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Drivers of customer satisfaction with public transport services

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ABSTRACT

This paper aims to improve the understanding of the drivers of customer satisfaction with public transport (PT). The methodology provides a relevant contribution to the previous studies since it highlights the complex interaction between the level and composition of satisfaction, negative social safety experiences (NSSEs), urban settings, and the PT mode used.

Overall, PT users see the service attributes on-time performance, travel speed, and service frequency as the most important, followed by personnel/driver behaviour and vehicle tidiness. A generic policy aimed at achieving these attributes may yield favourable results with respect to satisfaction.

Further, we demonstrate the influence of differences in customer characteristics on satisfaction. A policy aimed at increasing the service frequency and putting new vehicles into operation will probably lead specifically to more satisfied older people (>65), passengers travelling by regional train, and people living in dense urban areas.

These findings may be of help to PTAs intending to exert an influence on the actions of PT operators, for instance by using them as a measuring rod in incentive contracts.

1. Introduction

Especially in urban settings, public transport (PT) plays an important role. The share of PT usage in the modal split in the EU-19 overall is only approximately 17%,[1] but in urban areas, the share of PT is considerably higher: up to 50% (European Platform on Mobility Management, 2014). Congestion in the EU in most cases is located in and around urban areas and costs nearly 100 billion euros annually, or 1% of the EU's GDP (European Commission, 2014). Moreover, urban mobility accounts for 40% of all CO_2 emissions of road transport and up to 70% of other pollutants from transport (European Commission, 2014). Public transport can contribute to solving these problems. A recent study (Replogle and Fulton, 2014), for instance, calculates a 40% reduction in urban passenger transport emissions by 2050 if expanding the use of public transportation, walking, and cycling in cities.

In transportation studies, the attractiveness of PT is primarily considered by concentrating on the technical aspects of the PT services (for a synthesis see Currie and Wallis, 2008); the view of the customer is often neglected. In economics and marketing, however, the management of consumer services is a topic that is widely studied (see for instance Bougie et al., 2003; Curasi and Kennedy, 2002; Zeithaml et al., 1990). Few authors bridge the gap between measuring the technical quality of PT service provision and measuring passengers' perception of PT quality. Eboli and Mazulla (2011) are among the few to take

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[1] In the EU-15, in 2011, passenger cars had a share measured in passenger kilometres of 83%, buses and coaches 8.4%, train 7.2%, and tram and metro 1.4% (European Commission, 2013).

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both these perspectives into consideration. A challenge for a customer-based PT policy is that the PT service perception of non-PT users may be biased. These users may perceive PT as mainly homogeneous and not tailored to their individual needs compared with, for example, bicycles and cars. People who are acquainted with PT are better able to perceive and evaluate the quality and heterogeneity of the actual PT supply.

A specific aspect of PT services in most Western countries is that they are provided by operators acting under a contract with a public transport authority (PTA). In many cases, these services are offered by private or semi-public contractors operating in almost monopolistic conditions. Under such circumstances, PT operators are not bound by competitive market requirements in meeting passengers' needs. Operators may be inclined to focus on the needs of the PTA instead of the needs of the passengers. However, it is in the interest of customers, authorities, and operators that PT systems are more focused on passengers' needs. PTAs can enhance customers' orientation of operators by imposing on them (or negotiating with them) quality-based incentive payment schemes (see e.g. Hensher and Houghton, 2004). The question for PTAs is how their steering mechanisms may be adjusted to bring PT services more in line with different user preferences and at the same time warrant the best possible value for (subsidy) money.

Our paper aims to contribute to the knowledge of how customer and trip characteristics moderate the satisfaction of PT users in the light of the steering mechanisms and governance of PTAs acting in a tendering environment. These topics are considered from the perspective of the PTA acting in the role of the representative of the customer/passenger. Under the conditions of putting a PT contract out to tender, the authority sets the rules of the game; therefore, PTAs have to acquire knowledge concerning which incentives that they impose on the operators will enhance the customer satisfaction and which will not.

In this paper, we model overall satisfaction as a function of user satisfaction with 15 attributes of PT services. We also model the moderating effect of customer characteristics on attribute-level satisfaction. In this way, we are able to study the aspects that matter to PT customers and demonstrate that the factors that are important to customers differ significantly across socio-demographic and trip characteristics. We use a data set containing the satisfaction scores and background characteristics of PT in the Netherlands for the period 2010–2011.

This paper contributes to the existing literature on PT quality assessment in three ways. First, it highlights the complex interaction between satisfaction and negative social safety experiences (NSSEs). Second, our study takes both the level of satisfaction and the composition of satisfaction into consideration. Third, due to the rich data set used (180,000 observations), we are able to attain robust results for a variety of PT modes (bus, tram, metro, regional train) and several urban contexts.

We structure this paper as follows. In Section 2, we provide a theoretical framework and elaborate on the central concepts that build satisfaction. Based on this theory, we postulate a number of generic hypotheses. In Section 3, we derive three models that describe the relationships between satisfaction with PT and characteristics of the customer and of the PT trip. Section 4 describes the results obtained from applying the models to a sample of Dutch PT users for the period 2010–2011 and tests the hypotheses. We conclude in Section 5 with a summary of the main findings, implications for policy, and recommendations for further research.

2. Conceptual model and hypotheses

In this section, based on a literature review, we describe the concepts that influence customers' satisfaction and behaviour in PT and visualize the relations between these concepts. As the customer is the main research topic of this paper, we restrict the description and visualization of the conceptual model to the customer/passengers side. Based on the theoretical discussion, in this section we also formulate some generic hypotheses concerning the relationship between customer and trip characteristics and the level and composition of satisfaction.

2.1. Consumer setting: expectations, perceptions and behaviour

From the perspective of customers, a service relation is a value-based relation, i.e. the relationship is a function of the costs and benefits that accrue from the relationship. Customers' assessments of a service depend on the balance between sacrifices and benefits, both monetary and non-monetary. Sacrifices and benefits are moderated by customers' tastes and characteristics. The needs of individual customers (passengers) are significant determinants of the level of satisfaction the customers' experience (Bryant and Cha, 1996) and of repurchase intentions (Mittal and Kamakura, 2001). These needs differ among individual customers; they are heterogeneous. Many authors in transportation research point to this heterogeneity in passengers' perceptions of the different aspects of the service provided (Eboli and Mazulla, 2009; Dell'Olio et al., 2010; Andreassen, 1995; Baltes, 2003; Tyrinopoulos and Antoniou, 2008; Diana, 2012; Brons and Rietveld, 2009).

When focusing on the relationship between satisfaction and behaviour, the above-mentioned studies strongly suggest that satisfaction is a determinant of behaviour, but many also suggest that 'there must be more'. For example, it has been observed that not all satisfied customers return for a repurchase and not all dissatisfied customers disappear (Cronin, 2003). Numerous concepts that are related to or influence behaviour have emerged and "it still remains unclear if we really understand all fundamental issues relative to the conceptualization and measurement of service quality" (Cronin, 2003, p. 332). In the course of time, many concepts that aim at better predicting customer behaviour have been added to the basic

model. We consider the inclusion of the concepts of attitudes, involvement, emotions and loyalty to be among the most valuable contributions in improving the theoretical framework. In the context of this paper, there is no room to elaborate on these concepts; the interested reader is referred to Anable (2005), Lai and Chen (2011), Sánchez-Pérez et al. (2007a), Pantouvakis and Lymperopoulos (2008), Curasi and Kennedy (2002) and Lee et al. (2001).

Amongst researchers and practitioners, also in the field of transportation studies, agreement is widespread that overall satisfaction results from disconfirmation between expectations and perceptions (Oliver, 1980; Fornell, 1992) and that perceived service performance and satisfaction drive purchase intentions and behaviour (LaBarbera and Mazursky, 1983; Joewono and Kubota, 2007; Nathanail, 2008; Sánchez-Pérez et al., 2007a). An interesting aspect concerning the satisfaction/behaviour relationship is non-linearity; negative experiences (losses) leading to dissatisfaction are perceived to be of greater weight than gains of an equal amount (Andreassen, 1995). The impact of poor performance may carry a greater consequence than the benefits of performance excellence (Cronin, 2003). This understanding is especially useful when analysing the effect of negative social safety experiences (NSSEs). Concerning NSSEs, we postulate that people who have had an NSSE will be more dissatisfied with safety at stops and on-board the vehicle compared to people who have not had an NSSE. Also, we would expect that having an NSSE moderates the weight of the attributes 'safety at stops' and 'safety on board' in a positive way; i.e. people who have had an NSSE – relative to people who have not – put more weight on these attributes. We thus formulate the following hypothesis:

H1. Negative social safety experiences negatively moderate the level of satisfaction of the attributes safety on board and safety at stops (H1a) and positively moderate the importance of these attributes (H1b).

2.2. Transaction-specific satisfaction and overall satisfaction

A distinction must be made between customers' satisfaction with respect to specific transactions or service encounters and customers' global or overall evaluation of a service (Gustafsson and Johnson, 2004). As this is also a valuable distinction in the context of PT services, we elaborate on this. Transaction-specific satisfaction (TSS) is the result of a cognitive judgment of transactional service encounters (Andreassen, 1995; Cronin, 2003; Dell'Olio et al., 2010; Lai and Chen, 2011).[2] In contrast, overall satisfaction is an affective/emotional response to a perceived discrepancy between expectations and perceptions. Overall satisfaction is a more holistic affective construct after a service delivery experience, whereas transaction-specific satisfaction refers to transaction-specific (attribute-based) cognitive evaluation of service encounters. Consequently, satisfaction with individual attributes pertains to an ex post evaluation of services and acts as an antecedent for overall satisfaction (Dell'Olio et al., 2010, 2011).[3] This is also the way we treat the relationship between transaction-specific satisfaction and overall satisfaction in the PT sector.

Several empirical studies imply that consumers' perceptions of service attributes (e.g. waits) are more likely to be the basis for consumers' attribute experience and behaviour than objectively measured attribute service levels (Cameron et al., 2003; Zakay, 1989). In addition, several studies provide evidence that passengers are poor estimators of actual attribute values (e.g. waiting time duration). In our study, we focus on perceived rather than actual attribute service performance.[4]

Because TSS, consisting of attribute-based evaluations of the service, is an antecedent of overall satisfaction, we assume, as many authors do (see, amongst others, Anderson et al., 2008; Eboli and Mazulla, 2009; Gustafsson and Johnson, 2004; Brons and Rietveld, 2009), that the evaluations of the individual attributes reflect the weight of these attributes in overall satisfaction. The weights of the service attributes correspond to the relative importance customers attach to the individual attributes and define the composition of satisfaction. We postulate the following two hypotheses:

H2. Customer and trip characteristics moderate the level of overall satisfaction (H2a) as well as the level of service attribute satisfaction (H2b);

H3. Customer and trip characteristics moderate the composition of satisfaction (importance of service attributes).

2.3. Customer characteristics: Need for segmentation

For policy and managerial reasons it is efficient to focus resources or stimuli on specific groups of (potential) customers and herewith focus on those who are most likely to change behaviour. Essentially, segmentation is simply the act of defining meaningful sub-groups of individuals. It is about reducing the number of entities being dealt with into a manageable number of groups that are mutually exclusive and share the same well-defined characteristics (Anable, 2005). The goal of

[2] Perceived service performance (see Fig. 1) may be equated to transaction-specific satisfaction.

[3] For this reason, concerning the design of a consumer satisfaction survey (CSS), it is strongly advised to place the question on overall satisfaction *after* the question on satisfaction with attributes. Sánchez-Pérez et al. (2007a, 2007b) show in the context of PT satisfaction research a significant difference in passengers' OS evaluations before and after passengers reflect on the importance of service attributes.

[4] An additional practical argument is that reliable nationwide data on actual PT-performance are not available.

segmentation is to make it possible to target specific marketing measures or policies to specific groups and to predict the response to these stimuli.

A customer's assessment of value depends on sacrifice (i.e. the monetary and non-monetary costs associated with use of the service) and the customer's frame of reference (Zeithaml et al., 1990). Thus, differences in customers' assessment of service value are likely to be due to differences in monetary and non-monetary costs, customers' attitudes towards the service, prior experiences, situational circumstances, and socio-demographic and behavioural characteristics of the customers (Anderson et al., 2008; Dell'Olio et al., 2010; De Ona et al., 2012; Tyrinopoulos and Antoniou, 2008; Diana, 2012).

Two fundamentally different means of segmentation are described by Anable (2005), i.e. a priori and post hoc. A priori segmentation relates to selection of groups from a population in advance based on known characteristics such as sex, age, and car use. In contrast, post hoc segmentation uses statistical analyses to identify segments (see, for instance, De Ona et al., 2012). In the latter approach, respondents are clustered according to their multivariate profiles and thus the segments are determined by the data, not by the researcher. A potential drawback of the latter method is that the resulting segments are 'meaningless' and hard to interpret, so making it difficult to derive managerial or policy implications. In the empirical part of our study, we use the a priori method to segment the population.

The above-mentioned relationships between the concepts are visualized in the conceptual model shown in Fig. 1. Please note that in the structural model developed in Section 3, we consider only the relations that are shown with the solid lines and highlighted text boxes.

2.4. Summary of relevant literature

In Table 1, we summarize the main characteristics of twelve quantitative studies that are closely related to our study. This is useful in positioning our study in relation to similar studies. A comprehensive summary of these studies is reported in Appendix A.

Most studies consider either the level of satisfaction (S) or the composition of satisfaction (importance of attributes, I) as their research topic. Our study examines both parameters. Concerning the sample size, it is apparent that this is dependent on the survey method used. When stated preference (SP) techniques are used, the number of respondents is relatively small. A bigger sample is needed for revealed preference (RP) surveys. The sample size for RP surveys varies between 388 and 4123 respondents. There is one outlier: the study by Brons and Rietveld (2009). Our study pools observations for 2 years and contains 180,000 observations. The dominant survey method used is revealed preference. Only 2 studies use stated preference methods. Unlike most of the other studies, our study encompasses all PT modes. It is conspicuous that few studies refer to satisfaction with PT by train. If service attributes are pooled or clustered, a priori methods (factor analysis and principal component analysis) are the dominant methods used. We do not cluster attributes. Few studies consider negative social safety experiences (NSSEs) as a determinant of service satisfaction; our study constitutes an exception. Finally, Table 1 shows that half of the studies described here, as well as our study, take the interaction between transaction-specific satisfaction and customer characteristics into consideration; the other half only reports direct effects.

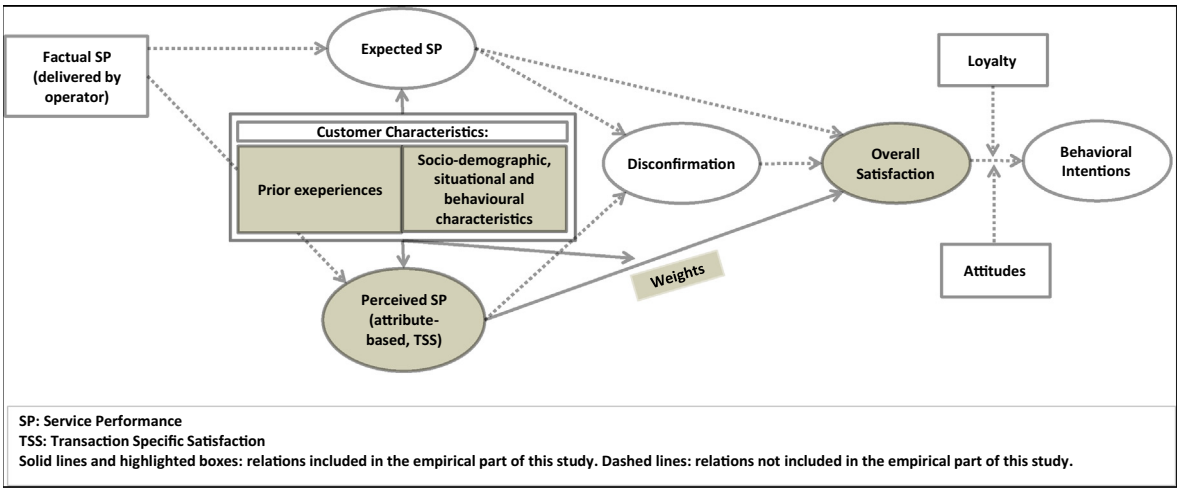

Fig. 1. Conceptual model: determinants of service performance (SP) with PT services.

Table 1
Summary of previous studies on satisfaction with PT.

Study	Importance (I) of and/or satisfaction (S) with service attributes	Sample size	PT mode	Survey method	Method used to cluster service attributes	NSSE in scope?	Interaction between TSS and customer characteristics
Andreassen (1995)	S	600	Tram, bus, train	RP	Expert opinion	No	Yes, only with urban context and freq. of use
Brons and Rietveld (2009)	Both	350,000	Train	RP	PCA	No	No
De Ona et al. (2012)	I	858	Bus	RP	Classification tree (post hoc)	No	No
Dell'Olio et al. (2010)	I	768	Bus	RP	No clustering	No	Yes
Dell'Olio et al. (2011)	I	36	Bus	Focus groups and SP	No clustering	No	Yes
Diana (2012)	S	4123	Bus, car (multimodal)	RP	No clustering	No	No
Friman et al. (2001a)	S	997	Bus, tram	RP	PCA	Yes	Yes, only with NCI
Friman et al. (2001b)	S	95	Bus, tram	SP	FA	Yes	Yes, only with NCI
Lai and Chen (2011)	n.a.	763	Metro	RP	FA	No	No
Pantouvakis and Lymperopoulos (2008)	Both	388	Ferry	RP	FA	No	No
Sánchez-Pérez et al. (2007a)	I	1000	Bus	RP	No clustering	No	No
Tyrinopoulos and Antoniou (2008)	I	1372	Bus, trolley, tram, metro	RP	FA	No	Yes, only with gender
This study	Both	180,000	Bus, regional train, tram, metro	RP	No clustering	Yes	Yes

The numbers in column 1 refer to the list of references.
FA: factor analysis (a priori method).
PCA: principal component analysis (a priori method).
RP: revealed preference.
SP: stated preference.

3. Model estimation

The relationships between attribute-based satisfaction, overall satisfaction and customer characteristics are studied by means of constructing three linear models. In the first model, overall satisfaction is the dependent variable and attribute-based satisfaction combined with customer characteristics are the explanatory variables, leading to importance scores or weights of the attributes for several groups of customers. These weights make up the composition of satisfaction. The second and third models are used to study the ways in which the level of satisfaction is directly subject to customer characteristics.

Model parameter estimations may be based on several techniques; for instance, normalized pair-wise estimation, principal components regression or multiple regression (see Gustafsson and Johnson, 2004). We use multiple regression to study the interaction between overall satisfaction and a number of customer characteristics. The dependent variables of the models are the measured satisfaction scores, scaled 1–10. We estimate the coefficients applying ordinary least squares (OLS).

3.1. Service attributes and customer characteristics

The specific transactions a passenger encounters are associated with specific PT service attributes, e.g. walking to a bus stop, waiting for the bus, or entering the vehicle. In our models, we distinguish 15 PT service attributes. We group the service attributes in core attributes, which display 'what' is delivered, and peripheral attributes, which display 'how' the service is delivered (see, similarly, Iacobucci et al., 1994; Anderson et al., 2008; Lee et al., 2001). Within peripheral attributes, we distinguish interactional and physical attributes (Table 2).

The satisfaction scores of these variables can take a range from 1 (very dissatisfied) to 10 (very satisfied). As can be seen in Appendix B, the correlations between the values of satisfaction for different attributes are significant at $p < .01$ and as expected, all correlations are positive. The majority of the correlations lie around 0.2, indicating a small positive correlation between the evaluations of attribute satisfaction. The level of satisfaction with the attributes *personnel behaviour* and *driver's behaviour*, between *on-time performance* and *travel speed* and between *safety on board* and *safety at stops* are mildly correlated. We choose for presenting the model results on the level of individual attributes, and not clustering them into factors

Table 2
Definition of service attributes.

	Name	Clarification
	Core attributes	
1	On-time performance	Accuracy of the realized departure times in relation to the schedule
2	Travel speed	Appreciation of travel speed and time
3	Service frequency	Number of departure opportunities per hour
4	Prices of the tickets	Price of various types of ticket and season cards
	Peripheral interactional attributes	
5	Personnel behaviour	Behaviour of the several types of personnel (e.g. drivers, station guards) when dealing with passengers
6	Driver's behaviour	Driving performance of the driver
	Peripheral physical attributes	
7	On-board information on delays	On-board information provision (static, dynamic, vocal) on delays
8	Ticket-selling network	Ease of obtaining a ticket from on- and off-board selling points
9	Information provision at stops	Information available for passengers at terminals and stops (static, dynamic)
10	Safety at stops	Safety at terminals and stops as perceived by passengers when waiting
11	Vehicle tidiness	Level of cleanliness of the vehicle in general
12	Ease of boarding and alighting	Ease of boarding and alighting from the vehicle
13	Seating capacity	Chance of getting a seat
14	On-board noise	Level of noise in the vehicle
15	Safety on board	Sense of safety during the trip

using a factor analysis as the latter would diminish the explanatory power of the model. Moreover, factors determined by using statistical methods, are hard to interpret and operationalize in real world.

The division of the data into age groups is based on a commonly used rule of thumb in PT research in the Netherlands where the legal driving age is 18 years old (below that age, all PT users are captive) and the retirement age for most individuals is around 65 years. The group limits of 27 and 40 years are chosen to represent respondents starting in the labour market and experienced employees respectively. The division into urban classes is based on quartiles, dividing the 70 areas we distinguish in the database into four classes, each class containing an equal number of areas.

3.2. Interaction between composition of satisfaction and characteristics of customers

There are two main ways of determining attribute importance. The first is to ask customers directly how important service attributes are to them, for instance using scale ratings. The alternative – the way we used – derives the importance of attributes indirectly via regression estimations.

In general terms, the function between overall satisfaction (OS), transaction-specific satisfaction (TSS) and customer characteristics can be expressed as:

$$\mathrm{OS}_i = f(\mathrm{TSS}_i, C_i) \tag{1}$$

where OS_i is the overall satisfaction of individual i, TSS_i is a vector of attribute satisfactions of individual i and C_i is a vector of characteristics of individual i.

More specifically, if customer i experiences satisfaction with N different service attributes and has M different characteristics, the model can be written as in (2), where u_i is a random disturbance term:

$$\mathrm{OS}_i = f(\mathrm{TSS}_{1i}, \mathrm{TSS}_{2i}, \ldots, \mathrm{TSS}_{Ni}, C_{1i}, C_{2i}, \ldots, C_{Mi}) + u_i \tag{2}$$

We will assume a linear relationship:

$$\mathrm{OS}_i = a_0 + \sum_{j=1}^{N} b_j \mathrm{TSS}_{ji} + \sum_{g=1}^{M} c_g C_{gi} + u_i \tag{3}$$

We will report b_j of model (3) as a standard estimate (no interaction). As we are primarily interested in the interactional effects between TSS_{ji} and C_{gi} for individual i, we add to (3) the interactions between 1 to N attribute satisfactions and 1 to M characteristics:

$$\mathrm{OS}_i = a_0 + \sum_{j=1}^{N} b_j \mathrm{TSS}_{ji} + \sum_{g=1}^{M} c_g C_{gi} + \sum_{j=1}^{N}\sum_{g=1}^{M} d_{jg} \mathrm{TSS}_{ji} C_{gi} + u_i \tag{4}$$

The value of the coefficient d_{jg} informs on the effect of a characteristic of the customer on the importance of each service attribute for the customer; b_j denotes the importance of the service attributes of the reference group; c_g denotes the contribution of the characteristics to the constant term of the equation.

Interaction is restricted to a first-level interaction: we only model the interaction of attribute satisfaction with each of the eight individual characteristics. In this way, the effects of the characteristics are not mutually dependent.

3.3. Interaction between level of satisfaction and characteristics of customers

The second type of model – see Eqs. (5) and (6) – relates the level of overall satisfaction (OS) and transaction-specific satisfaction (TSS) to customer characteristics. Thus:

$$\mathrm{OS}_i = f(C_i) \quad \mathrm{TSS}_i = f(C_i) \tag{5}$$

In linear form:

$$\mathrm{OS}_i = g_0 + \sum_{g=1}^{M} r_g C_{gi} + v_i \tag{6}$$

$$\mathrm{TSS}_i = h_0 + \sum_{g=1}^{M} s_g C_{gi} + w_i \tag{7}$$

where OS_i denotes overall satisfaction of individual i; TSS_i denotes transaction-specific satisfaction and, r_g and s_g are the coefficients to be estimated. We develop separate models for each service attribute. As we have 15 different service attributes we use 15 separate models to estimate the coefficients that represent the interaction between the level of satisfaction and customer characteristics.

4. Dataset and empirical results

4.1. Context

Dutch PT acts under highly regulated market conditions. The characteristics of the PT market structure in the Netherlands are such that this market can be described as only slightly competitive. Due to the system of tendering imposed upon the sector as of the year 2000, PT supply in a given geographically delineated area is the prerogative of a single supplier.[5] We term the conditions in the Netherlands after 2000 as a temporary monopoly (Van de Velde and Pruijmboom, 2003). Under these conditions, providers have hardly any incentives to compete for customers' satisfaction and providers are therefore not inclined to provide more heterogeneous services of their own volition. By means of setting the terms of requirements in a tendering procedure, PTAs may acquire a more heterogeneous service supply.

4.2. Dataset

We used a dataset containing the satisfaction scores of urban and regional Dutch PT users (bus, tram, metro and regional train) for the years 2010 and 2011. A random nationwide sample of approximately 90,000 passengers yearly was taken by means of a written questionnaire handed out to the passengers in the vehicles. Data collection was stratified for region, workday/weekend and peak/off peak. Satisfaction scores (scaled 1–10) were collected for the satisfaction with the total trip (overall satisfaction) and for the satisfaction with several service attributes (see Table 2). In addition, background characteristics of the respondents are asked for, such as gender, age, trip frequency, car use, and trip motive. As the location where the passengers are questioned was also known, we were able to add a location tag to the dataset (see Table 4).

4.3. Descriptive statistics

In Table 2, basic descriptive statistics concerning attribute satisfaction are given and Table 3 shows the profile of respondents. As can be seen from Table 2, the average level of overall satisfaction in the period studied is 7.28. Positive outliers are satisfaction with the attributes *seating capacity*, *ease of boarding and alighting* and *safety on board*. Negative outliers are satisfaction with *on board information on delays* and *prices of the tickets*. As may be expected, satisfaction evaluation is not normally distributed.

[5] See Mouwen and Rietveld (2013) for the relationship between tendering and satisfaction with PT.

Table 3
Basic descriptive statistics on satisfaction.

		N	Mean	Std. deviation	Skewness	Kurtosis
	Core attributes					
1	On-time performance	164,131	7.12	2.231	−.897	.432
2	Travel speed	163,414	7.34	1.847	−1.014	1.470
3	Service frequency	160,129	6.75	2.190	−.751	.243
4	Prices of the tickets	136,063	4.96	2.504	.055	−.737
	Interactional attributes					
5	Personnel behaviour	150,444	7.30	1.816	−.894	1.310
6	Driver's behaviour	161,771	7.18	1.708	−.886	1.538
	Physical attributes					
7	On-board information on delays	140,238	5.00	2.619	−.045	−.996
8	Ticket-selling network	140,222	7.19	2.368	−.817	.121
9	Information provision on stops	158,721	7.14	2.134	−.890	.614
10	Safety at stops	155,606	7.69	1.611	−.819	1.623
11	Vehicle tidiness	168,081	6.88	1.827	−.657	.696
12	Ease of boarding and alighting	166,967	8.45	1.645	−1.464	3.028
13	Seating capacity	168,343	8.45	2.256	−1.605	1.967
14	On-board noise	165,804	6.25	1.972	−.505	.123
15	Safety on board	154,959	8.03	1.481	−.964	2.265
	Overall satisfaction	165,594	7.28	1.384	−.862	2.613

Table 4
Profile of survey respondents.

Gender	Percent	Car availability	Percent	NSSE	Percent
Panel A					
Men	43.4	Yes	34.7	No	9.5
Age[a]	Percent	PT-mode	Percent	Urban class (# inh/sq. km build on area)	Percent
Panel B					
<18	17.0	Bus	52.2	Low urbanized (15–25)	18.3
18–27	44.9	Tram	7.7	Medium (25–35)	24.9
28–40	12.8	Metro	7.6	High (33–44)	18.6
41–64	20.5	Regional train	31.6	Very high (44–70)	38.2
>65	4.7	Ferry	0.9		
Number of PT trips past week[b]	Percent	Trip motive	Percent		
Panel C					
<=1	23.1	Live	33.7		
2–3	24.6	Work	15.6		
>3	52.3	Study	21.3		
		Other	29.4		

[a] Mean age 29.6 year (sd. 15.9).
[b] Mean trip frequency 3.5 trips per week (sd. 1.9).

4.4. Results: standard estimates, hypotheses and interaction effects

4.4.1. Introduction

In this section we describe the findings based on estimations of the models (3), (4), (6) and (7). In the left-hand panel of Table 5 estimates of the attribute weights when no interaction effects are included are presented (model (3)). The right-hand panel shows the effects of interactions on the attribute weights in model (4). For example, the figure 19% refers to d_{2_5} in model (4), showing the interaction between service attribute 2 (travel speed) and characteristic 5 (NSSEs). With respect to the interaction effects, we focus on the main findings. We restrict the description of the interaction effects to a selection of characteristics (i.e. age, PT mode, grade of urbanization and NSSEs). Full results are available on request.

We defined the reference group as follows: younger than 18 years of age, questioned on a trip in a rural environment, travelling by bus and not having had NSSEs. The interaction results of target groups are all to be interpreted relative to the reference group. To gain a better understanding of the findings, we transformed the interaction coefficients into percentages indicating the relative weight or importance score for each attribute/segment combination.

Table 5
Attribute weights for a selection of characteristics with (left hand panel), and without interaction (models 3 and 4).[a]

		Standard estimate, no interaction		Interaction effects								
				Reference group	Age		Mode		NSSE	Urban density		
		b	%	<18, bus, no NSSE, low urban density (%)	28–40 vs. <18 (%)	>65 vs. <18 (%)	Metro vs. bus (%)	Regional train vs. bus (%)	Had vs. had not an NSSE (%)	Medium vs. low (%)	High vs. low (%)	Very high vs. low (%)
	Core attributes											
1	On-time performance	0.10**	11**	4**	4	8*	6	7*	6*	7*	10*	5
2	Travel speed	0.14**	15**	15**	21*	17	15	18*	19*	13	13	16
3	Service frequency	0.10**	11**	12**	13	16*	8	11	13	12	13	14
4	Prices of the tickets	0.03**	4**	3*	3	7*	7*	2	3	2	2	0*
	Interaction attributes											
5	Personnel behaviour	0.08**	9**	11**	14*	14	6	11	11	11	12	9
6	Driver's behaviour	0.08**	8**	14**	12	16	7*	11	12	12	9*	14
	Physical attributes											
7	On-board information on delays	0.04**	4**	4**	4	2	8*	7*	2	3	3	3
8	Ticket-selling network	0.03**	4**	3*	1	−3*	2	0*	3	2	5	5
9	Information provision on stops	0.04**	4**	4**	7*	7	4	4	1*	4	6	4
10	Safety at stops	0.01**	1**	3	−4*	−2	−1	4	5	7*	9*	10*
11	Vehicle tidiness	0.08**	8**	9**	7	4	12	7	9	6	6	9
12	Ease of boarding and alighting	0.04**	5**	7**	6	5	8	9	3*	6	3*	5
13	Seating capacity	0.04**	5**	4**	4	2	5*	6	5	3	4	4
14	On-board noise	0.04**	5**	3	2	0	5	4	6*	6*	4	4
15	Safety on board	0.06**	6**	4	5	6	6	0	1*	5	2	−1*

** $p < .01$.
* $p < .05$.
Other: $p \geqslant .05$ (two-tailed).
[a] Significance for the standard estimates and reference group defined relative to zero. Significance for the interaction effects defined relative to the reference group.

Table 6
Effectst of a selection of characteristics on the level of overall satisfaction, and attribute satisfaction (model 6 and 7).

	Age		Mode		NSSE		Urban density	
	28–40 vs. <18	>65 vs. <18	Metro vs. bus	Regional train vs. bus	NSSE vs. none	Medium vs. low	High vs. low	Very high vs. low
Overall satisfaction	0.094*	0.763*	−0.292*	−0.427*	−0.416*	−0.071*	0.021	0.037
Core attributes								
1 On-time performance	0.303*	0.893*	−0.171*	−0.224*	−0.477*	−0.334*	−0.324*	−0.035
2 Travel speed	0.164*	0.795*	0.046	−0.377*	−0.421*	−0.038	0.025	0.116*
3 Service frequency	0.189*	1.071*	−0.177*	−0.462*	−0.375*	0.104*	0.239*	0.558*
4 Prices of the tickets	0.555*	2.071*	−0.612*	−0.475*	−0.474*	0.000	0.079	−0.106*
Interaction attributes								
5 Personnel behaviour	0.135*	0.802*	−0.8*	−0.45*	−0.496*	−0.216*	−0.195*	−0.364*
6 Driver's behaviour	0.089*	0.615*	−0.165*	−0.13*	−0.394*	−0.163*	−0.037	−0.207*
Physical attributes								
7 On-board information on delays	−0.113*	0.668*	1.21*	1.719*	−0.371*	0.135*	0.186*	0.359*
8 Ticket-selling network	−0.224*	0.196*	−0.287*	−0.048*	−0.634*	0.063*	−0.046*	−0.272*
9 Information provision on stops	0.078*	0.605*	−0.079	−0.058	−0.42*	−0.03	0.023	0.043
10 Safety at stops	0.022	0.441*	−0.508*	−0.264*	−0.759*	−0.082*	−0.081*	−0.13*
11 Vehicle tidiness	0.14*	0.754*	−0.785*	−0.576*	−0.469*	−0.033	0.014	−0.101*
12 Ease of boarding and alighting	−0.181*	−0.254*	0.217*	0.09*	−0.455*	0.097*	0.079*	0.022
13 Seating capacity	0.157*	0.597*	−0.517*	−0.607*	−0.45*	−0.068*	0.023	−0.261*
14 On-board noise	0.282*	0.767*	−0.022	−0.375*	−0.297*	−0.272*	0.051	−0.009
15 Safety on board	0.074*	0.437*	−0.563*	−0.239*	−0.735*	−0.043	−0.013	−0.088*

* $p < .05$.
other: $p \geqslant .05$ (two-tailed).

We describe the results on two levels: (1) by the attributes most influenced (potentially) by PTAs; (2) by customer characteristic. The first level of analysis is prompted by the perspective we take in this paper. We focus on the topic of satisfaction seen in the light of the steering mechanisms of PTAs in a tendering environment. Some attributes are largely in the control of PTAs, whereas others are not. PTAs in a tendering environment can exert the greatest influence on attributes associated with *service frequency* and vehicle attributes such as *on-board noise* and *on-board information on delays.* These attributes can be prescribed in the terms of reference (TOR) in a tendering procedure, so the PTA is the decision-making body in this respect. At the other end of the spectrum are service attributes in which many parties (operators, road authorities, other road users such as cars and bicycles, and central government) are involved. PTAs have only little control over these attributes. To this category we assign the attributes: *ticket selling network, prices of the tickets, on-time performance* and *travel speed*. The remainder of the service attributes we assume to be in between; to achieve goals in relation to these aspects, the PTA is very dependent on the actions and performance of the operator.

4.4.2. Standard estimates

The results without taking interaction into account (left-hand panel of Table 5) show that the attributes *travel speed, on-time performance* and *service frequency* (core attributes) are the most important determinants of overall satisfaction. This outcome is also found in many other studies (see Pantouvakis and Lymperopoulos, 2008 for Greek ferries, Anderson et al., 2008 for US airlines, Brons and Rietveld, 2009 for Dutch long-distance rail).[6] What is remarkable, however, is that the interactional attributes *personnel behaviour* and *driver's behaviour* and the physical attribute *vehicle tidiness* are also considered very important. Concerning the latter, Lai and Chen (2011) found cleanliness having a significant influence on passengers behavioural intentions. Bordagaray et al. (2013) found driver's kindness to be especially important for individuals between 35 and 55 years old, and for frequent PT users. Tyrinopoulos and Antoniou (2008) found that vehicle cleanliness is of great importance for PT users; driver behaviour however is in their study not rated among the most important attributes.

The results in Table 6 represent the outcomes of models (6) and (7) and indicate how the level of satisfaction is moderated by customer characteristics. The table shows that many user and trip characteristics have a significant effect on overall satisfaction and on attribute satisfaction.

[6] Pantouvakis and Lymperopoulos (2008) and Anderson et al. (2008) relate their finding to the time customers spend in a technical environment. Time spent in a technical environment might be connected to the importance customers attach to physical attributes. The relatively high weights passengers attach to physical attributes for trips using ferries, airlines or trains may be explained by the relatively long time spent in the vehicle.

4.4.3. Testing the hypotheses

Using the results in Tables 5 and 6, we test the hypotheses postulated in Section 2.

H1. Negative social safety experiences negatively moderate the level of satisfaction of the attributes safety on-board and safety at stops (1a) and positively moderate the importance of these attributes (1b).

Hypothesis 1a is supported by our data. Table 6 shows that having an NSSE has a significant negative impact on the satisfaction with the attributes *safety on-board* and *safety at stops*. However, hypothesis 1b is not supported by our data. Table 5 shows that having an NSSE significantly moderates the relative weight passengers attach to the attribute *safety on board*, but the impact of the change is not in line with our hypothesis (weight decreases compared to the reference group). Moreover, no significant influence on the relative weight of the attribute *safety at stops* can be observed.

H2. Customer and trip characteristics moderate the level of overall satisfaction (2a) as well as service attribute satisfaction (2b).

2a: Table 6 shows that all customer and trip characteristics – except in highly and very highly urbanized areas – are significantly associated with the level of overall satisfaction.
2b: Table 6 also shows that the majority of customer and trip characteristics are significantly associated with the level of satisfaction with the attributes; 98 of 120 interactional coefficients are significant. We may conclude that hypothesis 2 is supported by our data.

H3. Customer and trip characteristics moderate the composition of satisfaction (importance of service attributes).

The right-hand panel of Table 5 shows that this hypothesis is not supported by our data for most customer and trip characteristics. The differences in the weights of the service attributes relative to the reference group can only in a few cases significantly be attributed to differences in customer characteristics.

4.4.4. Influence of age on composition and level of satisfaction

Concentrating on the three attributes within the control of PTAs, it is conspicuous that elderly people attach significantly more weight to service frequency, implying that a policy aimed at increasing service frequency in general mainly leads to a shift in attribute importance for elderly people (Table 5). As service frequency is linked to waiting time, this shift in importance may be correlated to the declining physical condition of elderly people. Table 5 also shows that elderly PT users place more emphasis on the attributes *price*, *on-time performance* and *service frequency,* and less emphasis on *ticket-selling network* than young PT users (reference group). Compared to youngsters under 18, medium age passengers (28–65) attach considerable more importance to personnel, and drivers behaviour. Probably this is a international sociological phenomenon, caused by increasing infirmity, and is also found in Bordagaray et al. (2013). It is remarkable, Dell'Olio et al. (2010) finds a contrary result. Our results may imply that it is not so much that age moderates importance directly, but rather that the influence is to a certain extent exerted indirectly via differences in travel patterns between the age groups. In the Dutch situation, elderly people tend to travel more in off-peak periods when seat availability is not a problem and they also travel more on seasonal tickets than young people do. Therefore, they may attach less weight to the probability of getting a seat and to the quality of the ticket-selling network.

Concerning the level of satisfaction, it is very likely that policies aimed at the introduction of new buses and raising service frequency will lead to more satisfied elderly people (Table 6). Table 6 also shows that the level of satisfaction (overall and attribute-level) rises with age. This holds for all but one attribute. In particular, the satisfaction with the attributes *price* and *trip frequency* of elderly PT users relative to young PT users is remarkable. The high satisfaction of elderly people with the attribute *price* may be related to the reduced fares for elderly people. The negative satisfaction score of elderly people compared to youngsters in relation to the attribute *ease of boarding and alighting* is probably related to the declining physical condition of elderly people. Our findings are in line with those of other empirical studies (Mittal and Kamakura, 2001; Anderson et al., 2008; Bryant and Cha, 1996).[7]

4.4.5. Influence of mode choice within PT on composition and level of satisfaction

Mode choice within PT in most circumstances is not a free choice because no alternatives are offered. However, analysing differences in users' satisfaction with metro and regional trains compared to bus services, and the importance accorded the different modes of transport, offers useful information for the governance of PT systems. PT mode choice has significant impacts on the relative importance of the attribute *on-board information on delays*. It may therefore be expected that a PTA policy of replacing bus lines with metro lines will lead to a radical change in attribute importance

[7] The sample reveals that 50% of the respondents older than 65 years of age have a car at their disposal, which could be used in place of the PT trip. For PT users younger than 18 years of age this is only 16%. Therefore, elderly people are less constrained (captive) in terms of using PT than youngsters. However, we have not found any indication in our data that car availability moderates the level or the composition of satisfaction. This may be due to the lack of clarity in the questionnaire regarding car availability. Unfortunately, we are therefore unable to test the assumption that elderly users of PT are more satisfied than youngsters because of the more voluntary nature of their PT use.

(Table 5). Moreover such a policy would probably lead to an increase in the level of satisfaction of passengers in relation to the attributes *on-board information on delays* and less satisfaction with *on-time performance* and *service frequency* (Table 6).

We observe that PT users travelling by metro place more emphasis on *on-board information* and *price* and less emphasis on *driver's behaviour* than users of buses (Table 5). Concerning regional trains, PT users who travel by regional trains place more emphasis on *on-board information, on-time performance* and *speed* and less emphasis on the *ticket-selling network* than users of buses (reference group). For both modes, the high importance consumers attach to *on-board information* is remarkable. This high weight may be connected to the lack of visual orientating points outside the vehicle due to the high speed and/or underground routes. Consumers need on-board information systems to orientate themselves on the metro more than they do on a surface mode such as buses.

In accordance with the findings of Bordagaray et al. (2013) that PT users are perceiving heterogeneity in actual supply and quality of bus lines, in our study we found a strong effect of PT mode use on satisfaction: users of rail services (especially users of metros and regional trains) are *overall* less satisfied compared to users of bus services (Table 6). The attributes that negatively differentiate these users compared to those of buses are in particular *cleanliness, personnel behaviour, price* and *reliability*. Metro and regional train passengers are relatively very satisfied with *on-board information* and *ease of boarding and alighting the vehicle*. What is striking is that passengers even evaluate *on-time performance* and *service frequency* in metro services as more dissatisfying compared to bus services, whereas in general metros and regional trains outperform buses with respect to these service attributes. These results may indicate that passengers' satisfaction is moderated by their expectations; they expect metros to run on schedule and frequently and compare these expectations with perceived performance. These findings differ from the outcomes of several transportation studies indicating the existence of a 'rail bonus' (see, for instance, Axhausen et al., 2001). It is probable that these findings are also related to specific circumstances in the Netherlands during the study period. The period 2010–2011 was characterized by the decentralization of responsibility for regional trains from central government to regional PTAs. Regional PTAs were obliged to put these lines out to tender. The first round of bidding for regional train services did not go smoothly. In a number of cases, the new operators encountered difficulties in acquiring the specified rail vehicles and had many hurdles to overcome before services ran at the desired quality. These start-up problems may have had an effect on passengers' service evaluations.

4.4.6. Influence of negative critical incidents on composition and level of satisfaction

Negative critical incidents may play an important role in service evaluation (Friman et al., 2001a, 2001b; Voorhees et al., 2009). Negative experiences have more impact on service evaluation (satisfaction) than positive experiences. Negative experiences, for instance, elicit negative word-of-mouth, whereas positive experiences tend not to be shared with others (Bougie et al., 2003).

Our analysis includes NSSEs, i.e. encounters with, for instance, theft, robbery, harassment, aggression and bodily harm in the PT setting (at stops and on board the vehicle).[8] Our results indicate that introducing new vehicles or increasing the frequency of service provision will probably not have a major impact on the relative importance or the satisfaction of passengers who have had NSSEs. The moderating effect these incidents have on the attribute weights is depicted in Table 5. At first sight, it is a counter-intuitive outcome in that passengers who have had an incident with social safety weight *safety during the trip* significantly lower than passengers who have not encountered such an incident, but this may be an indicator that these incidents mainly occur at stops and not in the vehicle. We note that PT users who have had an NSSE place more emphasis on *speed* and *on-time performance* (core attributes) and less emphasis on *information provision at stops* and *ease of boarding and alighting* than PT users who have not experienced a social safety incident.

Table 6 shows that NSSEs have a significant negative effect on *overall satisfaction* and on attribute-level satisfaction (the regression coefficients for all 15 attributes are statistically significant). Friman et al. (2001a) found a similar strong effect of NSSE on satisfaction. These are remarkable results: passengers who have experienced one or more incidents related to safety not only rate satisfaction as relatively low for the attributes that are most likely to be related directly to such incidents (i.e. *safety during the trip, safety an stops*), but also attributes that seem to have no relationship with the incident itself.[9] It might well be that negative incidents impact heavily on attitudes towards PT in general. People who had a bad experience blame the whole PT system for not having 'protected' them. Thus, their focus in the objective evaluation of attribute performance is blurred.

4.4.7. Influence of urban environment on composition and level of satisfaction

The final segmentation variable analysed concerns level of urbanization, based on the location in which the consumer survey was administered. This urbanization measure is not the residential location or destination of the passenger, but represents the spatial environment of the trip.

[8] Grade of urbanization and NSSEs are positively correlated (see Table C2 in Appendix C); the chance of being involved in an unpleasant social safety situation increases as the grade of urbanization increases.

[9] Friman et al. (2001a) found in a sample of Göteborg (Sweden) PT users that the frequency of negative experiences exerts an impact on overall satisfaction via attribute-specific satisfaction.

Table 5 indicates the importance of the attribute *safety at stops*, which is strongly moderated by urban density. In urban environments, the chance of being confronted with an NSSE at stops is considerably higher than in rural environments (see Table C2 in Appendix C). So the importance that PT customers attach to the attribute *social safety* might be highly correlated to negative experiences with social safety. Another notable result is that PT users in highly urbanized environments place more emphasis on the attribute *safety at stops* and less emphasis on *safety on board* and *price of the tickets* than PT users in less urbanized areas.

Table 6 shows that for the segment 'very highly urbanized versus low urbanized' the satisfaction related to eight of 11 significant service attributes is lower in very highly urbanized environments compared to low urbanized environments. The three attributes for which the opposite holds true have a positive magnitude that over-compensates the negative impact. This concerns the attributes *service frequency, travel speed* and *on-board information on delays.* Also, the relatively low satisfaction for the attribute *personnel behaviour* in very highly urbanized areas compared to low urbanized areas is striking. Furthermore, we note two clear significant trends: (1) the level of satisfaction with the attributes *ticket-selling network* and *safety at stops* clearly decreases as the level of urbanization increases, whereas (2) the opposite holds for the attributes *on-board information on delays* and *service frequency.* These effects may indicate that people in smaller cities are more satisfied with PT than people in metropolitan areas. This may be caused by differences in actual service performance in dense urban areas compared to low urbanized areas.[10]

When evaluating the impact a PTA policy of introducing new vehicles and/or raising service frequency may have on differences in the perceptions of importance and satisfaction in relation to urbanization, we may conclude in general that the relative importance of attributes are scarcely likely to be influenced by such a policy. However, it is probable that increasing the frequency of service and the introduction of new vehicles will have a major positive effect on the level of satisfaction of passengers using PT in a highly urbanized area.

5. Conclusions and recommendations

5.1. Conclusions

We found that heterogeneity in the perception of PT (both the level and the composition of satisfaction) significantly depends on the customer characteristics, situational conditions (e.g. urban setting), and experiences such as NSSEs. Overall, the attributes *on-time performance*, *travel speed*, and *service frequency* are seen by PT users as the most important, followed by *personnel/driver behaviour* and *vehicle tidiness*. A generic policy aimed at achieving these attributes may yield favourable results with respect to satisfaction.

Further, we demonstrated the influence of specific customer characteristics on satisfaction and attribute weights and placed the results in the context of steering mechanisms of PTAs in a tendering environment. We took as a starting point the fact that PTAs in a tender can exert the greatest influence on the attributes associated with *service frequency* and vehicle attributes such as *on-board noise* and *on-board information on delays.* A policy aimed at increasing the service frequency and putting new vehicles into operation is likely to lead to more satisfied older people (>65), passengers travelling by regional train, and people living in dense urban areas. Concerning the attribute weights, specifically older people (>65), people travelling by metro or regional train, people who have experienced an NSEE, and people in medium-densely populated areas attach relatively great importance to these attributes.

Our theoretical framework assumes that customer behaviour is triggered by numerous concepts, such as attitudes, involvement, emotions, loyalty, and satisfaction; satisfaction is only one determinant. We concentrated the empirical part of this study on satisfaction only, thereby abstracting from the other above-mentioned constructs that drive behaviour. Within the concept of satisfaction, we indicated that a distinction has to be made between the level and the composition of satisfaction, and we consider the combination of these two as one of the determinants of behaviour. Our empirical results, however, do not support the hypothesis that the composition of satisfaction between user groups differs significantly.

From a practical viewpoint, the methodology provides a relevant contribution to the previous studies, as it stresses the impact of NSSEs, urban settings, and PT mode use. The method is easy to handle for PTAs and operators alike.

5.2. Policy recommendations

The performance and quality of PT systems should correspond as much as possible to the diverse demands of (potential) PT customers. It is therefore important for authorities and operators to acquire knowledge concerning the preferences and evaluations of customers. Authorities and operators may increase their efficiency by focusing their resources and strategies on retaining their existing customers rather than trying to attract new customers (Dell'Olio et al., 2011). In this respect, it may be wise for them to look for the most cost-efficient measures and aim specific instruments and policies at specific target groups. For instance, we found that trip frequency and speed impact heavily on satisfaction. When considering several possible policies, PTAs should take into account the problem that a policy aimed at increasing the service frequency to raise

[10] In Table C1 in Appendix C we show that the PT service level in low urbanized areas is indeed a lot worse compared to highly urbanized areas.

satisfaction is possibly not the most efficient, as it may be very costly. A more cost-efficient measure may be to increase the travel speed, as such a measure latches onto both satisfaction and operational efficiency. Therefore, we recommend that PTAs should perform supplementary calculations of the costs associated with the measures. In the case that the investment costs of measures are known, the results of this study make it possible to develop a cost/effect matrix, an instrument that indicates the expected increase in satisfaction from investing a monetary unit in a certain measure, and to identify which target group will presumably profit most in terms of a satisfaction increase.

We further recommend that PTAs should take notice of the following two observations. First, PT services are considered by passengers as intermediary services and thus the value they attach to these services is a derivate of the value of the activity at the final destination. This implies that PTAs should design their policy measures in accordance with knowledge concerning the trip motives of customers. Second, the majority of PT users are 'captive customers', constrained to use the PT service because they have no private alternatives, such as cars, at their disposal. Dissatisfied captive passengers have no transport alternatives and no way of expressing their dissatisfaction with these services other than complaining. Both observations imply that it may well be the case that PT patronage is rather inelastic with regard to satisfaction. In addition, PTAs intending to use satisfaction evaluations as part of incentive payment schemes towards providers should complement these schemes with objective measurements of performance, such as reliability of operations and/or actual numbers of passengers transported.

5.3. Discussion and recommendations for further research

The database we used for this study has a number of limitations. First of all, like many other studies (see Appendix A), this study is based on evaluations of existing PT users only. This implies a lack of generalizability of the outcomes for non PT users. More satisfaction research should be undertaken on non-captive users and non-PT users and specifically on the relationship between car availability and PT service satisfaction as the ultimate objective of PTAs is to stimulate the shift to more sustainable modes.

In this study we took the perspective of the steering possibilities of PTAs in a tendering environment. We have touched upon a number of drivers for satisfaction with PT, but it is probable that other drivers of interest for PTAs wishing to place incentives on operators' performance remain to be revealed. In particular, we recommend more research on (1) actual duration of travel time elements and (2) thresholds, keeping in mind that the drivers of satisfaction may be either more general or case specific.

Pantouvakis and Lymperopoulos (2008) show that differences in the importance of PT service attributes may be connected to the time customers spend in the different environments of the PT system (technical environment vs. interpersonal environment). The more time spent in a certain surrounding, the greater the chance of being affected by this setting. In-depth analyses of travel time proportions (in-vehicle time, walking, waiting) related to satisfaction may be helpful.

Experience-based satisfaction/behavioural thresholds are most probably present in continuous services such as PT (see Bolton and Drew, 1991; Mittal and Kamakura, 2001). These thresholds imply (dis)satisfaction arises beyond a certain tolerance level because a minimum service level is expected. These thresholds are probably not universal but are moderated by customer characteristics and so will vary between user segments. More knowledge of these thresholds is essential for PTAs to enable them to develop an incentive-based bonus/penalty arrangement regarding PT services to be delivered by operators.

Our study supports the findings of many other studies also showing that in the PT sector segmentation matters; however, we shed little light on why it matters. We recommend further research in the PT sector focusing on the distinction between general and situational circumstances that exert an influence on satisfaction. General circumstances can be defined as those which are universally valid, as opposed to situational (case-specific) circumstances that influence satisfaction only under specific conditions and/or in an indirect way. Age, for instance, is an exponent of a general determinant. International literature (Bryant and Cha, 1996; Anderson et al., 2008) strongly suggests that elderly people react differently to the same stimuli, whether concerning transportation or having a haircut, than youngsters with respect to satisfaction evaluation.

Urbanization is an example of a situational explanatory variable. We find in our sample that urbanization is an important determinant of satisfaction and attribute-level importance, especially influential in terms of the relative importance of the attributes *on-time performance* and *safety at stops*. It is most likely that actual service performance plays a major explanatory role, but it may also be the case that attitudes towards PT differ between city-dwellers and those from villages. More research efforts should be directed towards these possible determinants of satisfaction with PT.

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Appendix A. Review of relevant studies

Study	Importance and/or satisfaction of service attributes	Origin of sample	Sample size	PT-mode	Study object	Survey method	Segmentation variables used	Method used to cluster service attributes	Functional form of model	NSSE in scope?	Interaction between TSS and customer characteristics
Andreassen (1995)	S	Norway	600	Tram, bus, train	PT-users	RP	Freq. of use Urban context	Expert opinion	LISREL (max. likelihood)	No	Yes, only with urban context and freq. of use
Brons and Rietveld (2009)	Both	Netherlands	350,000	Train	PT-users	RP	Freq. of use Age Car avail.	PCA	Linear regression	No	No
De Ona et al. (2012)	I	Spain	858	Bus	PT-users	RP	Gender Age Occupancy Travel behaviour	Classification Tree (post hoc)	CART, (classification regression tree)	No	No
Dell'Olio et al. (2010)	I	Spain	768	Bus	PT-users	RP	Freq. of use Gender Age Income Car avail.	No clustering	Ordered probit	No	Yes
Dell'Olio et al. (2011)	I	Spain	36	Bus	PT-users and potential PT-users	Focus groups and SP	Freq. of use Gender Age Income Car avail.	No clustering	Multinominal logit	No	Yes
Diana (2012)	S	Italy	4123	Bus, car (multimodal)	PT-users	RP	Freq. of use Urban context Attitude	No clustering	Multivariate correspondence analysis	No	No
Friman et al. (2001a)	S	Sweden	997	bus, tram	PT-users	RP	None	PCA	LISREL (max. likelihood)	Yes	Yes, only with NCI
Friman et al. (2001b)	S	Sweden	95	Bus, tram	PT-users	SP	None	FA	LISREL (max. likelihood)	Yes	Yes, only with NCI
Lai and Chen (2011)	n.a.	Taiwan	763	Metro	PT-users	RP	Involvement	FA	SEM (max. likelihood)	No	No
Pantouvakis and Lymperopoulos (2008)	Both	Greece	388	Ferry	PT-users	RP	Freq. of use (proxy for loyalty)	FA	Linear regression	No	No
Sánchez-Pérez et al. (2007a)	I	Spain	1000	Bus	PT-users	RP	Freq. of use Gender Age Income Education Occupancy	No clustering	Ordered logit	No	No

(*continued on next page*)

Review of relevant studies (*continued*)

Study	Importance and/or satisfaction of service attributes	Origin of sample	Sample size	PT-mode	Study object	Survey method	Segmentation variables used	Method used to cluster service attributes	Functional form of model	NSSE in scope?	Interaction between TSS and customer characteristics
Tyrinopoulos and Antoniou (2008)	I	Greece	1372	Bus, trolley, tram, metro	PT-users	RP	Gender	FA	Ordered logit	No	Yes (only with gender)
This study	Both	Netherlands	180,000	Bus, regional train, tram, metro	PT-users	RP	Freq. of use Gender Age Trip motive Car avail. PT mode NCI Urban context	No clustering	Linear regression	Yes	Yes

Numbers in column 1 refer to the list of references.
FA: Factor analysis (a priori method).
PCA: Principal components analysis (a priori method).
RP: Revealed preference.
SP: Stated preference.

Appendix B. Correlations between satisfaction with service attributes

		Seating capacity	Vehicle tidiness	Personnel behaviour	Driver's behaviour	On-board noise	Ease of boarding and alighting	Information provision on stops	On-board information on delays	Ticket-selling network	Prices of the tickets	On-time performance	Travel speed	Service frequency	Safety on board	Safety at stops	Overall satisfaction
Seating capacity	Pearson correlation	1.00	.292**	.300**	.270**	.174**	.294**	.200**	.085**	.212**	.175**	.254**	.245**	.178**	.238**	.181**	.361**
	Sig. (2-tailed)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	N	168,343	167,385	149,749	161,063	165,076	166,212	158,008	139,578	139,549	135,337	163,363	162,657	159,382	153,955	154,560	164,816
Vehicle tidiness	Pearson correlation	.292**	1.00	.431**	.382**	.364**	.256**	.255**	.213**	.219**	.251**	.274**	.289**	.234**	.314**	.238**	.456**
	Sig. (2-tailed)	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	N	167,385	168,081	149,624	160,958	165,016	166,032	157,864	139,504	139,409	135,215	163,212	162,530	159,249	153,881	154,471	164,688
Personnel behaviour	Pearson correlation	.300**	.431**	1.00	.474**	.286**	.282**	.293**	.240**	.289**	.272**	.321**	.328**	.250**	.326**	.245**	.486**
	Sig. (2-tailed)	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	N	149,749	149,624	150,444	145,067	147,728	148,615	142,563	128,557	127,128	123,014	146,432	146,013	143,342	137,813	138,128	147,530
Driver's behaviour	Pearson correlation	.270**	.382**	.474**	1.00	.380**	.301**	.275**	.255**	.242**	.222**	.327**	.365**	.252**	.331**	.244**	.478**
	Sig. (2-tailed)	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	N	161,063	160,958	145,067	161,771	159,223	159,954	152,429	135,314	134,699	130,667	157,364	157,029	153,769	148,401	148,802	158,846
On-board noise	Pearson correlation	.174**	.364**	.286**	.380**	1.00	.226**	.223**	.230**	.169**	.251**	.226**	.282**	.237**	.214**	.165**	.381**
	Sig. (2-tailed)	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	N	165,076	165,016	147,728	159,223	165,804	163,939	156,008	137,940	137,674	133,487	161,173	160,572	157,294	152,036	152,549	162,608
Ease of boarding and alighting	Pearson correlation	.294**	.256**	.282**	.301**	.226**	1.00	.334**	.128**	.275**	.125**	.266**	.289**	.217**	.326**	.275**	.364**
	Sig. (2-tailed)	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	N	166,212	166,032	148,615	159,954	163,939	166,967	157,068	138,738	138,638	134,371	162,244	161,585	158,285	152,951	153,512	163,636
Information provision on stops	Pearson correlation	.200**	.255**	.293**	.275**	.223**	.334**	1.00	.373**	.303**	.232**	.355**	.319**	.302**	.251**	.233**	.423**
	Sig. (2-tailed)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	N	158,008	157,864	142,563	152,429	156,008	157,068	158,721	134,621	133,779	129,573	154,997	154,070	151,423	145,603	146,120	155,791
On-board information on delays	Pearson correlation	.085**	.213**	.240**	.255**	.230**	.128**	.373**	1.00	.241**	.257**	.324**	.256**	.274**	.138**	.122**	.356**
	Sig. (2-tailed)	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	N	139,578	139,504	128,557	135,314	137,940	138,738	134,621	140,238	120,620	116,104	137,371	137,058	135,109	129,664	129,599	137,966
Ticket-selling network	Pearson correlation	.212**	.219**	.289**	.242**	.169**	.275**	.303**	.241**	1.00	.306**	.256**	.272**	.233**	.262**	.234**	.366**
	Sig. (2-tailed)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	N	139,549	139,409	127,128	134,699	137,674	138,638	133,779	120,620	140,222	125,209	136,947	136,338	134,050	128,321	128,649	137,701
Prices of the tickets	Pearson correlation	.175**	.251**	.272**	.222**	.251**	.125**	.232**	.257**	.306**	1.00	.268**	.264**	.255**	.189**	.174**	.368**
	Sig. (2-tailed)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	N	135,337	135,215	123,014	130,667	133,487	134,371	129,573	116,104	125,209	136,063	133,146	132,397	130,235	124,393	124,634	133,565
On-time performance	Pearson correlation	.254**	.274**	.321**	.327**	.226**	.266**	.355**	.324**	.256**	.268**	1.00	.459**	.334**	.268**	.204**	.520**
	Sig. (2-tailed)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
	N	163,363	163,212	146,432	157,364	161,173	162,244	154,997	137,371	136,947	133,146	164,131	159,487	156,318	150,633	151,171	161,206

(*continued on next page*)

Appendix B (***continued***)

		Seating capacity	Vehicle tidiness	Personnel behaviour	Driver's behaviour	On-board noise	Ease of boarding and alighting	Information provision on stops	On-board information on delays	Ticket-selling network	Prices of the tickets	On-time performance	Travel speed	Service frequency	Safety on board	Safety at stops	Overall satisfaction
Travel speed	Pearson correlation	.245**	.289**	.328**	.365**	.282**	.289**	.319**	.256**	.272**	.264**	.459**	1.00	.417**	.305**	.233**	.560**
	Sig. (2-tailed)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	N	162,657	162,530	146,013	157,029	160,572	161,585	154,070	137,058	136,338	132,397	159,487	163,414	156,153	150,310	150,726	160,874
Service frequency	Pearson correlation	.178**	.234**	.250**	.252**	.237**	.217**	.302**	.274**	.233**	.255**	.334**	.417**	1.00	.225**	.214**	.488**
	Sig. (2-tailed)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
	N	159,382	159,249	143,342	153,769	157,294	158,285	151,423	135,109	134,050	130,235	156,318	156,153	160,129	147,440	147,915	157,636
Safety on board	Pearson correlation	.238**	.314**	.326**	.331**	.214**	.326**	.251**	.138**	.262**	.189**	.268**	.305**	.225**	1.00	.554**	.398**
	Sig. (2-tailed)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
	N	153,955	153,881	137,813	148,401	152,036	152,951	145,603	129,664	128,321	124,393	150,633	150,310	147,440	154,959	149,307	151,962
Safety at stops	Pearson correlation	.181**	.238**	.245**	.244**	.165**	.275**	.233**	.122**	.234**	.174**	.204**	.233**	.214**	.554**	1.00	.312**
	Sig. (2-tailed)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00
	N	154,560	154,471	138,128	148,802	152,549	153,512	146,120	129,599	128,649	124,634	151,171	150,726	147,915	149,307	155,606	152,463
Overall satisfaction	Pearson correlation	.361**	.456**	.486**	.478**	.381**	.364**	.423**	.356**	.366**	.368**	.520**	.560**	.488**	.398**	.312**	1.00
	Sig. (2-tailed)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	N	164,816	164,688	147,530	158,846	162,608	163,636	155,791	137,966	137,701	133,565	161,206	160,874	157,636	151,962	152,463	165,594

** Correlation significant at $p < .01$ level (2-tailed).

Table C1
Influence of urban density on PT proximity. Source: CBS Statline.

Density	Population per hectare built-on area	Distance to nearest train station (km)
Low	19.9	10.9
Medium	28.2	5.9
High	36.7	5.5
Very high	53.7	4.1

Note: correlation between population and distance: −0.8461.

Table C2
Number of times victim of a social safety incident on public transport.

Density	1–4 times	5 times+
Low	18%	17%
Medium	23%	17%
High	18%	21%
Very high	42%	46%
Number	3875	66

Appendix C.

See Tables C1 and C2.

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