Factors Influencing Public Transport Use: A Study of University Commuters' Travel and Mode Choice Behaviours

Dong WANG*, Yan LIU

School of Geography, Planning and Environmental Management, University of Queensland, St Lucia 4072, QLD, Australia

Abstract

Student numbers at Australian universities are growing, especially in capital cities. As education and employment destinations, universities are important generators of travel demand on urban transport networks. This study examines travel patterns and identifies factors that influence commuters' choice of travel mode, using web-based surveys conducted in two consecutive years of 2013 and 2014 in the University of Queensland (UQ). Data concerning where and how staff and students travel to UQ, their preference of different modes as well as potential reasons affecting their mode selection were collected. Our analyses indicate that the overall percentage of public transport users dropped by 9.5% in 2014 compared to those in 2013. Multiple regression models were run to identify key barriers that constrain public transport use. The results highlight that travel time and distance are the most influential predictors of public transport use, indicating that areas with better provision of transport infrastructure associated with higher public transport use. However, the response to transport fare policies varies amongst different user groups. Public transport is more popular for medium to long distance commuters, while student users are more vulnerable than staff to the increase of public transport fare. Therefore, policy intervention targeting specific user groups would be more effective to encourage public transport use.

Keywords: University campus, mode choice, travel behaviour, public transport, health promotion

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1. Introduction

Universities throughout the world have been endeavouring to create more sustainable campuses. Universities are important generators of travel demand on local transport networks, making commuting one of the largest impacts that a university has on the environment (Tolley, 1996, Shannon et al., 2006). One of the most important strategies to combat the environmental impacts is to encourage the use of active transport modes. Shannon et al. (2006) defined active transport modes as those transport forms that can encourage physical activities. According to this definition, public transport provides an active transport mode because it involves physical activities at both ends of travel. And thus, encouraging public transport use will not only benefit the environment through reducing the demand for parking spaces, but also improve public health by promoting more active lifestyle. The benefits that public transport offers make it an imperative issue to understand factors that motivate mode changes in automobile-dominant cities.

Understanding travel behaviour is essential to informing transport management and planning. Behaviour survey is often adopted as a method to understand individual travel behaviour. However, university students' travel behaviour has rarely been well-represented in national transport behavioural surveys even they are active commuters (Khattak et al., 2011). The Department of Transport and Main Roads (hereafter as 'the Department') is the government agency that manages regular household travel surveys in Queensland, Australia. Results of previous travel surveys indicated that only limited responses from university students were received. This was in part due to the fact that 1) general population was the surveys target, and 2) students often live in shared houses or other types of housing such as student dormitories which do not fit within the household categories that were used in the survey. The under-representativeness of university student population in general transport surveys made it difficult to analyse travel behaviour of this specific demographic group. To response to this issue, the Tertiary Student Travel Survey was first introduced by the Department in 2008 with an aim to improve quality of data on university students' travel behaviour (State of Queensland, 2012).

Previous studies showed that the travel behaviour of university students is different from those of the general population (Khattak et al., 2011). The result from tertiary student survey conducted by the Department confirmed this finding. For example, university students display a more favourable modal split towards active transport modes that include public transport and sustainable travel modes, in comparison to the rest of south-east Queensland. More than half of university student trips with education purpose (52%) were made by public transport, compared to only 8% for the rest of public trips. Private vehicles provided the primary travel mode, contributing 82% of general trips in south-east Queensland, whilst only 35% of trips with education purpose were made by private vehicles. The use of other modes such as walking and cycling in education trips was also slightly higher than the rest of the public (13% vs 11%). Therefore, universities offer a variety of features that make it an ideal context to studying individual travel behaviour and patterns, especially for understanding the factors that influence their mode choice. This is because universities have higher density of population, better access to mixed travel modes and provisions of high-quality transport infrastructure than other contexts (Shannon et al., 2006, Kamruzzaman et al., 2011, Miralles-Guasch and Domene, 2010). Public transport use is more popular among university commuters than other groups. In addition, university students are active in encouraging other groups to change towards more sustainable travel modes (Zhou, 2012). And thus, a better understanding of the factors influencing university commuters' travel behaviours will assist policy-makers to make better decisions to promote sustainable commuting (Whalen et al., 2013, Páez and Whalen, 2010, Khattak et al., 2011).

In Australia, studies on university students' travel behaviours are limited (Shannon et al., 2006, Rose, 2008, Kerr et al., 2010). For example, Shannon et al. (2006) analysed data from a survey conducted in the University of Western Australia. In their study, survey respondents were broken into three groups based on their responses to a survey question about stage of behavioural change. The results were then compared among the three groups to identify potential predictors of using more active transport modes. Similarly, Rose (2008) studied the travel behavioural change of students at Monash University in Melbourne, Victoria. Their data were collected from two separate surveys before and after the implementation of the University's TravelSmart program, with a research aim to identify significant factors that reduce single occupant commuting. The study also identified a range of barriers to promote behaviour change towards environmentally friendly modes, including public transport, cycling, walking and carpooling (Rose 2008). A more recent study was conducted by Kerr et al. (2010) who examined psychological factors that influence students' car use behaviour using data collected from a cross-sectional survey of 186 students from the Queensland University of Technology (QUT) in Brisbane, Queensland. This study found that students had a preference of travelling by car provided the awareness that public transport offers many environmental, health and social benefits. Their study highlighted the need to understanding factors influencing commuters' choice of transport modes and the need to promoting sustainable travel modes at all levels across the state, regional and local scales.

The review of literature indicated that existing research has primarily focused on subjectively measured factors that may influence individuals' travel behaviour. However, spatial elements such as travel origins and objective factors such as actual travel distance and travel fares have rarely been integrated into their analyses. This study aims to address this gap in knowledge through an empirical study conducted in the University of Queensland, Brisbane, Australia. Brisbane is a highly automobile-dependent, low-density city, with urban development extended beyond the old suburban limits of the Brisbane City Council. Recent years has witnessed extensive sprawl along the beach strips, largely due to the car ownership and a lack of beaches within the old radius of the city (Nightingale, 2006). About four out of five trips in Brisbane are made by private vehicles (State of Queensland, 2012). The University of Queensland (UQ), St Lucia campus is located just 6 kilometres southwest of the Brisbane's Central Business District (CBD), connecting with the CBD and the rest of Brisbane suburbs by frequent bus services. Figure 1 shows the locations of the campus and Brisbane CBD. UQ is the second largest trip generator in Brisbane, generating an estimated 65,000 daily car and public transport trips from across Brisbane metropolitan and surrounding areas (Queensland Government, 2009).

This study presents results of two transport surveys conducted in the University of Queensland in the two consecutive years of 2013 and 2014. The aim of this study is to examine how a combination of physical and non-physical factors influences staff and student commuters' public transport use decisions through seeking answers to the following research questions: (1) How did the proportion of public transport users and non-users change from 2013 to 2014? (2) What is the main mode of transport to UQ and how this varies geographically? (3) Is the use of public transport related to travel distance and fare? (4) Which physical or perceived factors contribute most strongly to public transport use?

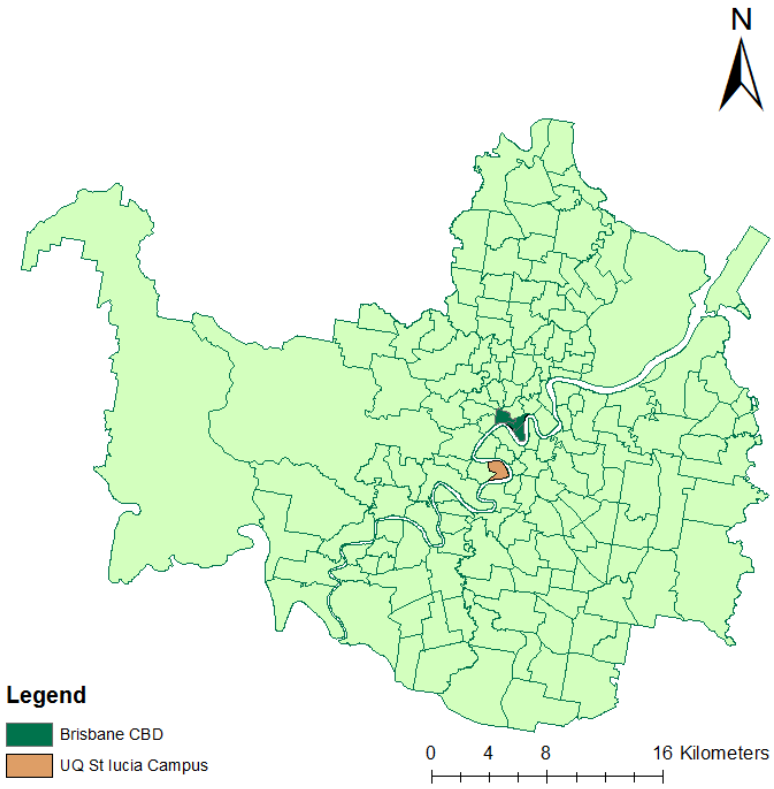

Figure 1 Locations of the University of Queensland, St Lucia campus and Brisbane CBD.

2. Methods

2.1 Recruitment

This study targeted UQ students and staff living in South East Queensland Region. The survey was implemented in two consecutive years of 2013 and 2014, using similar strategies in data collection for the comparison purpose. For example, to avoid the impact of weather conditions on travel behaviour, the surveys were delivered in comparable time periods (August in both 2013 and 2014) and available for 4 weeks for responses. Therefore, this study compares commuting behaviour of similar seasons between the two years. The surveys were promoted in UQ Sustainability Week in different ways (e.g., webpage, flyers, etc.). Incentives were provided in both years to encourage survey participation (e.g., a draw for a movie pass voucher in 2013 and for a $200 Co-op Bookshop voucher in 2014). Students and staff attending all four UQ campuses (St Lucia, Gatton, Ipswich and Herston) were invited to participate in the surveys, but only samples from the main campus (St Lucia) were used in analyses for the consistency of travel destination. Survey Monkey® was used to develop the online questionnaires in both years. Participants were asked to complete the on-line survey questions independently.

2.2 Survey design

The survey instrument was developed in conjunction with UQ Property & Facilities Division as part of the University's campus planning program. The final survey instruments were available on the UQ Sustainability website. Ethics clearances were approved by the University Human Ethics Committee. The survey questionnaire consisted of 7 main questions, with two questions making up of several items concerning different aspects of respondents' travel habits. For example, participants were asked to complete to a one-week travel diary to identify the arrival and departure time and mode used to or from the University for each day during the week before the surveys. We also asked questions about more general travel behaviour to identify suburbs as origin of travel and the most common mode used travel to and from UQ. We sought electronic participant consent at the start of the online survey in both years.

There were only 2083 responses in the 2013 survey due to the complexity and length of the questionnaire used. In 2014, the survey questions were simplified to deal with the under-representativeness issue of the 2013 sample. A pathway approach was adopted in the design of 2014 questionnaire to reduce the total number of questions that each respondent received. For example, if a respondent used public transport as main transport mode to UQ, they were then asked to select reasons why they chose to use public transport. If they were not active public transport user, the questions followed were the reasons for not using public transport. The pathway design effectively reduced the total number of questions that each respondent received in a web-based survey(Shannon et al., 2006). The change to a short and simple questionnaire successfully increased the sample size to a total of 8977 responses in the 2014 survey.

2.3 Analyses

We used IBM SPSS®v20 for statistical analyses and ESRI ArcGIS Desktop 10.3 for spatial analyses.

2.3.1 Characteristics of survey respondents

Survey responses were compiled and analysed. Descriptive statistical results were reported to describe the demographic profiles of our survey respondents, with the results compared between the two survey years of 2013 and 2014. Maps were created to show the geographic distributions of travel origins of the survey participants.

2.3.2 Public transport user and non-user

Descriptive results of public transport user and non-users were analysed and compared between the two survey years of 2013 and 2014. The distributions of public transport users of different population segments (staff and students) were reported to examine their changes over time respectively. Data from 2013 survey was not included in the analyses hereafter due to the concerns of sample representativeness associated with the relative small sample size.

2.3.3 Preference of transport modes to travel to UQ

We collected self-reported data about main transport modes to UQ. In the survey, respondents were asked for the most common mode of transport they use to travel to the campus. They were asked to choose from a list of eight specific transport modes (e.g., car, bus, ferry, bicycle and walk etc.). The self-reported transport modes were then compiled and analysed. Three general categories were created to group the original answers to main transport mode for comparison purposes. They were motor vehicles, sustainable modes and public transports. The motor vehicle category consists of automobile users with both multiple and single occupants and motorcycle drivers; sustainable transport mode category includes respondents who walked or cycled to the campus; and people who self-identified as either bus, ferry or train users were grouped to the public transport user category. Frequency analyses were conducted to show preference for these transport modes, with results compared between staff and students groups.

To illustrate the spatial pattern of transport modes, the self-reported mode preferences were then grouped by the respondents' origin of travel for spatial analysis. Each origin suburb was calculated for its percentage of car (automobile) users and public transport users. Maps were created to illustrate geographic distribution of the mode preferences by percentage. We compare the two maps for the geographic characteristics of dominant travel modes to UQ.

2.3.4 Relationship between public transport use and fare per kilometre or travel distance

To understand the relationship between public transport use and travel distance or cost, we run correlation analysis (spearman's rho) between the ratio of public transport user in each suburb, public transport fare and suburb distance to UQ St. Lucia campus. Two travel fare indicators were used in our analysis: fare per kilometre and total fare per trip. The inclusion of the two fare indicators were based on the presupposition of the potential relationship between total travel fares and distance travelled. Total travel fare was calculated based on 2014 fare policy of Translink (a Queensland government agency that mange public transport). The concession fares were used for student commuters. Fare per kilometre was calculated based on the actual travel cost and distance. The fare

per kilometre variable varies by suburb because current fares are calculated by travelling zone rather than distance in Queensland. Travel distance from each suburb to UQ was calculated based on Brisbane's actual road network using the network analysis function in GIS. Public transport (PT) user ratio referred to the percentage of the number of public transport users to total number of respondents in each suburb. Correlation between fare per kilometre and public transport user ratio was run to constrain preconceived confounding effect due to the collinearity between total fare and distance. Separate analyses were conducted for staff and student for comparison purpose.

2.3.5 Factors that influence public transport use

To answer the last research question about the significance of potential factors that influence the preference of public transport use, respondents were asked to select from a number of barriers and motivators to using public transport that fitted best to their situations. We conducted frequency analyses to highlight the most popular barriers and motivators for public transport use identified by the respondents. The results were then compared between the two groups of staff and students. Two multiple linear regression models (ordinary least squares, enter method) were constructed to identify the significance of exploratory variables. The first regression model used suburb PT user ratio as dependent variable, regressing against transport fare, distance and the 16 barriers that constraint public transport use. The second regression model used the same dependent variable of PT user ratio to regress against transport fare, distance and the 10 motivator variables that promote public transport use. Only top 50 suburbs with highest number of respondents were included in the regression analyses due to the concerns that the PT ratio may not be representative in the suburbs with a total of less than 15 respondents.

3. Results

3.1 Demographic profiles of survey respondents

In 2013, a total of 2083 respondents participated in the UQ transport survey wherein 1896 respondents attend St Lucia campus, consisting of staff (42.2%) and students (57.8%). In 2014, we collected a total of 8977 responses in UQ transport survey with 7045 respondents from St Lucia campus, marking an increase in sample size of 2.5 times than that of 2013 sample. In 2014 survey, students comprised the majority of respondents (72.7%), with more than 55% of respondents as undergraduate students. Table 1 lists the characteristics of the survey respondents of both years.

Table1. Characteristics of survey respondents

	2013 Survey		2014 Survey	
	No.	%	No.	%
Staff	801	42.2	1924	27.3
Postgraduate Student	357	18.8	1183	16.8
Undergraduate Student	738	38.9	3938	55.9
Student	1095	57.8	5121	72.7
Total	1896		7045	

Figure 2 shows the geographic distribution of travel origin suburbs for survey respondents in both year surveys. 2013 respondents reported 295 suburbs as their origins of travel to St. Lucia, compared to 361 suburbs of 2014. The numbers of respondents from each suburb were grouped into five categories, with red colour representing the highest number of respondents. Geographically, 2014 respondents were more clustered around St. Lucia campus than those who responded in 2013.

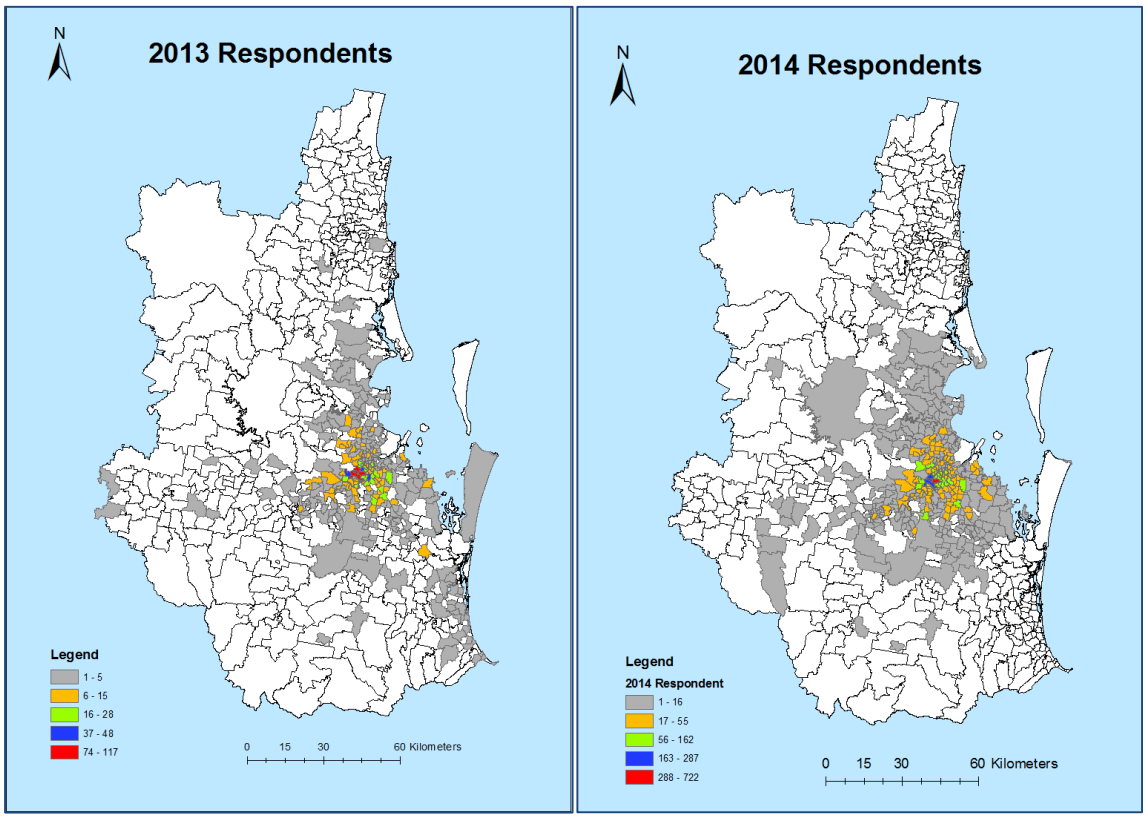

Figure 2 Geographic distributions of the UQ transport survey respondents in SEQ

3.2 Public transport user and non-user

Table 2 compares overall public transport (PT) user and non-users reported in 2013 and 2014 survey. Overall, 50.6% of 2014 survey respondents reported as PT user, compared to 60.2% of 2013. The results showed a decrease in percentage of PT user for both staff (11.4%) and student (14.3%), indicating the need to investigate reasons that explain why people choose or not choose PT to travel to UQ.

Table 2. Public transport (PT) user and non-user

		2013 Survey		2014 Survey	
		PT user	Non- PT user	PT user	Non- PT user
Staff	No.	358	443	641	1283
	%	44.7	55.3	33.3	66.7
Student	No.	783	312	2927	2194
	%	71.5	28.5	57.2	42.8
Total	No.	1141	755	3568	3477
	%	60.2	39.8	50.6	49.4

3.3 Main transport mode to St. Lucia

UQ staff and student reported different preference for transport modes to travel to UQ. The self-reported transport modes by UQ staff and student are listed in Table 3, wherein all transport modes were grouped into three categories of car, public transport (bus, ferry and train) and sustainable modes (walking and cycling). Table 3 shows that car uses are most popular amongst UQ staff than student, with 44% of UQ staff reported as car users. UQ students use public transport more often (59%) than staff (41%). Sustainable modes are important supplement to car and public transport travel, with 15% of staff and 17% of student reported as sustainable mode users to travel to UQ. The results are consistent with the findings about modal split of education trips from the Tertiary Student Travel Survey, supporting the representativeness of our sample.

Table 3. Main transport mode to St. Lucia campus

		Motor vehicle	Public transport	Sustainable modes
Staff	No.	846	789	289
	%	44	41	15
Student	No.	1229	3021	871
	%	24	59	17

To illustrate the geographic distribution of car and public transport users, all respondents were grouped by their travel origin suburbs. We only included suburbs with more than 15 respondents and use same four-level colouring scheme for analyses of both car and public transport users in each suburb (Figure 3). The two maps in Figure 3 present the percentage of car and public transport user in each suburb. The car user map shows that suburbs with dominant car use are clustered in the north-west of Brisbane. Pullenvale, Ascot, Moggill, Kenmore Hills and Middle Park are the top five suburbs with highest percentage of car users. Nevertheless, public transport user are more clustered in the south-east part of Brisbane, with Wishart, Capalaba, Morningside, Upper Mount Gravatt, South Brisbane and their surrounding suburbs recorded the highest percentage of public transport use. The map indicates a clear relationship between public transport use and the provision of reliable and convenient transport infrastructure such as bus way connection.

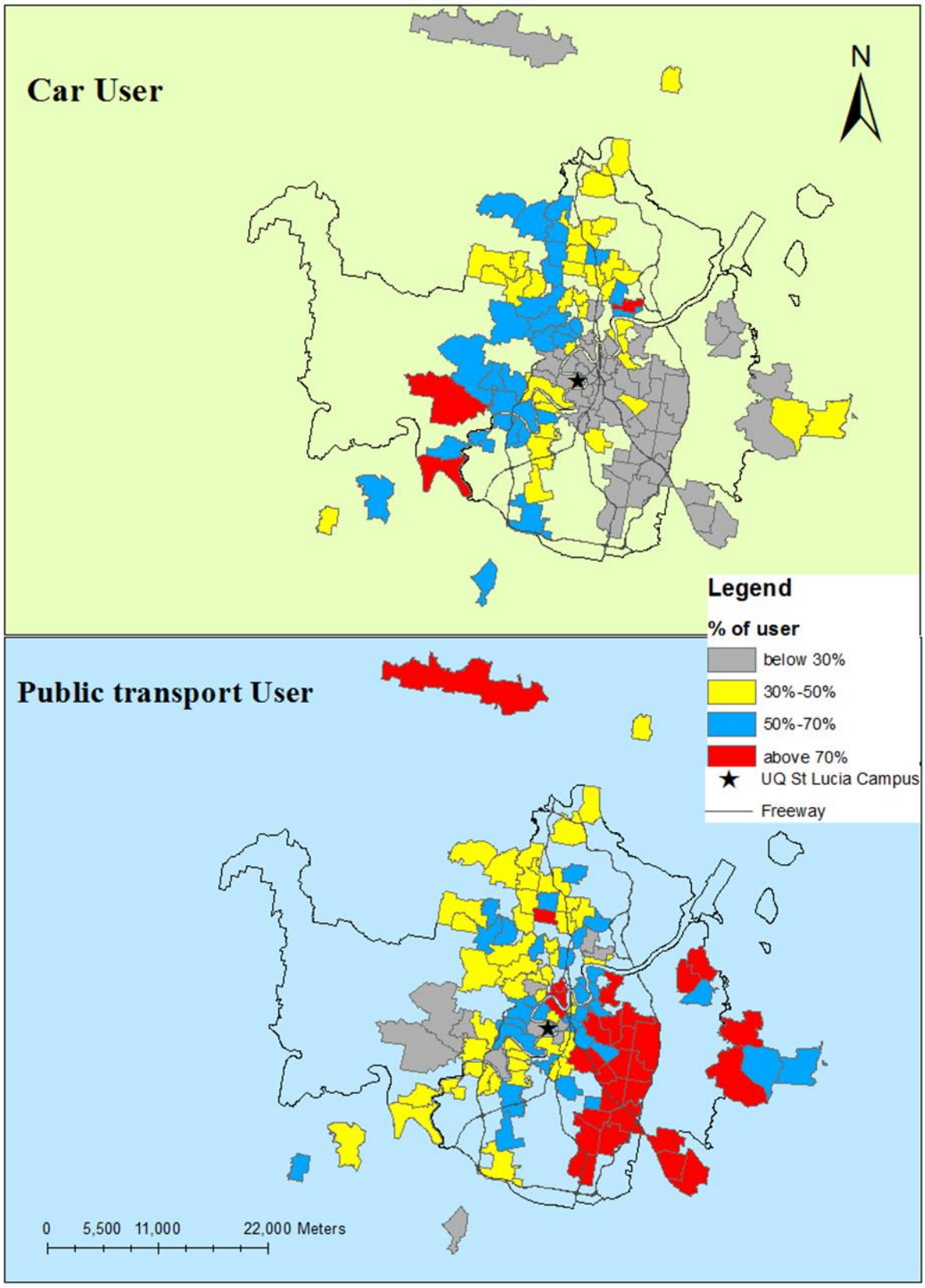

Figure 3 Percentage of car and public transport user of each suburb

3.4 Correlations between public transport use and transport fare or travel distance

The outcomes of spearman's rho analysis were reported in Table 4. Correlations between PT user ratio and fare per kilometre were negative for both staff and students. However, the relationship was only statistically significant for student. The result indicates that student's public transport use decisions are more likely to be influenced by fare per kilometre than those of staff. When the influence of total fare and distance of travel on public transport use was examined, both fare and distance reported significant positive relationships with PT user ratio of each suburb. The relationships are similar in strength for both student and staff, indicating travel distance may have a stronger influence on public transport use than travel cost. The positive relationship between fare and user ratio may be explained by the fact that public transport fare increase with the distance travelled.

Table 4. Correlations between PT ratio, fare/distance, PT fare and suburb distance to destination (spearman's rho)

	Student			Staff		
Variables	Fare per kilometre	Fare	Distance	Fare per kilometre	Fare	Distance
PT User ratio	-.37**	.31*	.34*	-.13	.39**	.29*
Fare			.59**			.35*

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
Note: Physical distance was calculated using ESRI ArcGIS software

3.5 Factors that influence public transport use

We asked respondent about their reasons to use or not use public transport as the main mode travel to UQ. Descriptive and regression analyses were conducted to provide insights into these responses.

3.5.1 Barriers to using public transport to travel to St. Lucia

Respondents were asked to select items that best describe their barriers to use public transport to travel to UQ from 15 barriers listed in Table 5. The top three reasons are travel time too long (16.23%), cost consideration (13.62%) and convenience of private vehicle (12.08%). The result supports our presupposition that transport distance and cost as two important factor influencing the decision to use public transport. Further, our respondents reported a preference to walk and cycle as one of the most popular reasons of not using public transport, indicating that active transport modes are likely to provide important supplements to traditional transport methods for UQ commuters.

Table 6 compares UQ staff and student for their most popular reasons of not using public transport. When staff and students were compared for the top ten barriers, no big discrepancy was found between the two groups for their respondents towards the questions. Nevertheless, a slightly higher percentage of UQ staff reported that they does not use public transport because there is reliable/convenient parking at place of work, while students has higher percentage response to the reason that they live too close to UQ to use public transport.

Table 5. Barriers to use public transport to travel to St. Lucia (for all respondents)

Barriers	No.	Percentage
Travel time too long	1678	16.23%
Cost considerations	1408	13.62%
Convenience/comfort/privacy in private vehicle	1249	12.08%
Public transport is unreliable/too crowded	1002	9.69%
Own vehicle needed before/during/after hours	986	9.54%
Prefer to walk/cycle	885	8.56%
No service available at right/convenient time	838	8.10%
Too close to work/study to use public transport	528	5.11%
Public transport services too far from home	506	4.89%
Carry equipment/tools/passengers/children	470	4.55%
Reliable/convenient parking near/at place of work/study	406	3.93%
Concerned about personal safety	229	2.21%
No service available at all	134	1.30%
Company or employer's vehicle needed during work/study hours	21	0.20%

Table 6. Barriers to use public transport to travel to St. Lucia by staff and student

Barriers	Staff	Student	Ratio-Staff	Ratio-Student
No service available at all	40	94	1.1%	1.4%
No service available at right/convenient time	271	552	7.6%	8.2%
Convenience/comfort/privacy in private vehicle	450	799	12.6%	11.8%
Public transport services too far from home	159	347	4.4%	5.1%
Travel time too long	653	1025	18.2%	15.2%
Cost considerations	495	913	13.8%	13.5%
Own vehicle needed before/during/after hours	358	628	10.0%	9.3%
Company or employer's vehicle needed during work/study hours	10	11	0.3%	0.2%
Carry equipment/tools/passengers/children	248	222	6.9%	3.3%
Reliable/convenient parking near/at place of work/study	221	185	6.2%	2.7%
Prefer to walk/cycle	281	604	7.8%	9.0%
Concerned about personal safety	52	177	1.5%	2.6%
Public transport is unreliable/too crowded	264	738	7.4%	10.9%
Too close to work/study to use public transport	78	450	2.2%	6.7%

3.5.2 Motivators to using public transport to travel to St. Lucia

Apart from the PT use barriers, respondents were asked to address their reasons to use public transport to travel to UQ and chose from 10 items in Table 6. The top three reasons are parking concerns (17.86%), public transport near to home (16.45%) and convenience/less stress (15.94%). The result supports UQ policies in regards to on-campus parking for their effectiveness to encourage public transport use. Table 8 compared staff and student for their reasons to use public transport. While staff prefer to use public transport due to reduce travel time and high frequency of service, higher percentage of students reported that they use public transport because they don't own motor vehicles or driver licences.

Table 7. Reasons to use public transport to travel to St. Lucia (for all respondents)

Motivators	No.	Percentage
Parking concerns	2189	16.86%
Public transport services near to home	2136	16.45%
Convenience/comfort/less stress	2069	15.94%
Doesn't own motor vehicle	1257	9.68%
Reduced travel time	1176	9.06%
Price/cost	1056	8.13%
Frequency of service	1022	7.87%
Environmental concerns	877	6.75%
Cannot drive/unlicensed	798	6.15%
Other household member uses car	403	3.10%

Table 8. Reasons to use public transport to travel to St. Lucia by student and staff

Motivators	Student	Staff	Ratio-Student	Ratio-Staff
Convenience/comfort/less stress	1614	455	15.1%	19.9%
Reduced travel time	893	283	8.4%	12.4%
Public transport services near to home	1729	407	16.2%	17.8%
Frequency of service	799	223	7.5%	9.7%
Price/cost	956	100	8.9%	4.4%
Doesn't own motor vehicle	1157	100	10.8%	4.4%
Cannot drive/unlicensed	737	61	6.9%	2.7%
Other household member uses car	322	81	3.0%	3.5%
Parking concerns	1812	377	16.9%	16.5%
Environmental concerns	675	202	6.3%	8.8%

3.5.3 Factors that influence using public transport to travel to UQ

Two multiple linear regression models were run to explain the variance of suburb PT user ratio. The first model regressed against fare, distance and all the 16 non-use reasons (barriers), and the second model used fare, distance and all the 10 use reasons (motivators) as independent variables. The results showed that both regression models are statistically significant at a 0.05 alpha level. The non-use model has better model fit (R^2 =0.63) than the model with use reasons (R^2 =0.50), indicating the higher explanatory power of the non-use model. Therefore, we used the non-use model hereafter to identify predictors of public transport use.

Four variables were reported as significant predictors of public transport use ratio of suburbs, including distance, too close to work, no service available at right time and travel time too long. Travel time was the strongest predictor variables (standardized coefficient = -.484) of public transport use with a negative relationship. This indicates that long travel time will significantly influence UQ commuters' decision to use public transport as primary travel mode. Second strongest predictor variable was too close to work (standardized coefficient = -.477), indicating people who live in surrounding suburbs won't choose public transport as primary travel mode. Travel distance is likely to have a positive impact on public transport use (standardized coefficient = .351), with the longer distance UQ commuters travel, the higher chance they use public transport. Further, service frequency and availability is also important in predicting public transport use. However, both actual fare and self-reported cost consideration were not shown as important predictor variables to influence public transport use of UQ commuters. This may partly be explained by the relationship between travel cost and distance.

In addition, travel time is important in influencing public transport use decision. This result is consistent with spatial analysis results that the areas with better provision of transport infrastructure reported higher public transport use.

Table 9. Regression model for perceived barriers travel distance and fare

Variables	**PT use ratio against fare, distance and all barriers**	
	Stand. coeff.	***p***
No service available at all	-.003	.966
No service available at right/convenient time	-.216	.022*
Convenience/comfort/privacy in private vehicle	-.087	.436
Public transport services too far from home	-.095	.235
Travel time too long	-.484	.000**
Cost considerations	-.026	.776
Own vehicle needed before/during/after hours	.060	.560
Company or employer's vehicle needed during work/study hours	.015	.834
Carry equipment/tools/passengers/children	.029	.716
Reliable/convenient parking near/at place of work/study	-.010	.904
Prefer to walk/cycle	.104	.422
Concerned about personal safety	.108	.222
Public transport is unreliable/too crowded	.096	.267
Too close to work/study to use public transport	-.477	.000**
Fare	.113	.142
Distance	.351	.000**
N	100	
R	0.79	
R^2	0.63	
Adjusted R^2	0.56	
F	8.78**	

***p*<0.01(2-tailed), **p*<0.05 (2-tailed)

4. Discussion

This paper analysed factors that influence public transport use, with both physical and perceived factors compared for their contributions to the dependent variable. Our analyses indicated that the percentage of public transport use in UQ has fallen by approximately 10% from 60.2% in 2013 to 50.6% in 2014. The decline may partly be explained by a total of 55% fare increase since 2010 in Queensland. The fare increase has been criticized for triggering a public transport patronage decline by 11% in South East Queensland (The Greens, 2015). We acknowledge that the low response rates in our surveys may increase the potential for non-response bias, especially in the 2013 sample. The representativeness of the 2014 sample was higher, with a sample size 2.5 times larger than 2013 and a better geographic representation of suburbs as travel origins (361 suburbs in 2014 vs. 295 suburbs in 2013). Staff and students were compared for their preferences of travel mode to the University. The results highlighted different preference of travel modes between the two groups of staff and students: UQ staff had higher preferences towards motor vehicles but more students travelled by public transport. The spatial analysis of UQ commuters' mode use showed a spatial correlation with the supply of high quality public transport infrastructure, indicating the importance of accessibility in promoting active transport use. There is a cluster of higher preference to public transport use in Brisbane's southeast suburbs that has busway connections to the University.

The outcomes of this study have both theoretical and practical implications. Theoretically, both physical and perceived factors were examined for their impacts on public transport use. We integrated both subjectively and objectively measured factors into the same regression model to compare their relative importance as predictors to public transport use. For example, the travel cost variable was both subjectively measured as *travel cost consideration* using survey questions and objectively measured as *travel fare* using actual dollars. Neither of them was reported as significant predictor variables to public transport use. And yet, travel distance was first objectively measured as actual distance between a respondent's travel origin and destination. For comparison, a subjective measure

of perceived *travel time*, which is closely related to the *distance* variable, was adopted. Consistent findings were found for both subjective and objective measures. Whilst both measures of travel cost were not significant, the two distance-related measures were the strongest predictors to public transport use. This outcome contrasts with previous studies that reported inconsistency between perceived and objective access to urban facilities (Ball et al., 2008, McCormack et al., 2008, Jones et al., 2009, Scott et al., 2007, Wang et al., 2015). This might be explained because accessibility is a fairly complex construct with multiple dimensions (Brown, 2008, Wang et al., 2015); and yet, the travel indicators such as travel time and cost are fairly simple variables that involve less measurement bias.

In late 2014, a 5% public transport fare reduction was initiated by the Queensland government with an aim to encourage public transport use (Bochenski, 2014). However, our study indicates that response to the fare change varies by population groups. There were empirical supports for the presence of the association between fare per kilometre and the preference of public transport use for the subgroup of students, but not for staff. The results from regression analysis further showed that transport fare was not a significant predictor variable to public transport use for all respondents. This finding has important policy implications as it indicates that a simple fare reduction may not necessarily result in an increase in public transport patronage. It is because that a change in public transport fare may have little impact on the preference towards car use, especially for non-student or adult users.

This study indicated that variables associated with service quality (e.g., travel time and service frequency) are more important in influencing public transport use amongst UQ commuters. Our model highlighted three variables with implications for encouraging public transport utilization. First, this study concurred with Shannon et al. (2006) who found that perceived travel time by bus has the greatest impact on commuting pattern. The negative relationship between perceived travel time and public transport use indicates that people won't use public transport if they consider travel time too long to be acceptable. Further, public transport use is more popular for medium to long distance commuters given the perceived travel time is acceptable. Service frequency provided another important predictor variable to public transport use. Therefore, policy interventions targeting service quality improvement may be more effective towards increasing public transport patronage than a fare change regardless of user preference.

5. Conclusion

An individual's intellectual abstraction of a geometric space defines their access to facilities (Ferreira and Batey, 2007). That is, the reality of geometric space tends to be adjusted by travellers' personal experience. A better transport connection or a pleasant trip can make places feel much closer than they actually are. Therefore, it is important to develop knowledge about the relationship between travel distance and the acceptability of travel time, given their important role in influencing decisions towards public transport use. The relationship may vary by contexts (e.g., high density vs. sprawl cities; different user groups such as staff and students). Future studies are needed to identify transport mode preference at local levels to inform transport management and planning.

Large employers like universities are important generators of travel demand on urban transport networks. They can also act as advocators to foster changes to more active and sustainable lifestyles. Although this study has not investigated other active transport modes such as walking and cycling due to the focus of research questions, our findings do suggest that walking and cycling provide important supplement to car and public transport trips, especially for people who live close to the university campus. Future studies may examine the effective service zone of these active travel modes and identify barriers that constrain their use to inform management for improvements to transport policies and infrastructure that support sustainable future of our cities.

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