Understanding travelers' satisfaction in ferry services: evidence from Brisbane, Australia

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Abstract

There has been little direct research on passenger satisfaction with ferry services, in part because these services are relatively uncommon. To help fill this gap, this paper investigates the effect of the built environment, weather, safety, security, operation, users' sociodemographic characteristics, and their use of public transport to help explain their satisfaction with ferry services. This study focuses on the ferry services in Brisbane using the Translink customer experience survey from July to September 2019. Common statistical methods were used to examine the passengers' reported satisfaction and the relative importance of different factors in their level of satisfaction. The results highlight the passengers' satisfaction with the service overall; satisfaction with their last trip; satisfaction with the perceived safety when waiting at ferry terminals. We found that punctuality has the largest contribution to satisfaction with the last trip, followed by the total journey time, the level of safety on-board, and accessibility on board. The service aspects with the relatively highest importance for improving ferry service satisfaction are punctuality, journey time, fares, and the design of off-board facilities. The findings can provide insight to improve passenger satisfaction with, and perhaps attract more passengers to, the ferry services in Brisbane.

1. Introduction

The importance of ferry services among urban mobility systems has decreased due to emerging mobility services (e.g., bicycle-sharing, transportation network companies, and metro) and the development of rapid road infrastructure (e.g., expressways, bridges, and tunnels). However, ferry services are expected to mitigate the recent worsening congestion and have regained much wider interest from governments/agencies in renewing public transport systems. Previous studies also indicate that ferry service is beneficial to reducing carbon emissions, improving commuters' job accessibility, increasing residential property value, enhancing transport resilience and travel experience, and facilitating the development of tourism (Tanko and Burke, 2015, Thompson et al., 2006, Tsai et al., 2017, Tsoi and Loo, 2021).

Given the huge potential of ferry service in promoting sustainable development, many cities are expanding their ferry services, such as San Francisco, New York, London, Stockholm, as well as Brisbane (Tanko et al., 2019, Tsoi and Loo, 2021). Understanding the factors impacting travelers' use of ferry services can provide better guidance for service planning and operations. Furthermore, for users of services of any type, their travel experience impacts their intentions to continue to adopt and use mobility services again in the future (Van Lierop and El-Geneidy, 2016). Therefore, recognizing significant factors influencing users' travel experience is critical to promote the sustainable development of ferry systems.

However, very limited studies focused on investigating travelers' experiences in urban ferry systems. Tanko et al. (2019) adopted a structural equation model (SEM) to examine the impacts

of service attributes on ferry service satisfaction in Sweden. The results reveal that the cleanliness of vessels, scenic views, service planning, and punctuality are significantly associated with levels of passenger satisfaction. Zuniga et al. (2013) investigated travelers' satisfaction with ferry services in Brisbane by distributing survey questionnaires at selected terminals. The results of the descriptive analysis indicate that the level of satisfaction is mainly determined by the timing and reliability of the ferry services. Khan et al. (2018) conducted a SEM study in Bangladesh and found that the appearance and physical features of vessels, the level of safety, and the level of comfort impacted satisfaction significantly.

In general, these studies provide some insights into the satisfaction analysis for ferry services. However, there are still several limitations in existing studies.

- Existing datasets used for analysis are constrained in the categories of explanatory variables. To the best of our knowledge, no study comprehensively explores the combination of the built environment (terminal characteristics), weather, safety and security (using proxies such as local crash rates), operational characteristics, users' socio-demographic features, and their usage of public transport in influencing the satisfaction with travel experiences in ferry service systems.
- The existing studies only focused on the satisfaction with ferry services, while few studies explore the factors which influence travelers' perceptions of safety when waiting at ferry terminals. Previous studies reveal that safety perception is also significantly associated with the use of other public transport modes (Abenoza et al., 2018, Yavuz et al., 2007).

To fill the gaps mentioned above, the paper constructs a comprehensive dataset and systematically explores factors affecting the satisfaction of travel experiences to provide useful insights into enhancing the attractiveness of urban ferry services. Specifically, this paper answers the following research questions.

- What factors impact ferry passengers' travel experience, including overall satisfaction, last trip satisfaction, and perceptions of safety when waiting at terminals?
- Which service attributes are important and should be prioritized to improve satisfaction with urban ferry services?

2. Data

This research analysed data from ferry users as a sample from the Translink customer experience survey (CES) in Brisbane. The data for our study were collected from July to September 2019, and importantly, before the COVID pandemic. The survey questionnaire contains three main parts: demographic information, last trip experience, and service satisfaction evaluation.

The demographic information of ferry users includes gender, age, whether they have disabilities, and the postcode of their residential location. The CES data also recorded the ticket type and their monthly frequency of use of public transport services, based on information from their *go* cards. It is important to note that the CES is sampled from persons who have registered their *go* card with Translink, and hence is a biased sample of all ferry users.

For the last trip experience, the most recent trip by ferry was recorded, including the date of travel, the boarding and alighting time, the line type, the boarding and alighting stops, and whether a transfer was involved.

For the service satisfaction evaluation, the CES survey also asked about users' satisfaction with the service overall, and with the service on their last trip. The overall satisfaction refers to the evaluation of average ferry trips taken during the last 4 weeks, while the last trip satisfaction

refers to the assessment of the most recent ferry trip. In addition, a total of 16 indicators were selected to evaluate the perception of aspects the last trip. They cover ferry users' attitudes towards the experience both on-board and off-board of the whole trip. The on-board evaluation includes the comfort of the ride, comfort on-board, cleanliness on-board, feeling safe on-board, availability of information on-board, punctuality, journey time, availability of seating, cost of the trip, and accessibility on board. The off-board evaluation covers accessibility of terminals, helpfulness of staff members, availability of information at terminals, the convenience of the starting location, cleanliness at terminals, feeling safe at boarding terminals, and the design of off-board facilities. The five-point Likert scale (1-5) is employed to record users' satisfaction levels, ranging from very dissatisfied (1) to very satisfied (5).

In addition to CES records, we also collected other relevant information for each ferry trip, including operational characteristics (extracted from *go* card records), boarding terminal characteristics, vehicular crash rates in residential areas and boarding terminals (matching by postcodes), and weather (extracting from Brisbane weather station and matching by date). Table 1 summarizes the variables' categories, names, data sources, and time periods.

Category	Variables	Source	Time Period
Travel experiences	Overall trip satisfaction, Last trip Satisfaction, Safety perception of boarding terminals	Customer Experience Survey (CES)	July – September 2019
Demographic	Gender, Age, Impaired or	Customer Experience	July – September
characteristics	not	Survey (CES)	2019
Travel characteristics	Ticket type, Monthly usage frequency of public transport, Day of week, Time of day, transfer or not	Customer Experience Survey (CES)	July – September 2019
Operational	Time difference between	Go Card Records	July – September
characteristics	scheduled and actual start, Journey time		2019
Boarding terminal characteristics	Whether seats are present at terminals, whether CCTV is present at terminals, whether assistance is available at terminals	Brisbane City Council	Uploaded by Brisbane City Council in June 2021
Crash rates in residential	The monthly occurrence	Queensland Government	January – June 2019
areas/boarding terminals	rate of crashes involving buses, the monthly	Open Data Portal	
	involving pedestrians		
Weather characteristic	Rainy or not	Bureau of Meteorology (BOM)-Brisbane Station	July – September 2019

Table 1: The description of explanatory variables

3. Travel experience analysis

3.1. Descriptive analysis of users' travel experience

Figure 1 presents the distribution of travel experiences of ferry service users. More than 90 percent of the travellers are satisfied with ferry services (e.g., both overall trips and their last trip). In addition, nearly 65 percent of the travellers feel very satisfied with the safety when waiting for ferry services at boarding terminals. The results of these services reveal that most users show positive attitudes towards ferry services in Brisbane, although the overall satisfaction with safety at terminals is slightly lower than for the overall and last trip satisfaction.



Figure 1: General distribution of ferry service perception

3.2. Factors affecting travel experiences in ferry service systems

A set of ordered logit modes are used to identify the significant factors affecting travel satisfaction of ferry users. This model has been widely employed to conduct analysis of satisfaction for public transport services (Abenoza et al., 2018, Abenoza et al., 2019). It models the relationship between service perceptions as recorded in an ordered Likert scale (e.g., satisfaction with the overall and last trip, safety perception when waiting at terminals) and various explanatory variables: e.g., demographic characteristics, travel characteristics, operational characteristics, boarding terminal characteristics, crash rates, and weather. Table 2 summarizes the modeling results for ferry service perceptions.

As shown in Table 2, several demographic characteristics of ferry users are found significant in the models. Specifically, female users show greater satisfaction than men with both their overall travel and the last ferry trip. The presence of an impairment has a sharply negative impact on both overall and last-trip satisfaction, as well as on safety perceptions towards ferry services. In addition, seniors and university-age adults are more significantly satisfied with overall and last trips of ferry services, while satisfaction is lowest for younger adults (25-45 years old).

Compared with high-frequency users, infrequent users are more likely to express satisfaction with their travel experiences in ferry systems. Perhaps not surprisingly, transfers during travel are negatively associated with satisfaction and perceived safety. Also, users are less satisfied with ferry services when travelling during peak hours. The journey time and weather have no significant effects in the models.

The number of bus-related crashes near users' residential location is negatively associated with the overall satisfaction with ferry travel. In addition, the number of crashes involving pedestrians near boarding terminals has negative impacts on the safety perception of waiting at the terminals.

From the aspects of boarding terminal characteristics, travellers boarding at terminals with seats

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show higher levels of satisfaction and safety perceptions. The interesting finding is that those terminals with CCTVs show worse travel satisfaction than other terminals. Finally, in line with our expectation, assistance facilities at boarding terminals have positive impacts on the satisfaction with the last trip.

Variable	Overall		Last Trip		Safety	
	Satisfaction,		Satisfaction,		Perception,	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
	(p-value)		(p-value)		(p-value)	
Gender (Reference: male)	-		•		•	
Female	0.288	0.189	0.317	0.188	-	-
	(0.127)		(0.092)			
Impaired (Reference: not impaired)	1	1	1	1	T	1
Impaired	-0.815	0.286	-0.724	0.290	-0.765	0.263
	(0.004)		(0.012)		(0.004)	
Age (Reference: prefer not to answer)	0.016	0.516	0.500	0.556	0.000	0.500
18-25	0.816	0.716	0.506	0.556	0.260	0.528
25.45	(0.254)	0.225	(0.363)	0.211	(0.622)	0.215
25-45	(0.155)	0.325	0.714	0.311	(0.823)	0.315
15.65	(0.033)	0.205	(0.022)	0.270	(0.009)	0.276
43-05	(0.031)	0.303	(0.930)	0.279	(0.014)	0.270
>65	1 124	0.335	1 424	0.316	0.343	0.285
	(0.001)	0.555	(0,000)	0.510	(0.228)	0.205
Usage Frequency of Public transport se	rvice (Reference	$e^{-2} > 40 \text{ time}$	mes/month)		(0.220)	
<pre><4 times/month</pre>	0.949	0 447	0.805	0 4 4 4	1 469	0.421
	(0.034)	0.117	(0.070)	0.111	(0.000)	0.121
4-20 times/month	1.169	0.453	0.895	0.442	1.349	0.420
	(0.010)		(0.043)		(0.001)	
20-40 times/month	0.853	0.494	0.792	0.484	1.075	0.463
	(0.084)		(0.102)		(0.020)	
Transfer (Reference: no transfer)	• • •	•	• • •	•	· · · /	•
Transfer	-	-	-0.401	0.287	-0.480	0.268
			(0.163)		(0.073)	
Peak Hour (Reference: Off-Peak Hour)) <u> </u>		•		•	
Peak Hour	-	-	-0.390	0.219	-	-
			(0.074)			
Journey time	-	-	0.006	0.004	-	-
		0.400	(0.151)			
No. of crashes involving buses	-0.988	0.408	-	-	-	-
in residential location/month	(0.016)				0.170	0.075
No. of crashes involving pedestrians	-	-	-	-	-0.170	0.075
at boarding terminals/ month			12.0(0	0.500	(0.023)	1.0((
Seats present at terminals	-	-	13.969	0.590	2.532	1.066
CCTV at terminals			(0.000)	0.022	(0.018)	1.049
CCI v at terminais	-	-	-1.330	0.925	-2.439	1.048
Assistance at terminals (Peference: No assistance)						
Assistance at terminals (Reference: No assistance)						
terminals	-	-	(0,000)	0.412	-	-
Disability Assistance at Boarding		_	0.674	0.528		_
terminals			(0.202)	0.520		
Rainv day (Reference: no rain)						
Rainy day - - - - - 0.333 0.208					0.208	
					(0.109)	

Table 2: Factor analysis of travel experiences of ferry service users

4. Service attribute diagnosis

4.1. Perceived scores of service attributes

Table 3 presents the averages and standard deviations of individual attribute scores and the overall service satisfaction of the ferry system in the passengers' last trip.

Table 3: Averages and standard deviations of service attributes.

Service Attributes	Average	S.D.
Overall satisfaction with last trip	4.72	0.61
The comfort of the ride	4.65	0.58
Comfort on-board	4.54	0.65
Cleanliness on-board	4.64	0.54
Feeling safe on-board	4.75	0.5
Availability of information on-board	4.54	0.7
Punctuality	4.69	0.61
Journey time	4.58	0.72
Availability of seating	4.65	0.63
Cost of the trip	4.38	0.87
Accessibility on board	4.73	0.54
Accessibility of terminals	4.69	0.56
Helpfulness of staff members	4.66	0.6
Availability of information at terminals	4.53	0.73
The convenience of starting location	4.58	0.67
Cleanliness at terminals	4.65	0.57
Feeling safe at terminals	4.65	0.56
The design of off-board facilities	4.5	0.71

The average score for overall service satisfaction was 4.72, indicating that the respondents are rather satisfied with the current ferry service quality. Furthermore, the average satisfaction is higher than that more recent observations since COVID-19 $(4.72 \text{ vs } 4.54)^1$. The mean scores of all the individual attributes were also higher than 4. Safety perception on-board received the highest satisfaction score of 4.75 whilst the cost of the trip scored the lowest (4.38).

4.2. The relative importance of service attributes

We employed gradient boosting decision trees (GBDT) to explore the relationship between satisfaction with the last trip and satisfaction levels of service attributes, controlling for other significant factors. This approach is particularly useful to rank the relative importance of ferry service attributes (Friedman, 2001) and thus to identify priorities for service quality improvement. Essentially, GBDT derives an importance of each attribute as a discriminator among different levels of satisfaction, with higher discriminatory power indicating greater importance to ferry users.

In the GBDT model, we set the shrinkage as 0.001, the number of trees as [1,20000], and the depth of tree as [1,49] for our parameter test. A four-fold cross validation was adopted to

 $^{^{1}\} https://www.publications.qld.gov.au/ckan-publications-attachments-prod/resources/75e51e8b-c666-4d3a-8614-b932e3f03f58/translink-open-data-february-2023-snapshot.pdf?ETag=6a95fe37d3b79c1ae7d71116ec61d065$

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determine the number of trees. Finally, the model obtained a relatively small root mean squared error (RMSE) of 0.4289 when setting the number of trees as 6070 and the depth of tree as 17. The factors in the satisfaction with the last trip are set as control variables in this analysis. Table 4 presents the relative importance of each service attribute, comparing its importance (scaled from 0 to 1) and its level of satisfaction with the last trip.

Table 4.	The rel	ative imno	ortance of	service a	attributes
I able 1.	I HC I Ch	aure mpe	munee or	Ser vice i	attinutes

Service Attribute	Importance (%)	Scaled Importance
The comfort of the ride	6.12	0.33
Comfort on-board	2.84	0.15
Cleanliness on-board	3.65	0.20
Feeling safe on-board	7.82	0.42
Availability of information on-board	3.60	0.20
Punctuality	18.43	1.00
Journey time	10.25	0.56
Availability of seating	5.73	0.31
Cost of the trip	6.03	0.33
Accessibility on board	6.75	0.37
Accessibility of terminals	2.73	0.15
Helpfulness of staff members	6.63	0.36
Availability of information at terminals	2.3	0.12
The convenience of starting location	3.18	0.17
Cleanliness at terminals	0.83	0.05
Feeling safe at terminals	1.14	0.06
The design of off-board facilities	1.72	0.09

Among all service attributes, the punctuality has the largest contribution (with a relative importance of 18.43%), followed by journey time, safety on-board, and accessibility on board. The similar findings are also found in the Sweden case (Tanko et al., 2019).

4.3. Priorities for service quality improvement

According to the satisfaction rating of service aspects (derived from the customer experience survey) and their importance scores (calibrated by the GBDT model), the importance-satisfaction analysis was employed to identify the priorities for actions to improve the ferry service quality. The importance-satisfaction analysis has been widely used in mobility services evaluations (Wong and Szeto, 2018, Wong et al., 2017).

As shown in Figure 2, there are two vertical lines (e.g., 4.522 and 4.705), which are calculated by adding or subtracting one standard deviation of 0.091 from the average satisfaction rating of 4.614. Similarly, the two horizontal lines (e.g., 0.055 and 0.518) are determined based on the mean value of the average important rating of 0.286, plus or minus one standard deviation of 0.232. According to the results of the importance-satisfaction analysis, the service aspects (in the purple quadrants) holding the relatively highest priority for improving ferry service satisfaction are punctuality, journey time, the cost of ferry trips, as well as the design of offboard facilities. These attributes show relatively lower satisfaction and relatively high importance to ferry users. In addition, the service aspects in the green quadrants, including safety and accessibility on-board, safety perception at terminals, and cleanliness at terminals, are recommended to keep monitoring their service quality. That is, they perform well and are

of lower importance. The remaining service aspects in the white quadrants are recommended to be maintained at existing levels for passenger satisfaction.





5. Conclusion

This paper explores the impacts of demographic characteristics, travel characteristics, operational characteristics, terminal characteristics, crash rates, and weather on travel experiences in urban ferry systems, for satisfaction with the overall and last trip, and with the perception of safety when waiting at terminals. The findings can provide better guidance for the planning and operation of ferry services in Brisbane:

- Among public transport services in Brisbane, most users show positive attitudes towards ferry services.
- Seniors are more significantly satisfied with overall and last trips of ferry services than other age groups. Infrequent users are more likely to express satisfaction with their travel experiences in ferry systems.
- Travelers boarding at terminals with seats show higher levels of satisfaction and safety perceptions. Assistance facilities at boarding terminals also have positive impacts on the satisfaction with last trips.
- The punctuality has the largest contribution to satisfaction with last trips, followed by journey time, safety on-board, and accessibility on board.
- The service aspects holding the relatively highest priority for improving ferry service satisfaction are punctuality, journey time, the cost of ferry trips, as well as the design of off-board facilities. Significant improvements, particularly in punctuality and journey time, are likely to increase the level of satisfaction among existing ferry passengers.

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