Australasian Transport Research Forum 2013 Proceedings
2 - 4October 2013, Brisbane, Australia

Making the train: An examination of five perspectives of rail access and how they resonate with existing and potential passengers

Kelly D Zuniga, Kaveh Bevrani,Jonathan M Bunker

Civil Engineering and Built EnvironmentSchool, Queensland University of Technology,

Email for correspondence:kelly.zuniga@qut.edu.au

Abstract

Rail operators recognize a need to increase ridership in order to improve the economic viability of rail service, and to magnify the role that rail travel plays in making cities feel liveable. This study extends previous research that used cluster analysis with a small sample of rail passengers to identify five salient perspectives of rail access (Zuniga et al, 2013). In this project stage, we used correlation techniques to determine how those perspectiveswould resonate with two larger study populations, including a relatively homogeneous sample of university students in Brisbane, Australiaand a diverse sample of rail passengers in Melbourne, Australia.

Findings from Zuniga et al. (2013) described a complex typology of current passengers that was based on respondents' subjective attitudes and perceptions rather than socio-demographic or travel behaviour characteristics commonly used for segmentation analysis. The typology included five qualitative perspectives of rail travel.

Based on thetransport accessibility literature, we expected to find that perspectives from that study emphasizing physical access to rail stations would be shared by current and potential rail passengers who live further from rail stations. Other perspectives might be shared among respondents who live nearby, since the relevance of distance would be diminished. The population living nearby would thus represent an important target group for increasing ridership, since making rail travel accessible to them does not require expansion of costly infrastructure such as new lines or stations.

By measuring the prevalence of eachperspective in a larger respondent pool, results from this study provide insight into the typical socio-demographic and travel behaviour characteristics that correspond to each perspective of intra-urban rail travel. In several instances, our quantitative findings reinforced Zuniga et al.'s (2013) qualitative descriptions of passenger types, further validating the original research. This workmay directly inform rail operators' approach to increasing ridership through marketing andimprovements to service quality and station experience. Operators in other parts of Australia and internationally may also choose to replicate the study locally, to fine-tune understanding of diverse customer bases. Developing regional and international collaboration would provide additional opportunities to evaluate and benchmark service and station amenities as they address the various access dimensions.

1. Introduction

Aiming to support an increase in the public transport mode share, current research in transport planning has identified a range of factors associated with passenger satisfaction and mode choice(Kittleson & Associates, 2009). Factors generally include stations' proximal locations to a range of land uses (Lam and Morrall, 1982), stations' physical characteristics (Galiza and Charles, 2012), provision of passenger information (TCRP, 2003), and service characteristics such as reliability, frequency, and stafffriendliness (Lam and Morrall, 1982).

The traditional connotation of 'accessibility' has been as an indicator of mobility and social inclusion, thus a significant share of railaccess research has focused on geographic coverage of transport systems and other external characteristics of public transport that might influence availability(Morris et al., 1979, Giannopoulos and Boulougaris, 1989, Vandenbulcke et al., 2007, Vandenbulcke et al., 2009).However, researchers investigating passenger satisfaction have found that characteristics of the passengers themselves, such as socio-demographic affiliations, have a moderating influence on travel behaviours andlevels of satisfaction(Alshalalfah and Shalaby, 2007). Those findings suggest a need to better understand the nature of passengers.

Recent efforts in transport planning research have included market segmentation to investigate the nature of public transport passengers, with the intention of targeting specific types of transport users for behavioural intervention (Shiftan et al., 2008). Typologies have included 'captive' verses 'choice' riders(Beimborn et al., 2003), or 'Anxious Amblers', 'Green Riders', 'Productive 9 to 5-ers', 'Routine Riders', 'Cautious Flyers', 'Green Flyers', 'Cautious 9 to 5-ers' and 'Routine Flyers'(Shiftan et al., 2008).In contrast with other segmentation studies, Zuniga et al. (2013) identified types of passengers based on their subjective viewpointsregarding a variety of issues relating to the rail travel experience. This customer-focused research has promising implications for guiding travel behaviour intervention, and deserves additional reflection.

Thispaper continues a research series aiming to evaluate and understand the rail travel market in Australia. The first outcome of the series included a focus group and Q sorting study, which identified five types of passengers based on their attitudes and perceptions of rail travel (Zuniga et al., 2013). In contrast to findings from other market segmentation research, those five passenger types conveyed respondents' shared prioritisation of issues rather than relying on socio-demographic or household characteristics to infer behavioural tendencies.That issue-based focus is advantageous to public transport authorities, since the connection between each passenger type and intervention measures is clear and direct. Zuniga et al. (2013) discussed the five types in detail, and indicated potential policy responses for each.

A disadvantage of the Q sorting approach was that it did not indicate a distribution of the passenger types in the larger population, which would be necessary to gauge the impact of any proposed intervention. Rather, the Q method data collection and analysis techniques were designed to identify shared perspectives among smaller groups of participants(Addams and Proops, 2000).

This paper extends the previous study by investigating the distribution of the five attitude-based passenger types among a larger potential customer base. It also examines each of the resulting attitude-based market segments to determine whether they correspond to selected socio-demographic and/or travel behaviour characteristics.Data included Q sorts and questionnaires completed by 144 new respondents recruited in Brisbane and Melbourne. It used correlation techniques to gauge the distribution of the five attitude-based passenger types and descriptive statistics to characterize the resulting market segments. Both processesenabledus to further validate and refine the initial typology.

Findings from this paper support an increase in ridership by improving policy-makers' understanding of existing and potential riders' priorities, preferences and attitudes towards intra-urban rail travel. That

understanding will allow them to shape behavioural interventions and quality of service improvements to more effectively influence target passenger markets.

The 'Station access research project' was established and is supported under the Australian Government's Cooperative Research Centres Program for Rail innovation. Academic participants in theproject include the University of Queensland (UQ) and Queensland University of Technology(Yigitcanlar et al.), which conduct research with input from several industry project partners across Australia. In this project, theUQ research focuses on station access planning and design. QUT research focuses on understanding travellers'behaviour and choices. Findings from UQ's research efforts in rail demand management and recommendations for rail operators and transit agencies have beenpublished elsewhere(Hale and Charles, 2009, Ryan et al., 2009, Hale and Charles).

3. METHODS

3.1Data Collection

For this study, we made minor revisions to the sorting activity and questionnaire used in the first stage of research (Zuniga et al. 2013), and distributed it electronically to a larger potential respondent pool. The online survey instructed participants to rank order a set of statements into a normalized distribution that ranged from most disagree (-4) to most agree (+4). It also included a short questionnaire that captured socio demographic, household, and travel behaviour characteristics of the respondents.

The respondent pool included two contrasting subgroups, which were selected to test the external validity of the five perspectives and of the sorting tool generally under divergent conditions. The first subgroup, located in Brisbane,Australia, was recruited from the third-year civil engineering classes at University of Queensland and Queensland University of Technology respectively. The result was a relatively homogeneous sample by age, education and socio-economic status.The second subgroup, located in Melbourne,Australia, was recruited by intercept at several railway stations in the city, and resulted in a comparatively heterogeneous sample, stratified by several socio-demographic characteristics, including age,gender, and frequency of travel. Recruitment strategies and resulting respondent pools are described below:

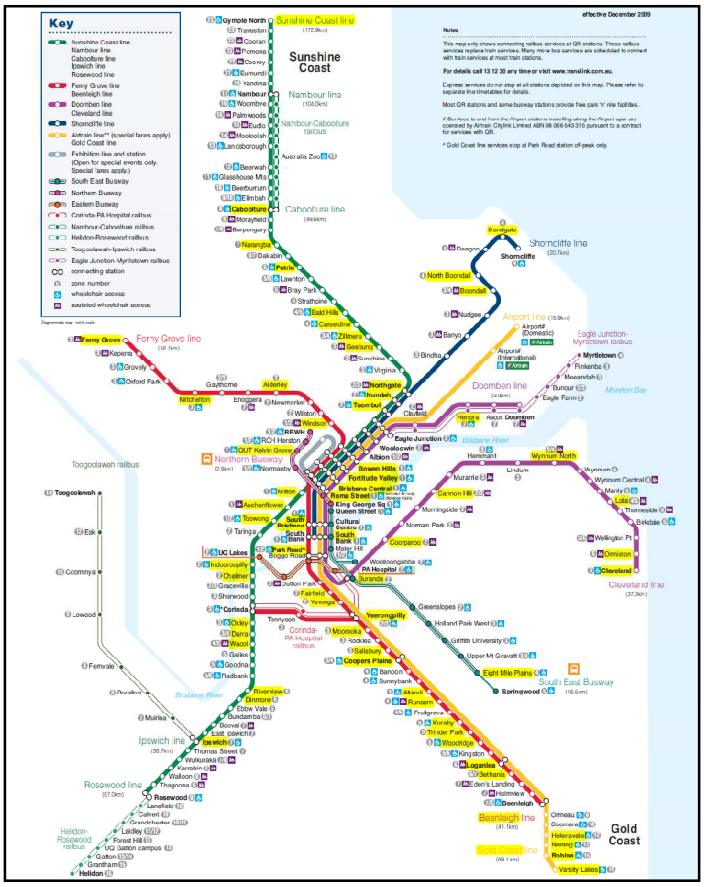
3.2 Brisbane Sample

For the first sample, we invited students from two third-year undergraduate civil engineering classes in Brisbane to participate in an electronic version of the Q survey. Instructors subsequently discussed the methodology and students' experiences as research participants as part of their instruction. Participants ranged in their level of ridership but were otherwise relatively homogeneous in terms of socio-demographic characteristics. We expected QUT students to use trains more frequently than UQ students because the institution is located in the CBD andsituated withinwalking distance of several stations, and because it is not a residential campus.

This recruitment strategy resulted in a total of 97 valid responses out of 500 students.Thesample is77% from young age groups (18-24 years), with 84% males. 90% respondents are full-time students with 50% part-time work and they 98% travel alone. Almost half of the respondents are frequent (>3 trips/week) rail users. 82%respondents have access to a car. Walking is the primary access mode, followed by car driving and public transport (PT)such as bus. Walking is significantly the primary egress mode, followed by PT.68% of passengers' rail travel purpose is study, followed by 18% for work.Based on socio-demographic characteristics alone, it would be expected thatthe range of perspectives would be narrow.However, respondents in this subgroup originated their travel from a wide geographic area, including 70 home stations, highlighted in Figure 1 below.The variety of stations prevents the result from being skewed towards a certain region, station category or trip type. Based on that information, it would

be expected that perspectives might depend on distance travelled or qualities of the origin station, in which case the range of perspectives would be wider.

Figure 1: Brisbane urban rail network (translink.com.au) with respondents' origin stations shaded

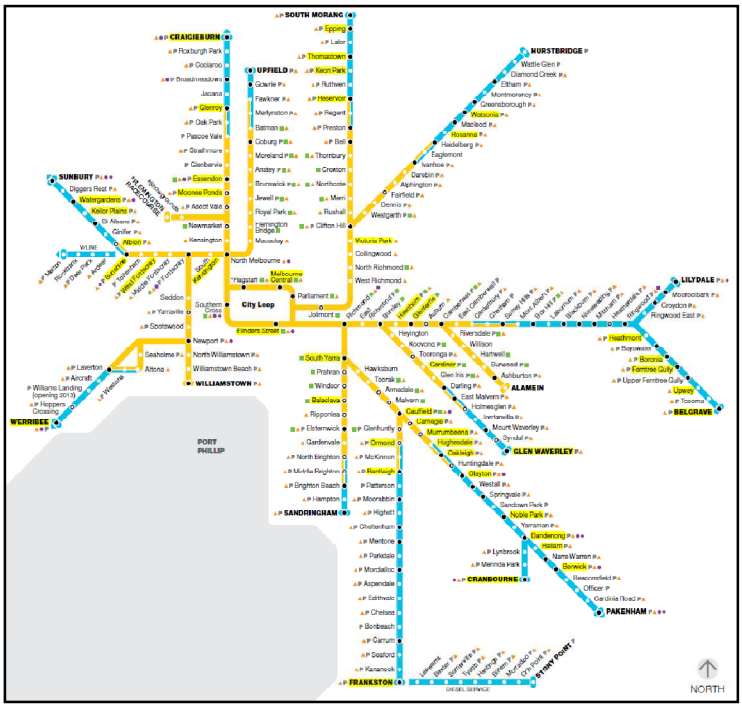


3.3 Melbourne Sample

In contrast, we used an intercept approach to recruitparticipants at two stations in CBD on the Melbourne urban rail network on the afternoons of 24 and 25 October 2012. Two surveyors approached passengers in the railway stations and briefly described the project before handing them a flyer stating the URL of the electronic survey and an opportunity to participate in a draw for one of several loaded fare cards. The purpose of this sampling technique was to recruit participants who varied more widely in their socio-demographic characteristics, and were more representative of whole of network ridership. This recruitment strategy yielded 47 valid responses from 1000 distributed flyers. We distributed the flyers at two of Melbourne's major railway stations to capture frequent rail users.

The sample included respondents with a balance of genders and age groups. 70%of respondents' rail travel purpose was work, followed by study. 83% respondents were frequent rail users and80% travelled alone. 80%own their cars and for 41% of themcar driving is the primary access mode, followed by 32% walking and PT including bus and tram. Walking is significantly (83%) the primary egress mode, followed by 21% PT. Similar to the Brisbane sample, Melbourne respondents originated their travel from a wide geographic area including 46 home stations, highlighted in Figure 2.

Figure 2: Melbourne urban rail network (ptv.vic.gov.au) with respondents' origin stations shaded.



4. DataAnalysis

The purpose of this study was to examine the broader distribution of five attitude-based perspectives that were identified through a Q sorting technique and case-wise cluster analysis and to thereby externally validate Zuniga et al.'s(2013) findings.

The first stage of research (Zuniga et al., 2013) yielded five clusters of respondents each possessing shared perspectives about rail travel. For each cluster, the data set indicated the mean scores (between -4 and +4) assigned to each of the 36 statements in the sorting activity (seeTable 1). Scores greater than |2.00| are highlighted to indicate that the statement was a strong shared priority among the cluster of respondents.

Zuniga et al. (2013) qualitatively defined each of its five perspectives based on the several statements that emerged as strong, shared priorities. The findings further characterized several of the perspectives by suggesting possible motives behind the shared priorities, which sometimes included socio-demographic or travel behaviour characteristics such as frequency of ridership. For example, it suggested that passengers who shared perspective 2 might have developed resilience by prolonged experience with rail travel, whereas passengers who shared perspective 4 might lack that resilience due to lack of rail travel experience. It also speculated that passengers who shared perspective 5 might either be captive riders who lack alternatives to the public transport that they find distasteful, or that it might be infrequent riders who would be an important target for behavioural intervention. In addition to determining the distribution of the perspectives in a larger population, this study examined relationships between the resulting market segments and personal characteristics, including socio-demographic characteristics and travel behaviours, to address those tentative assertions.

Table 1: Statements and mean scores for five clusters (Zuniga et al., 2013)

		Mean scores for Clusters				
ID	Statements	A	B	C	D	E
AA	I worry that I'll miss my train and be late to my destination.	2.83	3.00	1.71	0.83	2.00
BA	I don't want to be tethered to timetables.	2.17	2.00	2.14	0.83	0.75
CA	Coordinating transfers is difficult and annoying.	1.17	2.00	-0.29	1.17	2.00

DA	Public transport is unreliable.	2.67	-0.50	-2.29	-1.17	-1.00
EA	Railway timetables are easy to find and understand.	-0.67	1.25	1.00	-0.17	-1.75
AG	I cannot safely leave my bike at a railway station.	0.83	0.50	-0.57	0.83	-0.50
BG	I am intimidated by youths and strangers at railway stations.	-0.50	0.00	-0.29	-1.67	1.25
CG	I feel safe traveling to and from the railway station.	1.17	-0.25	1.29	2.00	1.00
DG	There is too much road traffic around the railway station.	-1.00	-0.50	0.14	1.17	0.00
EG	Neighbourhoods near railway stations are safest.	-0.67	-2.00	-0.14	-1.67	-2.00
AB	It is easy to find a parking space at the railway station.	-3.00	-0.25	-1.86	-3.00	-1.75
BB	There is a lovely footpath leading to the railway station.	-0.33	-1.50	-0.14	-0.83	-1.00
CB	It is NOT a problem to carry heavy bags onto the train.	-0.17	-0.75	-0.71	0.00	-3.00
DB	Public transport staff and drivers are hard to understand.	-1.50	-1.25	-1.43	-2.00	0.00
EB	Getting to the railway station is inconvenient.	0.17	1.50	-1.57	-1.00	1.25
AC	It is important to get exercise on the way to my destination.	-0.17	0.50	1.43	0.67	0.75
BC	I don't want to be wet or smelly when I get to work.	0.33	3.00	2.29	1.83	1.50
CC	There are too many stairs to climb at the railway stations.	-1.33	-0.50	-1.14	-0.17	2.00
DC	Public transport is a good place to catch an illness.	0.50	1.00	-0.86	0.83	0.25
EC	The railway station is a comfortable place to relax.	-1.50	-2.25	-0.86	-0.67	-2.00
AD	I always choose the fastest way to my destination.	3.17	3.50	2.86	1.17	1.75
BD	I can get work done at the railway station and on the train.	2.50	-2.00	2.57	1.00	-1.50
CD	It is cheaper to drive than to take public transport.	-2.33	-1.25	-2.71	-3.00	2.00
DD	I don't like to spend time at the railway station.	2.83	1.50	0.57	2.33	1.50
ED	It is a waste of time transferring from the bus to the train.	1.00	0.75	-0.71	-0.50	1.25
AE	Bus and railway stations are dirty and smelly.	0.50	1.00	-2.14	0.00	-0.25
BE	I'm concerned about air pollution caused by car traffic.	-0.33	2.75	2.29	1.17	0.00
CE	Affordable housing is located too far from railway stations.	0.50	0.00	0.71	-0.17	0.50
DE	Public transport is detrimental to the environment.	-2.83	-3.00	-2.71	-1.50	-3.00
EE	The climate here is ideal for rail travel.	-1.00	0.50	0.86	1.83	-0.50
AF	I feel welcome and comfortable on public transport.	0.00	0.00	0.71	1.17	-0.50
BF	I enjoy the energy and commotion of a busy railway station.	-1.83	-3.00	1.00	0.33	-0.25
CF	Public transport staff and drivers are helpful and friendly.	0.33	0.75	2.00	2.00	0.25
DF	Musicians and small vendors make railway stations enjoyable.	0.00	-0.75	0.43	0.33	1.50
EF	The railway station is a great place to socialize.	-1.67	-2.25	-0.29	-1.00	-1.25
GF	Public transport is mostly for poor people.	-1.83	-3.50	-3.29	-3.00	-1.25

An analytical technique typical to Q methodology involves using Pearson's coefficient to correlate individual member cases (the scores that individual respondents assigned the 36 statements) against their assigned cluster (the mean scores for the 36 statements) to determine which members best represent the group. The purpose of that process is to identify the 'best specimens' within each cluster for purposes of follow up interviewing and to provide a richer characterization of the cluster's corresponding perspective.

For this paper, we adapted 'best specimen' analysis to determine how well each of the five perspectives and their corresponding policy recommendations would resonate with members of a larger population. We determined Pearson's correlation coefficient using SPSS (IBM Corp., 2010) to compare the statement scores from each respondent in the new sample (n_B=97, n_M=47) with the mean scores of each of the five original clusters (seeTable 1). This revised procedure allowed us to determine which of the clusters (and corresponding perspectives) would be the best fit for each new respondent, and to see the distribution of each perspective in the larger population.

Table 2and Table 3 presentPearson's correlation coefficientsfor an extract ofrespondentsin the Brisbane sample and the full Melbourne sample respectively against each of the five original clusters from Zuniga et al. (2013). For each respondent case, the highest and second highest coefficients(closest to 1.000) are

highlighted and noted in columns at the right to identify the best-fit and second best-fit clusters and corresponding perspectives.

Among the more homogeneous Brisbane sample, the range of perspectives turned out to be very narrow. Nearly all (97%) of respondents correlated to perspective 2 and secondly to perspective 1. In contrast, among the more heterogeneous Melbourne sample, the range of perspectives was much more varied. For this sample, perspectives 1, 2 and 3 each correlated to approximately one quarter of the respondent pool. The remaining respondent cases correlated to perspectives 4 and 5.

Table 2: Brisbane respondents' Pearson's correlation coefficient by (Zuniga, et al. 2013) cluster

Case	Cluster A Perspective 2	Cluster B Perspective 1	Cluster C Perspective 3	Cluster D Perspective 4	Cluster E Perspective 5	1st Best Fit Perspective	2nd Best Fit Perspective
B1	.960	.874	.086	.082	.233	2	1
B2	.974	.900	.364	.541	.501	2	1
B3	.951	.802	.007	.048	-.005	2	1
B4	.959	.836	.198	.297	.625	2	1
B5	.989	.884	.743	.583	.058	2	1
B6	.999	.936	.155	.237	.277	2	1
B7	.998	.919	.291	.488	.485	2	1
B8	.964	.835	.433	.471	.404	2	1
B9	.961	.829	.350	.415	.162	2	1
B10	.992	.895	.432	.517	-.108	2	1
|	|	|	|	|	|	|	|
B23	.996	.921	.312	.517	.092	2	1
B24	.997	.917	.368	.331	.175	2	1
B25	.883	.970	.329	.504	.404	1	2
B26	.974	.883	.244	.265	.092	2	1
B27	.984	.878	.517	.467	.148	2	1
|	|	|	|	|	|	|	|
B91	.916	.781	.162	.230	.609	2	1
B92	.993	.930	.162	.293	.618	2	1
B93	.985	.976	.238	.344	.175	2	1
B94	.991	.888	-.004	.193	.427	2	1
B95	.999	.934	-.020	.117	.478	2	1
B96	.997	.914	.119	.158	.420	2	1
B97	.974	.865	.249	.304	.392	2	1

Table 3: Melbourne respondents' Pearson's correlation coefficient by (Zuniga, et al. 2013) cluster

Case	Cluster A Perspective 2	Cluster B Perspective 1	Cluster C Perspective 3	Cluster D Perspective 4	Cluster E Perspective 5	1st Best Fit Perspective	2nd Best Fit Perspective
M1	-.073	-.054	.461	0.269	-.293	3	N/A
M2	.334	0.363	.505	.355	.212	3	1
M3	.375	0.517	.373	.546	.353	4	1
M4	.548	0.453	-.015	.175	.251	2	1
M5	.343	.513	-.130	.120	0.505	1	5
M6	.700	0.676	.323	.345	.547	2	1
M7	.594	.464	0.514	.461	.422	2	3
M8	-.193	.097	.359	0.262	-.032	3	N/A
M9	0.498	.524	.215	.444	.383	1	2
M10	.189	.262	.492	0.371	.231	3	4
M11	.444	0.457	.124	.299	.491	5	1
M12	0.445	.479	.193	.213	.422	1	2
M13	.207	.279	0.426	.516	-.014	4	3
M14	.330	0.438	.080	.184	.457	5	1
M15	.469	.453	.536	0.499	.371	3	4
M16	.329	.706	.338	0.392	.240	1	4
M17	0.412	.408	.571	.372	.371	3	2
M18	.599	0.578	.260	.417	.279	2	1
M19	.421	0.401	.264	.283	.392	2	1
M20	0.420	.361	.547	.378	.367	3	2
M21	0.215	.434	.155	.171	.125	1	N/A
M22	.436	.084	.204	0.294	-.120	2	N/A
M23	.317	.153	.110	.168	0.238	2	5
M24	.051	.285	.501	0.403	.175	3	4
M25	0.390	.591	.304	.305	.288	1	2
M26	.275	.163	.516	0.512	.240	3	4
M27	.535	0.412	.309	.336	.081	2	1
M28	.542	.356	0.464	.270	.148	2	3
M29	.383	0.560	.148	.234	.563	5	1
M30	0.539	.709	.516	.450	.275	1	2
M31	.255	.432	.262	0.379	.337	1	4
M32	0.396	.427	.197	.192	.166	1	2
M33	.432	0.369	.097	.159	.316	2	1
M34	.221	.301	.659	0.499	.185	3	4
M35	.448	.288	.661	0.587	-.002	3	4
M36	.541	.460	.676	0.560	.129	3	4
M37	.643	0.591	.210	.196	.448	2	1
M38	.185	.303	0.334	.400	.012	4	3
M39	.440	.432	.622	0.512	.224	3	4
M40	.145	.423	.113	-.032	0.418	1	N/A
M41	.443	.256	.116	0.312	.291	2	4
M42	.197	.210	.547	0.473	-.037	3	4
M43	0.339	.090	.257	.475	.145	4	2
M44	.534	.668	.191	.348	0.600	1	5
M45	0.411	.436	.173	.359	.203	1	2
M46	.360	.367	0.390	.609	.390	4	5
M47	.207	.238	.758	0.542	-.012	3	4

Table 4summarizesthe distribution of the five original perspectives in the Brisbane, Melbourneand combined subgroups of respondents based on Pearson's correlation analysis. All of the respondent cases correlated significantly (at p<.01) to at least one of the perspectives. In addition, 96.5% of respondent cases also correlated significantly to a second perspective – with only five respondent cases from the Melbourne sample left out. That means that interventions tailored to an individual perspective would promise a broader overall impact.For example, an intervention tailored to perspective 1 in Melbourne would impact approximately half (51.1%) of the overall population at either primary or secondary levels.

Table 4: Revealed First and Second Preferences for Five Core Perspectives in Melbourne, Brisbane and combined data

	Brisbane Respondents' Preferred Perspectives				Total Potential Policy Impact	
Core Perspective	First	Percentage	Second	Percentage	First Two Choices	Percentage
1	3	6.4	94	200.0	97	206.4
2	94	200.0	3	6.4	97	206.4
3	0	0.0	0	0.0	0	0.0
4	0	0.0	0	0.0	0	0.0
5	0	0.0	0	0.0	0	0.0
N/A	0	0.0	0	0.0	0	0.0
Totals	97	206.4	97	206.4	194	412.8

	Melbourne Respondents' Preferred Perspectives				Total Potential Policy Impact	
Core Perspective	First	Percentage	Second	Percentage	First Two Choices	Percentage
1	12	25.5	12	25.5	24	51.1
2	12	25.5	9	19.1	21	44.7
3	15	31.9	4	8.5	19	40.4
4	5	10.6	13	27.7	18	38.3
5	3	6.4	4	8.5	7	14.9
N/A	0	0.0	5	10.6	5	10.6
Totals	47	100.0	47	100.0	94	200.0

	Combined Respondents' Preferred Perspectives				Total Potential Policy Impact	
Core Perspective	First	Percentage	Second	Percentage	First Two Choices	Percentage
1	15	10.4	106	73.6	121	84.0
2	106	73.6	12	8.3	118	81.9
3	15	10.4	4	2.8	19	13.2
4	5	3.5	13	9.0	18	12.5
5	3	2.1	4	2.8	7	4.9
N/A	0	0.0	5	3.5	5	3.5
Totals	144	100.0	144	100.0	288	200.0

An overwhelming majority of the Brisbane samplecorrelated with perspective 2placing high priority on timing and scheduling, and environmental benefits of public transport. In contrast, a third of the Melbourne sample correlatedwith Perspective 3 also placing high priority on timing, but sharinga

positive attitude toward psychological and social aspects of rail travel. The positive attitude about rail travel in the Melbourne sample might be attributable to a higher range of ages and a higher level of female participation. An alternative explanation may be that Melbourne's urban rail system may offer a more pleasant experience than does Brisbane's.Perspective 5 maintains a correlation with approximately 6.4 percent of respondents. This perspectiveseemed to indicate a negative experience with rail travel, with an emphasis on physical and psychological aspects of the journey. Agencies may target this perspective through identifying particular home and/or destination stations for improvement projects as an appropriate intervention.Table 4 also illustrates the distribution of the original five perspectives for the combined sample of respondents based on Pearson's correlation analysis. The resulting distribution is more evenly shared between perspectives 1and 3 andmore evenly shared overall. Zuniga et al. (2013)suggested possible intervention strategies to address each of the five perspectives. Given the relatively even distribution of each perspective in the larger study samples, this study suggests that a multifaceted intervention might be more appropriate than targeting a specific attitude type.

5. Investigating influential factors in travellers' perspectives

The second purpose of this study was to determine whether the attitude-based market segments might also be associated with certain socio-demographic or travel behaviour characteristics shared by their members. The questionnaire included several personal characteristics (e.g. concession, age, gender, access to car, and employment status), as well as several travel characteristics (e.g. trip purpose, travelling in company or alone, waiting time at the station, access time from home to station).This analysis included the full sample of respondents.

5.1 Multinomial Logistic Regression Analysis

The survey instrument included questions regardingsocio- demographic and travel characteristicsas well as fields for comments. Thatinformation enabled us to identify relationships betweentravellers' stated attributes and their assigned perspective.Multinomial logistic regression (MLR) was performed using a nominal outcome variable having an integer value between 1 and 5 corresponding to the perspective. We used this process to test the null hypothesis that personal variables would have no predictive capability, and that changing the independent variables would not alter the outcome variable.

Table 5details the model fitting regression analysis results for reference perspective 1. The reason for choosing perspective 1as the reference perspective is that it possesses fairly straightforward characteristics, and a quarter of the largesample population were included in this market segment. The cluster associated with Perspective 1in Zuniga et al.'s(2013)cluster analysis formed early, indicating strong attitudinal alignments and shared priorities amongits members. Based on our analysis, the null hypothesis in this regression model would be rejected. We can state with a 95 percent confidence level that at least one independent variable regression coefficient is non-zero, such that at least oneindependent variable has a predicting capability upon determining the respondent'sperspective.

Table 5: Multinomial Logistic Regression (MLR) Model'sfitting information for Perspective 1

Model	Model Fitting Criteria	Likelihood Ratio Tests			Hypothesis Test	
	-2 Log Likelihood	Chi-Square	df	Sig.	Confidence	Accept H0?
Intercept Only	237.382					
Final	110.784	126.597	60	.000	0.05	No

Using MLR, four models were created for each of perspectives 2 through 5 against perspective 1as the reference.

Table 6lists the predictor variable estimates of each regression model along with their statistics. The significanceindicates the effectiveness of variable in the predicting model. The odds ratio represents, for a unit change in its predictor variable, its chance of being placed in its present perspective rather than perspective 1. It is the exponentiation of the coefficients. It indicates that for one unit increase in average waiting time in home station for example, while the other variables remain the same, the chance to be placed in Perspective 2 rather than 1, is 1.335 times more likely.

The significance column in

Table 6indicates the effectiveness of a variable in the predicting model. For example, in the model for Perspective 2, average waiting time in home station, having concession and age significantly contribute to the predicting model with 95% levels of confidence, statistically differentiating perspective 2 from perspective 1. This is in harmony with the perspective definitions which we developed from the in depth focus group analysis. In perspective 2, the emphasis was on timing. Respondents particularly do not wish to spend time at train station, though they believe it is possible to make the waiting time productive. Knowing the significant characteristics of the perspectives enables policy maker to divide their market and understand their main concerns and eventually apply the appropriate policy to each segment.

The 95% confidence interval with lower and upper bound also shows the significance of the predictor, if the span does not include 1. In Perspective 3, the type oftravel companion was found to be a significant predictor (with 90% confidence level) while for Perspective4averagestation access time in home stationwasfound to be the most influential predictor. Both of these predictor variables are intuitive. The optimistic travellers in Perspective3have little issue with rail travel itself. For Perspective5 no predictor was found to be a significant contributor.

Table 6: Logistic regressionwith socio-economic and travel variables in determining travel perspectives

Perspective Number		Std. Error	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
					Lower Bound	Upper Bound
2	Intercept	2285.10	.997			
	Access time to station	.054	.284	.943	.848	1.049
	Wait time at home station	.124	.020	1.335	1.047	1.702
	Frequency of rail travel	.406	.942	1.030	.465	2.284
	Companion (alone)	1.220	.852	.796	.073	8.696
	Concession fare	1.412	.040	.055	.003	.877
	gender	.963	.764	.749	.113	4.948
	age	.614	.018	.233	.070	.777
3	Intercept	2759.94	.990			
	Access time to station	.104	.263	.890	.725	1.092
	Wait time at home station	.181	.954	.990	.694	1.411

Perspective Number		Std. Error	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
					Lower Bound	Upper Bound
	Frequency of rail travel	.548	.622	.763	.261	2.234
	Companion (alone)	2.003	.084	31.782	.627	1612.03
	Concession fare	2.036	.873	.722	.013	39.028
	gender	1.187	.970	1.046	.102	10.717
	age	.741	.329	2.063	.482	8.823
4	Intercept	4285.57	.993			
	Access time to station	.161	.192	.810	.590	1.112
	Wait time at home station	.182	.362	1.180	.827	1.685
	Frequency of rail travel	.687	.638	1.382	.359	5.311
	Companion (alone)	1.809	.272	.137	.004	4.751
	Concession fare	2.358	.865	.670	.007	68.069
	gender	1.566	.213	.142	.007	3.067
	age	.899	.437	.497	.085	2.895
5	Intercept	10884.4	.998			
	Access time to station	121.932	.995	.481	7.8E-105	2.9E103
	Wait time at home station	27.927	.968	3.072	5.1E-24	1.8E24
	Frequency of rail travel	447.418	.988	773.643	.000	.[b]
	Companion (alone)	699.721	.977	1.159E-9	.000	.[b]
	Concession fare	2041.49	.997	3375.721	.000	.[b]
	gender	616.540	.994	.013	.000	.[b]
	age	326.578	.982	1660.425	1.7E-275	1.5E281

5.2 Observational Relationshipsbetween Travel Attributes and Perspectives

We gained further insight into influential factors by examining variation in travel attributes betweenperspectives.Figure 1illustrates the gender split by perspectivefor the combined respondent pool.Perspective4, which emphasizes financial aspects of rail travel,correlatedmost strongly with female respondents. That perspective also highlighted psychological access in terms of safety and support, which might be expected among this demographic group.

Figure 1: Respondents' Gender Split of Rail Travel by Perspective

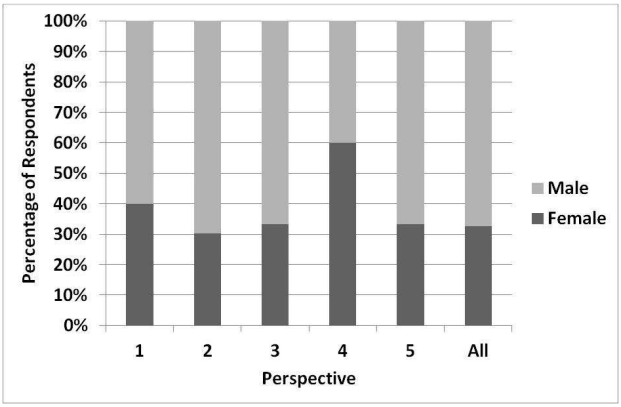


Figure 2illustrates the frequency of rail travel by perspective. The most frequent travellers correlated most often with Perspective 4, which suggests that they do not prioritise timing but are sensitive to financial aspects of rail travel.

Figure 2: Respondents' Frequency of Rail Travel by Perspective

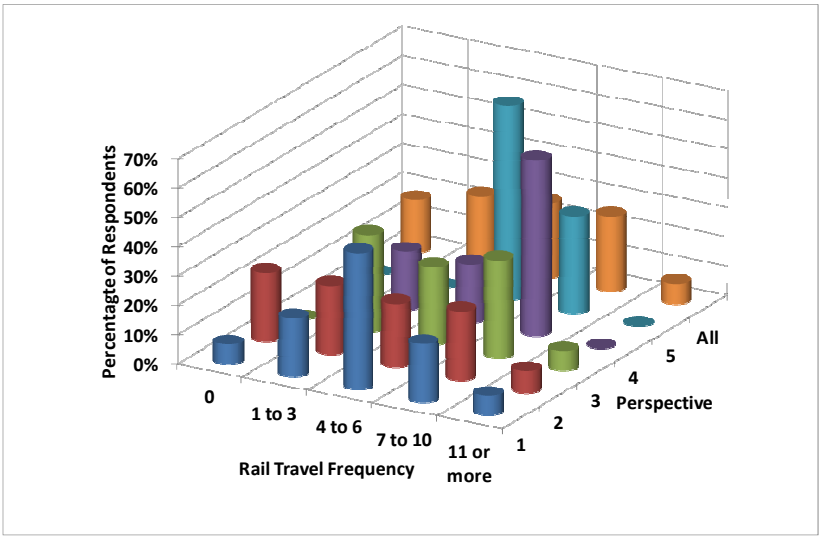


Figure 3illustrates respondents' travel companion status during rail travel by perspective. As would be expected, respondents who travelled with a companion correlated most frequently to Perspectives 4 and 3, which did not emphasize timing and reliability.

Figure 3: Respondents' Travel Companion of Rail Travel by Perspective

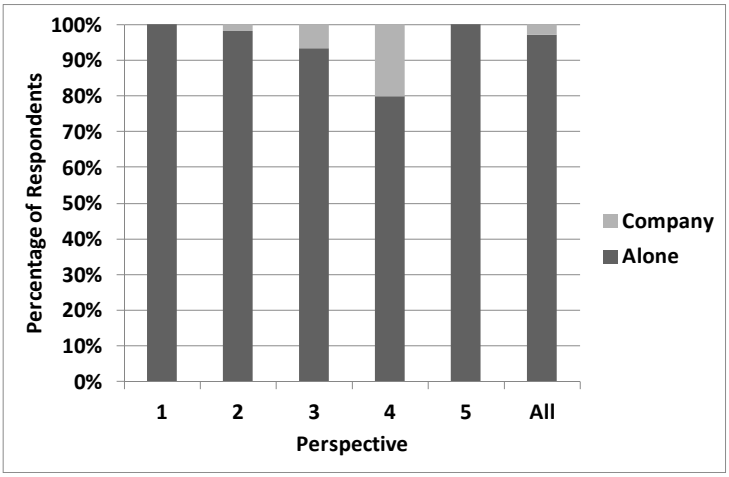


Figure 4illustrates the travel fare type (concession or full fare) by perspective. Respondents paying full fare correlated most strongly to perspective 3. This perspective was the most optimistic regarding rail travel. It is reasonable to assume that this group of respondents are either fully employed or are part time students (who are not entitled to the concession fare) and are more likely to hold a higher level of employment than average forthe respondent sample. It could be inferred that this perspective is more likely to include choice riders than other perspectives, which aligns with the positive attitude towards the experience.

Figure 4: Respondents' Fare Category by Perspective

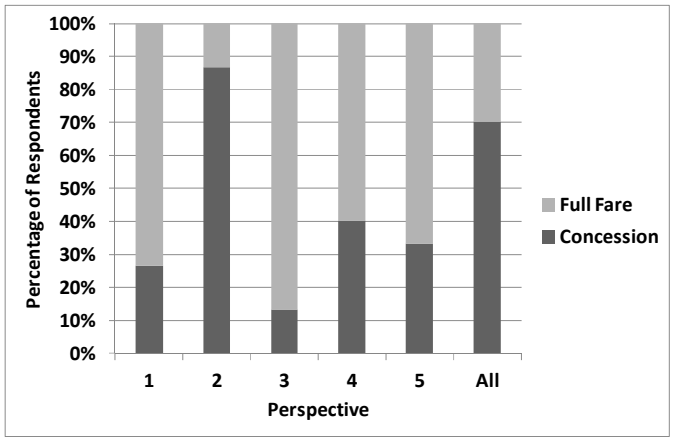
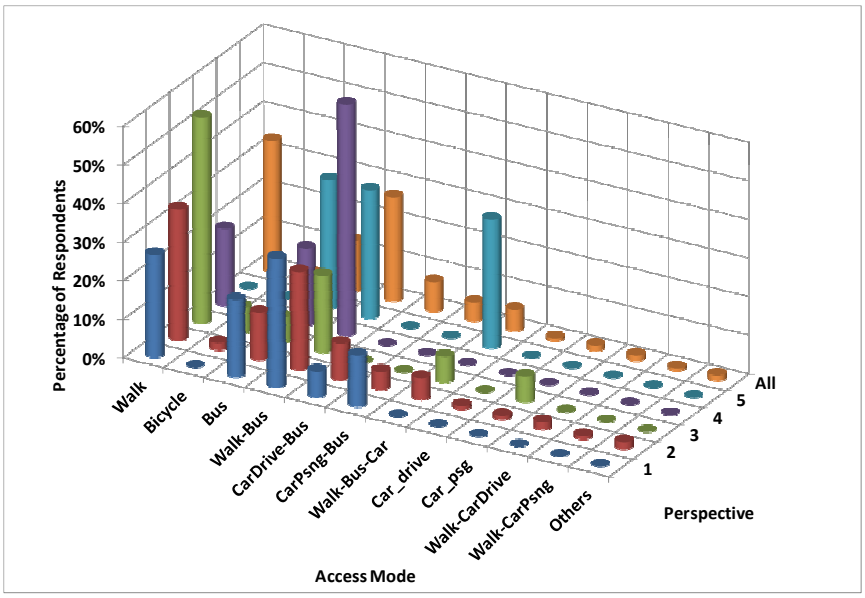


Figure 5illustrates access mode type by perspective. Respondents who typically walked to the station correlated most strongly with perspective 3, which indicates an optimistic attitude towards rail travel. Conversely, respondents who typically drove to the station more frequently correlated to perspective 5, which indicates a negative disposition towards rail travel. This suggests that active travel enhances the rail access experience.

Figure 5: Respondents' Access Mode by Perspective



Based on these observational relationships between travel attributes and perspectives,

Table 7 summarizesthe insight into the perspectives that were first identified in (Zuniga et al., 2013).

Table 7: Respondents' Overall Snapshot of Perspectives by Attribute

		Female Gender Split	Travel Frequency	Concession Fare	Access Modes	Overall Comments
Perspective	1	Slightly below average	Close to average	Below average	Close to average profile	• Pragmatic riders • Representative of "average" rider • Some concerns
	2	Lowest	Slightly below average	Most	Most walking and transit and least driving	• Pragmatic riders • Regular riders • Station access by car important
	3	Slightly below average	Slightly below average	Least	Most walking, Least driving	• More likely choice riders • Pedestrian station access important
	4	Slightly above average	Most	Slightly below average	Close to average profile	• Pragmatic riders • Representative of "average" rider • Not as concerned
	5	Below average	Average	Below average	Least walking, most driving	• Irregular riders • Concerned and/or displeased

6. Conclusion

This stage of research investigated the distribution of attitudinal perspectivesamong a larger sample population and found that the fivepassenger types discussed previously(Zuniga et al., 2013)correlated significantlywith samplegroups in Brisbane and Melbourne. As we anticipated, thehomogeneity of the Brisbane sample in terms of socio-demographic and educational status corresponded to a narrower range of perspective toward rail travel. That sample correlated primarily with the first two attitudinal perspectives, which emphasized the technical efficiency of the travel mode.

In contrast, the heterogeneous Melbourne sample group corresponded to a broad range of perspectives, with a more even distribution across the five perspectives. In this sample, the first three perspectives still commanded a stronger response than perspectives 4 and 5.

These findings suggest that travellers' perspectivestowards rail are affected by socio-demographicattributes and travel characteristics of the population. This paper highlighted more detailed characteristics of the target populations identified previously (Zuniga et al., 2013).That information will assistpublic transport authorities to tailor behavioural intervention strategies appropriately to several target market segments.

The proposed regression model identified significant predictor variables includingstation waiting time, age, concession fares, travel companions and station access time. The proposed model can be calibrated and used for other populations based on household level census data. The residential information can also help to geographically locate the perspectives and further target any intervention strategy.

By measuring the occurrence of attitudinal perspectives with rail travel, outcomes from this research can inform rail authorities' approach to growing ridership through advertising and enhancements to service quality and station experience. Replication of the study internationally and nationally is also possible, to locally fine-tune their understanding of their varied passenger base. Further investigation is recommended to refine market segmentation strategies based on the attributes and influential factors identified in this study.

References

Addams, H. & Proops, J. L. R. (2000) Social Discourse and Environmental Policy: An Application of Q Methodology. , Edward Elgar.

Alshalalfah, B. W. & Shalaby, A. S. (2007) Case study: Relationship of walk access distance to transit with service, travel, and personal characteristics. *JOURNAL OF URBAN PLANNING AND DEVELOPMENT-ASCE,* 133**,** 114-118.

Beimborn, E., Greenwald, M. & Jin, X. (2003) Accessibility, Connectivity, and Captivity: Impacts on Transit Choice. *Transportation Research Record: Journal of the Transportation Research Board,* 1835**,** 1-9.

Galiza, R. & Charles, P. (2012) Station Access: A Literature Review. IN INNOVATION, C. R. C. F. R. (Ed. Brisbane.

Giannopoulos, G. A. & Boulougaris, G. A. (1989) Definition of accessibility for railway stations and its impact on railway passenger demand. *Transportation Planning and Technology,* 13**,** 111-120.

Hale, C. & Charles, P. (2009) Practice reviews in peak period rail network management: Sydney & San Francisco Bay Area. *Auckland, NZ: 32nd Australasian Transport Research Forum (ATRF 2009). Australian Planner.*

Hale, C. A. & Charles, P. Rail Patronage Management-effectiveness in practice, and new theoretical frames.

Ibm Corp. (2010) IBM SPSS Statistics for Windows. 19 ed. Armonk, NY: IBM Corp.

Kittleson & Associates (2009) Literature Review for Providing Access to Public Transportation Stations. *TCRP Project B-38.* Transit Cooperative Research Program.

Lam, W. & Morrall, J. (1982) Bus passenger walking distancesand waiting times: A summer-winter comparison. *Transport Research, Part A.,* 16A**,** 431-445.

Morris, J. M., Dumble, P. L. & Wigan, M. R. (1979) Accessibility indicators for transport planning. *Transportation Research Part A: General,* 13**,** 91-109.

Ryan, R., Charles, M. B., Von Der Heidt, T. & Collier, C. (2009) Urban planning and railway corridors: resolving regulatory dysfunction in Australia. *Competition & Reg. Network Indus.,* 10**,** 333.

Shiftan, Y., Outwater, M. L. & Zhou, Y. (2008) Transit market research using structural equation modeling and attitudinal market segmentation. *Transport Policy,* 15**,** 186-195.

Tcrp (2003) Transit Capacity and Quality of Service Manual. Washington D. C., Transportation Research Board, National Academy Press.

Vandenbulcke, G., Steenberghen, T. & Thomas, I. (2007) Accessibility indicators to places and transports: final report. IN TRANSPORTS, B. S. P. A. F. M. A. (Ed. Brussels.

Vandenbulcke, G., Steenberghen, T. & Thomas, I. (2009) Mapping accessibility in Belgium: a tool for land-use and transport planning? *Journal of Transport Geography,* 17**,** 39-53.

Yigitcanlar, T., Supervisor, P., Qut, E. C., Qut, L. F. & Burke, M. (2010) A FRAMEWORK TO DETERMINE TRANSPORTATION DISADVANTAGED : THE CASE OF BRISBANE , AUSTRALIA Literature Review and Research Methodology A Report Submitted for the Confirmation of PhD Candidature Student Number : N 7049412 Supervisory Team : Review Panel :. *Analysis*.

Zuniga, K. D., Bunker, J. M. & Bevrani, K. (2013) Intraurban Rail Access: Policy Implications of Five Revealed Perspectives from a Q-Sorting Exercise in Three Australian Cities. *Transportation Reseach Board 92nd Annual Meeting*