

TRANSPORT FINDINGS

Do Users Prefer Particular Public Bus Transport Operators in Bhopal, India?

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Findings

This paper focuses on the unique situation of users' preferences when choosing between different Public Bus Transport Operators (PBTOs) in Bhopal. While many studies have examined the choice between different modes of transport (such as choosing a car over a bus), the factors that lead users to prefer one PBTO over another—despite similar characteristics—have not been studied. This paper analyzes these differences in preference through travel behavior attributes. It also explores how the three PBTOs in Bhopal serve the daily mobility needs of different segments of the population and reveals the factors influencing users' choice of one PBTO over another.

1. QUESTIONS

In Bhopal, three different public bus transport operators (PBTOs) run along various routes, sometimes covering the full or partial length of the same routes. These PBTOs operate in parallel across the city. Among them, *My Bus* is a Special Purpose Vehicle (SPV) managed by Bhopal City Link Limited (BCLL) under the Bhopal Municipal Corporation, while the minibuses and suburban midi buses are run by private operators. The Regional Transport Office (RTO) oversees these PBTOs, assigning routes and fleets, which are detailed in [Table 1](#). Though ridership across these PBTOs was heavily impacted during the COVID-19 pandemic, it gradually returned to normal levels afterward.

Table 1. Assigned Routes, Shared Routes, Fleet Strength and Operational Model of Bhopal PBTOs

Types of PBTO	PBTO wise assigned routes (as per RTO)	Shared routes	Number of fleets	Operational model
My Bus	16	8	360	Net-Cost contract through public-private partnership (PPP)
Midi Bus	4	2	100	Fare box revenue
Mini Bus	1	1	20	Fare box revenue

Source: Developed by the Author

The existence of three PBTOs operating in Bhopal, either along full or partial stretches of the same routes, raises the question of whether users prefer one operator over another, especially given that each operator must reach a certain ridership to break even. This prompts two key research questions: (i) Do users in Bhopal differentiate when choosing a PBTO? (ii) What travel behavior attributes influence the choice of one PBTO over another?

2. METHODS

The study employs both qualitative and quantitative methods. Due to the dynamic nature of the research, some steps and procedures evolved as the study progressed. A quantitative approach was used to measure target users' responses to a set of questions, enabling data comparison and statistical analysis. The qualitative approach provided insights into the decision-making processes related to travel across the three PBTOs in Bhopal. The overall methodology is outlined in [Figure 1](#).

Identification of travel behavior attributes: A conceptual framework for understanding the mode based paradigm of defining travel behaviour is described in [Figure 2](#).

The mode-based paradigm of travel behavior suggests that the choice of a particular transport mode is influenced by the following factors (Khisty and Lall 2003):

- The *characteristics of the transport mode* such as occupancy, ride time, frequency, and other service-related factors.
- The *characteristics of the trip* including trip distance, time of travel, and similar trip-specific elements.
- The *characteristics of the trip maker* defined by socio-economic, behavioral, and psychological factors, such as family income, vehicle ownership, and family size.

These factors form the basis for this study to identify the travel behavior attributes that help determine whether users have a preference for a specific PBTO. From a literature review, 29 relevant attributes were identified and validated through an expert opinion survey, which included 22 experts from academia, industry, and government. The experts ranked each attribute on a 3-point Likert scale: 3 for Agree, 2 for Neutral, and 1 for Disagree (see [Table 1](#) in Appendix I). Attributes were retained based on the modal values derived from these rankings. These 29 attributes, listed in Appendix I, were used in the primary survey (conducted through four sets of questionnaires) and in statistical analysis to identify any preference differences.

The survey was conducted after finalizing the travel behavior attributes, following these steps:

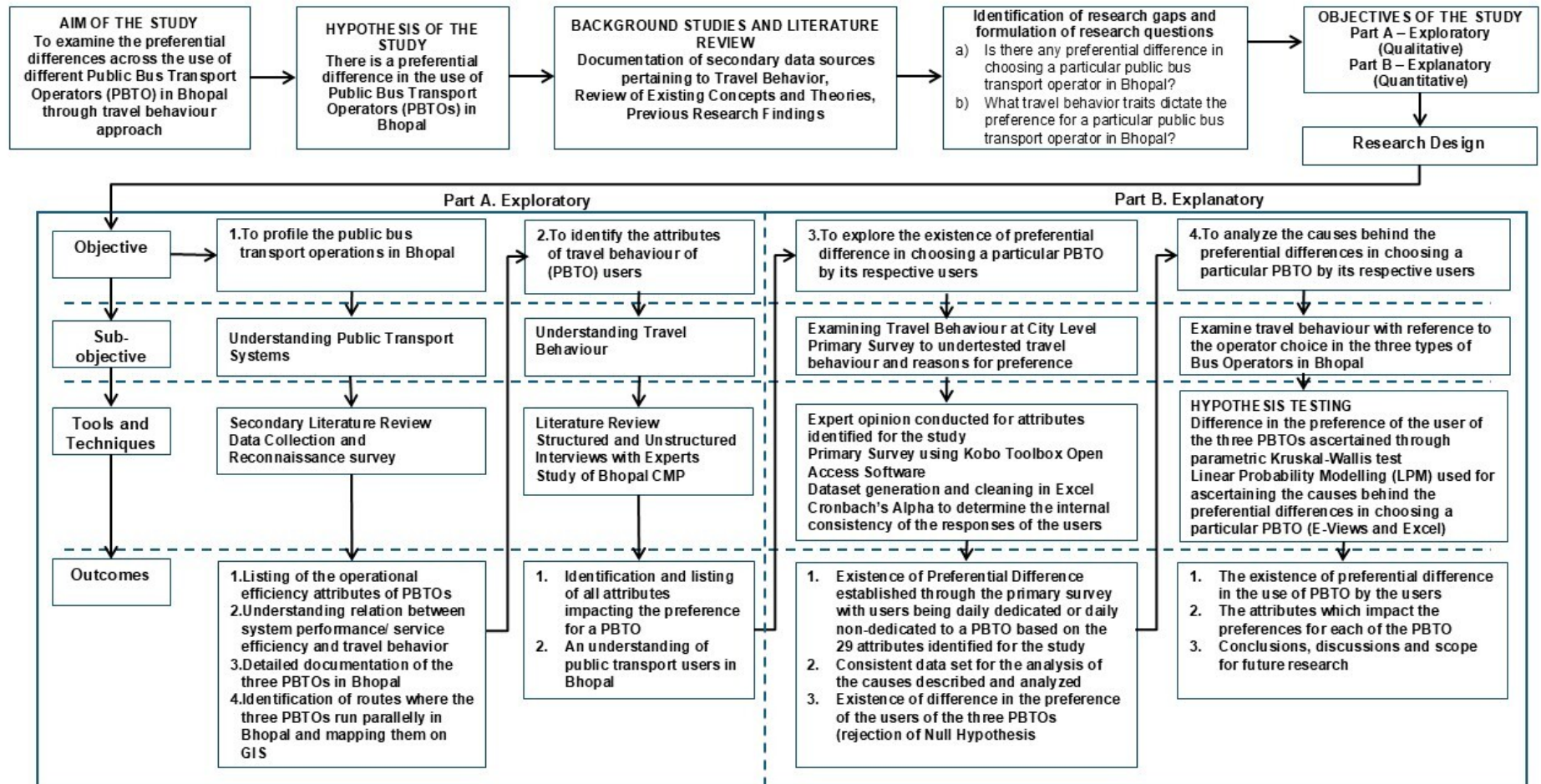


Figure 1. Methodology of the Study

Source: Developed by the Authors

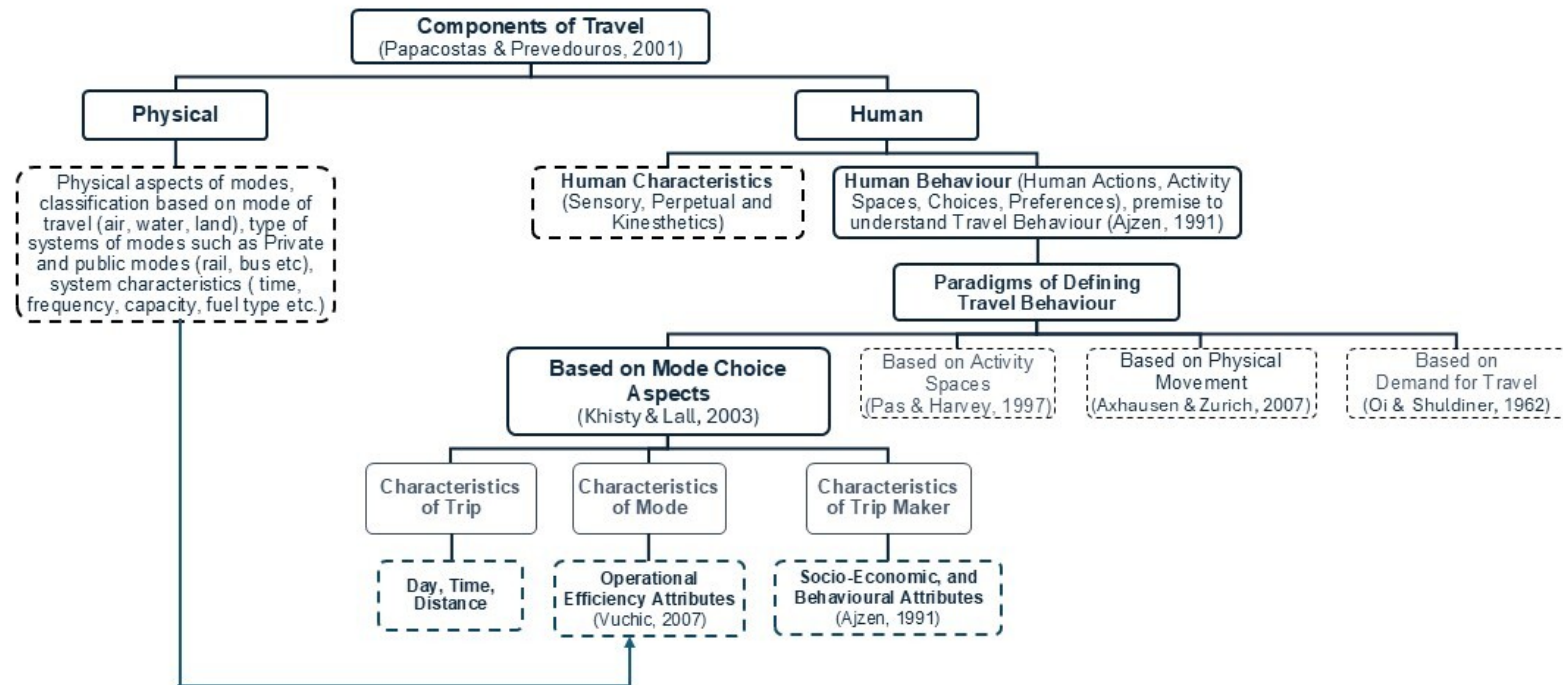


Figure 2. Conceptual Framework for the Identification of Attributes of Travel Behaviour

Source: Developed by the Authors

- **Complete Enumeration:** The survey included all users of the three PBTOs, meaning no specific sample size was set. A total of 767 responses were collected: 337 (44%) from My Bus, 207 (27%) from Midi Bus, and 223 (29%) from Mini Bus.
- **User Classification:** Based on the study's hypothesis, users were classified into three categories: (i) Daily, (ii) Weekly, and (iii) Occasional users. Further, users were categorized as either dedicated or non-dedicated to a specific PBTTO. A user was considered dedicated if they consistently chose the same PBTTO, regardless of how frequently they traveled. Most respondents (44%) were daily dedicated users. The majority of respondents (78%) were male.
- **Preliminary Field Study:** A reconnaissance survey was conducted to define the study area in Bhopal, mapping the routes where all three PBTTOs operate using GIS-based mapping.
- **Survey Procedure:** Two volunteers, along with the principal investigator, conducted the survey on both weekdays and weekends during peak hours (9 AM - 11 AM and 5 PM - 7 PM) and one non-peak hour (12 PM - 2 PM). They boarded all three PBTTOs from a common bus stop at various times and interviewed users as they boarded the buses at shared stops.
- **Data Collection Tool:** The survey was carried out using the open-source software KoBo Toolbox. The data collected was stored in Excel and coded for further analysis.

The data sets from the primary survey were stored in Excel format using the KoBo Toolbox, categorized for each of the PBTTOs. Users were classified as either daily-dedicated or daily non-dedicated. Most responses to the survey questions were recorded as dichotomous (yes/no), with 'yes' coded as 1 and 'no' coded as 0, except for age, which was recorded as specific age groups. These codes facilitated the statistical analysis of user preferences (see [Table 2](#)).

Table 2. Coding of Attributes in Dataset

Sl. No.	Attribute	Description	Code
1.	User Type	Daily (Dedicated)	1
		Daily (Non-Dedicated)	0
2.	Age	< 18 years	18
		18_25	22
		25_40	32
		40_60	50
		>60	60
3.	Gender	Male	1
		Female	0
4.	Occupation	Employed	Formal
		Self Employed (Business)	Formal

Sl. No.	Attribute	Description	Code
		Business	Formal
		Daily-wager	Informal
		Student	Informal
		Housewife	Informal
		Others	Informal
		Retired	Formal
		Formal	1
		Informal	0
5.	User Response	Yes	1
		No	0

Source: Developed by the Authors

To assess the reliability of the survey responses, Cronbach's Alpha was calculated, since the responses were recorded in binary form. The formula for Cronbach's Alpha is:

$$\alpha = (N \cdot \bar{c}) / (\bar{v} + (N - 1) \cdot \bar{c})$$

Where:

- N is the number of test items,
- $\bar{c}$ is the mean covariance between pairs of test items,
- $\bar{v}$ is the average variance.

The Cronbach's Alpha values for the survey responses were as follows:

- My Bus: 0.712
- Mini Bus: 0.933
- Midi Bus: 0.923

These values meet the threshold for response consistency, as outlined by Tavakol and Dennick (2011), indicating that the responses from users of each PBTO were reliably consistent.

To assess differences in user preferences for specific PBTOs, a Kruskal-Wallis One-way ANOVA by Rank test was conducted. The test checks if the variance between operators is greater than the variance within operators to determine if there is a significant difference in user choices. The Chi-square value (7.36) exceeded the critical value (5.99) for 2 degrees of freedom at a 5% significance level, and the p-value was below 5%, leading to the rejection of the null hypothesis. A Post Hoc test further identified significant differences in user preferences between Mini-Midi, Mini-My Bus, and Midi-My Bus, with a p-value of 10%, confirming the rejection of the null hypothesis.

Linear Probability Modelling (LPM) was used to explore the relationship between user preferences for a PBTO and 29 identified predictor variables (from [Table 1](#)). The LPM model takes the form:

$$Y_i = \beta_i + \beta_z X_i + u_i$$

The response variable (Y), representing the probability of choosing a particular PBTO, is binary: 1 if the user chooses a PBTO and is a daily dedicated user, and 0 if they do not.

3. FINDINGS

The results of the association analysis reveal a significant relationship between the travel behavior attributes and the users' preference for one PBTO over another. Linear Probability Model (LPM) results are summarized in [Table 3](#).

Table 3. Preference for a Particular PBTO

Sl. No.	Description of the Attribute	Coefficient	p-Value
My Bus			
1.	Habit	0.188	0.00
2.	Familiarity	0.204	0.03
3.	Discounts offered	0.175	0.04
4.	Safety during travel	0.321	0.05
5.	Motivation	0.094	0.05
6.	Overcrowding	-0.316	0.00
7.	Weather	-0.133	0.00
8.	Restricted boarding and alighting	-0.116	0.03
9.	Permission to carry luggage	-0.355	0.00
Midi Bus			
1.	No need of smart device to book ticket	0.799	0.01
2.	Price of ticket	0.590	0.02
3.	Permission to carry luggage	0.458	0.02
4.	Familiarity	0.394	0.01
5.	Gender (Female)	0.296	0.05
6.	Awareness of other PBTO on the same route	-0.536	0.02
Mini Bus			
1.	Permission to carry luggage	0.369	0.05
2.	Safety	0.326	0.01
3.	Preference - negotiation in making payments	0.241	0.04
4.	Age	0.008	0.00
5.	Norms – service disruption during COVID-19	-0.179	0.08

Source: Developed by the Authors

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Appendix I

Appendix Table 1. Shortlisted Travel Behaviour Attributes

Sl. No.	Factors	Attributes	Source
1.	Socio Economic Characteristics of Users	1. Age 2. Gender 3. Occupation	Abenzoza, Cats, and Susilo 2016 Begoña, Antonio, and Lopez Lambas 2016 De Vos and Witlox 2016 Dissanayake and Morikawa 2010 Farber et al. 2014 Friman et al. 2017 Mwale, Luke, and Pisa 2022 Ng and Acker 2018 Oyesiku and Odufuwa 2002 Scheiner 2010 Simičević, Milosavljević, and Djoric 2016 Veternik and Gogola 2017
2.	Operational Characteristics of Mode Operators	1. Frequency of operation 2. Driving skills of the driver 3. Punctuality 4. Safety 5. Seat availability 6. Convenience of boarding and alighting 7. Permission to carry luggage 8. Seating comfort 9. Over crowding 10. Attitude of the conductor 11. Cleanliness 12. Price of ticket 13. Discounts offered	Blitz and Lanzendorf 2020 Chase 2020 Cui, Loo, and Lin 2017 Drabicki, Islam, and Szarata 2021 Elias and Shiftan 2012 Elias, Albert, and Shiftan 2013 Garling 1998 Hani S. 2007 Iseki and Taylor 2009 Kumar and Kumar 2019 Morikawa and Sasaki 1998 Nilsson and Küller 2000 Papagiannakis, Baraklianos, and Spyridonidou 2018 Park et al. 2023 Paulssen et al. 2014 Raunak, Sawant, and Sinha 2020 Recker and Stevens 1976 Singh and Goyal 2019 Tomaino et al. 2020 Venezia 2009 Vuchic 2007
3.	Behavioral Characteristics of the Users	1. Familiarity 2. Awareness 3. Preference 4. Change in travel norms due to COVID-19 5. Intention 6. Motivation 7. Proximity to available travel option 8. Habit 9. Weather 10. Availability of smart device 11. Travel barrier due to lack of smart device 12. Preference to travel by available travel option 13. Availability of travel option	Ajzen 1991 Fishbein, Ajzen, and Flander 1975 He et al. 2023 Howarth and Ryley 2012 Kahneman, Wakker, and Sarin 1997 Reddy, Prasad, and Bhatnagar 2018 Sahu 2020 Vos 2018

Source: Developed by the Authors from the Literature Review