Title: *Analysis of passengers' experiences and travel time use onboard urban buses. The case of Brescia.*

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Abstract. Providing users of the public transport with a satisfactory service is necessary to discourage the use of private transport modes. In addition to ensuring high performance in terms of accessibility, usability and availability of the service, in recent years the concept of *travel experience* has been deepened, to consider how travel time can constitute a further quality factor instead of being conceived as wasted. The article studies the travel experience of a sample of 554 urban bus system users in the city of Brescia, where the bus service already achieves high levels of passenger satisfaction. Through in-depth analysis, factors which particularly influence travel time and some critical aspects of the service are identified, related to three main topics: perception of the onboard experience, possibility and comfort in time engagement and interaction with other passengers. The analysis made it possible to pinpoint where it would be appropriate to intervene to make the travel experience more satisfying.

1. Introduction

Fostering the modal shift of transport, from the individual vehicle to the collective one, proves to be a major challenge in a society that still reveals itself to be strongly car-oriented [1].

In Italy, in 2016, a motorization rate equal to 644 vehicles per thousand people has been registered[1]. This datum is related to the distribution of trips based on a geographical scale and by modal split: of all journeys, the 74% are made within urban areas (within 10 km) and the 65% by car[2]. It is well known that the reduction of the number of circulating vehicles is one of the objectives to be pursued, in order to mitigate problems related to environmental health, lack of public space and the aesthetic decay of the cities, ensuring a better quality of life especially for urban areas [2].

Users' mobility choices are influenced by different factors, which are related to the spatial coverage and accessibility of the service, infrastructure type and technology but also the individual's personal experience, that plays a key role in the overall assessment of service quality. Understanding the needs of passengers is crucial not only to achieve an optimal service quality, but it is also important to maintain and reinforce the regular users' loyalty and to attract and convince potential new users, especially from among the users of private motor vehicles [3] [4] [5] [6].

Although the bus shows spatial, temporal and network discontinuity, it represents the most widespread public transit system, owing to its characteristics: the adaptability to very different urban contexts and the possibility to be implemented with relatively low costs and quickly (compared to other transport systems) [7] [8]. However, by sharing (usually) the right of way with cars, the bus has always had to compete with them, since they are associated with greater levels of

1 In Italy, in 2017, there were 38.520.321 cars over a population of 59.979.977 inhabitants – Source: ACI (Ondaverde, periodical May-June 2018) and ISTAT at December 31, 2017.
2 Data 2016 from "14th report on Mobility in Italy" – Isfort.

comfort, freedom and reliability but also of privacy and control, being perceived as a personal and protective environment.

Conversely, the bus is usually judged as less convenient in term of cost (payment is often before each trip and may be perceived as excessive, especially if the ticket is used on a much shorter route than its average or maximum duration).

The bus may also be seen to have problems in terms of accessibility and usability, as well as being unreliable since the punctuality of the service and the journey cannot be directly controlled by the user [6] [9] [10]. For these reasons, it seemed to be appropriate to focus on this transport system, trying to understand whether potential interventions might be identified to promote bus use.

The investigation has a particular focus on in-vehicle time, how it is perceived and used: the aim is to examine whether the possibility of using the time spent on board in a beneficial way can, to some extent, contribute to defining an additional factor of quality, thereby favouring public transport over the private modes [11].

However, as also suggested by Clayton [12], the main focus within operations in order to generate a positive user responses remains on ensuring high level of service in terms of performance[3] and, only subsequently, to focus on secondary factors such as travel experience. Despite this, the research did not directly consider the service performance factors, as these were beyond the scope of the study and it just aims to define the value of travel experience [13].

2. The value of travel time

In the transport field, "*travel time"* is one of the fundamental parameters on which the service supply is based. Generally, in the most widespread meaning, travel time is translated into economic terms as a generalized cost, so that it is a benefit just when it is saved during travel, and therefore becomes available to be used otherwise. This perspective, considering time onboard as useless and lost, has induced mobility policies to be directed towards faster journeys and increasingly efficient systems [14]. In particular, the economic value related to time savings is correlated to several factors, including the individual wage, the type of activity to which one can allocate the time saved and its usefulness [15] [16].

Form a different perspective, travel time assumes a positive value as an available resource to be used during the trip itself. The definition of "*tripartite nature*" of travel time well accords with this interpretation: it shapes the potential of travel time on a triple dimension, that is the travel itself, the activities carried out at the destination, and the activity in which passengers can be involved during the journey [11]. However, it is important to underline that the value attributed to travel time depends on several personal factors, on travel conditions and type of vehicle used. Consequently, a more productive and active travel experience does not always correspond with a more positive and useful perception of it [10].

In the concept of "*Time as a Gift*", time can be either "time for", thus the opportunity to do personal business, a "break" (time to relax and disconnect from everyday life) or "transition time", in which the individual has the possibility of gradually moving between different environments, the one of origin and that of destination [17]. The way travel time is used can influence its perception, since the passenger can dilate or compress his or her time, shaping it with the resources he/she has available

3 Performance parameters are those generally considered in Customer Satisfaction Survey, also included within the UNI EN 13816:2002 [13]: Availability and accessibility of the service, information, timing, customer care, comfort, safety and environmental impact.

during travel[18]. In recent years, several studies have been undertaken[4] with the aim of investigating and deepening the concept of travel experience.

Between 2004 and 2010, a study was carried out on railway passengers of the , to investigate the use of travel time and its meaning [19] [20]. The comparison between the results obtained from two surveys, six years apart, led to some interesting results: stability factors emerged between 2004 and 2010 among the data related to the most common activities (reading, looking around and work/study) and those related to activities considered "technology independent" (talking to others, resting and eating / drinking).

At the same time, changes mainly concerned the availability and use of technological tools: there was a doubling in the percentage frequency of activities which required the use of mobile devices (notebooks and tablets), as well as their availability. It is reasonable, therefore, to foresee that this phenomenon can strongly influence the experience of traveling [16].

In the evaluation of travel time, the proportion of those who had defined the travel time as wasted time decreased by almost a third between the two surveys, while the proportion of those who defined it as useful increased. Another interesting result is related to the duration of the trip: there is a threshold (15 minutes) under which the only activity is to gaze around, and only above that threshold do people have enough time to be subsequently involved in something else. Although the train journey is not comparable to the bus journey in terms of comfort and durability, the fact that there could be a relationship between the use of travel time and travel experience is an important aspect to be translated and investigated among bus passengers as well.

In 2011, a survey was conducted of the passengers of the urban bus service of the Bristol area [11]. The research examined the interaction between activities undertaken, objects available during travel, the social environment, and users' behavior. Almost half of the respondents reported that they had an indifferent assessment of the bus trip and judged it as boring. Others found it relaxing, comfortable and useful. Applying regression analysis, it was possible for the researchers to highlight some activities that were associated with a positive influence on perceptions of the travel experience: looking around, listening to music or taking care of someone. These activities, along with reading and making personal calls, were in fact the most common on the bus. The results also showed that younger people were more likely to be involved in some activities, especially related to the use of technology.

Another element concerns the social sphere: the idea that public transit must be considered a public space in which people can come into contact and interact; in addition to the main function of transport, public transport is also an arena which can promote social inclusion. Both the environment and the behavior of other passengers can influence the behavior of the individual, especially in an environment where there is less space and privacy [21].

4 The experiences to which this study is mainly referred are those developed in Great Britain, in particular by the research group of the Centre for Transport and Society (CTS), Univeristy of the West of England, Bristol (UK), since this study was set in similar manner.

3. Case study

3.1 Brescia: background and collective transport

In 2017 Brescia[5] was classified first among the non-metropolitan cities of Italy for the quality of its public transport[6] [22] and it is one of few Italian cities to have a Sustainable Urban Mobility Plan (SUMP)[7]. The bus system, managed by Brescia Trasporti S.p.A.[8], transports annually 36,882,998 passengers[9]: it is structured on 16 routes covering the urban area and the 14 municipalities of the extra-urban area, with a network of about 290 km[10].

The Fleet consists of single decker buses, some with a rigid and some with articulated chassis, with a capacity of about 100 people, depending on the size of the vehicle, and an internal layout typical of the Italian urban bus. The city's urban bus service, despite showing an elevated assessment by the user (average rating of 8 points out of 10)[11], still demonstrates a certain margin for improvement given that, to date, there is a 55% of private motorized vehicles against a 17% of collective transport.

3.2 How to detect data and methodology of analysis adopted

To analyze passengers' travel experience, reference was made to the methodology adopted in the research carried out in Bristol [12], both for the detection and processing of data. For data collection, a questionnaire was prepared anddistributed directly on board, to give passengers, the possibility of completing it independently[12] in order to get the most accurate and realistic answers possible.

As the goal was to gather information about the specific trip, creating a data collection context that ensured immediacy of response to the current experience was essential to induce passengers to reflect on the specific trip, without having to rely on memories or previous journeys [23].

The survey activities were conducted between February and April 2017, from 9:00 to 19:00 on week days only, trying to collect as much data as possible during the less crowded hours, which was a more favorable environment to undertake activities. Before submitting the questionnaire to the users, they were given a few minutes to "settle down", so that they began their journeys (and any activities) in an ordinary, typical way.

In order to manage the scale of the survey task within available resources, some specific routes were selected, based on the route length and attractors (densely populated areas, train or metro station, city centre, shopping areas, schools, etc.). The routes selected were among those with the highest number of annual bus-km travelled (they reach the extra-urban area) and passengers transported[13].

As in the Bristol study, quantitative data analysis was carried out using different analytical procedures in parallel, exploiting the potential of each one of them: descriptive statistics were

5 The municipality has a population of almost 200,000 inhabitants, while the metropolitan area of Brescia Reaches half a million people.
6 "Ecosistema Urbano Rapporto sulle performance ambientali delle città 2017".
7 Pums Observatory in Italy, Link: Http://www.osservatoriopums.it/osservatorio/pums.
8 The local public transport system is managed by Brescia Mobility S.p.A., a company of the municipality of Brescia. It coordinates its subsidiaries Brescia Trasporti S.p.A. and Metro Brescia Srl.
9 Data monitoring of local public transport 2017, April 2018. Since 2013, Brescia benefits from the light automatic rail that, covering one of the main traffic routes, transports the remaining 17,398,544 passengers.
10 Data from "Brescia Mobility Group Sustainability Report" 2017 Https://www.bresciamobilita.it/il-gruppo/bilancio-sociale.
11 Data monitoring of local public transport 2017, April 2018.
12 In case of willingness to participate in research but difficulties in filling the questionnaire (mainly for the elderly), the surveyer could intervene and, under dictation, transcribe the answers to the questions.
13 Routes 3, 11 and 16 (the ones selected for research) exceed the threshold of 800,000 km/year routes and, together, they carry one third of the total passenger/year, that is 11,487,830 passengers. (Data from "general report Brescia Pums and monitoring TPL 2017).

necessary to return a general characterization of the sample, while the regression analysis was useful to identify correlations between the perception of travel and other elements that characterize the time spent on board. In the case of Brescia, a cluster analysis was also performed to verify the presence of specific profiles of users showing differences regarding the travel experience: profiling the sample is extremely useful for promoting targeted and customized interventions to enhance the service quality.

The IBM SPSS statistical analysis software was used for data processing.

With the aim of proposing "travel experience" as a further element to qualify the public transport service supplied, as a final step, the user experience was analysed using a Customer Satisfaction Index[14] to evaluate the judgements given by passengers in respect of three main topics characterising the travel experience itself.Table 1 – Overall sample characteristics

Variable (Variabili)	Categories (Categorie)	%
Age (Età)	16-24	51.2
	25-34	11.3
	35-44	9.8
	45-54	10.0
	55-64	8.6
	65+	9.1
Gender (Genere)	M	34.5
	F	65.5
Journey purpose (Motivo di viaggio)	Business (Affari)	2.5
	Personal Business (Motivi personali)	23.3
	Leisure (Svago)	6.0
	Work (Lavoro)	29.1
	Shopping	4.9
	Education (Istruzione)	23.7
	Visit Friends (Incontrare amici)	10.5
Ticket (Titolo di viaggio)	Single (Singolo)	22.8
	Daily (Giornaliero)	4.0
	Weekly pass (settimanale)	6.8
	Monthly pass (mensile)	28.8
	Annlual pass (annuale)	31.7
	Integrated ticket (Bus+treno)	2.6
	Other (Altro)	3.4
Car availability (Disponibilità dell'autovettura)	No	85.0
	Yes	15.0
User position (Posizione del passeggero)	Seated (Seduto)	94.7
	Standing (In piedi)	5.3
Use of other modes (Intermodalità)	No	61.4
	Yes	38.6
Frequency of service use per year (*) (Frequenza di utilizzo in un anno)	First time today (Prima volta oggi)	4.17
	2 – 5 times (2-5 volte)	5.62

14 The formula here employed, and explained in chapter 5, is the one of the Modified Customer Satisfaction Index (CSImod).

	5 – 10 times (5-10 volte)	3.1
	More than 10 times (Più di 10 volte)	87.1
Approximative journey length in no. Bus stop (Lunghezza approssimativa del viaggio in no. fermate) (**)	< 10	11.9
	10 – 20	49.2
	20 – 30	26.5
	30 – 40	9.1
	40 – 50	2.7
	>50	0.5

(*) La maggior parte degli intervistati ha dichiarato di usare il bus più di dieci volte in un anno e più della metà ha un abbonamento, segno che si tratta di utenza ordinaria.
(**) Dato desunto dalla matrice O/D del viaggio, inserita tra le informazioni di base dell'intervistato.

(*) Most of the interviewed said that they used the bus more than 10 times a year and more than half of them has a pass, which means that they are ordinary bus users.
(**) Data obtained from the O/D matrix of the trips, inserted among the interviewed information.

4. Quantitative analysis of data

The proposed questionnaire, as well as the general information about the respondent and trip (Table 1), contained specific questions about the perception of travel time:

- Q1: *General perception*: What do you think about travelling by bus in general? (expressed on a 5 points scale, from "I don't like it at all" to "I like it very much")
- Q2 *Perception of the current trip*: on a 7-point scale, my time on the bus today was (fun, relaxing, comfortable, helpful)
- Q3 *Comfort with the activities on board:* on a 7-point scale, how comfortable you are in carrying out these activities (making calls, listening to music, using a PC, use mobile devices, talk to others, eat or drink)?
- Q4 *Comfort towards of the social environment*: on a 7-point scale, how comfortable are you if other people carry out these activities (making calls, listening to music, using a PC, using mobile devices, talking to others, eating or drinking)?
- Q5: *Activities on board*: How did you spend your time on the bus today?
- Q6 *Objects On board*: Which of the following items did you have available and used on the bus today?

Of these, Q2, Q3, and Q4, were later selected as indicators for calculating the assessment index. The format contained a space for adding any comments or suggestions at the respondent's discretion.

4.1 Descriptive statistic

The collected sample included 554 completed surveys, of which the majority were young people between 16-34 years (62.5%) and women (65.5%). Almost all the interviewees said they did not have their own vehicle as an alternative to the bus for the same trip (85%), a sign that only a few have used public transport by choice (15%). The most frequent travel purposes were personal reasons (23.3%), work (29.1%) and education (23.5%) and most of journeys covered 10-20 stops[15] (49.2%). The sample collected, in terms of general characteristics of the respondents, reflects the traveler

15 Assuming a commercial speed of 18 km/h and a distance between stops of 250 meters, the time to travel a 10 stops distance is equal to about 10-15 minutes.

population characteristics identified through surveys conducted by the operator[16] and therefore can be considered indicative of the catchment area.

Table 2 – Responses to Q1 (Risposte alla domanda Q1)

Q1 - "What do you think about riding the bus in general?" (Cosa pensi in generale del viaggio in autobus)	%
I really don't like it (Non mi piace per nulla)	4.2
I don't like it (Non mi piace)	7.2
I neither dislike it nor like it (Indifferente)	36.3
I like it (Mi piace)	48.6
I really like it (Mi piace molto)	3.7

Table 3 – Responses to Q2 (Risposte alla domanda Q2)

"My time on the bus today has been…?" (Il mio tempo a bordo oggi è stato…?)			
		%	
	Agree (Concordo)	Nor agree nor disagree (Indifferente)	Disagree (Non concordo)
P1 – Enjoyable (Piacevole)	61.0	25.0	14.0
P2 – Relaxing (Rilassante)	63.0	20.4	16.6
P3 – Comfortable (Confortevole)	64.2	18.0	17.8
P4 – Useful (Utile)	78.0	10.4	11.7
I dati delle risposte, espressi in una scala 1-7, qui son stati ggregati per mostrare in maniera più compatta e chiara i risultati. The data of the answers, expressed in a scale 1-7, here have been aggregated to show in a more compact and clear the results.			

From Table 2, it is clear how the bus journey is perceived in a general positive way (48.6%), even if the percentage of those who have declared themselves indifferent (36.3%) is not negligible: it is important to underline this category as it constitutes one of the main targets of transport companies. Recording a medium/neutral judgement from users is crucial since it can be decisive when, owing to some service interventions, it can turn into a positive or negative one: being able to obtain the consent of this user is essential to improve the rating of the service. Analyzing the data referring to the specific bus journey for the various items of question Q2 (Table 3), the assessment of the average grade is lower (around 19%). Travel time, in fact, was perceived mostly as pleasant (61%), relaxing (63%), comfortable (64.2%) and useful (78%). This last percentage, about the usefulness of travel time, is interesting because, although the travel time for the same person may have been boring, stressful or uncomfortable, in most cases it is still useful, stressing once again that it is an extremely personal and variable characteristic. The fact that, for many people, the bus was the only alternative of mobility - and therefore the only possibility to reach the destination - could have influenced the perception of usefulness of time on board, element also confirmed by some comments left in the questionnaire.

Table 4 - Responses to Q3 (Risposte alla domanda Q3)

"How comfortable are you in doing … on board?" (Quanto sei a tuo agio nel fare … a bordo?)			
		%	
	Comfortable (A mio agio)	Indifferent (Indifferent)	Uncomfortable (A disagio)
P1 - Making phone calls (Fare chiamate)	35.4	16.6	47.9

16 The data of the April 2017 surveys carried out by the company and granted for research purposes were compared.

P2 - Listening to music (Ascoltare musica)	67.6	3.1	29.3
P3 - Using a notebook (Usare un notebook)	9.2	10.7	80.2
P4 - Eating or drinking (Mangiare o bere)	18.8	10.8	70.4
P5 - Using smartphone/tablet (Usare smartphone/tablet)	84.1	9.8	6.1
P6 - Talking to strangers (Parlare ad estranei)	41.0	15.3	43.6
I dati delle risposte, espressi in una scala 1-7, qui son stati ggregati per mostrare in maniera più compatta e chiara i risultati. The data of the answers, expressed in a scale 1-7, here have been aggregated to show in a more compact and clear the results.			

Table 5 -Responses to Q4 (Risposte alla domanda Q4)

"How comfortable are you with others doing … on board?" (Quanto sei a tuo agio se altri fanno … a bordo?)			
		%	
	Comfortable (A mio agio)	Comfortable (A mio agio)	Comfortable (A mio agio)
P1 - Making phone calls (Fare chiamate)	47.1	18.6	34.4
P2 - Listening to music (Ascoltare musica)	79.7	9.9	10.5
P3 - Using a notebook (Usare un notebook)	78.7	10.4	21.3
P4 - Eating or drinking (Mangiare o bere)	45.3	13.3	41.4
P5 - Using smartphone/tablet (Usare smartphone/tablet)	81.9	9.6	15.5
P6 - Talking to strangers (Parlare ad estranei)	62.5	15.8	21.7
I dati delle risposte, espressi in una scala 1-7, qui son stati ggregati per mostrare in maniera più compatta e chiara i risultati. The data of the answers, expressed in a scale 1-7, here have been aggregated to show in a more compact and clear the results.			

Table 4 and Table 5 show the answers referred to the personal comfort, that is to feel at ease in being involved in some activities (those considered most possible on board) and towards the behavior of other users.

Table 4 data shows that making calls, using a PC, eating/drinking and talking with other people are not well perceived: questions of privacy, availability of space and comfort can certainly be influential in this assessment. As for the behavior of other passengers, there is a general level of comfort and tolerance.

Table 6 shows the percentages related to onboard activities. As evident in Table 1, the interviewees were mostly seated on the bus, so in a favorable situation to be able to dedicate themselves to different activities (as opposed to standing). Users spent their time mainly window gazing (39.2%), talking with other users (33.2%), personal calls (30.5%), browsing the Internet (24.5%) and listening to music (14.3%), which are activities that do not required a lot of space or tools.

The activities which people have spent the most time[17] on are window gazing, listening to music and making personal calls. If the data related to the the use of mobile devices and internet connection was merged, it would be evident that most of the people spend their time in activities related to them.

Another element that emerged from the analysis is the higher level of activity among young people (16 - 34 years) compared to the other categories of users (35-54 and over 55), who are mainly dedicated to window gazing and resting. In general, these data align with those found in the researches discussed above.

[17] The column called ratio indicates the ratio between the percentage of response related to "having done that activity" and "having done that activity for longer"

Table 6 - Responses to Q5 (Risposte alla domanda Q5)

Variable (Variabili)	Categories (Categorie)	%		
		Done	Done the most	Ratio
How have you spent your time on this bus today? (Come hai trascorso il tuo tempo sul bus oggi?)	Sleeping/snoozing (Dormire/riposare)	5.4	1.8	0.33
	Reading for leasure (Leggere)	7.0	3.6	0.51
	Working/studying (Lavorare/studiare)	7.2	2.5	0.35
	Window gazing (Guardarsi attorno)	39.2	30.9	0.79
	Listening to music (Ascoltare musica)	14.3	13.4	0.94
	Work related calls/sms (Chiamare per lavoro)	6.1	1.3	0.21
	Personal calls/sms (Chiamate personali)	30.5	12.1	0.40
	Eating/drinking (Mangiare/bere)	4.0	0.4	0.10
	Caring for someone (Prendersi cura di qualcuno)	3.6	1.8	0.50
	Watching viedos/movies (Guardare video)	2.5	0.2	0.08
	Checking emails (Controllare email)	6.7	1.1	0.16
	Browsing the internet (Navigare in Internet)	24.5	7.2	0.29
	Accessing SNS (Accedere ai social network)	21.3	7.9	0.37
	Playing games (Giocare)	6.5	2.0	0.31
	Talking to others (Parlare con altri)	33.2	-	-

Table 7 displays the objects had at hand and used during the trip: almost all the passengers had a smartphone with them (95.5%) and more than half used it (67%). It is evident that objects such as smartphones are not only easily usable even in a dynamic and crowded place as the bus may be but offer a wide range of possibilities without the need of any other specific equipment.

Table 7 - Responses to Q6 (Risposte alla domanda Q6)

Variable (Variabili)	Categories (Categorie)	%		
		Had to hand	Used	Ratio
Which of the following items have you had to hand and used on this bus today? (Quali dei seguent oggetti hai avuto con te e usato sul bus oggi?)	Mobile phone/smartphone	95.5	64.3	0.67
	Music player	9.9	5.6	0.57
	Game (giochi)	1.4	0.7	0.50
	Laptop (computer portatile)	3.4	0.4	0.12
	Food/drink (cibo/bevande)	20.9	3.4	0.16
	Newspaper (Giornale)	3.6	0.2	0.06
	Magazine (Rivista)	5.2	2.0	0.38
	Reading book (Libro da leggere)	11.0	2.7	0.25
	School book (Libro di scuola)	20.2	3.4	0.17
	Documents (Documenti)	9.6	1.3	0.14

The data highlighted for Brescia present elements of comparison with those presented in the previous research [24] [20] [12]. In Brescia people read less than the two English samples (7% against about 50%) and eat/ drink less on board (it is forbidden by regulation), regardless of the vehicle. Conversely, passengers interacted much more with each other in Brescia (33%) than any of the British samples (14-24%).

Concerning the differences between train and bus, activities such as working, studying or sleeping are very common on trains (27% and 14%) unlikely on the bus (5-9%); this is certainly influenced by

the availability of space, comfort and travel duration. On the train the most used objects are smartphones, newspapers, and reading books, as it happens on the buses of Bristol, while in Brescia, essentially, mainly the smartphone is used.

4.2 Cluster analysis

Cluster Analysis (CA) is an exploratory procedure that identifies basic structures within a large amount of data. It allows to detect homogeneous groups of cases and overcome the problems related to data heterogeneity by stratifying the sample.

The grouping is based on two main features: high similarity between cases within the same cluster and low similarity between different clusters, which are calculated through measure of "distance" (e.g. *Log-Likelihood*). For this reason, it was considered interesting to implement the CA, in order to detect possible clusters and their peculiar characteristics, especially concerning the perception of travel time in relation to the use of it. The *Two-Steps* algorithm has been employed, since it allows to work with large amounts of data and, above all, to include continuous and categorical variables within the same model. It automatically identifies the optimal number of clusters and, compared to other algorithms, it is faster and more reliable [25].

In the model the variables related to the general characteristics of the sample and the activities performed have been inserted: basing on the values assumed by these variables, the algorithms were processed by the distances to determine the non-similarity between the groups, detecting an order of importance among the variables, that is hierarchy based on the greater distance (Table 8). The analysis revealed two clusters that include the 96% of respondents. Cluster 1 shows 303 people and Cluster 2 shows 227 people, with a total of 530 out of the whole sample of 554.

Table 8 Cluster Analysis results (Risultati dell'Analisi di Cluster)

Variable (Variabile)	Imp.	Cluster 1	%	Cluster 2	%
Mobile devices use (Uso di dispositivi mobili)	*1*	Yes	97	No	100
Travel time activity (Attività nel viaggio)	*0.81*	At least one or two (almeno una o due)	64	Resting or gazing (riposare o guardare attorno)	95
Personal calls or texts (Chiamate personali)	*0.36*	Yes	54	No	100
Browsing the Internet (Navigare in Internet)	*0.26*	Yes	42	No	100
Accessing Social (Accesso ai Social)	*0.23*	Yes	38	No	100
Age range (Fascia d'età)	*0.22*	16-24	68	16-24	29
Listening to music (Ascoltare musica)	*0.15*	No	75	No	100
Working or studying (Lavorare/studiare)	*0.07*	No	87	No	100
Checking emails (Controllare email)	*0.06*	No	89	No	100
Work related call/text (Chiamate di lavoro)	0.06	No	89	No	100
Reading for leisure (Lettura di piacere)	0.06	No	88	No	100
Travel purpose (Motivo di viaggio)	0.05	Work	31	Personal business	32
Ticket type (Titolo di viaggio)	0.05	Annual pass	41	Single	31
Eating or drinking (Mangiare o bere)	0.03	No	93	No	100
Watching a video (Guardare video)	0.02	No	96	No	100
Sleeping or snoozing (Dormire e riposare)	0.02	No	92	No	100
Talking to someone (Conversare)	0.01	No	64	No	72
Window gazing (Guardare fuori)	0.01	No	61	No	60

Cluster 1: Most people in this group are age 16-24 (67.9%); The main purpose of travel is related to work (30.5%) and education; the most used travel title is annual subscription (41.4%) and monthly. People in this cluster are generally engaged in at least one or two activities (63.6%) and almost the entire sample used mobile devices on board (96.7%), for personal calls (53.6%), Internet browsing (41.7%) and access to SNS (38.1%).

Cluster 2: Mostly of people over 55 belong to this group, although 16-24 year-old people are one third (28.9%). The main purpose of the trip was related to personal business (32.0%) and travel to work. The most used ticket is the single (31.1%). People in C2 have rested or looked around during the journey (95.1%). None of the passengers in this group used mobile devices (100%).

Table 9 Cluster Evaluation field (Campi di valutazione dei cluster)

		%	
		Cluster 1	Cluster 2
Enjoyable or boring (Piacevole o noioso)	Boring (Noioso)	14.4	12.2
	Indifferent (Indifferente)	28.4	21.6
	Enjoyable (Piacevole)	57.2	66.2
Relaxing or stressful (Rilassante o stressante)	Stressful (Stressante)	19.7	12.6
	Indifferent (Indifferente)	22.4	18.9
	Relaxing (Rilassante)	58.0	68.5
Comfy or uncomfy (Confortevole o scomodo)	Uncomfy (Scomodo)	19.6	14.0
	Indifferent (Indifferente)	23.7	12.6
	Comfy (Confortevole)	56.7	73.4
Useful or wasted (Utile o sprecato)	Wasted (Sprecato)	12.6	11.4
	Indifferent (Indifferente)	14.0	5.9
	Useful (Utile)	73.4	82.7

There are considerable differences between the two identified clusters, especially for those with a statistical importance greater than 0.1, which mainly concern the level of activity of people and the use of mobile devices (in the first more than in the second). Besides this, from the percentages related to Q2 and reported in Table 9, there are no particular discrepancies regarding the travel perception, since the most frequent category of response is that of the positive judgment for both. In this case, therefore, the cluster analysis made it possible to detect two distinct user profiles but did not allow to identify particularly influential factors on the travel experience, underlining once again that it is an element that is not easily controlled and categorize.

If very discordant results would result from the CA, it would have been interesting to apply the regression analysis separately on the two clusters detected, in order to highlight the correlations between perception of travel time and the different use of it while travelling. However, as the result were concordant for travel experience, the whole sample was analyzed as one.

4.3 Ordinal regression

The regression is a statistical procedure that allows dependency relationships between variables to be highlighted. In particular, ordinal regression (OR) is preferable to other procedures when it is required to study the trend of an ordinal categorical variable. First, as opposed to the linear or multinomial model, it allows to work with non-continuous variables, without losing the information

contained in the intrinsic ordering of the variable itself[18]; In addition it can include simultaneously multiple independent variables and to obtain more characteristics of correlations, such as direction (direct or inverse) and its entity (strong or weak) [26] [27].

In the case study, the variables employed are those referred to Q2 *Perception of the current trip*, where, to each request (e.g. "My time on the bus was enjoyable"), could have been associated to a judgement on a 1 to 7 points ordered scale (e.g. 1 = "Absolutely disagree, "4 = "Indifferent" and 7 = "Absolutely agree"). These are ordinal categorical variables, that is, variables that can assume different "values" linked to one another by a hierarchy. The independent or predictor variables can be either categorical, nominal or ordinal variables, continuous or combinations of them[19].

Through the OR it was possible to link perception variables with the other parameters collected with the interviews. Four separate models (Table 10) have been built, one for each of the topics of travel time perception (enjoyable, relaxing, comfortable and useful) and, within each model, all the other independent variables have been included: done activities, general and travel information etc.

The goodness of the model (best fits) was assessed through the p-value, which represents the degree of significance of the correlation between a single dependent variable and a predictor. P values lower than 0.05 are considered valid and, for a better interpretation, 3 levels have been identified according to an increasing order of significance: * p-value <0.05; ** p-value <0.02 and *** p-value <0.01. The "Estimate" coefficient indicates the characteristics of the correlation between the variables: the absolute value represents the magnitude[20], the sign the direction. As previously specified, the correlation refers to the last response category of the dependent variable, which in this case corresponds to 7, or the highest degree of satisfaction.

Table 10 Ordinal Regression Results (Ordinal regression results)

Main predictor category (Principali categoria dei predittori)	Predictor (Predittore)	*p-value* – Significance (Significatvità)	Estimate (stima)
Journey experience: Enjoyable or Boring [21] *(Esperienza di viaggio: viaggio piacevole o noioso)*			
Patronage level (Livello di affollamento)	Free seats (posti liberi)	*	.950
Social Disposition (Socialità)	More sociable (Più socievole)	***	.205
Travel-time activity (Attività di viaggio)	Sleeping (Dormire)	*	.969
	Eating (Mangiare)	*	-1.643
	Chatting (Parlare)	*	.451
Used items (Oggetti usati)	Newspaper (Giornale)	*	-5.032
	Magazine (Rivista)	*	2.190
Sitting/standing (Seduto/in piedi)	Standing (Stare in piedi)	***	-1.180
Age range (Età)	16-24	*	-.836
Journey experience: Relaxing or stressful [22] *(Esperienza di viaggio: viaggio rilassante o stressante)*			
Social Disposition (Socialità)	More sociable (Più socievole)	***	.164
Travel-time activity (Attività di viaggio)	Eating (Mangiare)	*	-1.636

18 The ordinal regression procedure defines dependency relationships by taking as reference one of the levels between the categories of response, which usually corresponds to the last in the order of levels.

19 A nominal categorical variable identifies categories, that is, the subject's quality, without having an order or hierarchy between them. It is labelled as dichotomic if it identifies only two categories (e.g. yes/no, done/not made) or polytomous, if it identifies more than two categories (e.g. age groups, titles and travel purpose). Continuous variables are expressed in numerical value and belong to continuous range.

20 The + shows a direct correlation between variables while – shows an indirect correlation between them.

21 χ^2 (59df)=171.48, Sig.=0.000, Pseudo R-Square (Nagelkerke) = 0.312. Reference category: 'Really enjoyable'

22 χ^2 (59df)=170.87, Sig.=0.000, Pseudo R-Square (Nagelkerke) = 0.309. Reference category: 'Really relaxing'

	Chatting (Parlare)	***	.718
Used items (Oggetti usati)	Magazine (Rivista)	***	2.552
	Book (Libro)	*	-1.209
Journey purpose (Motivo di viaggio)	Business (Affari)	*	-2.129
Sitting/standing (Seduto/in piedi)	Standing (Stare in piedi)	***	-1.519
Journey experience: Comfortable or uncomfortable [23] *(Esperienza di viaggio: viaggio comfortevole o scomodo)*			
Time of day (Ora del giorno)	10am – 12pm	*	.689
Patronage level (Livello di affollamento)	Free seats (posti liberi)	***	1.311
Social Disposition (Socialità)	More sociable (Più socievole)	***	.261
Travel-time activity (Attività di viaggio)	Working/studying (Lavorare/studiare)	**	-1.125
	Chatting (Parlare)	***	.584
Used items (Oggetti usati)	Smartphone	***	.689
	Magazine (Rivista)	**	2.478
Sitting/standing (Seduto/in piedi)	Standing (Stare in piedi)	*	-.922
Age range (Età)	16-24	**	-.918
Journey experience: Useful or wasted [24] *(Esperienza di viaggio: viaggio Utile o sprecato)*			
Car avialability (Disponibilità auto)	Not available (Non disponibile)	*	-.617
Travel-time activity (Attività di viaggio)	Window watching (Guardare attorno)	**	-.452
	Chatting (Parlare)	***	.655
Used items (Oggetti usati)	Magazine (Rivista)	*	2.548
Age range (Età)	16-24	*	-1.023

One of the recurring elements in the regression analysis concerns the effect of overcrowding (*patronage level*): a less crowded onboard environment (therefore more seat) demonstrates a positive correlation with undertaking a pleasant, relaxing and comfortable journey. This agrees with the negative relationship between the need to stand during the journey (*standing*) and the likelihood of spending time on board in a pleasant way and the relation with the time of travel: travelling during a non-peak hour (*Time of day: 10:00 am to 12:00 pm*) makes the journey more comfortable. This is a fair obvious relationship, but the model has identified and underlined it.

Another interesting aspect, also found in Bristol, is the fact that young people (*Age range: 16-24*) are much more critical about the travel experience, because they are much more likely to express negative judgments about it. This is the largest portion of users and it is therefore important to be able to provide a more targeted service aimed at modern, increasingly active and technological users.

As for the activities carried out and the objects used, only some showed a certain significance. Reading books and newspapers shows a negative correlation while the use of magazines has a positive correlation with a more positive perception of travel. This is probably related to the level of comfort given by the availability and orientation of the seats (traveling opposite to the vehicle's direction of travel, often causes discomfort) and the ease in using these objects on board. Similarly, the use of smartphones seems to make the journey more comfortable, for the ease of use of the device and its potential in a dynamic and limited environment such as the bus. Resting on the bus was positively related to an experience of a pleasant journey while the fact of looking around showed a negative correlation with its usefulness, which for example had the opposite result in the research

[23] χ^2 (59df)=246.98, Sig.=0.000, Pseudo R-Square (Nagelkerke) = 0.417. Reference category: 'Really comfortable'

[24] χ^2 (59df)=130.32, Sig.=0.000, Pseudo R-Square (Nagelkerke) = 0.252. Reference category: 'Really useful'

of Bristol. This result emphasizes once again that perception is a very subjective factor and consequently the positive value associated with travel time is variable. Eating or drinking on board is associated with a more negative experience as well as working or studying.
Another analogy with the British research is the one concerning the social sphere. In both studies, among the predictors, the parameter of Q3 "feeling comfortable in talking with people" has been included (*Social disposition - more sociable*): the OR revealed that passengers showing a greater propensity (ease) in interacting with others, tend to have more positive travel experiences than those who declare the opposite. Likewise, for Brescia, chatting on the bus is linked to a more pleasant, comfortable and relaxing travel experience.

5. Evaluation index of the travel experience

As previously introduced, considering the travel experience as a quality factor of the transport service, here authors suggest that it can be included in the Customer Satisfaction analysis as well as other performance parameters (e.g. punctuality and reliability). For this reason, referring to the questions Q2, Q3 and Q4 which identify and define specific areas of investigation concerning the general concept of "travel experience", three indices have been devised.

Table 11 Travel Experience Indices (Indici dell'esperienza di viaggio)

Index (indice)	Associated query (Domanda associata)	
TPI – Travel time Perception (Percezione del tempo di viaggio)	*Q2*	My time on the bus today has been (adjective)? *(Il mio tempo sull'autobus oggi è stato (aggettivo)?)*
ACI - Activity Comfort (Comfort nelle attività)	*Q3*	How comfortable are you in doing (activity) on board? *(Quanto sei a tuo agio nel fare (attività) a bordo?)*
SEI - Social Environment (Ambiente sociale)	*Q4*	How comfortable are you with other doing (activity) on board? *(Quanto sei a tuo agio se altri passeggeri fanno (attività) a bordo?)*

The formula used for the calculation of the new parameters is that of the *Modified Customer Satisfaction Index* CSI_{mod} [28]; the choice was made because of its mathematical structure, developed starting from the CSI formula proposed by Bhave [29] which returns a simple weighted average. In order to exploit the potential of the chosen formula and, above all, to get results expressed in a scale of values which could be easier to interpret, the evaluation scale of the questionnaire was converted from a 1-7 scale into a scale of 1-10.
Travel experience has been implemented in the CSI_{mod} formula through the coefficient α_{mod}, given by the ratio of the judgment x_{ij} and the mean value of the evaluation scale. It allows to influence the original value of the weighted average by multiplying it for an amplification factor, that is proportional to the assigned x_{ij} rating, giving greater emphasis to very positive/negative judgments. In fact, for an x_{ij} equal to 5 (neutral value), the result does not vary, since $\alpha_{mod} = 1$; for x_{ij} equal to 10 (maximum value) the result increases because $\alpha_{mod} = 2$ and for an x_{ij} equal to 1 (minimum value), the result decreases because $\alpha_{mod} = 0.20$.

Equation 1- Modified Customer Satisfaction Index

$$CSI_{mod} = \frac{1}{q} \cdot \frac{1}{n} \cdot \sum_{j=1}^{q} \sum_{i=1}^{n} x_{ij} \cdot \frac{w_j}{w_{j'}} \cdot \alpha_{mod}$$

$n = interviewees\ numbers;\ numero\ intervistati$
$q = parameters\ number;\ numero\ parametri$
$x_{ij} = score\ of\ the\ i-user\ to\ the\ j-parameter;\ pupunteggio\ del\ i-utente\ al\ j-parametro$
$w_j = peso\ assegnato\ al\ j-parametro$

$w_{j'} = media\ dei\ pesi, \qquad w_{j'} = \frac{1}{q} \cdot \sum_{j=1}^{q} w_j$

$\alpha_{mod} = coefficiente\ del\ peso\ delle\ risposte, \qquad \alpha_{mod} = \frac{x_{ij}}{5}$

The result of the indices is expressed in a 1-20 scale, with a ranges distribution as follow: very negative (1-5), negative (6-10), neutral (11-12), positive (13-16) and very positive (17-20).
Since the importance (weight) related to the parameters has not been directly collected during the interview activities, the authors decided to assign to the factors w_j different combinations of values in a scale 1-10: in this way it allowed to obtain the best and worst result for each of the three indices. The combinations, whose results are shown in Table 12, are described below:

- *Case 1*: all parameters have the same weight, that is equal to the arithmetic average of the judgments declared for each index is obtained;
- *Case 2:* each parameter is considered individually. For example, in iteration I1, parameter P1 is associated with maximum value (10) while the others with a null value;
- *Case 3:* each parameter is considered with twice the weight of the others. For example, in iteration I1, the parameter P1 is associated with a maximum value of 10 while at the other value 5;
- *Case 4:* each parameter is considered to be three times the weight of the others. For example, in iteration I1, parameter 9 is associated with value 9 while at the other value 3;
- *Case 5:* the parameters are considered in pairs; For example, in iteration I1, parameter P1 and P2 is associated with value 5 while at the other null value.

The formula has been implemented for each of the j-parameters of each of the indices and it returned the average modified by α_{mod}. Secondly, the average of all the j-parameters has been calculated to obtain the value of the index.

Table 12 Indices results – Risultati degli indici

TPI	*Iterations*[25] *(Iterazioni)*														
Case (Caso)	*I1*	*I2*	*I3*	*I4*	*I5*	*I6*	*I7*	*I8*	*I9*	*I10*	*I11*	*I12*	*I13*	*I14*	*I15*
1	11.8														
2	**10.8**	11.2	11.2	**14.1**	Just 4 iterations (Solo 4 iterazioni)										
3	11.6	11.7	11.7	12.3	Just 4 iterations (Solo 4 iterazioni)										
4	11.5	11.6	11.6	12.6	Just 4 iterations (Solo 4 iterazioni)										
5	11.0	11.0	12.5	11.2	12.7	12.6	Just 6 iterations (Solo 6 iterazioni)								
CAI	*Iterations (Iterazioni)*														
Case (Caso)	*I1*	*I2*	*I3*	*I4*	*I5*	*I6*	*I7*	*I8*	*I9*	*I10*	*I11*	*I12*	*I13*	*I14*	*I15*
1	8														
2	7	12	**2**	4	**16**	7	Just 6 iterations (Solo 6 iterazioni)								
3	8	9	7	8	9	8	Just 6 iterations (Solo 6 iterazioni)								
4	8	9	7	7	10	8	Just 6 iterations (Solo 6 iterazioni)								
5	10	5	5	11	7	7	8	14	10	3	9	5	10	6	12

25 Nel caso dell'indice TPI è stato necessario riportare anche la prima cifra decimale del risultato al fine di poter apprezzare le differenze di valore, seppur piccole, tra i casi. Tale risultato è dovuto ad una forte somiglianza tra i giudizi dati dagli utenti.

SEI	*Iterations (Iterazioni)*														
Case (Caso)	*I1*	*I2*	*I3*	*I4*	*I5*	*I6*	*I7*	*I8*	*I9*	*I10*	*I11*	*I12*	*I13*	*I14*	*I15*
1	12														
2	9	14	14	**8**	**16**	11	Just 6 iterations (Solo 6 iterazioni)								
3	11	12	12	11	12	12	Just 6 iterations (Solo 6 iterazioni)								
4	11	12	12	11	13	12	Just 6 iterations (Solo 6 iterazioni)								
5	11	11	**8**	12	10	14	11	15	13	11	15	12	12	10	13

In Table 12 it is possible to compare the results of the iterations. For all the three indices, the combination in which the difference between the values is most remarkable is the one corresponding to case 2, in which each parameter is singly considered. Some observations following:

- *Travel time Perception Index TPI*: the highest value (14.1) corresponds to the iteration I4, thus when the Usefulness of travel time is singly considered: this implies that the judgement of this parameter is very positive. The lowest value (10.8) corresponds to Iteration I1, thus when the only enjoyability of travel time is considered: the judgement of this parameter falls within a range of values at the limit of the neutral value.
- *Comfort in Activities Index CAI*: the highest value (16) corresponds to the iteration I5, that is when is the comfort in using smartphone/tablet is singly considered: the judgement of this parameter is very positive. The lowest value (2) corresponds to the iteration I3, that is, when it is considered only comfort in the use of laptops: the judgement of this parameter falls into a very negative range of values.
- *Social Environment Index SEI*: the highest value (16) corresponds to the iteration I5, that is, when only the judgement about feeling at ease if other users use smartphones is considered: the value falls within a very high satisfaction range. The lowest value (8) corresponds to the iteration I4, that is, when comfort to feel comfortable if other users eat or drink on board is considered: the judgement encounters a negative assessment. This value is also achieved in case 5 iteration I3, when both the comfort if other users make calls and others eat/drink on board are considered at the same time.

The results obtained from the application of the formula help not only to highlight the most negative judgments (which are the ones of greatest interest for the transport company) but also to interpret and integrate the results obtained previously. Regarding the perception of travel time (TPI), despite 61% of respondents saying they had spent their time in a pleasant way, the indicator assumes its lowest value precisely with this parameter.

The formula allowed to highlight that a portion of the users were dissatisfied with the pleasantness of the time spent on board and that, therefore, they defined it as boring /unpleasant. Based on the results obtained by the OR, it would be possible to intervene by improving this aspect by acting on factors that have shown a positive correlation with a more pleasant journey: providing more space and seating or ensuring a more pleasant and familiar environment in which passengers can both relax and dedicate themselves to personal activities. The TPI has shown its greatest value in correspondence with the usefulness of the trip, for which there is 78% satisfied users.

Furthermore, it would be useful to investigate more thoroughly the experience of young people, who are more critical on the assessments given, in order to better understand how to meet their needs in a more targeted way.

As for the comfort in carrying out activities, the formula for CAI emphasizes how using mobile devices (smartphones and tablets), find a very positive judgment, given their ease of use. On the contrary, using laptop computer is perceived as a discomfort, probably influenced by the surrounding conditions and the difficulty in using this object on board. Also eating / drinking on board has recorded a very negative level of comfort, confirmed by the RO results. Regarding the social environment, it is highlighted that the greatest factor of discomfort is related to other people eating on board but also making calls. Conversely, the fact that they use mobile devices does not cause any inconvenience. Therefore, in order to offer a better public environment, a restrictive action on regulation could be useful, simultaneously with more precise awareness campaign.

To summarise an overview of the results, still referring to case 2, it can be noted that with regard to the TPI index a medium / positive level has been reached for the several parameters investigated, for the CAI index a rather negative one while for SEI a medium level has been shown. Although there are parameters that singly reach the most positive range in the scale of values, those results underline the fact that there is still some room for improvement in some areas in order to reach more positive levels of satisfaction.

6. Conclusions

This research, hoping to contribute to background knowledge of the travel experience and its evaluation, considers this parameter as a potential significant factor in service quality evaluation. Here has been explored the case study of Brescia, where the bus transport service already shows a good level of satisfaction in terms of performance, even if these aspects have not been taken into consideration for this research. The analysis of travel time has brought to light interesting comparison elements with those obtained from past research: some activities, independently of the transport system, are common to different contexts, while others are specific to the means of transport or social and cultural contest.

Cluster analysis made it possible to identify two macro categories of users, whose discriminating factor is linked to the activities done, especially related to the technology. However, no strong differences regarding travel experience perception have been detected. For this reason, the forthcoming elaborations have been implemented on the whole sample, sonot considering separately the identified clusters.

The formulation of the indices, as well as the ordinal regression, has allowed to highlight the elements of dissatisfaction of the passengers with the travel experience, emphasizing the negative responses, thanks to the amplifying power of the formula used.

Following the obtained results, some suggestions can be given for service improvements: equipping the fleet with a WIFI connection[26], with charging points for electronic devices and crowding control systems onboard. Improving the environment in both its layout and functionality (e.g. seats and their orientation, interior design etc.) but also as a social space, inserting elements for information dissemination (news and culture) and improving the communication of the rules which have to be respected on board. Finally, it is essential that, for any intervention implemented on the service,

[26] To date, the internet connection is guaranteed only in the city centre and other few surrounding areas, thanks to the WIFI network of the Municipality of Brescia. However, not all the routes transit on this itinerary. Nonetheless, this could be a quite expensive solution.

corresponds a monitoring phase of the effects that it can bring into the quality and satisfaction evaluation by users.

Since this is a major field of investigation and not easy to characterize, it would be desirable for the analysis to be continued and deepened to overcome certain limitations. It would be useful, for example, to extend the survey to the whole public transit network in order to gather more information and to generalize the result; furthermore, it would be valuable to insert additional elements of analysis among the questions of the survey, as well as use more specific or performing procedures.

Despite the recognized limitations and the possibilities for improvement, the proposed analysis can be beneficial for the public transport companies in addressing the "decision-making" operations: it would help to identify interventions, in order to make the public transport offer more attractive and competitive, so that it could intercept more users, especially the occasional ones.

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