ORIGINAL PAPER

Passengers receptivity of a new public transport mode: case of a BRT project in Lebanon

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Abstract

This study examines how far the level of knowledge on a new public transport mode in Lebanon might affect mode choice. Indeed, passenger mode choice is a major issue associated with the effectiveness of new transport projects, as their level of effectiveness and feasibility will depend on the number of new adopters. This investigation is performed by developing mode choice models based on data collected via a questionnaire-based survey. The models were used to compare preferences among private cars, current public transport modes and a newly proposed Bus Rapid Transit system. The driving factors are divided into two categories: economic and psychological. The results reveal that explicit evaluations of several factors on the proposed transport modes yields mode choices different from direct evaluation. Besides, the structure of the utility function reveals that economic driving factors prevail over the psychological aspects, which is the opposite of what is observed with direct mode assessment. Moreover, people's expectations of the proposed Bus Rapid Transit were significantly positive in terms of usability in addition to operational and economic reliability. This study shows that people's level of knowledge of previous transport modes and their perceptual expectations of new travel modes must be taken into consideration in the feasibility studies of any transport implementations in the developing countries where the public transport services are discouraged.

Keywords: Level of knowledge, Travel mode choice, Transport implementations, Bus rapid transit, Lebanon

1 Introduction

A key point for new transport infrastructure or new transport service is to determine the willingness of the population to use it, as it generally determines its economic equilibrium. The modal shift towards a new transport mode will likely depend on the level of knowledge (LoK) of the population on this new infrastructure. Indeed, the performance and quality of service of a new transport mode need to be experienced by potential users before they choose to shift mode or not (Nerhagen, 2003). When dealing with a project

that has not been implemented elsewhere in the country, potential users have no first-hand knowledge of the new transport mode. However, classical mode choice models used in the field of transport studies barely include parameters characterizing the LoK of potential users on provisional infrastructures.

This paper considers the case of a bus rapid transit (BRT) project on the southern entrance highway of Beirut, Lebanon. This kind of project is quite new for Beirut, so that potential users have only partial knowledge on BRTs. This paper tries to investigate the potential for modal shift towards the BRT through dedicated surveys (CDR, 2019). Towards this aim, mode choice models that take explicitly into account the LoK have been designed and compared.

Several previous studies have investigated the criteria to include in a mode choice model and the importance

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of the specification of utility functions for each mode. An overview of relevant recent studies is presented as follows.

In many studies as those conducted by Andrejszki et al. (2015) and Ram et al. (2016), the quantitative transport factors, as travel time, cost and waiting time, in addition to qualitative factors, as comfort, safety, reliability and mode's environment, were used to develop the utility functions of passengers via a questionnaire-survey. The authors reported that the identified transport modal split gives an overview of passengers' preferences and could be linked in further studies with their socio-economic conditions. Sarangi and Manoj (2020) found that the travel mode choice of members of a university in New Delhi city depends on many factors as housing location, educational qualifications, and vehicle ownership. Similarly, Mayo and Taboada (2019) found that safety, accessibility, travel cost, comfort and the environment of modes are the key factors that determine the commuter's choice in developing countries.

From another viewpoint, Wan et al. (2019) found that the factors affecting the mode choice for commuting trips as not necessarily having the same impacts on choice behavior for non-commuting trips but they rather could have opposite effects and vice-versa. Moreover, Chen and Li (2017) combined the discrete choice model for public transportation (PT) services with another mathematical model: *Structural Equation Model* to enhance the accuracy of modal split outputs. The authors found that the PT operators in Chengdu city in China should improve the safety, convenience and the environment of their services in order to increase their modal share.

It is worth noting that few studies have discussed the passengers' LoK on the aspects of travel modes. For instance, Nerhagen (2003) revealed that personal transport choice does not refer only to habitual behavior, but it reflects also the previous experience and the good knowledge of a specific travel mode without knowing the aspects of other modes. Moreover, Yatskiv et al. (2018) conducted a survey study in Latvia to investigate the LoK, of different stakeholders, on strategies and policies relevant to transport modes. Policymakers, transport industry experts, students and researchers represent the main population groups of the survey. Findings revealed varied knowledge levels on new transport strategies; and the authors recommended the development and the delivery of academic and professional practice training programs to decision-makers, planners, transport professional practitioners and students to improve their academic and professional knowledge. However, taking into account LoK in a mode choice model is complicated also because the notion of LoK is not so well-defined.

This concept stems from Economics. Hayek (1945) reveals that people's information about economic circumstances exists only in incomplete, contradictory and "dispersed knowledge". No economic stakeholder has perfect information about all the factors affecting the economic system, hence the existence of a "partial knowledge". The inevitable imperfection of knowledge exacts continuous communication processes (Hayek, 1945). From a human viewpoint, Collins et al. (1975) argued that people rely a lot on uncertain, inconsistent and incomplete information to make decisions. The authors showed that "incomplete knowledge" leads people to make default or illogical assumptions that should be changed or adjusted with empirical and real observations. The "knowledge level" was introduced by Newell (1982) as a new term in computer sciences. He defined the "knowledge level" as a process intended to determine the actions within the capabilities of the computer system to attain defined goals. Likewise, Levesque (1984) introduced the terms "incomplete knowledge" and "partial knowledge" as the limitations in Database Management of languages in Artificial Intelligence. In this study, the LoK on a travel mode is defined as the capability to assess several aspects of this mode (time, cost, comfort, safety, information and environment). It is hypothesized that the LoK stems from previous passenger's experience. For the proposed BRT project in Lebanon, the LoK of potential users is necessarily rather low and disparate, as they have no direct experience of this kind of mode.

Designing mode choice models that take into account passengers' LoK will give an overview to planners, decision-makers and other stakeholders of the importance of understanding travel modes during the evaluation phase. Potential users are passengers doing daily trips to Beirut.

Their stated preferences have been collected via questionnaire surveys. The model is constructed with the valuation of several factors and partial rankings of modes with respect to these factors, which increase the LoK. It is then compared to the stated preferences approach (with low LoK).

The structure of the paper is as follows. The second section presents the geographical and social context of the study area, as well as the BRT project. The third section explicates the methodology and the techniques of data collection. Section four presents the structure of mobility patterns. Section five provides an analysis of the developed models and their results. Section six summarizes the results and discuss them. The final section recapitulates and states the main concluding remarks of the paper, the limitation of the study as well as future areas of research.

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2 Study area

2.1 Location and population

The research interest is in Lebanon, where new BRT projects are proposed for implementation to link the Northern and Southern parts to the capital Beirut (CDR, 2019). This kind of project has never been implemented in Lebanon, so the population has no direct knowledge of BRTs. For the moment, private vehicles, unreliable paratransit services and Jitneys represent the main transport modes (Kaysi et al., 2010). Out of Lebanon, a smaller zone was taken to be the study area of this paper. The study area is the zone located adjacent to Beirut's southern entrance highway. The study area, which is extended in 12 km length and 7 km width, is located within the greater Beirut area. Figures 1 and 2 show respectively the location of the study area relatively to Lebanon and its geometrical boundary. The zone was selected since it represents the main catchment area of the highway because of its high accessibility. In addition, a significant part of its population commutes daily to the capital Beirut where different economic activities such as businesses, retails, universities, schools, etc. take place at different day periods (The World Bank Group, 2017; IDAL, 2018). For people living in the study area, a questionnaire survey was administrated, with questions about the stated preferences of passengers with regard to mode choice. Representativeness of the population was ensured by an appropriate sampling. Further details on the survey type and characteristics are indicated in the data collection section.

2.2 Travel patterns

Mode choice models require information about travel patterns. As no official travel survey exists for the area, the material is taken from research articles from the year 2010 to the year 2014. Kaysi et al. (2010) stated that the PT modes (Public and private buses and minibuses) serve only 10% of travel demand in the Greater Beirut Area (GBA) in which our study area is located. 19% of the whole travel demand in GBA is served by another paratransit mode called Jitneys (Kaysi et al., 2010). In this article, Jitneys are a PT mode privately operated by car within the form of shared taxi service. Danaf et al. (2014) indicated that the undefined time schedules, unreliability and limited coverage of bus service have encouraged people to use the Jitneys. The remaining travel demand (71%) is served by using private cars. This highest share of private vehicles is due to several factors as the non-reliability, the mismanagement and the inappropriate distribution of PT systems over the market in Lebanon (BlomInvest Bank, 2017; CDR and ELARD, 2018).

Moreover, Danaf et al. (2014) indicated that the personal security of PT passengers is not ensured since the passengers are disposed to discrimination and harassment. Moreover, low parking fees, ranging between two to four (United States Dollar) USD in Beirut city center per day, increase the market share of private cars.

Aoun et al. (2013) stated that the use of PT services is discouraged by the cultural habits of the majority
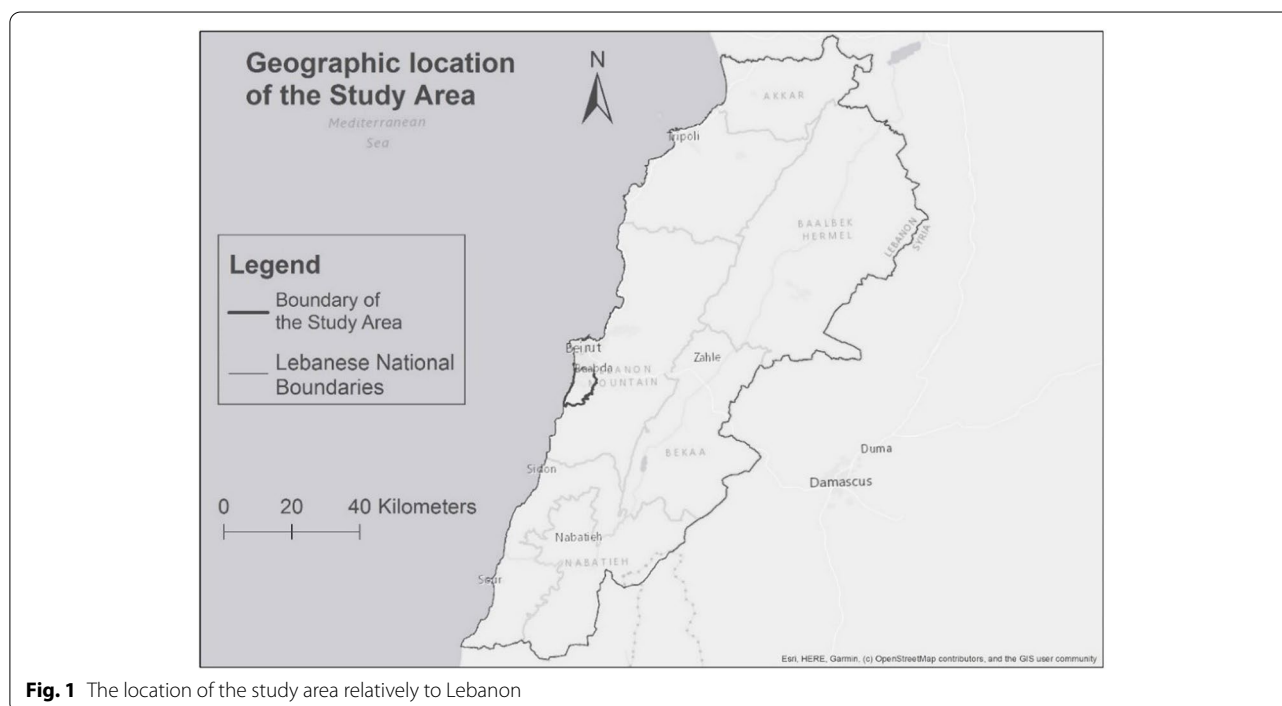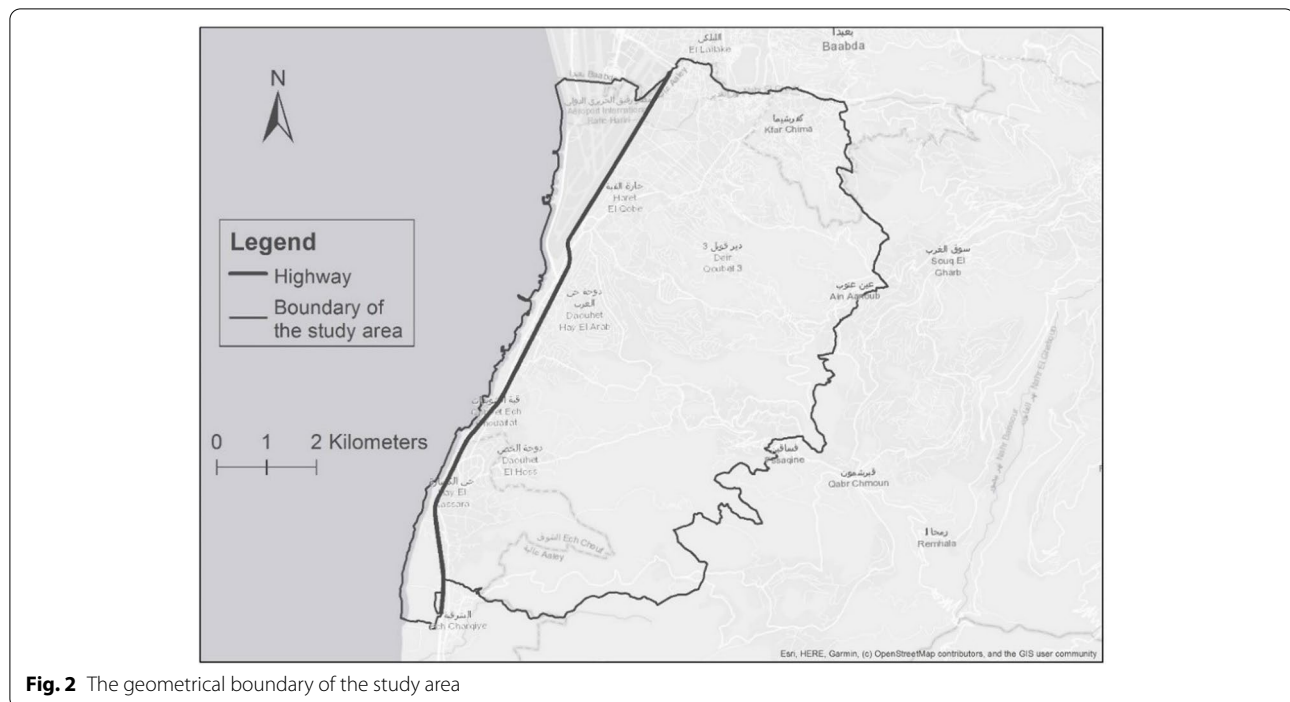

Fig. 1 The location of the study area relatively to Lebanon

Fig. 2 The geometrical boundary of the study area

of the Lebanese society, and that the social image is sponsored by owning and using private vehicles as an indication of a wealthy lifestyle. It is concluded by the authors that high-end luxurious paratransit modes could attract the mode choice of wealthy people. This confirms the results by Liu (2007) indicating that, in developing countries, subway and bus travel services are perceived by people with middle to high-income levels as inferior services compared to private vehicles.

2.3 The proposed BRT
A new BRT system linking the southern part of Lebanon to Beirut was proposed as an important and vital project as indicated by the feasibility study prepared by the Council for Development and Reconstruction in Lebanon (CDR, 2019). Based on this, it is considered that the reliability aspects of the service, capacity, bus headways and frequency, as well as fulfilling the demand over different day times, are well ensured. Additionally, the travel cost is reduced relatively to other transport modes since the BRT operation costs will be, to some extent, subsidized by the Lebanese government. In this study, the BRT feeder services are supposed available. As far as the physical implementation of the BRT, its route could be spatially located within the highway by dedicating one of the three existing traffic lanes, and one shoulder lane, in each direction. The operating speed of the proposed BRT was assumed to be 80 km/hour. For this research, data has been collected about the public attitude of the BRT

through a questionnaire that showed a high percentage of supporters (86%). The survey is described in details within the following sections.

3 Methodology and data collection
This section comprises three subsections. The first section refers to the adopted research methodology. The second subsection discusses the utility functions and the attributes selected. The third subsection describes the data collection technique and the associated limitations.

3.1 Research methodology
Following Ram et al. (2016) and Liu et al. (2019), the stated preferences of passengers can be used to specify a discrete choice model. This model is composed of a utility function that is used to rank each of the three possible modes: the mode with the highest score will be the preferred one. The utility function summarizes several partial rankings of modes according to specific characteristics (information, safety, travel time and cost, environment, comfort) and with respect to individual preferences for each of these characteristics. The individual preferences for each characteristic are surveyed via a quotation on a Likert scale ranging from 1 to 5. Thus, the discrete choice model is not estimated by a classical econometric approach, but specified from the results of the survey.

The main objective is to analyze how the LoK of the population on different travel modes affect the discrete choice models (Bonnel, 2003).

The travel modes to be compared are defined as: (i) Private vehicles, (ii) current PT modes, and (iii) the proposed BRT system complemented with feeder services.

The criteria associated with the travel mode selection, known as the modes attributes, were selected and divided into three categories: (i) physical and operational, (ii) economic, and (iii) social.

When dealing with qualitative mode attributes as well as with the appreciation of modes, a Likert scale from 1 (least important) to 5 (most important) is used. One hypothesis to be tested states that the majority of the population does not have a high LoK on the different travel modes and their characteristics, especially for the BRT. A comparative analysis is conducted to check the validity of this hypothesis by comparing the mode choice, obtained with the help of the utility function, to the preferred mode that is directly asked for. In the survey, the three modes (private car, PT and paratransit, and BRT) are ranked by all participants with respect to every characteristic, and the final ranking is obtained by a weighted sum of all ranks, where each weight is the importance of the corresponding characteristic, evaluated on a Likert scale. Table 1 summarizes the way mode preference is obtained from the survey.

3.2 Specification of the utility functions and attributes

The form of the utility function is the following:

$$U_{mode\ (i)}(x) = B_1 x_{1 mode\ (i)} + \cdots + B_j x_{j mode\ (i)} + \cdots + B_n x_{n\ mode\ (i)} \quad (1)$$

Where $x_{j mode(i)}$ represents the value of the jth attribute of a transport mode i (here, the rank coded with 1, 3 or 5) and B_j is the coefficient associated with this attribute (here, the weight defined on a Likert scale). Chen and Li (2017) and Liu et al. (2019) stated that generally, the main factors to consider in a utility functions are: travel time, travel cost, schedule information reliability, passenger comfort, safety and the environment. In this study, the factors are divided into three groups: physical and operational, economic, and social. The physical and operational group comprises the travel time, schedule

information reliability, comfort and the mode's safety measured by the number of accidents (Andrejszki et al., 2015). The economic group includes solely the travel cost. The social group comprises the personal security (Chen & Li, 2017) and the mode's environment, that is to say (a) the cleanness of the used mode, and (b) the demographic dimension comprising the level of preference for passengers to be in the same transport mode with people from different religious/ethnic groups and with different social levels.

3.3 Data collection

Following Levy and Lemeshow (1999), the sampling geographical cluster is selected first so that its population, on average, has the same social characteristics (gender and age) as the target population of Lebanon. The area was selected since it is adjacent to the highway section that was put in service by the year 2003 (CDR, 2005) and since the BRT project is proposed to be implemented within this road section (CDR, 2019). The survey was conducted through an online Google Form. In order to ensure randomness, the website link of the online survey was sent to different aldermen and municipalities' council members to distribute it randomly to residents, in each of the study area towns, after contacting them and explaining the aim of this study. Moreover, a brief description of the objectives of this survey in addition to its link was posted in social media groups of the residents in the aforesaid area.

The survey is composed of a questionnaire with four main sections:

- socioeconomic backgrounds of participants: questions on gender, age, occupation, educational level, individual monthly income, residence area, number of regular trips per day, daily regular trip purpose, daily regular trip destination, the usually used travel mode, the preferred travel mode, average travel time and cost;
- previous knowledge of BRT projects;
- questions about acceptance and potential usage of the proposed BRT, the ability to walk and acceptable walking time to reach the BRT stations;

Table 1 Construction of mode preference from the survey

	Ranking of modes with respect to specific criteria	Importance of criteria	Final ranking
Criteria	Travel time, travel cost, Information, Comfort, Safety, Environment	–	
Scenario 1	Mode *x* preferred to mode *y* preferred to mode *z*: mode *x* = 5, mode *y* = 3, mode *z* = 1	Weight defined on a Likert scale ranging from 1 to 5	Weighted sum of ranks; Preferred mode: mode with the highest score
Stated preferences	–	–	Preferred travel mode stated by participants

- general preferences about transport modes (Private vehicles, PT/paratransit, and BRT complemented with feeder service), and Likert scales for assessing modes' attributes from 1 (least important attribute) to 5 (most important attribute). Travel modes' environments are assessed via three questions as the ability of a passenger to be in contact with other passengers from: (i) different religions/ethnic groups, (ii) different social levels and (iii) different nationalities.

The methodology of the adopted survey, and the utility functions are respectively illustrated in Figs. 3 and 4. The survey's response rate is 81.6%. The number of collected responses over the period extended from June 16th, 2020 to August 4th, 2020 is 257 out of 315 invitations to participate to the survey. A data cleansing process was conducted. The excluded survey responses are the cases where (Andrejszki et al., 2015) the answers on the Likert scales are obviously wrong (same level for all questions); (Aoun et al., 2013) major incoherencies in the answers, such as a retiree with daily commuting trips; and; (BlomInvest Bank, 2017) participants living outside the study area. The number of valid responses is 200 corresponding to a 90% level of confidence (Cochran, 1977) and a 5.81% margin of error, as the population size of the study area for the year 2019 is 144,611 persons.

This study investigates only the modal choice among private car, current PT services (Jitneys, Taxis, buses and minivans) and the proposed BRT service. Carpooling was assimilated into a private car trip except for the stated travel cost which is divided by the number of car passengers. Additionally, the powered two-wheeler mode was not taken into account in the analysis. The population of the conducted survey represents only the residents of the study area.

PT operators, shop and business owners, local officials, policy makers and other stakeholders, who might also be impacted by the BRT, are not in the scope of this study.

The male to female ratio of the survey participants is 104% (51% male and 49% female), whereas the Lebanese Central Administration of Statistics (CAS, 2020) indicated that the male to female ratio in Lebanon for the years 2018 and 2019 is 93.7%. Similarly, the age profiles (used in the questionnaire form) of respondents are indicated in Fig. 5. These values show that young categories are not over-represented; also, these numbers are in good conformity with the data of Lebanon's population given in the reference (Lebanon population, 2019). The use of an online questionnaire might introduce a selection bias for people who do not use the internet (16% in 2020 according to the World Bank). However, the figure is probably much lower in the urbanized area of the study.

These values are not different enough to justify a marginal calibration of the data.

The survey shows that the majority of respondents (81%) are adults belonging to an age distribution ranging from 18 to 64 years. It could be concluded that they mostly represent the students and the working group of the community who have daily commute trips. This was asserted by the total percentage of work and study daily trips (77%). The actual modal share and preferred transport modes are indicated in Fig. 6. There is a strong discrepancy between the actual and the preferred transport mode shares. While Jitneys and PT modes are largely used, they have a bad image in the population. The introduced BRT service will potentially have a high mode share (36%) mainly at the expense of private vehicles, Jitneys and PT modes since it may be a highly sought-after mode. This is noticed with a dramatic decrease in modal share of Jitneys and PT modes in the models.

4 Structure of mobility patterns

The travel time and cost for the proposed BRT were based on literature documents, stated data (questionnaire), and design assumptions. The daily fare of the BRT is assumed to be 1 USD equivalent to 8000 Lebanese Pound in August 2020 (Lebaneselira, 2020) as the same fare of Bogota's BRT (Cervero, 2013). The BRT travel cost for one trip is considered to be 4000 Lebanese Pound since the survey's responses indicated that 50% of daily travels are made of two trips (2 origins and 2 destinations) only. The data collected from the survey showed that 83% of potential BRT users are able to walk to reach the BRT stations; in addition, the majority (52%) of these users show their ability to walk for 5 to 10 minutes to reach the BRT station for every destination. Williams and Thompson (2013) indicated that the walking speed of 4 km/hour (66 m/minute) is the average speed between work, home and transportation facilities. Based on these data, the proposed stations' spacing is taken 1.3 km to be compatible with the ability of potential BRT users to walk. The studied road section (as shown in Fig. 2) is of 12 km in length divided into 10.5 km on-grade road and 1.5 km underpass. Over this 10.5 km road section 9 stations exist. The travel time of the BRT over this 12 km road section is calculated as 14.25 minutes taking into account the times of accelerations, decelerations and waiting at stations.

The responses corresponding to trips' times are summarized in the histograms from Fig. 7 (durations of long trips were cut to 1 hour). Figure 8 presents the histograms of average stated travel times and travel costs of private cars, jitneys, buses and minivans.

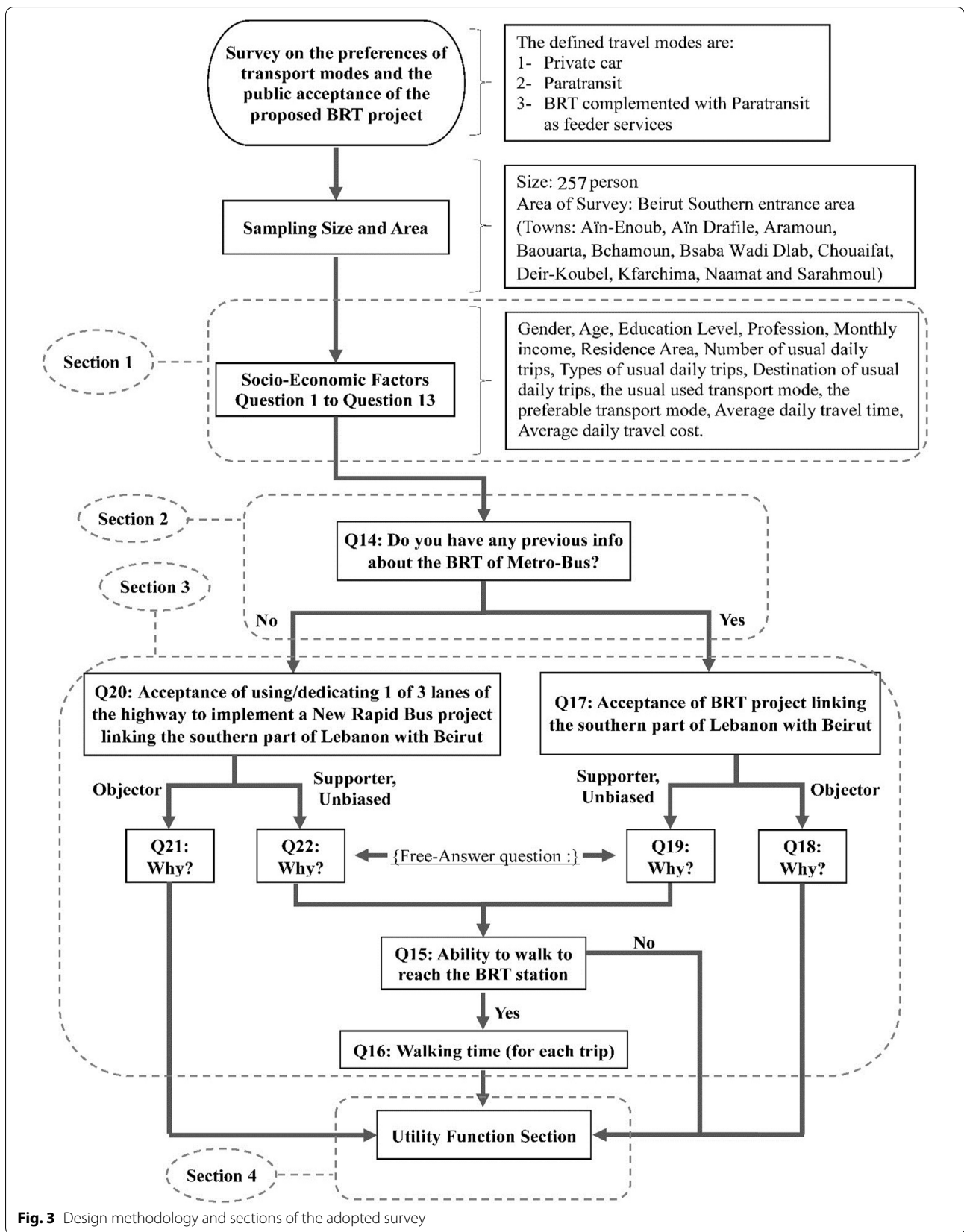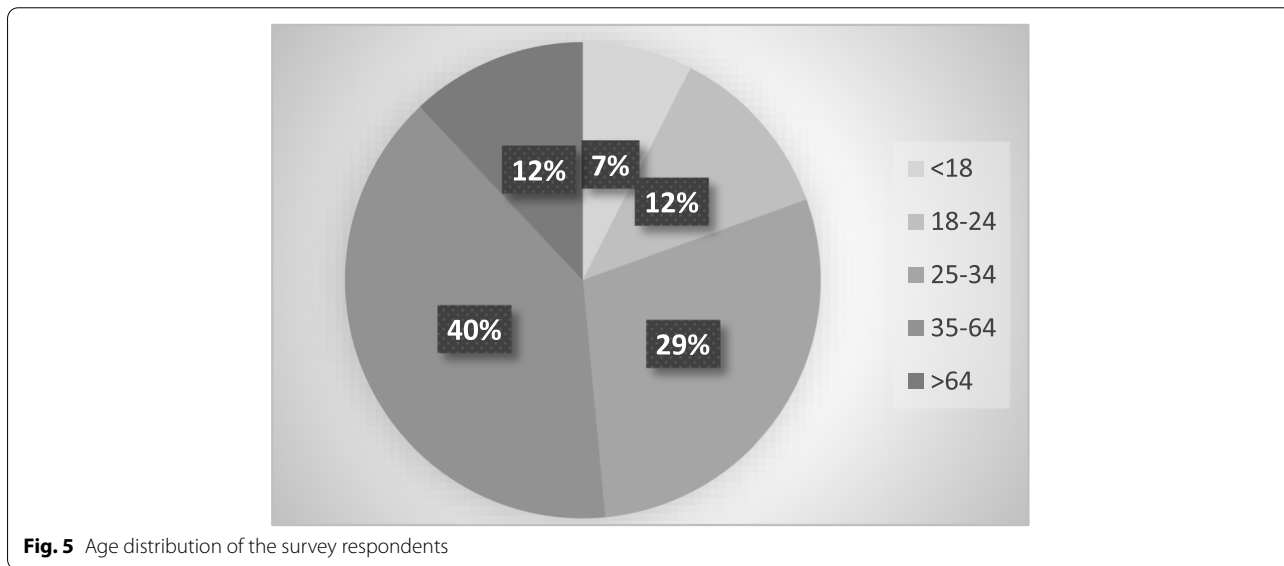Approximately 60% of trips by jitneys were found ranging between 30 and 45 minutes. About 45% of trips
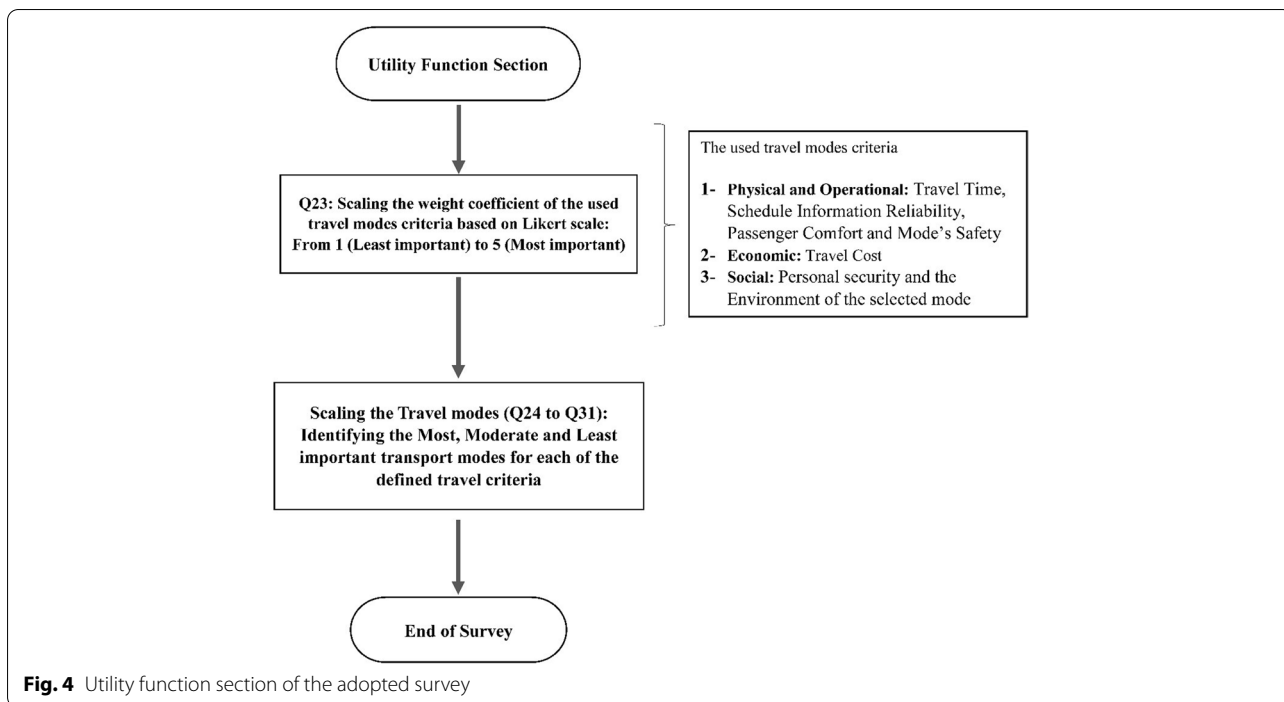
Fig. 3 Design methodology and sections of the adopted survey

Fig. 4 Utility function section of the adopted survey

Fig. 5 Age distribution of the survey respondents

by buses and minivans were found having a travel time ranging between 15 and 30 minutes. However, about 35% of car trips have a travel time between 15 and 30 minutes.
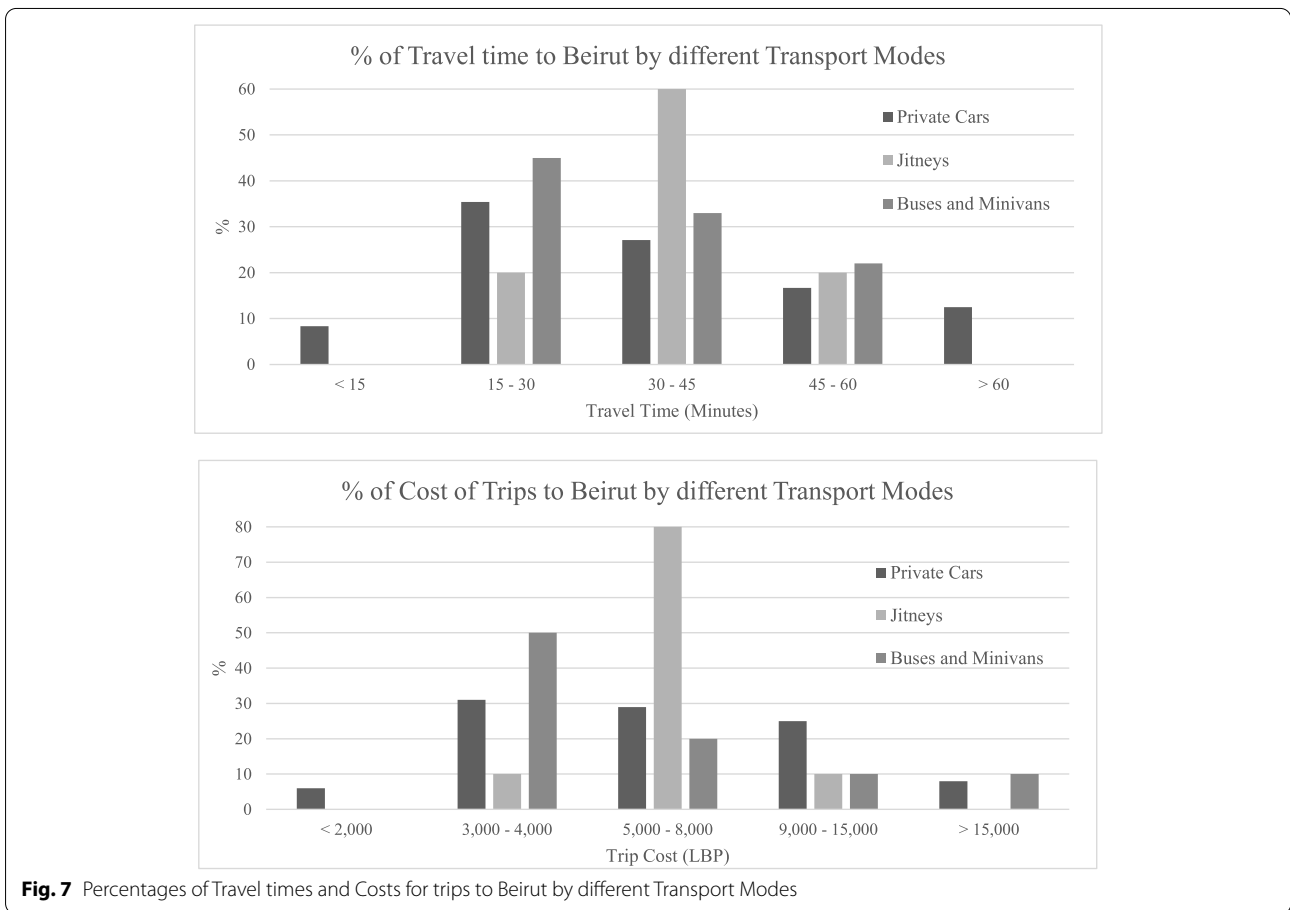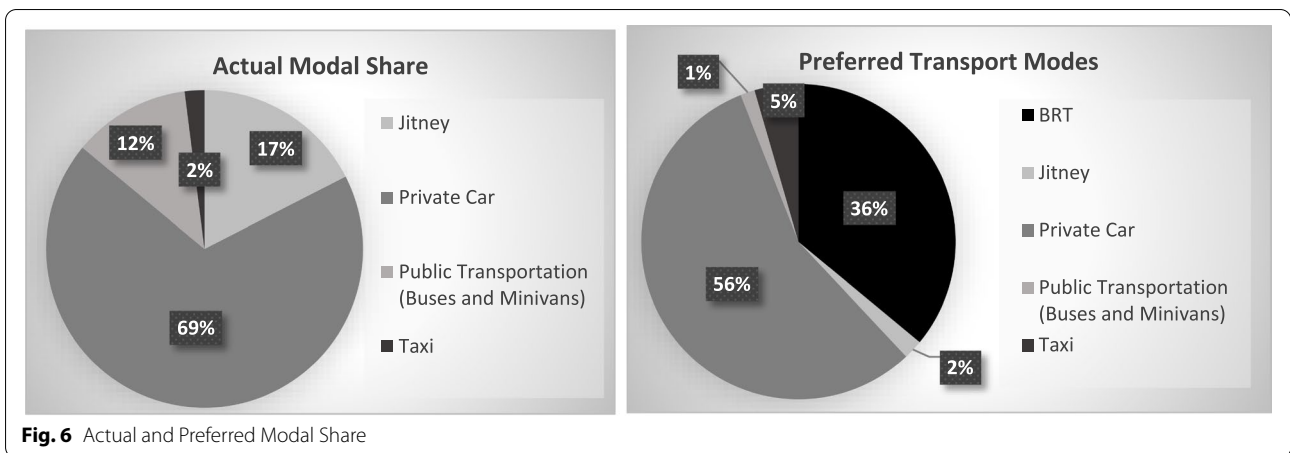
Within this first examination, it could be concluded that private car trips are the best in terms of travel time and that the jitneys trips are the least beneficial. In the context of travel costs, for one trip to Beirut city in the year 2020, 80% of trips by jitneys were found costing a value between 5000 and 8000 LBP. About 50% of trips by buses and minivans were found having a travel cost ranging between 3000 and 4000 LBP. However, about 32% of car trips have a travel cost ranging between 3000 and 4000 LBP.

5 Modal share models

The utility function enables to rank the three modes for each respondent.

Fig. 6 Actual and Preferred Modal Share

Fig. 7 Percentages of Travel times and Costs for trips to Beirut by different Transport Modes

5.1 Mode choice estimated with the help of the utility function

The mean Likert scaling values are presented in Table 2, and the mean partial ranks are presented in Table 3.

Table 2 reveals that inhabitants of the area give a high value to safety, comfort and travel time, and that all values are between 3 and 4 on average, on a Likert scale ranging from 1 to 5 (Table 2).

As far as partial preferences for modes are concerned, PT is given quite low mean ranks compared to private cars, which seems to be better appreciated by far for almost all characteristics. Values for the BRT are getting
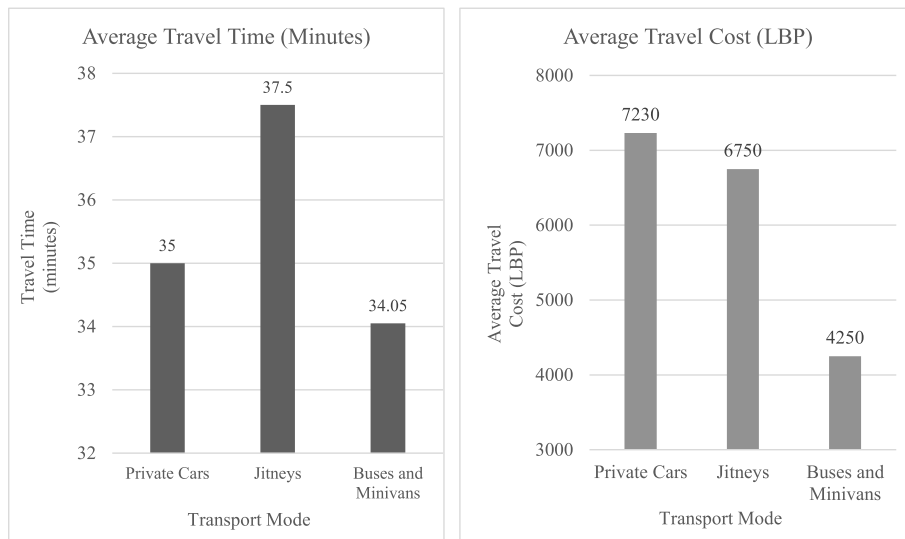
Fig. 8 Average of stated travel times and travel costs for different transport modes

Table 2 Mean weighting values of criteria

Criteria	Scaling Value
Travel Time	4.01
Travel Cost	3.825
Information	3.415
Comfort	3.93
Safety	4.2
Environment: being with passengers: • from different ethnic and religious groups • with different social levels • with different Nationalities	2.91

close to private cars and even exceed it for travel cost (Table 3), which reveals that a priori knowledge of BRT is, on average, correct for this characteristic. Indeed, as the BRT will be subsidized, the travel fare will be relatively low. Obviously, the BRT operation that will follow a

regular schedule, is valued, leading to a high mean score for information.

5.2 Cross-analysis of actual transport mode, preferred mode estimated by the utility function and stated preferred mode

The results of the survey show that the majority of trips (85%) are heading towards Beirut city.

For each respondent, the value of the utility function has been computed for each of the three modes (car, public transport and BRT), and the maximum value indicates the preferred mode. Out of 200 respondents, only 3 prefer the PT, 103 the private car and 94 the BRT. Thus, the BRT seems to be a competitive mode, very different from PT.

Table 4 reveals that, while only 3 respondents prefer PT, 31.5% of all respondents use this mode actually. The users of PT would prefer to switch to BRT (33 out of 63),

Table 3 Mean ranking of alternatives relatively to criteria

Criteria	Scaling Value		
	Private Car	Public Transportation	BRT
Travel Time	3.69	1.49	3.82
Travel Cost	1.98	2.79	4.23
Information	3.27	1.67	4.06
Comfort	4.36	1.27	3.37
Safety	3.87	1.4	3.73
Environment (being with passengers from different ethnic and religious groups)	4.32	1.59	3.09
Environment (being with passengers with different social levels)	4.24	1.67	3.09
Environment (being with passengers with different Nationalities)	4.36	1.61	3.03

or to car (28 out of 63). Present users of cars are mostly satisfied with their mode (75 out of 137). However, a significant proportion (61 out of 137, i.e., 44.5%) of car users would be satisfied by BRT.

These results are more contrasted when separating respondents that have travel times shorter than 45 minutes from the others (Table 5).

For short travel durations, the car remains the preferred mode for present car users (63 out of 110), and shares the same preference as BRT of present PT users. However, respondents who experience longer travel durations prefer BRT to cars. It can be hypothesized that these respondents take into consideration the fact that BRT will have a flat fare, while car cost increases with distances and duration.

The evaluation with the utility functions forces respondents to value explicitly all the characteristics of each mode, including the BRT, for which information was given in the survey questionnaire.

Table 6 is far from being a diagonal matrix, highlighting the fact that LoK is crucial in assessing mode preference. Indeed, the stated preferred mode is determined globally by respondents, and thus is constructed with their previous knowledge of mode, while the utility function enables to introduce a priori knowledge of modes. BRT is, according to the utility function, preferred by 93 respondents, while only 72 respondents spontaneously declare their preference for this mode. Moreover, only 46 respondents give consistent answers for this mode. Besides, PT is

little valued by respondents, as already mentioned in the literature, and only 3 respondents give it the highest utility. However, 16 respondents indicate that it is their preferred transport mode.

6 Results and discussion

The modal shares estimated by this survey can be summarized as follows.

The survey yields mode shares that are quite similar to those found in the literature (Table 7). The present study designed to highlight the importance of LoK for a new mode reveals that the estimation of the BRT modal share is 30% higher when the LoK is enhanced. Moreover, Table 6 reveals that only half of the people whose utility function is highest for BRT (46 out of 93) actually choose this mode when directly asked for.

These figures confirm the necessity to provide all potential users and citizens with adequate information on the project before the feasibility studies and design phases.

The analysis of attitude toward BRT with respect to travel duration has revealed that potential users are mostly people with long trips. Indeed, for longer trips, BRT is systematically preferred to private car. Moreover, the survey questionnaire included questions about the socioeconomic factors, as well as direct question on the acceptance of the BRT project. This enables to analyze whether mode choice depends rather on the LoK about BRT characteristics, or on the global attitude towards the BRT project.

Table 4 Cross-classification of actual and preferred transport mode computed by the utility function

	Preferred mode (by utility)		
	BRT	Private Car	Public Transportation
Currently Used Mode			
Private car	61	75	1
Public Transport	33	28	2

Table 6 Cross-classification of preferred mode computed with the utility function, and stated preferred mode

	Stated favorite mode		
	BRT	Private car	Public Transport
Preferred mode (by utility)			
BRT	46	43	4
Private car	26	67	11
Public Transport	0	2	1

Table 5 Cross-classification of actual and preferred transport modes with respect to travel duration

	Preferred mode (by utility)					
	Less than 45 minutes			More than 45 minutes		
	BRT	Private car	Public Transport	BRT	Private car	Public Transport
Currently Used Mode						
Private car	47	63	0	14	12	1
Public Transport	26	26	2	7	2	0

The acceptance of BRT is correlated to present mode use (Table 8). The public acceptance of BRT does not mean that the service will be the preferred mode. For instance, while 86% of respondents indicated their support for implementing the service, only 36% (stated) and 46.5% (estimated with the utility function) of the studied population are willing to use BRT.

This support could be explained mainly as their belief in the ability of BRT service to reduce traffic congestion and enhance the level of service. Moreover, the survey data indicate that over 63% of respondents who do not have any previous idea about the BRT concept 84% support the implementation of the proposed BRT project after explaining briefly to them the proposed project features and the feeder services. Besides, 91% of the respondents who have previous ideas/experience of BRT support the BRT project. Significant public acceptance was observed on both respondents having knowledge on/experiencing previous BRT services and respondents with no previous info on BRT; this could be respectively referred to good impressions of BRT and high expectations, and the essential need for a new reliable rapid transport mode.

7 Concluding remarks and future researches

This paper investigates the importance of the level of knowledge on a new transport mode when estimating modal split. Estimating the modal share of a new mode such as a BRT is a key element to support the decision about its implementation and funding. However, this estimation might be biased by the lack of knowledge of the population about this new mode.

Within the study, two main problems are distinguished: (i) the attitude towards a new service which will impact users of the highway, and (ii) the future transport modal share. Previous findings indicate that the psychological aspects prevail over other economic factors when comparing the choice behavior among traditional PT modes in Lebanon and private vehicles (Aoun et al., 2013). This is clearly depicted by the desire of the Lebanese people to use private vehicles as the highly preferred mode in comparison to traditional PT services.

However, when comparing the transport modes within the framework of mode choice models, the economic characteristics were recognized as having considerable effects in the context of mode choices. The results of the developed model show an increase in choosing BRT services by 10% relatively to stated preferences. This would clearly illustrate a significant knowledge gap in mode choice.

When assessed by potential users, the proposed BRT reaches or exceeds private cars for all characteristics except comfort and environment. Thus, this study confirms the importance of the psychological aspects of mode choice in Lebanon. However, these aspects do not prevail over the overall performance of the service, including time and cost.

However, the correct evaluation of safety, comfort and environment would require an actual BRT ridership experience. Increasing the level of knowledge of people could change to some extent the attitude towards the project. Explanatory campaigns and workshops about new transport implementations should be carried out in case of low knowledge/experience level of these implementations. These campaigns must be tailored for different target audiences: policy-makers, the general public and future operators. New researches on the design and the integration of these campaigns in relative legislations must be carried out as a fundamental part of the transport implementations.

Furthermore, enhancement for the mode choice models in the context of imperfect information could be obtained by: (i) integrating the discrete logit model with other selection analyses techniques as the Analytical Hierarchy Process, and by (ii) introducing latent variables

Table 7 Observed and estimated modal shares

	BRT	Car	PT
Present mode (observed)	–	68.5%	31.5%
Modal share in the literature for 2020	–	71%	29%
Mode choice with the utility function	46.5%	52%	1.5%
Stated mode choice	36%	56%	8%

Table 8 Percentages of Supporters, Neutral responses, and Opposers among the users of different travel modes

Present Transport Modes	Supporter (%)	Neutral (%)	Opposer (%)	Number of Respondents
Public Transport	100	0	0	**24**
Jitneys	85.7	0	14.3	**35**
Private Cars	85.4	7.3	7.3	**137**
Taxis	50	25	25	**4**

in the model such as performed in Structural Equation Models.

Authors' contributions
Walid Al-Shaar, Nabil Nehme, Olivier Bonin, Jocelyne Adjizian Gérard, Mohamad Al-Shaar: Conceptualization, Methodology, Analysis and Validation. Walid Al-Shaar, Olivier Bonin and Mohamad Al-Shaar: Resources, Data curation, Software, Writing - Original draft preparation. Olivier Bonin, Nabil Nehme, Jocelyne Adjizian Gérard: Supervision, Writing - Review and Editing. The author(s) read and approved the final manuscript.

Availability of data and materials
The data that support the findings of this study are available from the corresponding author upon request.

Declarations

Competing interests
The author declare that they have no competing interests.

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