Australasian Transport Research Forum 2013 Proceedings
2 - 4 October 2013, Brisbane, Australia
Publication website: http://www.patrec.org/atrf.aspx

Route Choice Behaviour of Cyclists by Stated Preference and Revealed Preference

Chao Yang[1], Dr Mahmoud Mesbah[2]
[1]Postgraduate student, School of Civil Engineering, The University of Queensland, Brisbane, QLD 4072 Australia
[2]School of Engineering, The University of Queensland, Brisbane, QLD 4072Australia
Email for correspondence: chao.yang@uq.net.au

Abstract

Cycling is becoming a vital mode of transport in the cities of the developed countries. It can ease traffic congestion in the transport network, improve the health of cyclists, develop the urban environments and save money. According to the Brisbane Active Strategy 2012-2026, 1 in 5 transport trips should be by cycling by 2026. In the meantime, cyclists have a variety of factors to choose their travel route including but not limited to distance, safety, grade, and scenery. This study investigates the relative importance of these factors by conducting two survey types, namely Stated Preference (SP) and Revealed Preference (RP). First the significant factors in cyclist route choice are listed; after that, a SP and a RP survey are conducted. A pilot survey is run to show the method in practice. Finally, the survey results are reported to compare SP & RP approaches. Moreover, the relative importances of cyclists' route choice factors are presented.

1. Introduction

Cycling is the energy efficiency and healthy transport mode in the cities of developed countries. Due to the increasing global warming and traffic congestion issues, non-motorized forms of transport, particular cycling has become more and more prevalent (Broach, Dill, & Gliebe, 2012). In addition, cycling can decrease carbon emission from travelling, ease traffic congestion in the transport network, improve the health of cyclists, develop the urban environment and save money. The recently released Brisbane Active Transport Strategy 2012-2026 direction includes, encouraging cycling, connecting commuter network, building safe and accessible network and providing information at fingertips (Brisbane City Council, 2012). The strategy acknowledges the need for cycling network to improve a multitude of factors (safety, bike lanes, and cycle facilities) to increase the cycling share by 2026. Providing better bicycle routes is crucial for encouraging bicycling. However, Brisbane Active Transport Strategy does not consider as many as factors affecting route choice.

In spite of the advantages of cycling, and the efforts of city council to encourage

cycling, a variety of factors affect cyclists' route choice behavior cause of declining cycling using (Sener et al., 2009). Therefore, doing a survey to investigate the vital factors influence cycling route choice is extremely significant, because it can enhance these factors that contribute to increase the cycling using. This study uses two survey types, namely Stated Preference (SP) and Revealed Preference (RP). RP survey premise information on actual choices is made by individuals. The benefits of using RP data is that such data stand for information in an actual choice atmosphere. However, its limitation in term of data collection can be time consuming and limiting the sample size. On the other hand, the advantage of SP data collection is easier and enables to gain a large sample size; nevertheless, the limitation of SP data is that the widespread capability respondents probably restrict the number of variables used to characterize route choices. Therefore, in this paper, two survey types are applied to provide an intermediate solution.

The objective of this study is to investigate the relative significant factors influence cyclists route choice behaviors. The remainder of this paper is organized as follows: section 2 reviews and lists the vital factors in cyclist route choice; section 3 designs the forms of SP and RP surveys ; section 4 runs a pilot survey(with limited sample) to show the method in practice, followed by the survey results reported in section 5. Finally, section 6 concludes the paper.

2. Literature review

2.1 Groups of cyclist

Regarding the different purpose of trip, the cyclist can be classified into two groups: commuting and recreational (Hunt & Abraham, 2007). Commuting cyclists use bicycle to travel form home to work or study (Larsen & El-Geneidy, 2011)**,** while the recreational cyclist use bicycle for pleasure or leisure and usually conduct a short trips (Raith, Van Houtte, Wang, & Ehrgott, 2009). In the meantime, those commuting and recreational cyclists have distinctive preferences, commuter cyclists prefer less travel time and lower traffic volume, whereas recreational cyclists pay more attention to scenery and roadway grade (Ehrgott, Wang, Raith, & Van Houtte, 2012; Menghini, Carrasco, Schüssler, & Axhausen, 2010; Chen& Chen, 2013). In other words, commuter cyclist route choice preferences are more destination based, whereas recreational cyclist are more leisurely based. The analysis of using behavioral, cognitive and affective dimension would bring about better results.

In addition, Caulfield, Brick, and McCarthy (2012) suggests that commuting cyclists are relatively more susceptive to distance and less impressible to most other factors contrasted with cyclists cycling for other utilitarian purposes. This means that commuting cyclists are possibly under time pressure to arrive their destination in the work direction. On the other hand, Noël and Lee-Gosselin (2002) mentions that recreational cyclists are more sensitive to basic bicycle facilities and scenery.

2.2 Stated preference (SP) and Revealed preference (RP)

Stated preference and revealed preference are the key approaches used to analyze cyclist preferences in cycling route choice behaviors (Sener, Eluru, & Bhat, 2009;

Stinson, & Bhat, 2003). More specific, the stated preference survey is the dominant data collection process. First of all, the simplest stated preference survey in cycling route choice behavior asks respondents to rank their preference for different factors; then more complicated stated preference supply side by side route options. The respondents should trade off presumably active characteristics, for instance fantastic scenery, with longer route; or a separated cycling lane, with longer travel time. Subsequently, the stated preference survey includes a route choice model that investigates key attributes considered to contribute importantly in route choice behavior of cyclists. The attributes examined are travel time, distance, gradient and traffic safety (Howard & Burns, 2001; Parkin & Rotheram, 2010; Raith, & Ehrgott, 2009). Furthermore, stated preference approaches is attractive for a variety of reasons: initially, data collection is usually easier or less cost, contrasted with fiting out participants with GPS devices; secondly, it does not require detailed travel network data but resolve the issue of producing alternative routes on a real network; similarly, stated preference surveys permit researchers to test unusual or inexistent options that are impossible with revealed preference data. Moreover, the method investigates cycling preference and relative important factors contributing in route choice by assessing suitable options using stated preference observations of choices made by people. The observations results are gathered from choices made by the respondent with respect to the hypothetical cycling conditions and options provided. On the other hand, there are some disadvantages to stated preference data for cyclist route choice. First of all, it is hard to know how well a participant can map these textual or pictorial representations to her/his preferences for real facilities. Simultaneously, the small sample size could result in incorrect prophecies for experiments. It is imperative to maintain the stated preference surveys as simple as possible to reduce the incorrect of the results gathered, as a result of extremely intricate task supplied to the respondent. Most generally, cyclists have been asked to recall routes in revealed preference survey. The routes are then contrasted with pre-selected routes based on shortest paths or other definitions of optimal paths. In the meantime, the revealed preference data represents the actual choice of environment, but sometimes it does not evaluate a full route choice model.

Survey questionnaire includes both stated preference and revealed preference questions, and results gathered will reveal both preferences effect on route choice behaviour of cyclists. To be more specific, the stated preference section of the questionnaire requires respondents asked from selected hypothetical cycling route to which alternatives they indicated would take. The questionnaire also requires respondents to complete questions with respect to their personal basic information. Personal basic information includes gender, age, marital status, level of education, occupation, individual income, level of experience in cycling and level of comfort in cycling with mixed traffic. Though the parameters used in estimating in order to develop stated preference observations expressed in ratios between them do not suffer identical difficulties. In return stated preference are much more reliable indicators of corresponding relative magnitudes of the influences in the revealed preference thus of real choice behaviors.

2.3 The important factors in cyclist route choice

In order to understand the route choice behavior of cyclists, the factors that affect their choices should be understood. Regarding the significant factors affecting cyclist's route choice, past studies have identified some factors for instance travel time, distance, traffic safety ,bicycle facilities and scenery (Noël& Lee-Gosselin,2002; Tilahun, Levinson, & Krizek, 2007; Scarf & Grehan 2005). Commuter cyclists often have multitude of objectives when selecting their cycling route: travel time and the compatibility of a route for cycling (Wardman, Tight, & Page, 2007; Winters, Brauer, Setton, & Teschke, 2010). Travel time is the most essential to influence the commuter cyclists' route choice decision. The suitability of cycling route includes set of factors, such as traffic speeds and volumes, presence of separate bicycle path and terrain (Winters, Brauer, Setton, & Teschke, 2010; Hunt & Abraham, 2007). It seems that commuter cyclists did not select cycling routes merely based on traffic safety, shortness or straightness, but on some combination of these factors (Parkin, & Rotheram, 2010).Some of these factors are traffic speed, cycling facilities(bike lane or shared lane), traffic volume and on-street parking. For recreational cyclists, there is not only basic bicycle facilities affecting route choice, but also other essential factors influencing cycling route choice including the level of bicycle experience, cycling lane type, gradient and scenery (Chen & Chen, 2013; Sener, Eluru, & Bhat, 2009).

Nevertheless, there are sets of other factors that affecting cycling route choice. Some of these factors are subjective for example physical characteristics cannot be quantitatively evaluated (Broach, Dill, & Gliebe, 2012). Other factors for instance traffic volume, cycling basic facilities and gradient are objective and therefore can be accessed in a cycling route choice study. Raith and Ehrgott (2009), Stinson and Bhat (2003) also found that environmental factors influence cyclists' preferences such as traffic volume and bicycle lane type. And more recently, Broach, Dill, and Gliebe (2012) suggest that cyclists are susceptible to the influences of distance, turn frequency, ramp, traffic signals and traffic volumes. Bike lanes probably can offset the passive influences of adjacent traffic, but may be not fascinating than a low traffic volume street. What is more, Sener, Eluru, and Bhat (2009) examines a synthetically variety of factors that affect cycling route choice, such as bicyclists' characteristics, on-street parking, bicycle facility type, roadway physical characteristics, roadway functional characteristics, and roadway operational characteristics. It highlights especially length/travel time, gradient, existence of cycle lanes, type of intersections, presence of parking, traffic volume and age and cycling experience among the characteristics of cyclists.

3. Design the questionnaires of SP and RP surveys

The questionnaire is separated into three parts, namely respondent's basic information, stated preferences and revealed preferences. More specifically, respondent's basic information for instance gender, age, marital status, highest completed level of education, occupation and individual income(after tax) enable to realize groups of people choosing cycling, hence we put these questions (refer to Appendix A basic information questions) in the first part.

Then, the focus of stated preference experimental design in the second part was to contribute toward assessing the trade-off among factors that affect cycling route choice. Therefore, we identified a variety of relative important factors of cycling route choice based on our review of earlier studies, namely distance, travel time, traffic safety, gradient, scenery, security (dark roads, alleyways, etc) and facilities(toilets, shower, changing room, bike storage, drinking tap ,etc). Simultaneously，a table with these relative seven significant attributes with an important scale from one to ten, respondents need to provide the score for each important factor.

Subsequently, the designed questionnaire was also to gain information on respondents' frequency about riding bike, the main reason of cycling on working days and weekends, travel time difference between working days and weekends respectively. Furthermore, in the last part, respondents were asked to recall routes in revealed preference survey. Specifically, a map was presented to respondents asking them which route they took last time from work/school/ social functions/ recreational origin to home, along with the frequency of cycling ,the purpose of last cycling trip from home to destination and last travel time from home to destination or destination to home. What is more, the survey also includes one sheet for consent form, one sheet was for information on the purpose of the survey, and another one was for optional comments and contact details of the respondent. In the meantime, the main principle of designing questionnaire was that maintain the SP and RP questions relatively simple to prevent inaccurate results from misunderstanding the questions for respondents.

4. Methodology

4.1 Earlier Research

Hunt and Abraham (2007) modeling method is advanced based on the common observations that travel time appears to have the most vital influence on route choice decisions of cyclists and that other effecting factors, for instance, traffic safety and gradient are also significant. Some cyclists prefer to travel longer distances in order to contain facilities (toilets, shower, changing room or bike storage) on their cycling routes (Howard& Burns, 2001). In other words, the shortest route is not necessarily the most attractive route to a cyclist. Additionally, the factors influencing bicycle commuting-related decisions can be broadly categorized into link-level factors and route-level factors. Then, individual factors, for instance age and gender, can influence cycling route choice through their interactions with link- and route-level factors. For example, older individuals may prefer a flatter terrain, compared with what younger individuals may prefer. A multitude of studies indicate that traffic safety is the most vital factor effecting cyclists route choice behaviors (Noël & Lee-Gosselin 2002; Scarf & Grehan, 2005; Sener, Eluru, & Bhat, 2009). Studies from Stinson and & Bhat (2003) bring about the result from stated preference that travel time is valued more than traffic safety. However, the perspective of travel time and traffic safety value varies among individuals. According to different perspectives of perceived values, the cycling route choice model needs to separate the attributes into the model. With this reason, Parkin and Rotheram (2010) conducted a stated preference test with the

method of using model route choice based on travel time, traffic level and surface quality factors.

4.2 Model

It is vital to find a systematic method of accessing cyclist route choice behavior to decide attractiveness as one factor of influencing route choice. Studies from the assessment evaluated route attractiveness in cycling route choice. The advanced approach aimed to minimize subjective factors, rather than based on each individual link, cycle trips in their entirety was considered. The factors effecting cyclist route choice was simplified to route-level and link-level, for modeling reasons. Route-level took into account travel time, whereas link-level regarded attractiveness, safety and comfort. The problem with traditional route assignment lies in the assumption of the driver having one single objective. Compared to drivers, cyclists have various objectives. Thus, based on route-level and link-level a bi-objective route choice model would be more appropriate to model cyclist route choice behavior. Given an origin-destination we can use the model to identify the cycling route choice.

4.2.1 Logit Model

According to Chen & Chen (2013), logit model can be used to estimate the influence level of factors on cyclist route choice behaviours. Before applying the logit choice model, we need to know influential factors of cycling preferences. This can be gained through participants' response to hypothetical options and situations towards Stated Preference and Revealed Preference observations. Coefficient estimates and associated statistics come from the influences of specific factors strengths and statistical significance. Using logit choice model to formulate the route choice should consider:

$$P_a = \frac{\exp(U_a)}{\exp(U_a) + \exp(U_b)}$$

P_a : Probability that bicycle use alternative a is preferred

U_a : Utility value associated with bicycle use alternative a

U_b : Utility value associated with bicycle use alternative b

The utility general linear form:

$$U_i = \emptyset 1 \times X_{1_i} + \emptyset 2 \times X_{2_i} + \ldots + n \times X_{n_i} + \ldots$$

n : Index representing attributes

X_{ni} : Value of attribute of n for alternative i

Øn : Utility function coefficient with attribute n

The nature of discrete choice models permits multi-objective decisions and dependence of personal preference as well as levels of competence in cycling makes it the most mainstream model used for cyclist route choice behavior (Hunt & Abraham, 2007). Binary logit model can be used to evaluate the influences of the factors in cycling route choice decision analysis. The model system is:

$$U_i = \beta X_{in} + \epsilon_{in}$$

i = Index for route

n = Index for individuals

X_n = Vector of explanatory vairables specific to i and n

β = Corresponding vector of parameters

U_{in} = Utlity associated with route i by n

ϵ = Random error term

Probability of route i over route j is given by:

$$= \frac{e^{\beta X_{in}}}{e^{\beta X_{in}} + e^{\beta X_{jn}}}$$

Probability that n selects route i = Prob ($U_{in} > U_{jn}$)

5. Survey results

The percentage of male gender was relatively higher than female, 57.9% male and 42.1% female, respectively. 68.4% of respondents were in the 18-27 age group and 26.3% in the 28-37 age range. 84.2% of the sample was shown never married, 10.5% was married and merely 5.3% was divorced. The results for highest completed level of education showed that more than half of respondents (57.8%) were postgraduate education, 31.6% of respondents were high school education and less than 15% of the sample was tertiary education. 63.2% indicated they were unemployment and 68.4% said they were full time student. In terms of individual income (per month after tax), there were same percentage in the less than 2000 dollar and 2001 dollar -4000dollar group, which were 31.6% and 26.3% respondents were rather not say. These results showed the basic information about respondents.

In the stated preference questions survey, 73.7% respondents did not own a bike in working condition. In terms of main reason cycling on working days, 47.4 % and 36.9%

respondents chose recreational and school reason respectively. In addition, in terms of the reason of riding the bike on weekends, 57.9% respondents chose the recreational as the main reason**.**

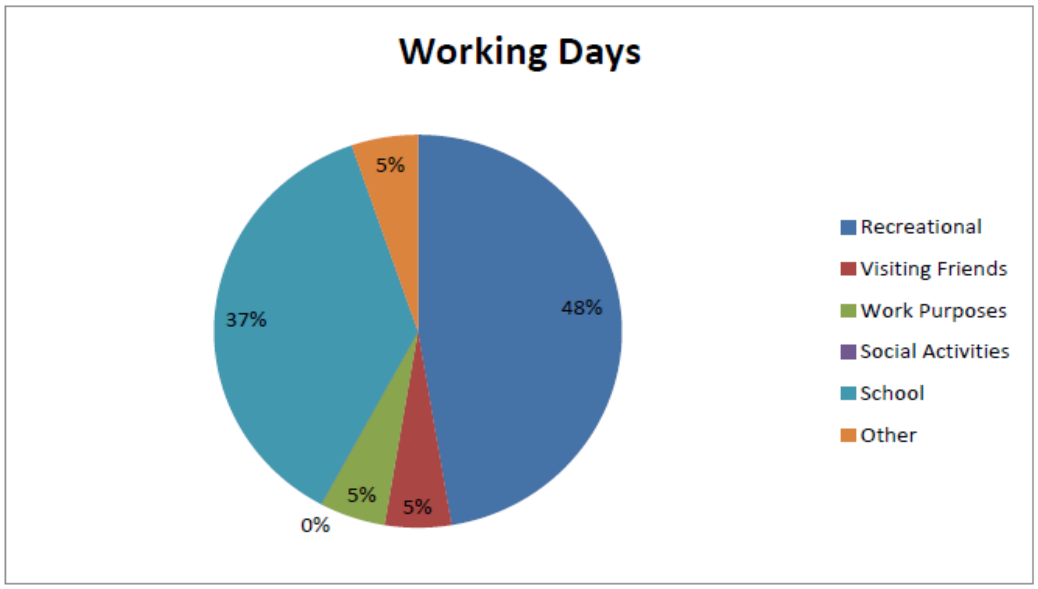

Figure 1 Main reason for cycling on working days(Stated Preference)

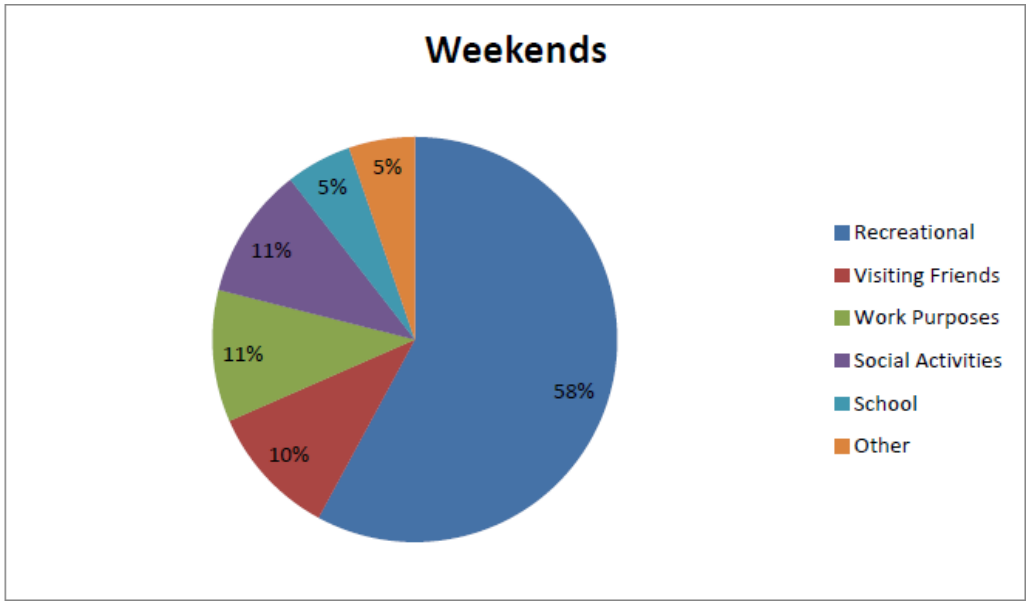

Figure 2: Main reasons for cycling on weekends (Stated preference)

In terms of the travel time by cycling in a one way trip during working days and weekends, the majority respondents chose more than 10 minutes and less than 30 minutes on working days and weekends.

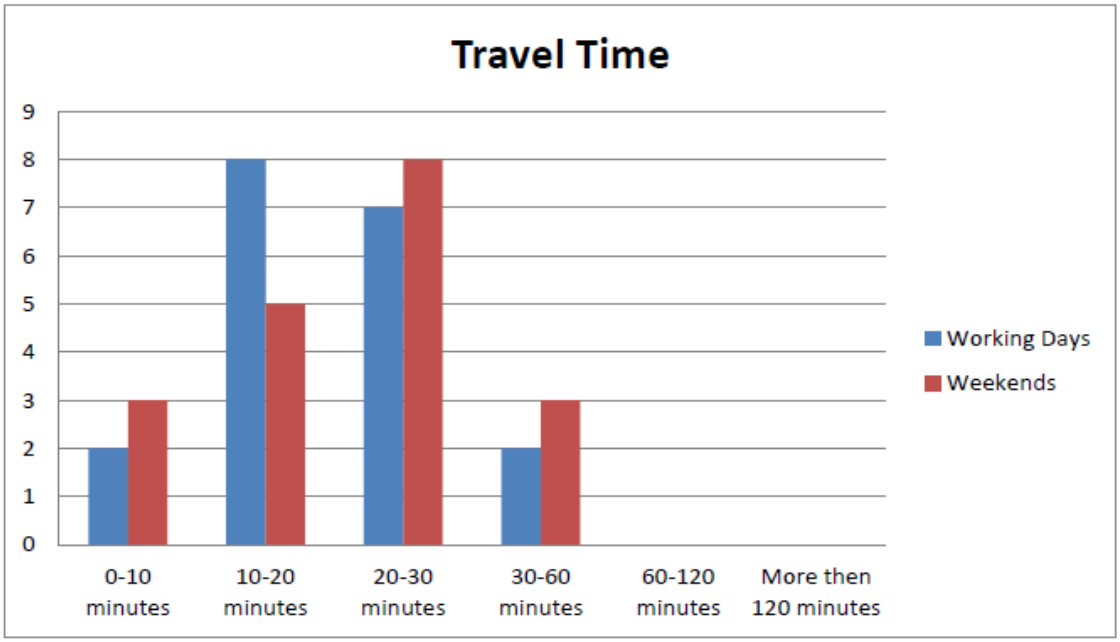

Figure 3: Travel time for one way trip (Stated Preference)

In the score of significant factors section, 57.9% of respondents assigned a score of ten for travel time as the most important attributes compared with other six relative factors. Moreover, 26.3% respondents gave a score of ten for both traffic safety and gradient or terrain factors.

Least Important	1	2	3	4	5	6	7	8	9	10	Most Important
Distance	-	-	-	-	-	-	3	2	11	3	
Travel Time	-	-	-	-	-	1	2	2	3	11	
Traffic Safety	-	-	-	2	3	1	4	3	2	5	
Gradient/Terrain	-	-	-	-	-	7	2	3	2	5	
Scenery	-	-	7	1	4	3	1	-	-	3	
Security	-	3	4	2	3	2	3	2	-	-	
Facilities	1	-	2	9	7	-	-	-	-	-	

Table 1: Table of important factors (Stated Preference)

After that, we can calculate the overall score for each of the important factor.

$$Overall\ Score = Score \times Frequency$$

Factors	Overall Scores
Distance	166
Travel Time	173
Traffic Safety	145
Gradient/Terrain	148
Scenery	100
Security	90
Facilities	78

Table 2: Overall score for factors

In the revealed preference questions survey, as expected stated preference travel time for one way trip, similar results came out to the revealed preference, the majority respondents selected between 10 minutes and 30 minutes in working days and weekends.

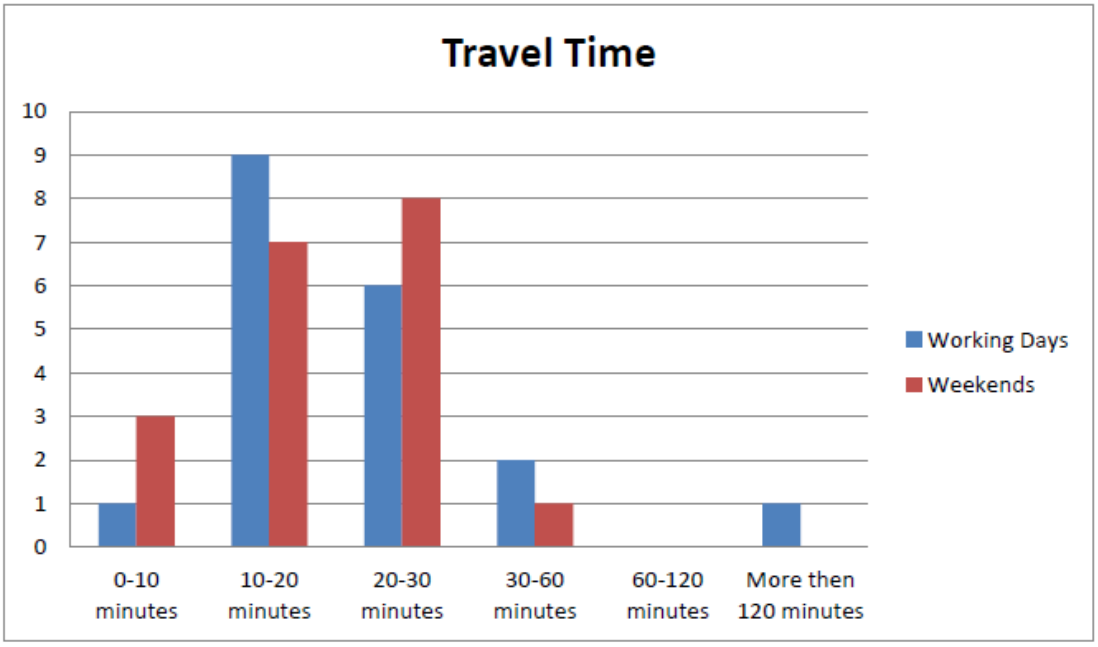

Figure 4: Travel time for one way trip (Revealed Preference)

In terms of the purpose about lasting trip form home to destination, 47.4% respondents chose recreational and 36.9% respondents for the purpose of school.

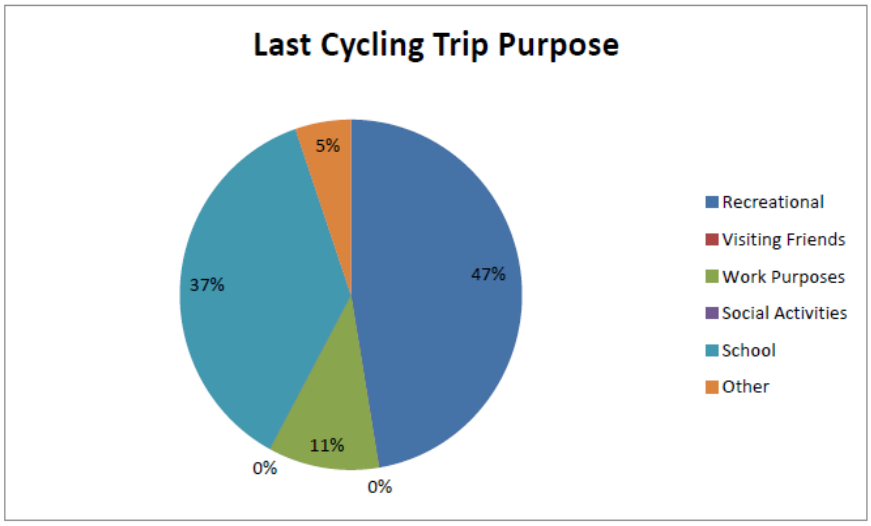

Figure 5: Main reason for cycling from home to destination (Revealed Preference)

6. Discuss the results

The survey was conducted in the University of Queensland in Brisbane, Australia and total 19 respondents finished the questionnaire survey. From the results in the section five, it can be found that majority of the participants were postgraduate and high school students, therefore the limitation of sampling in this survey probably not reflect on those at large. On the one hand, the survey results were based on the students' perceptions and the data used to predict the cycling route choice model may be insufficient to the requirements of the design population. On the other hand, these samples possible include more experts than broader samples attain. The cumulative data may be more accurate evaluation of cycling route choice for that specific target group (student group).

The questionnaire results of section one revealed that there was a slightly different between percentage of male and female gender, hence gender probably can be considered low or unimportant factor in affecting the cycling route choice behavior. Although 68.4% respondents were 18-27 years old, it cannot be connected with the conclusion due to small student samples size. The age factor plays a significant factor probably for the restrictions on automobile driving in younger age group. The remainder questions results showed that 84.2% respondents were never married and 63.2% respondents' individual income were lower than 4000dollors; it seemed that single lower income student may choose cycling.

In the stated preference survey part, majority of respondents selected recreational (47.4%) or school (36.9%) as key reasons for cycling during working days, while 57.9% of respondents selected recreational as the main reason for cycling during weekends. These data indicated that bicycle was more used by recreational cyclists in the weekends and for school during working days. This probably meant that commuting cyclists were rarely using cycling for working purpose during working days and weekends. In addition, 57.9% respondents gave a score of ten for travel time compared with the six other cycling factors and the overall scores indicated that

respondents perceive travel time as the most vital factor in cycling route choice, with travel distance as the second most essential factors among the seven affecting factors in cycling route choice behaviors.

In the revealed preference part, as expected stated preference travel time for one way trip yielded similar results to that of travel time for revealed preference and the travel time duration was longer during weekends than working days. Simultaneously, 47.4% respondents listed the purpose of last cycling trip as recreational and 36.9% for the purpose of school also similar as expected stated preference. On the other hand, there was a disadvantage in revealed preference surveys for cycling route choice. To be more specific, the weakness was found in separate input route for respondents. This can result in inaccurate results as the input routes might not be the actually recall route choice, so we can attempt to model cycling route choice model through bi-objective route approach.

Further research is needed to advance route assignment to assign cyclist their preferred route. This is on the basis of experience commuter cyclist, which may not consider the safety or gradient of the route, while other cyclist on the other hand prefer route that is more safe. Hence, cyclist would like to choose more attractive routes even though the route may be longer. In determining cyclist route choice behaviour conventional traffic assignments are not directly applicable, since it is based on the Broach, Dill and Gliebe's (2012) principle due to the principle being a single objective assignment. The significant success of cyclist route choice modeling is generating realistic choice set.

7. Conclusion

Cycling is a significant mode of transport in the cities of the developed countries. It can ease traffic congestion in the transport network, improve the health of cyclists, develop the urban environments and save money. Simultaneously, cyclists have a multitude of factors to choose their travel route including but not limited to distance, safety, grade, and scenery. This paper analyzed cyclist's route choice behavior by two main surveys conducting, namely Stated Preference and Revealed Preference. From the studies conducted from Stated Preference and Revealed Preference surveys it seems that travel time and distance were the most important factors in cyclist route choice behavior variables.

In addition, there are two groups of cyclist to distinguish from for understanding the diverse effecting factors, which are recreational and commuter cyclist. More specific, commuter cyclist route choice preferences are more destinations based, whereas recreational cyclists are more leisurely based. A small sample size was used in conducting an investigation to advance sub-model that would form the foundation of a much larger model with subsequent larger sample size. The design survey focused on gathering basic information of respondents, as well as including mapping on their route choice from home to a certain destination either social activities, work, school or recreational. The designed paper concentrated on respondents scoring their own perspective of valuing seven effecting relative factors on a one to ten importance scale. The seven factors were chosen based on earlier research of other studies,

factors contained distance, travel time, travel safety, gradient or terrain, scenery, security and facilities. Further data on a larger sample size would lead to a more comprehensive understanding on behavioral factors that influence both recreational and commuter cyclist on route choice behavior. Designed questionnaire based on Stated Preference and Revealed Preference requires more time to effectively construct in order to obstruct more in depth data.

What is more, perceived traffic safety, facility type, travel time and distance factors contributing to cyclist route choice are only partly appreciated despite their importance of predicting cycling route choice behaviors, and remains the subject of much debate. Future studies should link the behaviors between facility type and preferences with perceived traffic safety. Time and money cost can affect route choice behavior due to trip purposes, therefore cycling travel time may be diverse during certain days.

Acknowledgements

First of all, I would like to thank Dr Mahmoud Mesbah for his guidance towards completing this project. Without his consistent and illuminating instruction, this thesis could not have reached its present performance. In addition, I would also like to thank Michael Yang, for his contributions to design the questionnaire and collect data together.

Appendix

Cycling Route Choice Questionnaire

Cyclists have a set of factors to choose their travel route including but not limited to distance, safety, grade, and scenery. This questionnaire is to gather information in order to analyze the route choice behavior of cyclist.

I. Basic information

1. Gender:
    - ○ Male
    - ○ Female
2. Age:
    - ○ Under 18
    - ○ 18-27
    - ○ 28-37
    - ○ 38-47
    - ○ 48-57
    - ○ 58-67
    - ○ 68 or up
3. Marital status:
    - ○ Never Married
    - ○ Married / De facto
    - ○ Divorced/ Separated/ Windowed
4. Highest Completed Level of Education:
    - ○ Primary School
    - ○ High School

- ○ Tertiary Education
- ○ Postgraduate Education

5. Occupation:
   - ○ Full time employment
   - ○ Part time employment (less than 35 hours/week)
   - ○ Unemployment
   - ○ Retired
6. Are you a student?
   - ○ Yes, full time student
   - ○ Yes, part time student
   - ○ No
7. Individual Income (per month after tax):
   - ○ Less than $2,000
   - ○ $2001-$4,000
   - ○ $4001-$6,000
   - ○ $6001-$8,000
   - ○ $8001-$10,000
   - ○ More than $10,000
   - ○ Rather not say

II. Stated Preference Questions:

8. Do you own a bike that is in working condition?
   (If answer is “No” go to Question 9)
   - ○ Yes
   - ○ No
9. How often do you ride your bike?
   - ○ Everyday
   - ○ 4 times a month
   - ○ At least once a month
   - ○ At least once a year
   - ○ Never

(If you haven’t cycled before, answer following questions based on if scenario)

10. What is the main reason you ride your bike on working days?
    - ○ Recreational
    - ○ Visiting friends
    - ○ Work purposes
    - ○ Social Activities
    - ○ School
    - ○ Other
11. What is the main reason you ride your bike on weekends?
    - ○ Recreational
    - ○ Visiting friends
    - ○ Work purposes
    - ○ Social Activities
    - ○ School

○ Other

12. On average, how long you usually ride in a one way trip during working days?
    - ○ 0-10 minutes
    - ○ 10-20 minutes
    - ○ 20-30 minutes
    - ○ 30-60 minutes
    - ○ 60-120 minutes
    - ○ More than 120 minutes
13. On average, how long you usually ride in a one way trip during weekends?
    - ○ 0-10 minutes
    - ○ 10-20 minutes
    - ○ 20-30 minutes
    - ○ 30-60 minutes
    - ○ 60-120 minutes
    - ○ More than 120 minutes
14. Which of the following do you find significant when choosing a cycling route. Please score in order of importance (Cannot have same scores):

Least Important	1	2	3	4	5	6	7	8	9	10	**Most Important**
Distance											
Travel Time											
Traffic Safety											
Gradient/Terrain											
Scenery											
Security											
Facilities											

Notes: Security: Dark roads, alleyways, etc.

Facilities: Toilets, shower/changing room, bike storage, drinking tap, etc.

III. Revealed Preference Questions

15. Which route did you take last time to get home from work/school/social functions/recreations origin?

    Attach Map
16. When was the last time you cycled?
    - ○ Less than 1 week
    - ○ Less than a fortnight
    - ○ Less than 1 month
    - ○ Less than 3 month
    - ○ Less than 6 month
    - ○ Less than a year
    - ○ More than a year
17. On your last cycling trip how long did it take to cycle from home to the destination?

- ○ 0-10 minutes
- ○ 10-20 minutes
- ○ 20-30 minutes
- ○ 30-60 minutes
- ○ 60-120 minutes
- ○ More than 120 minutes

18. On your last cycling trip how long did it take to cycle to home?

- ○ 0-10 minutes
- ○ 10-20 minutes
- ○ 20-30 minutes
- ○ 30-60 minutes
- ○ 60-120 minutes
- ○ More than 120 minutes

19. What was the purpose of your last cycling trip from home to destination?

- ○ Recreational
- ○ Visiting friends
- ○ Work purposes
- ○ Social Activities
- ○ School
- ○ Other

Comments:

_____

_____

_____

Leave us your contact details (Optional)

Name: _____

Contact number: _____

Email: _____

Reference

Brisbane City Council.(2012). *Brisbane Active Transport Strategy 2012-2026*. Brisbane, Australia: Brisbane City Council.

Broach, J., Dill, J., & Gliebe, J. (2012). Where do cyclists ride? A route choice model developed with revealed preference GPS data. *Transportation Research Part A: Policy and Practice, 46*(10), 1730-1740.

Caulfield, B., Brick, E., & McCarthy, O. T. (2012). Determining bicycle infrastructure preferences - A case study of Dublin. *Transportation Research Part D: Transport and Environment, 17*(5), 413-417.

Chen, C. F., & Chen, P. C. (2013). Estimating recreational cyclists' preferences for bicycle routes - Evidence from Taiwan. *Transport Policy, 26*, 23-30.

Ehrgott, M., Wang, J. Y. T., Raith, A., & Van Houtte, C. (2012). A bi-objective cyclist route choice model. *Transportation Research Part A: Policy and Practice, 46*(4), 652-663.

Howard, C., & Burns, E. K. (2001). Cycling to work in Phoenix: Route choice, travel

behavior, and commuter characteristics *Transportation Research Record* (pp. 39-46).

Hunt, J. D., & Abraham, J. E. (2007). Influences on bicycle use. *Transportation, 34*(4), 453-470.

Larsen, J., & El-Geneidy, A. (2011). A travel behavior analysis of urban cycling facilities in Montréal, Canada. *Transportation Research Part D: Transport and Environment, 16*(2), 172-177.

Menghini, G., Carrasco, N., Schüssler, N., & Axhausen, K. W. (2010). Route choice of cyclists in Zurich. *Transportation Research Part A: Policy and Practice, 44*(9), 754-765.

Noël, N., & Lee-Gosselin, M. (2002). Achieving a better understanding of cycling practices. A detailed study of the travel behaviours of cyclists in the Quebec Metropolitan Region. *Mieux comprendre la pratique de la bicyclette Enquête sur les déplacements et les activités de cyclistes de la Region métropolitaine de Québec*(74), 25-49.

Parkin, J., & Rotheram, J. (2010). Design speeds and acceleration characteristics of bicycle traffic for use in planning, design and appraisal. *Transport Policy, 17*(5), 335-341.

Raith, A., & Ehrgott, M. (2009). A comparison of solution strategies for biobjective shortest path problems. *Computers and Operations Research, 36*(4), 1299-1331. doi: 10.1016/j.cor.2008.02.002

Raith, A., Van Houtte, C., Wang, J. Y. T., & Ehrgott, M. (2009). *Applying bi-objective shortest path methods to model cycle route-choice.* Paper presented at the 32nd Australasian Transport Research Forum, ATRF 2009.

Scarf, P., & Grehan, P. (2005). An empirical basis for route choice in cycling. *Journal of Sports Sciences, 23*(9), 919-925.

Sener, I. N., Eluru, N., & Bhat, C. R. (2009). An analysis of bicycle route choice preferences in Texas, US. *TRANSPORTATION, 36*(5), 511-539. doi: 10.1007/s11116-009-9201-4

Stinson, M., & Bhat, C. (2003). Commuter Bicyclist Route Choice: Analysis Using a Stated Preference Survey. *Transportation Research Record, 1828*(1), 107-115. doi: 10.3141/1828-13

Tilahun, N. Y., Levinson, D. M., & Krizek, K. J. (2007). Trails, lanes, or traffic: Valuing bicycle facilities with an adaptive stated preference survey. *Transportation Research Part A, 41*(4), 287-301. doi: 10.1016/j.tra.2006.09.007

Wardman, M., Tight, M., & Page, M. (2007). Factors influencing the propensity to cycle to work. *Transportation Research Part A, 41*(4), 339-350. doi: 10.1016/j.tra.2006.09.011

Winters, M., Brauer, M., Setton, E. M., & Teschke, K. (2010). Built environment influences on healthy transportation choices: Bicycling versus driving. *Journal of Urban Health, 87*(6), 969-993

Winters, M., Davidson, G., Kao, D., & Teschke, K. (2011). Motivators and deterrents of bicycling: comparing influences on decisions to ride. *Transportation, 38*(1), 153-168. doi: 10.1007/s11116-010-9284-y