability constraints are associated with cycling intentions. For instance, we could assume that if there is a possibility to rent a bicycle, as well as if it provides ease and is feasible to cycle, an individual would tend to choose cycle as an option to commute. Past studies have shown that availability and accessibility of the infrastructures has a positive effect on users' intention (Vogel, & Mattfeld, 2010; Chen, & Chao, 2011; Chen et al., 2013; Hazen, Overstreet, & Wang, 2015; Kabra, Belavina, & Girotra, 2015). Meta-analysis of 185 studies also showed that components of TPB, particularly perceived behavioural control shows the strongest relationship with behavioural intention (r= 0.43) (Milković et al., 2015). Similarly, according to Eriksson et al., (2011) PBC was found associated with cycling, whereas attitude and social norm have been found associated in other work rather than cycling.

In addition, cycling has been proved that contributes towards a green environment, a more sustainable transports mode and ease of traffic congestion (Buehler, & Pucher, 2011; Buehler, 2012; Poulos et al., 2012). Further, a research conducted in Klang Valley, Malaysia has shown that the availability of public transport system as well as non-motorized mode of transport around neighbourhood, would increase the use of the services (Khoo, & Ong, 2015). Hence, the present study will focus on how the infrastructural factors affects the cycling intention in East-Asia region specifically Malaysia.

Availability of public bike

Public bike is becoming more popular (Shaheen et al., 2014) and recently emerged in major cities over the world rapidly (Vogela, Greisera, & Mattfeld, 2011). Bike share began in Europe since 1965 (Runde Sache, 2011) and now it is available in 50 countries with 712 cities, and operating approximately 806,200 bicycles at 37,500 stations at June 2014 (Shaheen & Guzman, 2011). Currently, the top 3 countries with the most systems in term of quantity are Spain 132, Italy 104, and China 79 (Shaheen & Guzman, 2011). However, according to James (2010), public bike system been criticized as less convenient than privately owned bicycle due to the number of places for bicycle to rent or return was limited.

Bicycle is being one of the sustainable transport options where it can reduce the reliability on motorized vehicle especially in short distance travel (Larson, &

Sasanuma, 2010). Pucher and Buehler (2012), express in their new book *City Cycling*, that using public bike or bike share are able to overcome the challenges such as car dependence, population health issues, liveability, traffic congestion, and oil dependence as well as to addressing climate change. Further, according to (Fishman et al., 2015), public bike or bicycle share provides users a flexible mobility, financial savings, emission reductions, reduced congestion and fuel use, health benefits, support for multimodal transport connection and acting as 'last mile' that connecting to public transport.

The role of public bike or bike sharing system not only increases the mobility choices, but also improved air quality and most important is to reduce congestion (Midgley, 2011). Beside, public bike or bike sharing system also prevent from the inconvenience of bike ownership, the need to find parking lot, as well as the worry about theft and vandalism, and maintenance requirement (Shaheen, Susan, Guzman, Zhang, 2010). Moreover, the user also able to take a bike from one hub and drop it off at another facilitates one-way trip and the combination of other mode of transport to complete their journey.

Moreover, Vogel and Mattfeld (2010), claims that bike availability is a crucial factor in encouraging people for the use public bike or bike sharing system. Bike availability is then further being discuss by Kabra, Belavina and Girotra (2015), as the likelihood of finding a bike at the station or the ease to access to the bike. The availability of bike is closely related to user satisfaction, as it would affect the decision to cycle. The findings of the research have suggested that the proportion of actively commuting was decreased mainly because of the decreases of bike use over the time (Grize et al., 2010). Moreover, Kabra et al., (2015) has also express their bike availability that closely to the concept of operation management's service level. Hence, the bike availability is the probability of successful bike rental (Vogel et al., 2011). According to Vogel and Mattfeld (2011), ensuring high bike availability is crucial in encouraging people to choose bike sharing system or public bike as an option to commute. Thus, it also can be said the high level of availability of public bike or the ease of access to the system, can influences the user's perception of barriers for cycling (de Souza, Sanches & Ferreira, 2014).

Route planning for urban cycling

In additional, route planning seems to be common in logistics context which generally being defined as planning for the best route for cost effective and efficient distribution which route planning needs to be able to quickly respond to any of the events occurred (Murray, 2016). Referring to Jiang (2014), route optimization is crucial which it could significantly increases productivity and efficiency, at the same time reducing costs. Past studies on route planning were usually focusing on algorithms or mathematical calculation, for calculating ideal logistics routes or networks (Bast et al., 2015; Romero et al., 2012; Sayarshad, Tavassoli, & Zhao 2012; Souffriau et al., 2011). However, the present study aims to seek whether route planning is one of the criteria that affect cycling intention. Based on the study of Shin (2016), a sample about 1000 cyclists has been conducted based on two cities in Netherlands and Sweden which are Groningen and Vajxo respectively, had shown that among several criteria, distance is the most important criteria affecting cycling route option.

In the study of Ransdell, Manson, Wuerzer and Leung (2013) also claims that every 1-mile increase in distance, the likelihood of biking regularly for transportation will

decreased by 0.26 times. Further, findings from the study of van Holle et al., (2012) indicates cycling for transport is positively associated with land use mix, street connectivity, and access to destinations as well as evidence showing the relationship between cycling for recreational and cycling infrastructure. Cyclists have a high preference for bicycle facilities, adding facilities such as bicycle lanes actually increases the likelihood of cycling (Mesbah, M., Thompson, R., & Moridpour, S., 2012). Referring to the study of Larsen, J. and El-Geneidy, A. (2011), claims that the likelihood to use bicycle facilities are different between recreational cyclists, regular and frequent cyclists by taking into consideration with several route characteristics, however the results had raise crucial issue, which is the importance of bicycle facility location and design for transportation planner.

Past studies have also shown that built environment such as dedicated cycle path actually influence cycling rates. The environmental factors such as the density of bike lanes are positively correlated with bicycle commute in US study (Fraser, S. D. S., & Lock, K., 2011). In addition, findings on Australia respondents have also shown that the accessibility to bicycle path as well as the facilities along road were positively associated with cycling for transport (Titze, Giles-Corti, Knuiman, Pikora, Timperio, Bull & Van Niel 2010). Hence, a comprehensive system of separated bicycle lanes or paths, providing cyclist reserved right of way, would probably be the most visible commitment for people to cycle (Fishman, Washington & Haworth, 2012).

Accessibility to public transit

In the logistics industry accessibility is an important location factor which accessibility translates to lower transportation costs and shorter time to markets (Limao, 2001). Litman (2011) indicated that if transportation is evaluated based on accessibility then it would need to take into consider about rideshare, roadway, public transit, as well as the improved walking and cycling conditions. According to Owen and Levinson (2015), accessibility combines the simple concept of mobility with an understanding that travel is driven by a desire to reach destination. The concept of accessibility is then further being used to evaluate the impact of land-use and transport strategies which is ‘catering for mobility’ towards ‘catering for accessibility’ in urban planning and policy making (Bertolini, Clercq & Kapoen, 2005; Condeço, Gutiérrez & García 2011; Omer, 2006).

Further, Bocarejo and Oviedo (2012) stated that the development and evaluation of accessibility policy is significantly related to urban structure, transport system quality, individual characteristics and purchasing power. This shows that the functions of accessibility play an important role in distribution activities, ability and desire of users to overcome the spatial separation between activities (Puello & Geurs, 2015). Hence, accessibility is essentially crucial for economic development as it enables the movement of people and goods to support the functioning of the economy (Ford, Barr, Dawson & James, 2015). Litman (2015) suggests that transit services mainly to provide basic mobility for non-drivers. Rahul and Verma (2014) stated that cycling has the limit distance for the residents ride on it. In order to facilitate cycle–transit coordination, installing bicycle infrastructures at the front of transit buses or allowing bicycles to be brought on board rail cars, might be the alternatives that enlarge the public transit catchment areas (Flamm, Sutula & Meenar, 2014). Based on (Meng, Koh, Wong & Zhong 2014) stated that the social benefits of cycling such as equity of road uses, greater accessibility to facilities would eventually encourage more people to choose cycling as an option.

Based on Tilahun and Fan (2014) the industries near transit accessible locations may help to access gap that can be created when clusters are promoted without regional multimodal accessibility in mind. Mingardo (2013), suggests that the more the park and ride of bicycle provided, residents might be more likely to use bike. A great cycling system has to link directly to the hierarchy of the road network (Ribeiro, Neiva & Lemos, 2014). Ribeiro et al. (2014) also indicates that cycling network is referring to the compatibility between existing traffic characteristics and the implementation of a bicycle infrastructure. The strategies to promote cycling can be grouped into the categories of travel-related infrastructure, end-of-trip facilities, transit integration, promotional and other programs, bicycle access, and regulations (Pucher, Dill & Handy 2010). Cycling facilities must be available in order to assure any form of inter-modality. Hunt and Abraham (2007) reviewed the influences factors on cycling, where cycling facility and the roadway type were found to be significant on the cyclist travel preference. Lastly, Tilahun and Fan (2014) claims that the industries near transit accessible locations may help to access gap that can be created when clusters are promoted without regional multimodal accessibility in mind.

METHODOLOGY

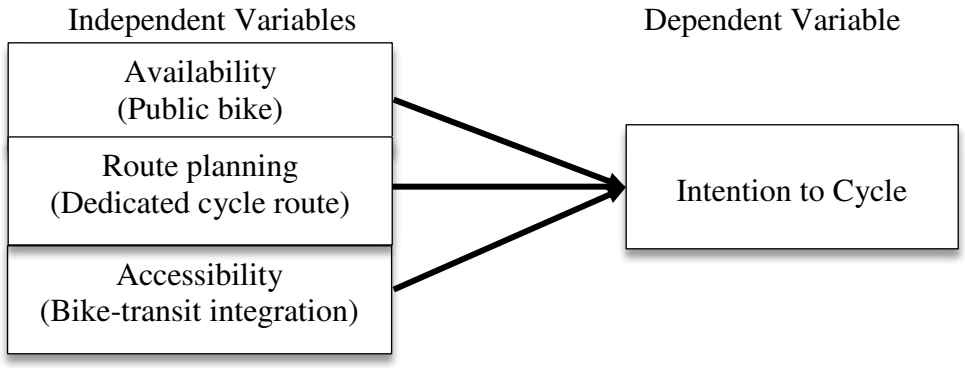

Figure 1
Research framework of user's intention

Research hypothesis

H_1a: There is a relationship between availability of public bike and user's intention to cycle.

H_1b: There is a relationship between route planning in urban cycling and user's intention to cycle.

H_1c: There is a relationship between accessibility to public transit and user's intention to cycle.

Research design

The current research is conducted based on non-contrived setting where events occur in nature, do not involve the manipulation of respondents experiences. A correlation study to determine the relationship between predictor variables (availability, route planning, accessibility) and the criterion variable (intention to cycle). Quantitative approach is used to conduct the present study. The unit of analysis in this study will based on individual as the data is collected from individual residents in Penang. Present

research will base on cross-sectional study which also known as one shot studies due to time constraints.

Sampling and data collection method

The sample size in the present study is 400 Penang residents based on (Krejcie and Morgan 1970)'s formula. A judgmental sampling method was applied in this study due to present study mainly focus on Penang's residents. Further, findings of the survey show that 42.5% of them are male and 57.5% are female. The proportion of ownership of private vehicle shows 53.8% and 46.3% with having and not owning private vehicles respectively. As well as, findings show that 38.8% of respondents own a bicycle and 61.3% doesn't. Data were obtained from Penang residents through structured questionnaire. An online questionnaire is being administered via e-mail to collect respondent opinion as well as printed questionnaire that is distributed by researchers to Penang residents.

Measurement scale

The construction of the questionnaire is adapted from past studies (Hazen, Overstreet, & Wang, 2015; Shin, 2016; Krizek & Stonebraker, 2011; Ransdell, Mason, Wuerzer, & Leung, 2013; Cheng, & Liu, 2012; Akar, & Clifton, 2009). Respondent were asked to use a 7-point Likert-type scale to indicate the extent to which they will intended to cycle if the infrastructures are well provided. Response choice alternatives ranged from 1 (strongly disagree) to 7 (strongly agree).

Data analysis

Reliability test was assessed in the study to indicates the extent which it is error free and hence ensuring the consistent measurement across time and various items in the instrument. A higher Cronbach's alpha value would represent a high internal consistency reliability. Pearson correlation will be used in present study to test the strength of the relationship between the predictor variables (availability, route planning, accessibility) and criterion variables (cycling intention). Lastly, a multiple regression analysis is being executed for the purpose to conclude whether there is significant relationship between the predictor variables and criterion variables.

RESULTS

Table 1

Correlations between construct and scale reliability values

Variable	Number of Item	Mean	SD	APB	RP	ACT	CCB
APB	7	5.893	0.620	(0.844)	-	-	-
RP	6	6.075	0.658	0.734**	(0.857)	-	-
ACT	4	5.872	0.696	0.530**	0.535**	(0.817)	-
CCB	3	6.114	0.751	0.345**	0.340**	0.295**	(0.810)

**. Correlation is significant at the 0.01 level (2-tailed).

Table 2
Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.382	0.146	0.140	0.69668

a. Dependent Variable: MeanCCB
b. Predictors: (Constant), MeanAPB, MeanRP, MeanACT

Table 3
ANOVA table

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	32.918	3	10.973	22.608	0.000[b]
	Residual	192.201	396	0.485		
	Total	225.120	399			

a. Dependent Variable: MeanCCB
b. Predictors: (Constant), MeanAPB, MeanRP, MeanACT

Table 4
Coefficient table

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	T	Sig.
1	(Constant)	3.076	0.371		8.292	0.000
	MeanAPB	0.207	0.085	0.171	2.426	0.016
	MeanRP	0.169	0.081	0.147	2.088	0.037
	MeanACT	0.136	0.061	0.126	2.222	0.027

a. Dependent Variable: MeanCCB

DISCUSSION

The results of the present study were analysed by using Statistical Package for the Social Sciences (SPSS). The present study has conducted a descriptive analysis as well as identifying whether the demographics data are normally distributed, results show all the data are normal distributed. Further, the study is also tested with Chi-Square (X^2) tests, where the findings have shown that there is no major difference between nominal data which is demographics. All the variables in this study show a reliability value (Cronbach's Alpha) that is greater than 0.7 which indicates that all the variables could be confidently used in this study (Sekaran & Bougie, 2013; Nunnally, & Bernstein, 1994). In another words, all items measuring the respective construct achieve a minimum threshold reliability value of 0.7 suggesting that all the items used in the questionnaire has good internal consistency.

The present research objective is to determine the relationship between availability (APB), route planning (RP), accessibility (ACT) and user's intention to cycle (CCB). The correlations between constructs and scale reliability values are presented in *Table 1*. Findings from *Table 1* indicates that all the predictors variables are significantly correlated with cycling intention (availability $r = 0.345$, route planning $r = 0.340$, accessibility $r = 0.295$, all $ps < 0.05$). The strongest correlation was found between availability (APB) and cycling intention (CCB). The result from this correlation test

preliminary support the alternative hypothesis that the variables have a significant relationship with user's intention to cycle. Findings have shown consistent to the previous study indicating bike availability (Vogel, & Mattfeld, 2010; Schlote, Chen, Sinn, & Shorten, 2013), route planning (Winter, Teschke, Grant, Setton, & Brauer, 2010; Fraser et al., 2010) and accessibility (Krizek et al., 2011; Cheng, & Liu, 2012) are significant predictors towards the use of public bike. A multiple regression analysis was conducted to test the extent to which the infrastructural factors influence user's cycling intention. The findings of the regression analysis for the current study hypothesis was statistically significant, $R^2 = 0.146$, Adjusted $R^2 = 0.140$, $F(3,396) = 22.608$, $p < 0.05$) which means that 14% of the variance in user's cycling intention is explained by the predictors variables (APB, RP, ACT). The hypothesis of current study predicted that availability (H_1a), route planning (H_1b), accessibility (H_1c) is related to cycling intention.

Further, based on Table 3, results show that the regression model was statistically significant ($R^2 = 0.146$ $F(3,396) = 22.608$, $p < 0.05$). By referring to *Table 4*, availability (APB) was positively related to user's intention to cycle (CCB) ($\beta = 0.171$, $p < 0.05$) indicating where the higher the availability of public bike, the higher the user's intention to cycle (CCB). Route planning (RP) ($\beta = 0.147$, $p < 0.05$) was positively related to CCB, which suggest that the higher the level of efficiency of the route planning, the higher the user's intention to cycle. Finally, accessibility (ACT) ($\beta = 0.126$, $p < 0.05$) was positively related to CCB, showing that the higher the level of accessibility, the higher the user's intention to cycle. The above findings support the alternative hypothesis H_1a, H_1b, H_1c. Hence, the findings of present study suggest that users will more likely to commute by bike, if there is a quality and comprehensive cycling infrastructures.

RECOMMENDATIONS AND CONCLUSION

Outcome of this study indicate that the infrastructure factors (availability, route planning, accessibility) are positively associated with cycling intention in which the weak positive significant relationship between independent variable and dependent variable has shown. The weak positive significant relationship that happened might due to some limitations in such as human norms, attitude, environmental factor, and more are excluded to be variables in this study. Besides, the item that excluded during questionnaire development for the purpose of minimizing respondent burden, as well as the absence of mediating and moderating factors such as service quality or, user's attitude, might also be the factors causing the weak relationship in correlation analysis. Therefore, future research is encouraged to apply mediating factor as well as study other possible variable items in order to get a stronger relationship.

Further, most of the infrastructures are not yet widely implemented in Malaysia, where respondent's view and thought would be different. Thus, future research is advised to have a brief about the title to ensure their respondent have a basic understanding towards the questionnaire. The present study has been focusing on a single geographical location which is in Penang, however the results might not generalize well to other states in Malaysia or overseas countries. There is different perception towards intention to bike in different places. Therefore, future research is recommended to use stratified sampling method which enable researcher to get a better generalizability for their study.

As a conclusion, the result in this research is useful for government, urban planner and society to reach the green environment and green logistic concept by acknowledging the influence of infrastructure factors towards cycling intention. Government can promote the concept of cycling by improving the safety of the bike user and applied regulation that the bike lane is dedicated for bicycle used only. For example, dedicated bike lane is only for bicycling but not included motorcycling used. Urban planner also can promote the cycling culture by having a well plan of dedicated route for cyclist in order to provide them a more efficient transportation mode and ensuring the facility for bike user to assess to public transport is comprehensive.

Meanwhile, availability of public bike shown the strongest positive relationship in this study which suggesting society like education institution, non-government organization can raise the road user's intention to cycling by enhance the awareness to use public bike in a mature manner. Along with the initiative, it can significantly reduce the possibility of public bike been stolen and remain the availability of the public bike and further promoting the cycling culture. Therefore, the improvement of cycling infrastructures stimulates user's intention to cycle, especially in a safe, convenience, and efficient way. Word of mouth might be another alternative to increase the awareness of cycling via society, sharing to their friend and family about their knowledge toward cycling. Users having positive cycling experience will give a positive feedback and result in a positive image for cycling which can also further promote cycling culture. In short, hopefully this study can be a guide or citation for future research about cycling intention, and to become a reliable resource for the urban planning especially in the planning of infrastructure for bicycle in order to achieve a green environment and green logistic as well as green transportation.

REFERENCES

Ajzen, I. (2011). The theory of planned behaviour: Reactions and reflections. *Psychology & Health*, *26*(9).

Akar, G., & Clifton, K. (2009). Influence of individual perceptions and bicycle infrastructure on decision to bike. *Transportation Research Record: Journal of the Transportation Research Board*, 2140, 165-172.

Ariffin, N. F. M. (2016). Analyzing the Factors Impact on Social-Behavioral Aspects of Cyclists in UPM Serdang Campus toward Promoting Green Transportation system. *Research Journal of Fisheries and Hydrobiology*, *11*(3), 74-81.

Bast, H., Delling, D., Goldberg, A., Müller-Hannemann, M., Pajor, T., Sanders, P., & Werneck, R. F. (2015). Route Planning in Transportation Networks. *Microsoft Research Technical Report*, 1–65. Retrieved from http://research.microsoft.com/apps/pubs/default.aspx?id=207102\nhttp://arxiv.org/abs/1504.05140.

Bertolini, L., le Clercq, F., & Kapoen, L. (2005). Sustainable accessibility: A conceptual framework to integrate transport and land use plan-making. Two

test-applications in the Netherlands and a reflection on the way forward. *Transport Policy*, *12*(3), 207-220. http://doi.org/10.1016/j.tranpol.2005.01.006

Bocarejo S., J. P., & Oviedo H., D. R. (2012). Transport accessibility and social inequities: a tool for identification of mobility needs and evaluation of transport investments. *Journal of Transport Geography*, *24*, 142–154. http://doi.org/10.1016/j.jtrangeo.2011.12.004.

Boye, J., & Arcand, Y. (2012). Green Technologies in Food Production and Processing (Google eBook), 704. http://doi.org/10.1007/978-1-4614-1587-9.

Buehler, R. (2012). Determinants of bicycle commuting in the Washington, DC region: The role of bicycle parking, cyclist showers, and free car parking at work. *Transportation research part D: transport and environment*, *17*(7), 525-531.

Buehler, R., & Pucher, J. (2011). Sustainable transport in Freiburg: lessons from Germany's environmental capital. *International Journal of Sustainable Transportation*, *5*(1), 43-70.

Buehler, R., & Pucher, J. (2012). Cycling to work in 90 large American cities: new evidence on the role of bike paths and lanes. *Transportation*, *39*(2), 409-432.

Chen, B., Pinelli, F., Sinn, M., Botea, A., & Calabrese, F. (2013). Bicycles and parking lots I T', (Itsc).

Chen, C. F., & Chao, W. H. (2011). Habitual or reasoned? Using the theory of planned behavior, technology acceptance model, and habit to examine switching intentions toward public transit. *Transportation Research Part F: Traffic Psychology and Behaviour*, *14*(2), 128–137. http://doi.org/10.1016/j.trf.2010.11.006.

Cheng, Y. H., & Liu, K. C. (2012). Evaluating bicycle-transit users' perceptions of intermodal inconvenience. *Transportation Research Part A: Policy and Practice*, *46*(10), 1690–1706. http://doi.org/10.1016/j.tra.2012.10.013.

Christopher, T. (2016). Create more bike lanes, please. Retrieved 25 August, 2016, from http://www.thestar.com.my/metro/community/2016/04/05/create-more-bike-lanes- please-club-move-will-encourage-people-to-cycle-to-work/.

Condeço-Melhorado, A., Gutiérrez, J., & García-Palomares, J. C. (2011). Spatial impacts of road pricing: Accessibility, regional spillovers and territorial cohesion. *Transportation Research Part A: Policy and Practice*, *45*(3), 185–203. http://doi.org/10.1016/j.tra.2010.12.003.

de Souza, A. A., Sanches, S. P., & Ferreira, M. A. (2014). Influence of attitudes with respect to cycling on the perception of existing barriers for using this mode of transport for commuting. *Procedia-Social and Behavioral Sciences*, *162*, 111-120.

Eriksson, L., & Forward, S. E. (2011). Is the intention to travel in a pro-environmental manner and the intention to use the car determined by different factors?

Transportation Research Part D: Transport and Environment, *16*(5), 372–376. http://doi.org/10.1016/j.trd.2011.02.003.

Fernández-Heredia, Á., Jara-Díaz, S., & Monzón, A. (2016). Modelling bicycle use intention: the role of perceptions. *Transportation*, *43*(1), 1–23. http://doi.org/10.1007/s11116-014-9559-9.

Fishman, E., Washington, S., & Haworth, N. (2012). Understanding the fear of bicycle riding in Australia. *Journal of the Australasian College of Road Safety*, *23*, 19-27. Retrieved from http://eprints.qut.edu.au/53981/.

Fishman, E., Washington, S., Haworth, N., & Watson, A. (2015). Factors influencing bike share membership: An analysis of Melbourne and Brisbane. *Transportation Research Part A: Policy and Practice*, *71*, 17-30.

Flamm, B. J., Sutula, K. M., & Meenar, M. R. (2014). Changes in access to public transportation for cycle-transit users in response to service reductions. *Transport Policy*, *35*, 154-161. http://doi.org/10.1016/j.tranpol.2014.05.013.

Ford, A., Barr, S., Dawson, R., & James, P. (2015). Transport Accessibility Analysis Using GIS: Assessing Sustainable Transport in London. *ISPRS International Journal of Geo-Information*, *4*(1), 124-149. http://doi.org/10.3390/ijgi4010124.

Fraser, R. T., Johnson, K., Hebert, J., Ajzen, I., Copeland, J., Brown, P., & Chan, F. (2010). Understanding Employeers' Hiring Intentions in Relation to Qualified Workers with Disabilties: Preliminary Findings. *Journal of Occupation Rehabilitation*, *20*(4), 420–426. http://doi.org/10.1007/s10926-009-9220-1.

Fraser, S. D. S., & Lock, K. (2011). Cycling for transport and public health: A systematic review of the effect of the environment on cycling. *European Journal of Public Health*, *21*(6), 738–743. http://doi.org/10.1093/eurpub/ckq145.

Grize, L., Bringolf-Isler, B., Martin, E., & Braun-Fahrländer, C. (2010). Trend in active transportation to school among Swiss school children and its associated factors: three cross-sectional surveys 1994, 2000 and 2005. *International Journal of Behavioral Nutrition and Physical Activity*, *7*(1), 1.

Hazen, B. T., Overstreet, R. E., & Wang, Y. (2015). Predicting public bicycle adoption using the technology acceptance model. *Sustainability (Switzerland)*, *7*(11), 14558–14573. http://doi.org/10.3390/su71114558.

Heinen, E., Maat, K., & van Wee, B. (2013). The effect of work-related factors on the bicycle commute mode choice in the Netherlands.*Transportation*, *40*(1), 23-43.

Hunt, J. D., & Abraham, J. E. (2007). Influences on bicycle use. *Transportation*, *34*(4), 453–470. http://doi.org/10.1007/s11116-006-9109-1.

James, M. (2010). 'Cycling Proficiency with James May, The Daily Telegraph, 2010. London: Telegraph.co.uk.

Jiang, T. (2014). The Ins and Outs of Route Optimization. Retrieved 20 October, 2016 from https://www.geotab.com/blog/ins-outs-route-optimization/.

Kabra, A., Belavina, E., & Girotra, K. (2015). Bike-Share Systems: Accessibility and Availability. *INSEAD Working Papers Collection*, (8), 1–35. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=101536004&lang=es&site=ehost-live.

Kabra, A., Belavina, E., & Girotra, K. (2015). Bike-share systems: Accessibility and availability. *Chicago Booth Research Paper*, (15-04).

Kaplan, S., Manca, F., Nielsen, T. A. S., & Prato, C. G. (2015). Intentions to use bike-sharing for holiday cycling: An application of the Theory of Planned Behavior. *Tourism Management*, *47*, 34–46. http://doi.org/10.1016/j.tourman.2014.08.017.

Khoo, H. L., & Ong, G. P. (2015). Understanding sustainable transport acceptance behavior: A case study of Klang valley, Malaysia. *International Journal of Sustainable Transportation*, *9*(3), 227-239.

Krejcie, R. V. & Morgan, D. W. (1970). Determining Sample Size for Research Activities. *Educational and Psychological Measurement, 30*, 607-610.

Krizek, K. J., & Stonebraker, E. W. (2011). Assessing Options to Enhance Bicycle and Transit Integration. *Transportation Research Record: Journal of the Transportation Research Board*, *2217*(1), 162–167. http://doi.org/10.3141/2217-20.

Lafaye, H., & Hill, E. (2011). Recreate Your Commute: An application of the Theory of Planned Behavior on Cycling as Transportation.

Larsen, J., & El-Geneidy, A. (2011). A travel behavior analysis of urban cycling facilities in Montreal, Canada. *Transportation Research Part D: Transport and Environment*, *16*(2), 172–177. http://doi.org/10.1016/j.trd.2010.07.011.

Larson, R. C., & Sasanuma, K. (2010). Urban vehicle congestion pricing: a review. *Journal of Industrial and Systems Engineering*, *3*(4), 227-242.

Limão, N. (2001). Infrastructure, Geographical Disadvantage and Transport Costs and Trade. *The World Bank Economic Review*, *15*(3), 451–479. http://doi.org/10.1093/wber/15.3.451.

Litman, T. (2011). *Evaluating public transit benefits and costs: Best practices guidebook*. Victoria Transport Policy Institute.

Litman, T. (2015). Evaluating Accessibility for Transportation Planning Measuring People's Ability to Reach Desired Goods and Activities, (January 2015), 57.

Lois, D., Moriano, J. A., & Rondinella, G. (2015). Cycle commuting intention: A model based on theory of planned behaviour and social identity. *Transportation Research Part F: Traffic Psychology and Behaviour*, *32*, 101–113.

Maitra, B., & Sadhukhan, S. (2013). Urban Public Transportation System in the Context of Climate Change Mitigation: Emerging Issues and Research Needs in India. In *Mitigating Climate Change* (pp. 75-91). Springer Berlin Heidelberg.

Meng, M., Koh, P. P., Wong, Y. D., & Zhong, Y. H. (2014). Influences of urban characteristics on cycling: Experiences of four cities. *Sustainable Cities and Society*, *13*, 78–88. http://doi.org/10.1016/j.scs.2014.05.001.

Mesbah, M., Thompson, R., & Moridpour, S. (2012). Bilevel optimization approach to design of network of bike lanes. *Transportation Research Record: Journal of the Transportation Research Board*, 2284, 21–28. http://doi.org/10.3141/2284-03.

Midgley, P. (2011). Bicycle-sharing schemes: enhancing sustainable mobility in urban areas. *United Nations, Department of Economic and Social Affairs*, 1-12.

Milakis, D. (2015). Will Greeks Cycle? Exploring Intention and Attitudes in the Case of the New Bicycle Network of Patras. *International Journal of Sustainable Transportation*, *9*(5), 321-334.

Milkovic, M., & Stambuk, M. (2015). To bike or not to bike? Application of the theory of planned behavior in predicting bicycle commuting among students in Zagreb. *Psychological Topics*, *24*(2), 187.

Miltenburg, N. V. (2011). Knowing and Doing.

Mingardo, G. (2013). Transport and environmental effects of rail-based Park and Ride: Evidence from the Netherlands. *Journal of Transport Geography*, *30*, 7–16. http://doi.org/10.1016/j.jtrangeo.2013.02.004.

Murray, M. (2016). Route Planning for Logistics and Distribution Companies. Retrieved 22 September, 2016 from https://www.thebalance.com/route-planning-2221322.

Nunnally, J. C., & Bernstein, I. H. (1994). Psychometric theory (3rd ed.). New York: McGraw-Hill.

Omer, I. (2006). Evaluating accessibility using house-level data: A spatial equity perspective. *Computers, Environment and Urban Systems*, *30*(3), 254–274. http://doi.org/10.1016/j.compenvurbsys.2005.06.004.

Owen, A., & Levinson, D. M. (2015). Modeling the commute mode share of transit using continuous accessibility to jobs. *Transportation Research Part A: Policy and Practice*, *74*, 110–122. http://doi.org/10.1016/j.tra.2015.02.002.

Poulos, R. G., Hatfield, J., Rissel, C., Grzebieta, R., & McIntosh, a. S. (2012). Exposure- based cycling crash, near miss and injury rates: The Safer

Cycling Prospective Cohort Study protocol. *Injury Prevention*, *18*(1), e1-e1. http://doi.org/10.1136/injuryprev-2011-040160.

Pucher, J., Dill, J., & Handy, S. (2010). Infrastructure, programs, and policies to increase bicycling: An international review. *Preventive medicine*, *50*, S106-S125.

Puello, L. L. P., & Geurs, K. (2015). Modelling observed and unobserved factors in cycling to railway stations: Application to transit-oriented-developments in the Netherlands. *European Journal of Transport and Infrastructure Research*, *15*(1), 27–50.

Rahul, T. M., & Verma, A. (2014). A study of acceptable trip distances using walking and cycling in Bangalore. *Journal of Transport Geography*, *38*, 106–113. http://doi.org/10.1016/j.jtrangeo.2014.05.011.

Randal, E. (2013). What Makes a Commuter Cyclist? A Mixed Methods Study of Behavioural Antecedents and Perceptions of Commuter Cycling in the Wellington Region, 118.

Ransdell, L. B., Mason, S. G., Wuerzer, T., & Leung, K. M. (2013). Predictors of cycling in college students. *Journal of American College Health : J of ACH*, *61*(5), 274–84. http://doi.org/10.1080/07448481.2013.799479.

Ribeiro, P., Neiva, C. L., & Lemos, P. (2014). Planning process of a cycling network: case study of Ponte de Lima, Portugal. *Recent Advances in Environmental Science and Biomedicine*, 168-174.

Romero, J. P., Ibeas, A., Moura, J. L., Benavente, J., & Alonso, B. (2012). A Simulation-optimization Approach to Design Efficient Systems of Bike-sharing. *Procedia - Social and Behavioral Sciences*, *54*, 646–655. http://doi.org/10.1016/j.sbspro.2012.09.782.

Runde Sache (2011). Readers Digest Deutschland (in German). 06/11: 74–75.

Sayarshad, H., Tavassoli, S., & Zhao, F. (2012). A multi-periodic optimization formulation for bike planning and bike utilization. *Applied Mathematical Modelling*, *36*(10), 4944–4951. http://doi.org/10.1016/j.apm.2011.12.032.

Schlote, A., Chen, B., Sinn, M., & Shorten, R. (2013). The effect of feedback in the assignment problem in shared bicycle systems. In *2013 International Conference on Connected Vehicles and Expo (ICCVE).*

Schröder, T., Stewart, T. C., & Thagard, P. (2014). Intention, Emotion, and Action: A neural theory based on semantic pointers. *Cognitive Science*, *38*(5), 851-880. http://doi.org/10.1111/cogs.12100.

Sekaran, U. & Bougie, R. (2013). Research Methods for Business (6th ed.). United Kingdom: Wiley & Sons Ltd.

Shaheen, S. & Guzman, S. (2011). "Worldwide Bikesharing".*Access Magazine No. 39*. University of California Transportation Center.

Shaheen, S.A., Martin, E.W., Chan, N.D., Cohen, A.P., & Pogodzinski, M. (2014). North America: Public Bikesharing in North America During a Period of Rapid Expansion: Understanding Business Model, Industry Trends, and User Impacts.

Shaheen, Susan; Guzman, S.; Zhang, H. (2010). "Bikesharing in Europe, the Americas, and Asia: Past, Present, and Future". *Transportation Research Record: Journal of the Transportation Research*.

Shin, D. K. (2016). Explanation of factors influencing cyclists' route choice using actual route data from cyclists.

Souffriau, W., Vansteenwegen, P., Vanden Berghe, G., & Van Oudheusden, D. (2011). The planning of cycle trips in the province of East Flanders. *Omega*, *39*(2), 209–213. http://doi.org/10.1016/j.omega.2010.05.001.

Susilo, Y. O., Williams, K., Lindsay, M., & Dair, C. (2012). The influence of individuals' environmental attitudes and urban design features on their travel patterns in sustainable neighborhoods in the UK. *Transportation Research Part D: Transport and Environment*, *17*(3), 190-200.

Thinnes-Elker, F., Iljina, O., Apostolides, J. K., Kraemer, F., Schulze-Bonhage, A., Aertsen, A., & Ball, T. (2012). Intention concepts and brain-machine interfacing. *Frontiers in Psychology*, *3*(NOV), 1–10. http://doi.org/10.3389/fpsyg.2012.00455.

Tilahun, N., & Fan, Y. (2014). Transit and job accessibility: An empirical study of access to competitive clusters and regional growth strategies for enhancing transit accessibility. *Transport Policy*, *33*, 17–25. http://doi.org/10.1016/j.tranpol.2014.02.002.

Titze, S., Giles-Corti, B., Knuiman, M. W., Pikora, T. J., Timperio, A., Bull, F. C., & van Niel, K. (2010). Associations between intrapersonal and neighborhood environmental characteristics and cycling for transport and recreation in adults: baseline results from the RESIDE study. *Journal of Physical Activity & Health*, *7*(4), 423-431.

Van Holle, V., Deforche, B., Van Cauwenberg, J., Goubert, L., Maes, L., Van de Weghe, N., & De Bourdeaudhuij, I. (2012). Relationship between the physical environment and different domains of physical activity in European adults: a systematic review. *BMC Public Health*, *12*(1), 807. http://doi.org/10.1186/1471-2458-12-807.

Vogel, P., & Mattfeld, D. C. (2010). Modeling of Repositioning Activities in Bike-Sharing Systems, 1-13.

Vogel, P., & Mattfeld, D. C. (2011, September). Strategic and operational planning of bike- sharing systems by data mining–a case study. In *International Conference on Computational Logistics* (pp. 127-141). Springer Berlin Heidelberg.

Vogel, P., Greiser, T., & Mattfeld D.C. (2011). Understanding Bike-Sharing Systems using Data Mining: Exploring Activity Patterns (20, 514-523). Germany: University of Braunschweig.

Willis, D., Manaugh, K., & El-Geneidy, A. (2013). Cycling under influence: Summarizing the influence of attitudes, habits, social environments and perceptions on cycling for transportation. In *Paper accepted for presentation at the 92nd Transportation Research Board Annual Meeting, Washington DC, USA*.

Winters, M., Teschke, K., Grant, M., Setton, E. M., & Brauer, M. (2010). How far out of the way will we travel? Built environment influences on route selection for bicycle and car travel. *Transportation Research Record*, (March), 1-18. http://doi.org/10.3141/2190-01.

Zhang, K., Batterman, S., & Dion, F. (2011). Vehicle emissions in congestion: Comparison of work zone, rush hour and free-flow conditions. *Atmospheric Environment*, *45*(11), 1929-1939.