Are the preferences of travelers same across cities? A tale of two Indian cities

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Abstract. The paper reports an investigation on the preferences of travelers in two Indian cities. The importance of travelers was collected from Kolkata and Kollam cities using 5-point Likert-type importance scale, and RIDIT analysis was carried out to obtain the priority rankings of travelers. A three-level analysis was carried for travelers, captive riders (travelers without car), and choice riders (travelers with car) of the two cities. The priority ranking obtained for the travelers of two cities were then compared using Spearman’s rank correlation test. It was shown that there is a substantial difference in the perception of travelers from two cities. This was instrumental in establishing the fact that preferences of travelers are not transferable across the cities. Therefore, the selection of attributes for WTP studies require a separate investigation to understand the preference of travelers of the city under consideration. On-board safety was identified as a major concern for the travelers of Kolkata and Kollam cities, which clearly shows the importance of addressing safety issues for enhancing the quality of public transport. The results obtained from the present work is city specific. However, the derived insights are expected to encourage researchers and policymakers to carry out separate investigations in various cities for identifying important attributes prior to behavioural studies.

1. Introduction
Public transport is well recognized for the sustainable growth of cities [1]. Traditionally, in emerging countries such as India, public transport serves the mobility needs of marginally weaker segments of the society [2]. With the alarming increase in private vehicle usage, public transport has now recognized as an effective instrument for demand management by attracting private vehicle users [3], [4]. This shift in focus of public transport is necessary for mitigating the negative externalities (congestion, pollution, and vehicular delay) of increased private vehicle usage [5],[6]. However, the quality of public transport service in Urban India (in terms of waiting time, travel time, crowding, etc.) is inferior to those in developed countries [7]. This often discourages the private vehicle users to use public transport for their travel. Therefore, it is important to improve the service quality of public transport in Indian cities to mitigate congestion and pollution with a larger aim to improve the quality of urban life.
Understanding the preferences of travelers is important for enhancing the quality of public transport [8]. Moreover, development of demand and Generalized cost models are necessary for rational improvement planning of public transport [2]. The number of attributes to be included in such models are generally limited, and it necessitates a rational basis for the selection of most important attributes [9]. Several studies have been conducted for developing demand and generalized cost models across various Indian cities [9]. However, in many cases, the selection of attributes in such studies was either based on expert opinion or using the preferences of travelers adopted from other cities based on literature [10], [8]. Selection of attributes based on expert opinion may not be rational always as travelers are the decision makers of their mode choice and their preferences are to be determined for the selection of attributes [10]. Practically, no investigation is carried out in Indian cities to check if the preferences of travelers are same across the cities for confirming the rationality of adopting the same from literature. Therefore, the present work aims to study the perception of travelers from two Indian cities and compare to check whether their preferences are same. The study was conducted in Kolkata and Kollam cities in the state of West Bengal and Kerala, respectively.

The paper is organized into five sections. After introduction, Section 2 includes the theoretical background and methodology of the study. The design of survey instrument and the procedure of data collection are discussed in Section 3, while the data analysis and discussions are presented in Section 4. Finally, the study is summarized in Section 5 by highlighting major outcomes and scope of future research.

2. Theoretical background

Researchers have used several techniques, like TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) [11], GRA (Gray Relational Analysis) [12], and RIDIT analysis [13] for the prioritization of attributes in various contexts. And past studies have shown that RIDIT is more ideal and gives rational results among the three techniques [8]. Therefore, RIDIT was preferred for the present work.

RIDIT is a technique introduced by Bross for analyzing data with responses measured on an ordered categorical scale [13]. The data collected using rating scales of three or more points are statistically analysed in this technique. Although the theoretical background of RIDIT is available in standard literature [13], a brief algorithm of the technique is provided here.

Step 1: The technique starts with the selection of a population to serve as a reference data set. In general, the total responses obtained from the survey is considered as a reference data set if the responses are collected using Likert-type scale.

Step 2: The frequency \( f_j \) is calculated for each category of responses, where \( j = 1 \ldots n \).

Step 3: Subsequently, the midpoint accumulated frequency \( F_j \) is calculated for each category of responses using Equation 1 and Equation 2.

\[
F_j = \frac{1}{2} f_j \\
F_j = \frac{1}{2} f_j + \sum_{k=1}^{j-1} f_k
\]

Step 4: In this step, RIDIT value \( R_j \) is calculated for each category of responses in the reference data set using Equation 3.

\[
R_j = \frac{F_j}{N}
\]

where \( j = 1, \ldots, n \) and \( N \) = total number of responses from the Likert scale survey of interest. By definition, the expected value of \( R \) for the reference data set is always 0.5.

Step 5: This step includes calculation of RIDITs and mean RIDITs for comparison data sets. This essentially ensures that the comparison data set includes the frequencies of responses for each category of a Likert-type scale item. This further means if there are \( m \) Likert-type scale items in the response scale, there will be \( m \) comparison data sets.

Step 5(a): Here, RIDIT value \( r_{ij} \) for each category of scale items is calculated using Equation 4.
\[ r_{ij} = (R_j \times \pi_{ij}) / \pi_i \] where \( i = 1, \ldots, m \) (4)

where \( \pi_{ij} \) = frequency of category \( j \) for the \( i \)th scale item, and \( \pi_i \) = short form for the summation of frequencies for scale item \( i \) across all categories, i.e. \( \pi_i = \sum_{k=1}^{n} \pi_{ik} \)

Step 5b: Compute mean RIDIT value \( \rho_i \) for each category of Likert-type scale items using Equation 5.

\[ \rho_i = \frac{1}{n} \sum_{k=1}^{n} r_{ik} \] (5)

Step 6: The confidence intervals of RIDIT values (\( \rho_i \)) are calculated in this step. The 95% confidence interval of any \( \rho_i \) for a substantially large dataset is calculated using Equation 6.

\[ CI = \rho \pm \frac{1}{\sqrt{3\pi_i}} \] (6)

3. Survey and data collection

It was decided to conduct the study in two Indian cities viz., Kolkata and Kollam, which are culturally and geographically different. Kolkata, being the third most populous metropolitan city in India with a population of 14.1 million has the mix of modern mass rapid transport and other transport modalities like Buses [14]. On the other hand, Kollam city in Kerala is habitat to a population of 3.97 lakhs with bus being the most widely used public transportation system.

In order to collect the perception of travelers from both cities, a paper-based questionnaire was developed. The questionnaire included three sections, namely (i) trip characteristics of the travelers, (ii) importance of the attributes, and (iii) socio-economic characteristics of the travelers. While the trip characteristics include predominant travel mode, trip purpose, and frequency of travel, the socio-economic characteristics include household income, car and two-wheeler ownership details, gender, and educational qualification. Based on literature review [8], [15], [16], [17], [18], a total of 18 attributes were selected for the study. The selected attributes include on-board information, in-vehicle travel time, safety on-board, staff behaviour, cleanliness, comfort, security, transfer time, number of transfers, span of service, fare, ticketing system, wayside information, punctuality, headway, access & egress time, pedestrian environment, and bus stop facilities. The importance of the attributes was collected using 5-point Likert type scale, where 1 indicates least important and 5 indicates the most important [8]. Although different scales were adopted during pilot study, the respondents were found comfortable in giving the responses in 5-point importance scale. The responses were collected from several locations in Kolkata and Kollam cities using simple random sampling technique. Trained enumerators were employed for collecting the responses. A total of 2000 responses were collected and 1854 refined responses were obtained from Kolkata city which is satisfying the required sample size requirement at 95% confidence level [7]. On the other hand, 300 refined responses were obtained out of 350 responses which is significant at 90% confidence level [7].
Table 1. Descriptive statistics of socio-demographic data

| Variables                      | Kolkata City | Kollam City |
|--------------------------------|--------------|-------------|
|                                | Number (%)   | Number (%)  |
| Observations                   | 1854         | 300         |
| Male                           | 1197 (65)    | 151 (50.3)  |
| Female                         | 657 (35)     | 149 (49.7)  |
| Age (Years)                    |              |             |
| <20 years                      | 258 (14)     | 51 (17)     |
| 20-35 years                    | 811 (44)     | 112 (37.3)  |
| 35-55 years                    | 690 (37)     | 125 (41.7)  |
| >55 years                      | 95 (5)       | 12 (21)     |
| Frequency of travel (number of trips) |             |             |
| <3                             | 382 (21)     | 67 (22.3)   |
| 3-4                            | 303 (16)     | 102 (34)    |
| 5-6                            | 601 (32)     | 95 (31.7)   |
| >6                             | 568 (31)     | 36 (12)     |
| Car Ownership (number of cars) |              |             |
| 0                              | 1166 (63)    | 125 (41.6)  |
| 1                              | 563 (30)     | 110 (36.67) |
| 2                              | 125 (7)      | 50 (16.7)   |
| >2                             | 0 (0)        | 15 (5)      |

4. Results and discussion

After collecting the data, RIDIT analysis was carried out to study the preferences of travelers. The analysis aimed to understand and compare the preferences of travelers from Kolkata and Kollam cities. It was also aimed to classify the travelers based on their car ownership as captive and choice riders and compare their preferences in two cities. Thus, a three-level RIDIT analysis was carried out between travelers, captive riders, choice riders of Kolkata and Kollam cities. After obtaining the preferences, Spearman’s rank correlation test was carried out compare the perception of travelers,
captive riders and choice riders of two cities. In statistics, Spearman’s rank correlation coefficient denoted by Greek letter ρ is a non-parametric measure of rank correlation (statistical dependence between the rankings of two variables). It analyses the relationship between two variables using a monotonic function. Spearman’s rank correlation between two variables will be high if the ranks are similar. It may be mentioned that in the present study, Spearman’s rank correlation test was conducted using SPSS (Statistical Package for the Social Sciences) Software [8].

The RIDIT analysis and Spearman rank correlation test results on the perception of travelers of Kolkata and Kollam cities are presented in Table 2. A spearman’s rank correlation coefficient of 0.10 was obtained for the preferences of travelers from Kolkata and Kollam cities. The p-value (0.69) indicate that the priority ranks of travelers are significantly different. This clearly suggests that the travelers of Kolkata and Kollam cities are substantially different in terms of their preferences towards travel.

Table 2. Priority ranking of attributes for travelers in Kolkata and Kollam

| Attributes           | Travelers of Kolkata | Travelers of Kollam |
|----------------------|----------------------|---------------------|
|                      | Average RIDIT Score  | Rank                |
|                      |                      | Average RIDIT Score  | Rank    |
| Safety               | 0.77                 | 1                   |
| Security             | 0.51                 | 8                   |
| Staff behavior       | 0.38                 | 16                  |
| Cleanliness          | 0.51                 | 7                   |
| Comfort              | 0.56                 | 5                   |
| Transfer time        | 0.44                 | 14                  |
| Number of transfers  | 0.44                 | 13                  |
| Punctuality          | 0.50                 | 9                   |
| Headway of service   | 0.57                 | 4                   |
| In-vehicle travel time| 0.57                | 3                   |
| Span of operation    | 0.69                 | 2                   |
| Fare                 | 0.54                 | 6                   |
| Ticketing system     | 0.45                 | 11                  |
| On board information | 0.37                 | 17                  |
| Way side information | 0.44                 | 12                  |
| Access & egress time| 0.45                 | 10                  |
| Pedestrian environment| 0.42                | 15                  |
| Bus stop facilities  | 0.35                 | 18                  |

Note: Spearman’s Rank Correlation Coefficient, ρ = 0.10, p-value=0.69

Although the preferences are significantly different, safety is identified as the most important attribute by the travelers of both cities. With the increasing number of road accidents and resulting fatalities, this result clearly shows the growing safety concerns of travelers and the need for improving safety. While pedestrian environment and bus stops facilities were given least priority by the travelers of Kolkata, the two attributes were given high priorities by the travelers of Kollam. It is also interesting note that fare was given high importance by the travelers of both cities. Headway and in-vehicle travel time was given high importance by travelers of Kolkata, while the same were given relatively less importance by travelers of Kollam city. This may be due to the better performance of public transport, especially bus service, in terms of headway and travel time in Kollam as compared to Kolkata. Being one of the most densely populated cities, travel time of bus service in Kolkata is severely affected by the congestion especially during morning and evening peak hours.

The RIDIT analysis and Spearman’s correlation test results of choice riders from the two cities are summarized in Table 3. The results clearly suggest that there is a substantial difference in the priority rankings of choice riders of Kollam and Kolkata cities.
Table 3. Priority ranking of attributes for choice riders in Kolkata and Kollam

| Attributes               | Choice riders of Kolkata | Choice riders of Kollam |
|--------------------------|--------------------------|-------------------------|
|                          | Average RIDIT Score      | Rank                    |
|                          |                          |                         |
| Safety                   | 0.75                     | 1                       |
| Security                 | 0.49                     | 9                       |
| Staff behavior           | 0.38                     | 17                      |
| Cleanliness              | 0.49                     | 8                       |
| Comfort                  | 0.53                     | 6                       |
| Transfer time            | 0.45                     | 13                      |
| Number of transfers      | 0.54                     | 5                       |
| Punctuality              | 0.57                     | 3                       |
| Headway of service       | 0.52                     | 7                       |
| In-vehicle travel time   | 0.55                     | 4                       |
| Span of operation        | 0.66                     | 2                       |
| Fare                     | 0.47                     | 11                      |
| Ticketing system         | 0.48                     | 10                      |
| On board information     | 0.38                     | 16                      |
| Way side information     | 0.45                     | 12                      |
| Access & egress time     | 0.44                     | 14                      |
| Pedestrian environment   | 0.42                     | 15                      |
| Bus stop facilities      | 0.37                     | 18                      |

Note: Spearman’s Rank Correlation Coefficient, $\rho = 0.10738$, p-value = 0.67149

As in the case of travelers, choice riders also consider safety as the most important attributes, which is reconfirming the urge for safe travel by travelers in Indian cities. The choice riders of Kolkata and Kollam were found to give nearly equal and high importance to attributes such as headway, comfort and punctuality. This is clearly in line with the observations of previous studies [10]. It is also interesting to note that the fare was given least importance by the choice riders of both cities. In emerging countries such as India, keeping in mind the captive riders, fare of public transport is always kept low by compromising the service quality. However, these findings clearly indicate the importance of service quality in terms of headway comfort, punctuality over fare for choice riders. This point towards the need for having premium service with superior service quality and also higher fare to meet the increase in expenditure.

The priority ranking of attributes for captive riders of the two cities are summarized in Table 4. Although the correlation coefficient is marginally higher as compared to the previous two cases, there is a substantial difference in the preferences of captive riders of two cities as indicated by the p-value.

While safety was given highest importance by the captive riders of Kolkata city, fare was given the highest importance by the captive riders of Kollam city. Overall, the importance of fare given by captive riders as compared to choice riders is substantially high in both cities. Unlike choice riders, captive riders cannot afford to have premium service with high fare, and therefore, it is important to maintain the present fare with possible improvement in service quality. While captive riders of Kolkata were found to give less importance to pedestrian environment and bus stop facilities, the same were given higher importance by the captive riders of Kollam city. It may be noted that the priority ranks of on-board and wayside information are same for the captive riders of two cities. Interestingly, the importance of information given by the captiveriders of two cities is low. This may be attributed to the fact that on-board information in the form of digital display is not pertinent as the relevant information are generally provided by the staff inside the vehicle. Wayside information in the form of printed schedules are often available at bus stops, and the schedule of buses is generally known to frequent travelers like captive riders. This might have reduced the importance of wayside information to captive riders.
Table 4. Priority ranking of attributes for captive riders in Kolkata and Kollam

| Attributes                     | Captive riders of Kolkata | Captive riders of Kollam |
|-------------------------------|---------------------------|--------------------------|
|                               | Average RIDIT Score | Rank     | Average RIDIT Score | Rank     |
| Safety                        | 0.79                    | 1        | 0.66                 | 2        |
| Security                      | 0.52                    | 8        | 0.65                 | 4        |
| Staff behavior                | 0.39                    | 15       | 0.47                 | 12       |
| Cleanliness                   | 0.53                    | 7        | 0.47                 | 10       |
| Comfort                       | 0.58                    | 6        | 0.45                 | 14       |
| Transfer time                 | 0.44                    | 12       | 0.50                 | 8        |
| Number of transfers           | 0.34                    | 17       | 0.49                 | 9        |
| Punctuality                   | 0.45                    | 10       | 0.65                 | 3        |
| Headway of service            | 0.62                    | 3        | 0.51                 | 7        |
| In-vehicle travel time        | 0.59                    | 5        | 0.46                 | 13       |
| Span of operation             | 0.72                    | 2        | 0.42                 | 17       |
| Fare                          | 0.61                    | 4        | 0.72                 | 1        |
| Ticketing system              | 0.42                    | 13       | 0.26                 | 20       |
| On board information          | 0.34                    | 16       | 0.44                 | 16       |
| Way side information          | 0.44                    | 11       | 0.47                 | 11       |
| Access & egress time          | 0.46                    | 9        | 0.45                 | 15       |
| Pedestrian environment        | 0.42                    | 13       | 0.54                 | 5        |
| Bus stop facilities           | 0.33                    | 18       | 0.54                 | 5        |

Note: Spearman’s Rank Correlation Coefficient, $\rho = 0.15444$, p-value=0.54061

5. Conclusion

An investigation is carried out in the present work to study the preferences of travelers in Kolkata and Kollam cities. The data collected from two cities were subjected to RIDIT analysis for obtaining the priority rankings, and subsequently, spearman’s rank correlation test was conducted to compare the preferences of travelers from the two cities. Overall, there is substantial difference in the perception of travelers from two cities, which was instrumental in establishing the fact that preferences of travelers are not transferable across the cities. Hence, the selection of attributes for WTP studies require a separate investigation to understand the preference of the travelers of city under consideration. Several interesting findings regarding the perception of travelers were obtained. It was shown that safety is a major concern for the travelers of Kolkata and Kollam. This clearly shows the importance of addressing safety issues for enhancing the quality of public transport. While choice riders of both cities gave more importance to service quality in terms of safety, headway, transfer time, etc., the captive riders’ priority was fare over other attributes. This clearly suggests the need for having two distinctly different service in Indian cities one with superior service quality and high fare for choice riders while the second with a reduced service quality to maintain low fare for captive riders. The priority rankings obtained from the present work may be used for the selection of attributes to improve public transport in Kolkata and Kollam cities. Although the results are city specific, the evidences obtained from the present work is expected to encourage researchers and policymakers to carry out separate investigations in various cities for identifying important attributes prior to behavioral studies. However, further studies may be required to investigate the impact of socio-cultural characteristics on priority rankings and to develop statistical models to investigate the same.

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