

Investigation into Travel Modes of TOD Users: Impacts of Personal and Transit Characteristics

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Transit Oriented Developments (TODs) are often designed to promote the use of sustainable modes of transport and reduce car usage. This paper investigates the effect of personal and transit characteristics on travel choices of TOD users. Binary logistic regression models were developed to determine the probability of choosing sustainable modes of transport including walking, cycling and public transport. Kelvin Grove Urban Village (KGVU) located in Brisbane, Australia was chosen as case study TOD. The modal splits for employees, students, shoppers and residents showed that 47% of employees, 84% of students, 71% of shoppers and 56% of residents used sustainable modes of transport.

Keywords: *TOD, sustainable mode choice, logistic regression, mode share*

1. Introduction

Transit Oriented Development (TOD) has become popular due to the need for providing sustainable living in urban areas. These developments are often looked as a solution to the adverse effects of pollution, congestion and delays caused by steady population growth, urban sprawl and increasing use of the private car. The claim of sustainable transport is the central aspect of TOD planning and design. Public transport, walking and cycling are preferred as sustainable modes of transport. TODs are generally designed as a mixed use development with a major transit station at its centre and also characterised by public open spaces and pedestrian friendly design.

“A TOD is moderate to higher – density development, located within an easy walk of a major transit stop, generally with a mix of residential, employment and shopping opportunities designed for pedestrians without excluding auto. TOD can be new construction or redevelopment of one or more buildings whose design and orientation facilitate transit use.” [14]

In addition to residential, commercial and office space the mix of land uses may consist of recreational and educational uses. TODs are known by many names all over the world; transit precincts, smart growth, urban form, walkable communities, activity centres to name a few. These developments are classified as urban downtown to commuter town center based on the scale of development, types of land uses and type of transit service provided [7]. Although different names and scales the basic design principles are the same. The

mixed uses at a TOD are supposed to promote walking trips while the transit centre is provided for promoting use of public transport.

Different types of land uses provide space for interaction to various categories of people in a relatively small sized area. Various people interacting at a TOD may include residents to students, shoppers and employees. In this paper, the people residing in the TOD are termed as ‘residents’ and people using the TOD but residing outside the TOD boundary are termed as ‘visitors’. Due to involvement of various categories of people, the travel characteristics of a TOD can not be specified by assessing only residents’ travel data or visitors’ travel data. The travel characteristics of both groups of TOD users need to be analysed. The next section reviews past literature related to the studies dealing with travel characteristics of TOD users.

2. Past studies

The travel characteristics of TOD users are considered to be different than that of people living in conventional development due to its atypical development pattern. The TOD characteristics like mixed use, pedestrian friendly design, good quality of public transport service are regarded as key parameters for making a difference in travel characteristics of TOD users. Some studies have shown that urban densities, traditional neighbourhood schemes and land use mix have a substantial impact on car ownership and use while others have shown a marginal impact [1].

The commuting characteristics of transit – oriented and auto – oriented suburban neighbourhoods were compared in the San Francisco Bay Area and in Southern California, USA. Regression models were built to study the relationship between neighbourhood type, transit mode shares and generation rates [4]. In another study, the effects of New Urbanism design principles on non – work and commuting travel were studied by comparing modal split between two distinctly different neighbourhoods in the San Francisco Bay Area. A Binomial Logit model was developed to predict the probability of using a non car mode for non work trips as a function of the type of neighbourhood of respondents as well as other control variables. Another Binomial Logit model was developed for work trips to predict the probability of commuting by a non single occupant vehicle (non-SOV). Results of the Logit model were used to simulate mode choice based on neighbourhood origin and number of vehicles per household [5].

Five types of variables, namely: socioeconomic, land use, street network, transit service and other (interaction) variables were used to model bus mode shares using full – information maximum likelihood (FIML) method [12]. A normative model was developed for mode choice weighing the influence of density, diversity, design of built environments along with factors associated to generalised cost and socioeconomic attributes of the travellers [3]. The probability of automobile ownership was calculated using an ordered Logit regression. Household characteristics, neighbourhood characteristics and urban design characteristics were used in the model considering Portland, Oregon, USA as a case study site [10].

A multinomial Logit mode choice model was developed consisting of drive-alone, shared-ride, transit, walk and bike as choice set. The impact of urban form on nonwork trip mode choice was investigated by using the travel data from 1995 Portland Metropolitan Activity Survey conducted by Portland Metro, which collected travel information from members of a sample of households over a two weekday period [15]. The influence of population density, relative share of commercial and service land uses, and relative share of vacant land on an individual's propensity to make home-based, nonwork, non-school (HB NWNS) walking trips was exhibited for assessing the influence of land use on travel behaviour in Santiago, Chile [17]. It was argued that if there is poor transit service, the land use qualities will never influence a modal shift to transit [8].

The impact of urban form on travel patterns was evaluated by considering the role of individual travellers and space-time context of cities in Europe,

Canada and the USA using Ordinary Least Square Regression modelling in SPSS software [6].

The literature review has indicated that most studies have assessed the travel characteristics of a TOD development by studying residents' travel data, while visitors travel data was not used. Also, the neighbourhood and development characteristics were considered but the impact of transit characteristics on mode choice was not assessed. So this paper aims to assess the mode choices of TOD residents, and visitors, based on their personal and transit characteristics.

3. Objective of this paper

The main objective of this paper is to investigate the relationship between travel modes of TOD users and their personal and transit characteristics and to study how TOD users use sustainable modes of transport like walking, cycling and public transport. For this purpose, this paper presents binary logistic models predicting the probability of choosing these modes. These models predict the probability based on personal characteristics such as age group, gender, licence availability, employment status and transit characteristics such as trip length, travel time difference and car availability of a TOD user. The travel data collected from various users of a case study TOD was used in statistical analysis. The next section gives an overview of the case study TOD.

4. Case study TOD: KGUV

A newly developing TOD, Kelvin Grove Urban Village (KGUV) located approximately 2km north west of Brisbane, Australia's central business district (CBD) was selected as a case study. The mixed use development spanning over 16.57 Ha of land area is the first of its kind of development in Australia. The various land uses include residential (consisting of townhouses and apartments), commercial and retail, office and educational land uses (school and university campus extension). Details of the land uses are given in Table 1 and an overview of the KGUV is shown in Figure 1. KGUV has an existing university campus and a state high school located on its northern boundary. This site is still under development and is expected to be fully operational by late 2009.



Figure 1 Ariel View of Kelvin Grove Urban Village (Development has been taken place since the photograph was taken)

The main aspects considered for study site selection were the transportation facilities and proximity to Brisbane's Central Business District (CBD). The site is well connected to arterial roads and has an internal street network forming a grid pattern, with parks and open spaces promoting walking and cycling. Generally, TOD developments are planned around a major transit node. As the distance from the node increases the density often decreases. However, KGUV does not have a major transit station at its centre; instead major public transport corridors run along east and west flank with an intercampus shuttle bus service running through its heart (see Figure 1). KGUV is served by 17

bus services including 10 express and very high frequency services. KGUV is close to two major busway stations (ST1 and ST8), four express bus stops (ST3, ST4, ST5, and ST7) and two local bus stops (ST2 and ST6); the locations of bus stops can be seen in Figure 1. Quality of service was analysed for public transport availability according to a formal framework specified in TCQSM [11]. The results indicated that KGUV has overall good quality of public transport service (For further information about calculations of quality of service, please refer to [13]).

Brisbane City Council stipulates car parking rates of a minimum 3 spaces per 50m² GFA at ground floor level and 1 space per 30m² GFA above ground level for centre activities, 1 space for two staff and 1 space per 10 students at tertiary institutions and 1 space per 30m² GFA for offices [2]. In KGUV the number of car spaces is restricted to 1 space per 30m² GFA for all non residential development. Usually, restricted parking facilities are provided at TODs to discourage drivers from driving their cars and to promote the use of sustainable modes of transport like walking, cycling and use of public transport.

In order to study the travel characteristics of TOD users, travel surveys were planned. It can be observed from Table 1 that KGUV has residents, and visitors including employees of a retail shopping centre, employees of educational land uses, university students, school students and shoppers as users of this development. The survey instruments and their performance for each group of TOD user are briefly explained in the next section.

Table 1 Mixed land uses at Kelvin Grove Urban Village

Land use	Area (sqm)	Description
Residential	35,668	1000 residential units including 200 affordable units, 455 beds of student accommodation and managed accommodation for older people
Educational	14,770	QUT campus extension, QACI high school
Retail	Not Available	Centrally located shopping centre with street level shops
Commercial	3,878	Commercial office facilities
Recreational	6,897	Network of parks, theatre, sports complex
Mixed	11,995	Mixed use area for residential, commercial and retail land use
	26,014	Mixed use area for educational and commercial purposes

5. Overview of Data Collection

Travel surveys were conducted for various groups of KGUV users to collect their demographic details and travel details. Different survey instruments were employed to optimise the response rates. The professional employees and university students who had good internet access were surveyed using internet based surveys. Retail shop employees and shoppers who may not have internet access and office email

were surveyed using the personal interview technique. For these two groups, initially CAPI surveys were planned but the survey instrument was modified to pen and paper form for convenience. The residents and school students were surveyed using a mail back survey technique. Two weeks after posting of the questionnaire, a reminder letter was sent to these respondents. Only people interacting within the KGUV boundary were targeted for data collection. The sample size was kept as 100% of the population size to reduce

coverage and sampling error. Table 2 represents the summary of data collection with the final response

rates obtained after sending the reminder message for each user group.

Table 2 Details of data collection

TOD User group	Type of survey instrument	Sample size	Response rate
Residents	Mail back	34	8%
Professional employees	Internet based	125	10%
Retail shop employees	Personal interviews	39	31%
University students	Internet based	89	15%
School students	Mail back	28	20%
Shoppers	Personal interviews	117	68%

6. Travel modes of TOD users

Figure 2 to Figure 7 show classified mode shares for various groups of TOD users. The public transport mode shares include combined trips made by train and bus. There were no ferry trips undertaken by any TOD users as there is no ferry terminal in the vicinity of KGUV. Taxi was not considered as a mode of everyday transport. For statistical analysis, the classified mode shares were divided into two groups; more sustainable modes of transport such as walking, cycling and public transport, and less sustainable mode of transport being the car.

6.1. Mode shares of employees

A data set of 125 responses (10% of population) was obtained from the internet based survey conducted for professional employees. A significant number of employees possessed a valid driving licence (92%). The professional employees travelled by various modes

of transport (Figure 2). Only 50% of respondents travelled by car while others travelled by the more sustainable modes of transport. The bicycle mode share can be attributed to good quality access and availability of trip end facilities such as shower and bike lockers. The higher public transport mode share was observed as the employees travelled typically during peak hours in which public transport provision is at its best [13].

The personal interviews carried out for retail shop employees collected travel data of 39 employees with a 31% response rate. From the interviews it was found that a substantial number of employees were working part time (around 30%). These were mainly students studying at university or living in KGUV. Figure 3 shows the mode shares for retail shop employees. These employees travelled by 3 modes of transport; car, public transport and walking. A majority of employees used car as their mode of transport, likely due to odd (late night or early morning) working hours and availability of free parking space.

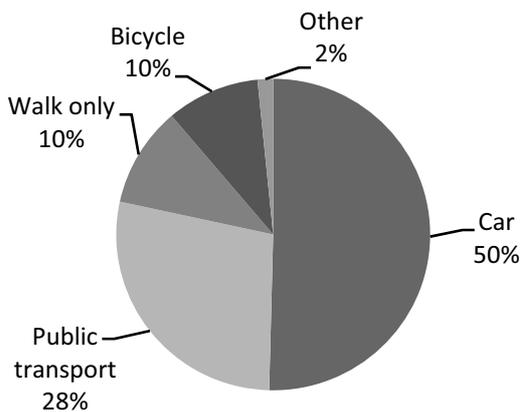


Figure 2 Mode shares for professional employees at KGUV

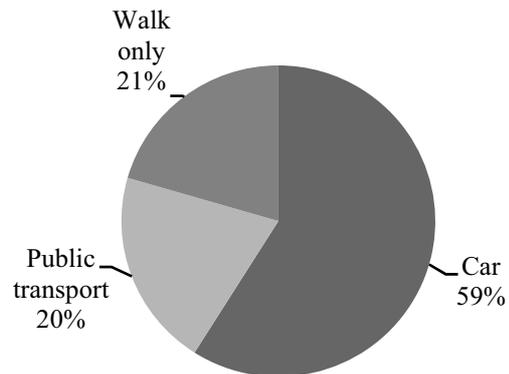


Figure 3 Mode shares for retail shop employees at KGUV

6.2. Mode shares of students

The mail back survey conducted for students obtained 28 responses with a 20% response rate. These respondents were school students of Grade 10 to Grade 12; hence they all were less than 18 years old. These

school students did not have an open driving licence so by and large had no access to car as driver. Due to this, this group of TOD users can be termed as ‘captive riders’. Figure 4 shows that the school students travelled by only two modes of transport; public transport and car. Almost 86% of students used public

transport for their trip to school and remaining 14% students were dropped at school by car. There were no walk only and bicycle trips for school students; these two modes were not considered any further as an alternative option for journey to school. (It is noted that QACI is an elite school, to which students will travel across Brisbane.)

Figure 5 shows the mode share of university students using 89 responses (at a response rate of 15%)

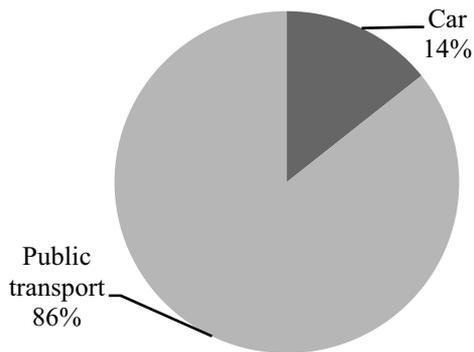


Figure 4 Mode shares for school students at KGUV

obtained from an internet based survey. Similar to retail employees, university students travelled by only three modes of transport; walk only, car or public transport. Similar to school students no bicycle trip was recorded for university students. Almost two-thirds of students travelled to university by public transport and only 16% arrived by private car. The higher public transport mode share may be attributed to the student having no driving licence or the cost involved in using a car.

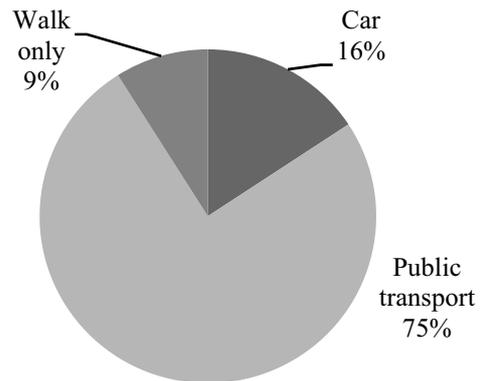


Figure 5 Mode shares for university students at KGUV

6.3. Mode shares of shoppers

Figure 6 shows the classified mode share values for shoppers at KGUV. A dataset of 117 respondents from the quick interview was used for analysis. Almost 60% respondents were students and others were residents of KGUV or those living in close vicinity to KGUV. Only 27% of shopping trips were undertaken by car, while very few shoppers used bicycle and motorcycle. It may be postulated that the mixed land uses promoted walking trips (44%). The mode distribution shows that more than 70% of shoppers travelled by the more sustainable transport modes.

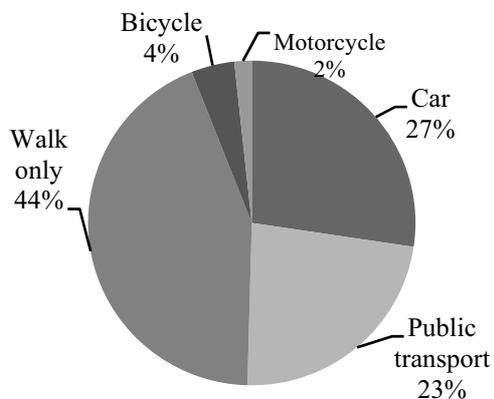


Figure 6 Mode shares for shoppers at KGUV

6.4. Mode share of Residents

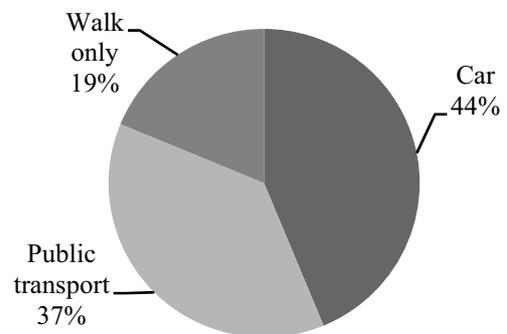


Figure 7 Mode shares for residents at KGUV

The travel mode shares from a sample of 32 residents of KGUV are shown in Figure 7. Two respondents did not travel on the assigned day so were not considered in this analysis. Similar to the university students and retail shop employees, the residents of KGUV typically travelled by either car, public transport or walk only. No train, ferry or bike trips were reported.

7. Statistical models for mode choice prediction

In order to determine the parameters affecting the sustainable mode choices and determine the probability of choosing a more sustainable mode of transport, a binary logistic regression analysis was performed. The general form of logistic regression is shown in Equation 1 and Equation 2.

Logistic regression function,

$$p(y) = \frac{e^z}{1 + e^z} \quad \text{Equation 1}$$

The linear regression equation,

$$z = a_0 + a_1 \times x_1 + a_2 \times x_2 + a_3 \times x_3 + \dots \quad \text{Equation 2}$$

Where,

- a_0 = Regression constant
- a_1, a_2, \dots = Regression coefficients
- x_1, x_2, \dots = Independent variables
- $p(y)$ = Probability of predicting y, in this case use of a sustainable transport mode, using independent variables
- z = Linear function of independent variables

The travel modes were considered as dependant variables and car ownership, employment status, gender, age group, driving licence availability, trip length, and travel time difference were considered as independent variables. Trip lengths and travel times were calculated with the help of the “home suburbs” specified using “Google Maps”. Trip length was the

actual road distance travelled by car from home suburb to Village Centre. The car travel time was the time required to travel the trip length (Given by Google Maps [18]). The public transport travel time was calculated using the journey planner on the Translink Transit Authority’s public transport information website. The origin location was the home suburb and for convenience the destination was given as the QUT Kelvin Grove busway station. The option of fastest travel time for a weekday was considered in travel time calculations. An additional travel time of 10 minutes and 15 minutes was added to the estimated travel time for car and public transport respectively to take into account walking times. In the Translink journey planner, the options of arriving before start time and departing after start time were selected for visitors and residents of KGUV. The travel time difference was calculated by subtracting public transport travel time from car travel time. The travel time difference for the cases in which no public transport option was available were coded as missing values for the travel time difference. The coding of other variables is shown in Table 3.

The following section presents binary Logistic regression models developed for employees, students and shoppers at KGUV. A software package “SPSS” was used for analysis. An exploratory analysis of residents’ data is also presented. A pseudo R^2 (ρ^2) value was calculated to test the Goodness of fit of the model. A model having pseudo R^2 (ρ^2) value in between 0.2 to 0.4 is considered as a statistically significant model [9].

Table 3 Details of variable coding

Variable coding	
Mode of transport (Mode)	
Sustainable mode of transport = 1	Non sustainable mode of transport = 0
Age group (AG)	
0 to 18 years = 0	18 years to 30 years = 1
30 years to 45 years = 2	45 years to 65 years = 3
65 years and above = 4	
Car availability (CA)	
Car available = 1	Car not available = 0
Gender (Gen)	
Female = 0	Male = 1
Employment status (Emp_Sta)	
Employed full time = 0	Student full time = 1
Employed part time = 2	Student part time = 3
Unemployed / Retired = 4	Self employed = 5
Driving licence availability (LA)	
Driving licence available = 1	Driving licence not available = 0

7.1. Model for Employees

The professional employee and retail employee data was combined to develop a binary logistic regression model predicting the probability of an employee choosing a sustainable mode of transport based on their personal and transit characteristics. Six predictor variables namely, age group, gender, trip length, travel time difference, employment status and car availability, were used to develop the model. Table 4 represents the complete model with all predictor variables. The complete model was statistically significant having a pseudo R^2 (ρ^2) value of 0.3954 predicting 75.8% cases correctly. From the model, it can be confirmed that employment status and trip length were statistically significant variables and car availability was the most insignificant variable.

The model was simulated for a male employee of age group 30years – 45years who has car available for his work trip and has faster travel time by car by 15 minutes. Figure 8 shows the impact of trip length variation on the probability of choosing a more

sustainable mode of transport. The probability of using public transport or walk reduces as trip length increases. For zero trip length the probability of walking is almost 60%. The probability for similar conditions becomes 10% for a trip length of 50km. The odds of trip length suggest that for every kilometre increase in trip length the employee has 0.953 times the odds of using a sustainable travel mode. The odds for travel time difference indicate that for every minute increase in travel time difference the employee has 0.995 times the odds of using a sustainable travel mode.

The odds ratio for gender was noted as 1.320 indicating a male employee has 1.32 times the odds of choosing sustainable transport than a female employee. This accords with results presented in the past [16]. The odds ratios for age group and employment status indicate that older and more senior employees have much lower odds of choosing sustainable transport. This is justified because the senior employees and businesspeople had a parking space available at their work space which makes their car travel more convenient.

Table 4 Binary logistic regression for employees at KGUV

Variable	Coefficient (B)	Standard error	Significance	Odds ratio Exp(B)	95 % C. I. for odds ratio	
					Lower	Upper
Age Group	-0.550	0.306	0.073	0.577	0.317	1.052
Gender	0.278	0.457	0.543	1.320	0.539	3.235
Trip Length	-0.048	0.024	0.048	0.953	0.908	1.000
Travel time difference	-0.005	0.026	0.850	0.995	0.946	1.047
Employment status	-0.621	0.260	0.017	0.537	0.323	0.895
Car availability	-39.349	3.485E7	1.000	0.000	0.000	
Constant	40.358	3.485E7	1.000	3.368E17		

Summary Statistics: No of cases: 164

Pseudo ρ^2 (1- ratio of log likelihood of complete model to the constant only model) = 0.3954,

Chi-square = 81.682, Probability = 0.001

% cases correctly predicted = 75.8% (criterion, if estimated probability > 0.500, the predicted mode is sustainable mode of transport)

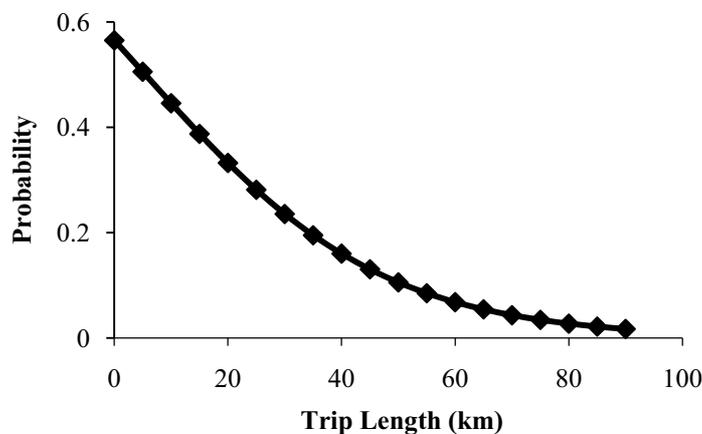


Figure 8 Sensitivity of choosing sustainable mode of transport as a function of trip length

7.2. Model for Students

A binary logistic regression model was developed combining school students' and university students' data. An additional variable, licence availability (LA), was used as that was apparently a difference between school students and university students. The other five independent variables used to speculate the probability of choosing sustainable mode of transport for educational trip were travel time difference, trip length, car availability, gender, and age group. Table 5 represents the detailed final model. The final model form obtained a pseudo R^2 (ρ^2) value of 0.35 with 85.5% cases predicted accurately. The significance values indicate that none of the variables is statistically

significant. Statistically, car availability was the least significant variable with significance value 1 and odds ratio of 0. For this case, it was attributed to a very small sample size.

The odds ratio for driving licence availability showed that if the student possesses a valid driving licence then the odds of them using a sustainable travel mode is 0.397 times that of those not possessing one. If similar conditions exist, then a male student has 2.15 times the odds of using sustainable transport than a female student. The odds ratios of travel time difference and trip length indicates that a unit increases in these variables increases the odds of using sustainable transport by 1.003 and 1.018 respectively. This is consistent with the general trend.

Table 5 Binary logistic regression for students at KGUV

Variable	Coefficient (B)	Standard error	Significance	Odds ratio Exp(B)	95% C. I. for odds ratio	
					Lower	Upper
Travel time difference	0.003	0.028	0.902	1.003	0.950	1.060
Trip length	0.018	0.029	0.539	1.018	0.962	1.078
Car availability	-37.784	5.519E7	1.000	0.000	0.000	
Gender	0.765	0.873	0.381	2.150	0.388	11.898
Age group	0.005	1.133	0.997	1.005	0.109	9.251
Licence availability	-0.923	1.249	0.460	0.397	0.034	4.598
Constant	38.821	4.519E7	1.000	7.241E16		

Summary Statistics: No of cases: 117

Pseudo ρ^2 (1- ratio of log likelihood of complete model to the constant only model) = 0.35,

Chi-square = 31.954, Probability = 0.001

% cases correctly predicted = 85.5% (criterion, if estimated probability > 0.500, the predicted mode is sustainable mode of transport)

7.3. Model for Shoppers

Binary logistic regression was performed to assess the impact of personal and transit characteristics on the likelihood that the KGUV shoppers choose a sustainable mode of transport for their shopping trip to KGUV. The model contained five independent variables; age group, frequency of shopping trip, employment status, trip length and travel time difference. The complete model containing all predictor variables was statistically fit having a pseudo R^2 (ρ^2) of 0.2371 with 80.9% cases predicted correctly. This indicated that the independent variables played an important role in predicting the mode choice.

As shown in Table 6, age group was the most significant variable followed by travel time difference and frequency of shopping trip. The strongest predictor, age group reported an odds ratio of 0.337. This implied that older shoppers had much lower odds of using a sustainable transport mode. Figure 9 shows the simulated results for the model showing variation of probability of choosing a sustainable mode of

transport with age group. The graph was plotted for a student living 5km from the shopping centre and having a travel time difference of -10 minutes with the frequency of shopping trip as 3 trips per week. These assumed values represent the approximate average values. The graph shows that the probability of choosing a sustainable mode is very high for young shoppers; as the age of shoppers increases the tendency of driving to shopping centre increases (0.92 to 0.12).

The odds ratio of frequency of shopping trip implies that if the shopper visits the shopping centre once more in a week then their odds of using public transport, walking or cycling are 1.434 times higher. This is justified because many employees and students visit the shopping centre often by walk as this is there intrazonal trip within a short walking distance. The odds ratio for occupation also indicates the similar trend implying better odds of choosing a sustainable mode for students and full time employees. The retired persons and householders have more tendency to drive to the shopping centre. The model also showed that a unit increase in the trip length increases the odds of

choosing public transport by 1.046. The odds of travel time difference also indicates a similar trend with an odds ratio of 1.084. Figure 10 plots the changes in the probability of selecting sustainable mode with the travel time difference. As the car travel time becomes

more than the public transport travel time the probability of choosing public transport, walk or cycle increases. This is obvious because the shoppers aim at travel time savings. For zero travel time difference the probability is 0.89 which is quite impressive.

Table 6 Binary logistic regression for shoppers at KGUV

Variable	Coefficient (B)	Standard error	Significance	Odds ratio Exp(B)	95.0% C. I. for odds ratio	
					Lower	Upper
Age Group	-1.088	0.311	0.000	0.337	0.183	0.620
Frequency of shopping trip	0.360	0.153	0.018	1.434	1.063	1.934
Employment status	-0.121	0.256	0.636	0.886	0.537	1.462
Trip Length	0.045	0.026	0.081	1.046	0.994	1.100
Travel time difference	0.081	0.030	0.008	1.084	1.021	1.151
Constant	2.039	0.635	0.001	7.680		

Summary Statistics: No of cases: 117

Pseudo ρ^2 (1- ratio of log likelihood of complete model to the constant only model) = 0.2371,

Chi-square = 31.029, Probability = 0.0005

% cases correctly predicted = 80.9% (criterion, if estimated probability > 0.500, the predicted mode is sustainable mode of transport)

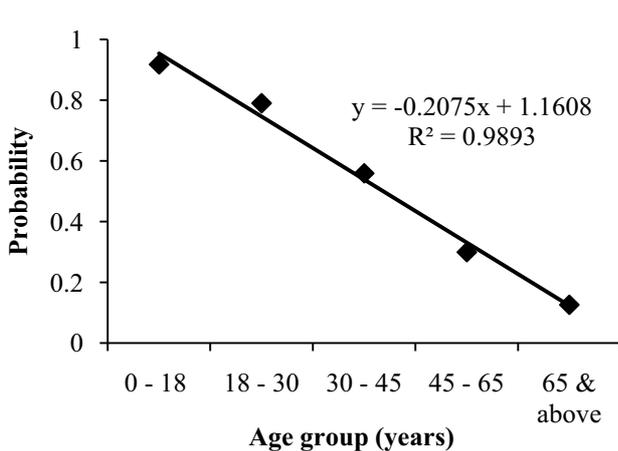


Figure 9 Sensitivity of choosing sustainable mode of transport as a function of age group

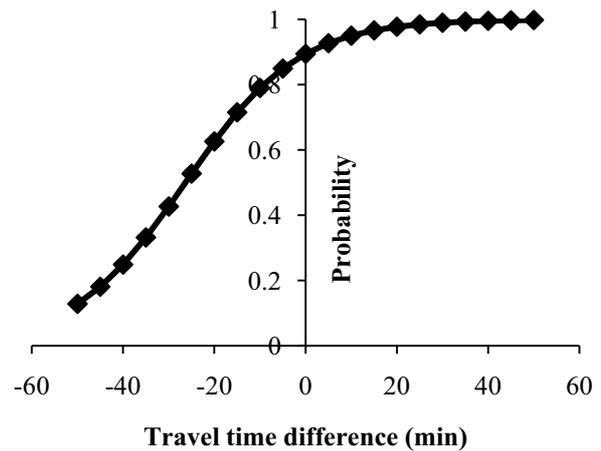


Figure 10 Sensitivity of choosing sustainable modes of transport as a function of travel time difference

7.4. Model for residents

A binary logistic regression was performed on KGUV residents' data to predict the probability of using sustainable modes of transport with five predictor variables; age group, employment status, gender, trip length and travel time difference. Table 7 reveals the results of the model. As expected, gender and trip length were noted as statistically most significant variables. Male residents tend to use car more than their female counterparts. As the residents travelled longer distances the probability of choosing public transport decreased and as the travel time difference increased the probability of using public transport

increased because of travel time savings. The model indicates that the elder residents used car due to availability of car and parking space at the destination. Contradictory to the previous body of research which justifies higher use of car by women [5], the women residents of KGUV used more sustainable modes of transport than their men counterparts. The full time employees and students used more sustainable modes of transport as they were working in the CBD (where they have good public transport service) or their university was within walkable distance of KGUV.

The odds ratio for travel time difference is 1.024, so for every unit of travel time difference, the odds of

choosing a sustainable transport mode increases by 1.024. On the contrary, the odds ratio for trip length shows that for every kilometre increase in trip length the odds of choosing a sustainable transport mode decreases by 0.521. These ratios follow the general trend observed in peoples' travel choices. The model

has relatively good predictive ability with pseudo R^2 (ρ^2) of 0.3398 with prediction accuracy of 75%. Although the values of indicators are encouraging, this model can not be used as a final model due to the limited number of cases used. Hence, this analysis can be only viewed as an exploratory analysis.

Table 7 Binary Logistic regression model for residents at KGUV

Variable	Coefficient (B)	Standard error	Significance	Odds ratio Exp(B)	95.0% C. I. for odds ratio	
					Lower	Upper
Age Group	-1.133	0.734	0.123	0.322	0.076	1.358
Employment status	-1.211	0.739	0.101	0.298	0.070	1.268
Gender	-2.997	1.526	0.050	0.050	0.003	0.994
Trip Length	-0.652	0.335	0.051	0.521	0.270	1.004
Travel time difference	0.023	0.066	0.724	1.024	0.899	1.166
Constant	7.129	3.118	0.022	1247.319		

Summary Statistics: No of cases: 32,

Chi-square = 14.905, Probability = 0.0005

Pseudo ρ^2 (1- ratio of log likelihood of complete model to the constant only model) = 0.3398,

% cases correctly predicted = 75% (criterion, if estimated probability > 0.500, predicted mode is sustainable mode of transport)

8. Conclusions

The mode share plots for KGUV users demonstrated encouraging mode share values for the more sustainable modes of transport. Fewer cycling trips were reported by KGUV users, possibly due to relatively treacherous cycling conditions on certain Brisbane arterial roads and hilly topography around KGUV. Walk trips were considerable due to the appropriate land uses placed together and attractive walk paths constructed at KGUV. Even walk and cycle trips were lesser, the share of public transport was significant which is an encouraging result.

The Binary Logistic models revealed that personal and transit characteristics have an impact on the decision of mode selection. Car availability had least effect on mode choice of KGUV employees and students. Trip length was an important parameter for employees and residents. All the TOD users except shoppers showed lesser odds of choosing public transport for greater trip lengths. Travel time difference did not have significant role for mode selection in case of employees. The other groups of TOD users exhibited higher odds of using public transport for larger travel time difference because of travel time savings.

The older KGUV users showed higher odds of using car compared to younger KGUV users. For students, this was an opposite case with age group being less significant. The male visitors exhibited higher odds of using more sustainable modes as compared to female visitors. On the contrary, KGUV residents showed an opposite inclination. Overall, it can be noted that the

characteristics of both the trip ends as well as the type of TOD user and their characteristics affect the decision of mode choice. So while designing transport for a TOD, the demographic characteristics as well as the transit characteristics and availability of parking space for visitors as well as residents need to be considered.

9. Future directions

This analysis has provided some interesting findings for TOD users but further analysis needs to be done using and comparing the logistic regression equations calibrated for this site, and then compare results against TODs with various scales at various places to verify the results and use them in actual practice. Further, the results from some non TOD areas need to be obtained and compared with the results from the TOD areas to confirm TOD and sustainable mode choice characteristics.

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