

# Review on Factors Influencing Passenger Behavior on Vehicle Sharing

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doi: <https://doi.org/10.21467/proceedings.156.5>

## ABSTRACT

Transportation experts are attempting to promote a variety of sustainable travel alternatives in order to mitigate the negative effects of private vehicle use and traffic congestion. One of the widely accepted solutions is to endorse the public transit system. The vehicle share system introduced in recent times is proving to be another way by which the same can be achieved without compromising people's utility and convenience as in the case of public transit. The purpose of this review paper was to convey the necessity of a thorough study of the elements that influence vehicle share demand. Several studies have focused on relevant factors that influence traveler's mode selection, as well as their attitudes and traits about choosing various vehicle-sharing systems. This paper reviews recent studies in the literature on non-motorized (bicycle) bike-sharing, motorized (bike-taxi) bike-sharing, and car-sharing.

**Keywords:** Car sharing, Bicycle sharing, Bike taxi

## 1 Introduction

The adverse effects of private transit and traffic congestion are felt in most urban cities around the globe. It has a detrimental effect on urban life in terms of delay and pollution. Public transportation services can tackle these issues to a certain extent. The improved living standard and comfort preferences discourage people from using public transit services. The recent endorsement of the vehicle share system has proven to tackle these problems without compromising on convenience and utility. Statistics show that, in the context of urban transport, India has positioned a stronger focus on moving vehicles than on moving people since the twenty-first century, resulting in widespread abandonment of the public transportation sector [1]. The National Urban Transport Policy, developed by the Indian government in 2014, gave mass public transportation top priority at both the national and state levels [2]. The advent of metro services, bus rapid transit systems and larger bus fleets promoted public transit preference. Even though there has been significant improvements made to urban public transport, personal vehicle sales have steadily accrued over time. According to Sun, [3] the number of privately owned vehicles in India enhanced from 141.8 million vehicles in 2011 to 295.7 million in 2019 showing 108% increase in vehicle ownership [3]. An alternative to the use of private transit mode is the need of the hour. The vehicle share system was introduced as a way to tackle these challenges while conserving people's flexibility and convenience. The vehicle sharing system considered in this study is a car, motorized and non-motorized bikes.

Chan and Shaheen [4] defined carpooling as "a setup in which more than one individuals share the use of a personally owned vehicle for a trip and the travelers pay for driver's trip-related costs" [4]. With the simplest approach, Ayaz *et al.* [5] defined carpooling as a form of transportation that requires one rider and one passenger to share rides from the same origin and destination [5]. Carpooling is commonly used for work trips, shopping, school, time-out activities and picking up children [5]. We normally consider carpooling and car-sharing as same, but they must be distinguished from each other. Burkhand and millard [6] defined car sharing as "hiring a vehicle for some time (in hours)" [6]. It refers to a type of short-term



car rental as per Ayaz *et al.* [5]. Both carpool and car share minimizes the number of autos on the road and thus reduce the congestion and emission. Bicycle sharing has grown in popularity in cities as a promising alternative active transportation mode [7]. The benefits of bicycle sharing are outlined by Shaheen *et al.* [8] as reduced fuel cost, flexible mobility, reduced congestion, individual financial savings, physical activity benefits, emission reductions and feeder for multimodal transportation connections [8]. This sharing system progressed through four major stages. In the first stage, “white bikes” were unlocked bicycles randomly placed throughout the city. The users could be picked up and dropped off anywhere in the city, and they were free to use. Because of the greater number of stolen bicycles, these programs were discontinued after a few years [8], [9]. The unique design and bright color of bicycles as well as designated docking stations differentiated the second stage of bicycle sharing programs. Docking stations were also outfitted with a secure locking system to reduce the risk of theft [9]. In the third stage in addition to the features of the second stage of the bicycle share system, in-cooperated transaction kiosks that allowed for the identification of users and also membership system was also introduced. In the fourth stage of the bicycle share system, solar-powered or mobile docking stations and smartcard use systems were also introduced in addition to all other features of sharing system [9], and [8]. Tuan *et al.* [10] defined a bike taxi as a motorized bike that typically carries single passenger as a pillion behind the rider [10]. They are accessible to the public and typically lack regular routes, fixed timings and fixed stations. For use as contract carriage, these modes require a legal contract or permit. This paper reviews recent studies in the literature on non-motorized (bicycle) bike-sharing, motorized (bike-taxi) bike sharing and car sharing and goals to answer a key question, what are the most important governing parameters for car sharing, bicycle sharing and bike-sharing.

## 2 Methodology

About bike taxi, Tuffour and Appiagyei [11] conducted a field survey involving bike taxi operators, users and non-users in Accra using a questionnaire that concerned with driver bio data, organization and management of services, general operations and service characteristics, accident and safety issues of the operator, socio-economic characteristics of the respondent, respondents service demand characteristics, safety concerns and users opinion on bike taxi based public transportation services [11]. Characteristics of passengers as well as their performance and significance on online bike taxis by distributing questionnaires in Yogyakarta city, Indonesia was studied by Risdiyanto *et al.* [12]. Risdiyanto *et al.* [12] determined performance and interests using the Likert scale, and evaluations were done using the Importance Performance Analysis (IPA) method [12]. Tangibles, reliability, responsiveness, assurance and empathy are the references used by Risdiyanto *et al.* [12] in their study. IPA is an easy science evaluation tool which is used to set priorities to attributes for progress and it can also offer guidelines for development of strategies. This method does not account for variable reliance and the consequences of the existence or absence of various variables on overall quality of service. The partial least square method was used by Pratiwi *et al.* [13] to analyze the correlation between satisfaction and loyalty level of online bike taxi customers. It is a structural equation model based on variance which is mainly used for predictive purpose. Prediction is in the sense of development of existing theories. In the case of the bicycle sharing system, Bachand Marleau *et al.* [14] conducted an online survey considering the attributes, socioeconomic, travel behavior, and spatial factors of the people who are already using the BIXI, Montreal’s shared bicycle system to understand the factors alter the likelihood of using the shared bicycle system and the frequency of use by developing a binary logistic model and linear regression model [14]. A logistic regression model was developed by Fishman *et al.* [15] to understand and quantify the factors that affect bicycle-share membership in Melbourne and Brisbane by conducting an online survey considering the user’s reactions to mandatory helmet legislation, riding activity over the former month and convenience [15]. In Beijing, Campbell *et al.*

[16] used a stated preference survey and multinomial logit to model the factors control the decision to switch from a current mode of bicycle transportation to e- bicycle share [16]. With the help of a stated preference questionnaire survey conducted in Lahore city, Javid *et al.* [17] aim to identify the key motives and constraints in the consideration of carpooling policy [17]. Respondents personal and traveling information, traveler's responses on stated carpooling scenarios, important benefits of carpooling in the respondent's view, stated preference to use carpooling under some incentives on service and disincentives on use of a private car, lifestyles and attitudes were all considered by Javid *et al.* [17] in their study. In Islamabad, Ayaz *et al.* [5] conducted a study with the same goal, taking into account respondents' personal information, travel information, traveler's responses to described carpooling conditions, carpooling benefits, the likelihood of switching from own vehicle to carpooling and traveler's responses to carpooling with a known and unknown partner [5]. Structural equation model (SEM) and Factor Analysis (FA) were used to find the key motives and constrains of carpooling policy. SEM is a powerful regression- statistical tool used to find out the relation between observed variables and latent variables. Factor analysis is a data reduction technique. FA consists of Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). In factor analysis large number of variables were summarized to present them in different components. To identify the probability of carpooling among French people Delhomme and Gheorghiu [18] conducted a study and developed a binary logistic regression to forecast whether participants carpooled or not [14]. In addition, Delhomme and Gheorghiu [18] investigated, how factual data and motivational factors differentiate carpoolers and non-carpoolers and what all are the major attributes of the practice of carpooling [14]. Using logit models like the mixed logit regression model and multinomial logit regression model Xu *et al.* [19] conducted a web-based stated choice experiment considering mode-related attributes, socioeconomic demographic attributes, and COVID-19 precautionary measure attributes [19]. The multinomial Logistic model was also used by Catalano *et al.* [20] to study the possibility of using sustainable transport systems like car-sharing and carpooling in Palermo, Italy [20].

For data collection research works used stated preference survey (SP), revealed preference survey (RP), or combination of SP and RP surveys. For the estimation of travel characteristics of a hypothetical case, SP survey is used, while for the prediction of travel characteristics of a present travel scenario RP survey is used. Some captivating aspects of the forecasting versus observed demand comparison reveal that the model calibrated by stated preference data may underestimate or overrate the shifting demand. These results revealed the difference between SP and actual behavior concerning different mode users. Questionnaire forms were prepared for data collection. Field and online data collection methods were adopted for most of the studies. The sample size needs to be calculated before conducting the survey. Watson method of sample size calculation showed better results in comparison to other methods. Pilot survey has an important influence on getting valid data. Studies suggested that data collection techniques and survey questionnaire layouts should be thoroughly validated using a pilot survey. Data collection needs to be initiated only after getting satisfactory results from the pilot survey. A well designed survey and research instrument definitely brings richness to the data and ultimately to the research outcomes [21]–[23].

### **3 Factors Influencing Car Sharing**

As per Huang *et al.* [24] safety, travel time, social contact, travel cost, comfort, punctuality and identity promotion are the significant variables of carpooling schemes [24]. Delay, residence location, convenience, security and the number of passengers were the factors affecting drivers participating in carpooling to public transport services, according to Mitropoulos *et al.* [25]. Dinesh *et al.* [26] discovered that value, beliefs, safety perceptions and platform quality perceptions all have a serious influence on attitude and intention to participate in carpooling behavior [26]. Studies were also done to find out the influence of socioeconomic

characteristics on carpooling participation. Study results indicate that age, education, gender, being native and household composition can influence one in carpool participation [27]. According to Catalano *et al.* [20] the main attributes affecting car-sharing demand were one-way trip travel time, parking time, cost, number of cars available to each person in household, car type and the individuals participating in car sharing [20]. Xu *et al.* [19] conducted a study to find the significant attribute among mode-related variables (automobile mode, trip time, trip cost, access time, parking time), socio-economic demographic variables and coronavirus disease 2019 precautionary measure variables and found out that economic variables associated with mode of transport and COVID-19 preventive measures were highly significant [19]. Based on a structural model developed for carpooling, results revealed that significant attributes in encouraging carpooling were social benefits, environmental benefits, economic benefits, dis-incentives in car use, preferential parking facilities, comfort and convenience [17]. However, the constraints for encouraging carpooling were people with a strong belief in privacy, security and freedom in traveling [17]. Pro auto, pro-carpooling attitude, marital status, profession and travel purpose also impart influence on carpooling [17]. Stranger carpooling partner has a negative influence on carpooling [5].

#### **4 Factors Influencing Bicycle Sharing**

According to Barbour *et al.* [7] gender, income, age, commute type, commute length, household size, vehicle ownership, and health measure like body mass index plays an important part in the bicycle sharing system [7]. Some studies point out that bicycle stations near residents and work areas increase the frequent use of bicycle share services [28]. Convenience and mandatory helmet legislation also affect bicycle share usage [15]. According to Campbell *et al.* [16] bicycle share choice is more sensitive to effort and comfort while it is negatively impacted by trip distance, high temperature, precipitation and poor air quality [16]. User demographics, on the other hand, do not play a significant role in bicycle share selection. Adding stations, a number of bikes, parking availability technologies, improved bike maintenance, locking mechanisms, separated bicycle lane and extended operational hours are some features recommended by authors to improve bike-sharing [28], & [15].

#### **5 Factors Influencing Bike Taxi**

Safety, quality of motorcycle, quality of messaging applications and cleanliness of the motorized bike seat are the variables that reflect the level of customer satisfaction [13]. Users considered bike taxi as a convenient mode in areas having high traffic congestion and they found it safe to do short-distance trips [11]. Among the small number of studies conducted about bike taxis, they all mentioned that safety is a major concern.

#### **6 Conclusions**

Adopting appropriate transportation guidelines is required to meet rising travel demand without worsening traffic congestion. Vehicle sharing is a sustainable solution for most of the present problems like traffic congestion, emission issues, air pollution, etc. Several studies were done in order to identify the factors that influence the passenger travel for opting a sharing mode. A consolidated RP-SP research study can provide a reasonable user perception. The methodology for data collection and survey instrument layouts should be extensively tested using a pilot survey. Undoubtedly, a well-designed survey and research instrument will enrich the data, results, and research findings. Traveler's needs and preferences for using the modes need to be identified.

Now bike taxi would be a potential solution to all these problems. In several Indian cities bike taxi have become one of the most budget friendly and accessible mode of transportation for all. Bike taxi is an emerging mode of transport and only a few studies were done based on it. Therefore it is adequate to do

more research on bike taxis. The parameters considered by users in order to choose bike taxis as a mode, facilities that operators need to establish, road infrastructure facilities, etc. need to find out.

## 7 Publisher's Note

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## How to Cite

Kavitha *et al.* (2023). Review on Factors Influencing Passenger Behavior on Vehicle Sharing. *AIJR Proceedings*, 40-45. <https://doi.org/10.21467/proceedings.156.5>

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