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User experience in public transport as versatile and flexible key factor

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Abstract

Public transport is seen as a way to solve challenges in mobility. Increasing mobility demand, energy consumption and GHG emissions as well as excessive costs could be addressed by resource efficient services as an alternative to the private car. A precondition for this mode shift is a positive experience of passengers with public transport. A broad study carried out in cities across eight European countries plus the FIA network measured passengers' experience based on interviews to understand which aspects contribute to satisfaction or dissatisfaction. To understand the differing needs of passengers, we built a typology based on a cluster analysis leading to six groups with specific characteristics. Working commuters appeared especially sensitive to reliable services and comfort on their daily trips. Leisure travellers need orientation to reduce insecurity related to their occasional trips. Dissatisfaction with ticketing was an issue in all groups, and student commuters were critical in their assessments, which puts transport providers at risk of losing their potential future customers at an early stage.

Keywords: public transport, user experience, passenger, sustainability, mobility behaviour, sustainable mobility.

1. Introduction

Public transport is seen as a way to solve today's and future challenges in mobility such as increasing demand, growing energy consumption and GHG emissions as well as excessive costs. In order to address these problems by assuring resource efficiency and lowering the negative effects of traffic in general, mobility demand should be met by public transport replacing the car. To support this mode shift, it is crucial not only to provide public transport infrastructure, but also to understand whether potential consumers or passengers accept and choose public transport as their preferred mobility mode. When it comes to mobility behaviour and acceptance in this context, passengers' assessment of public transport in comparison to other modes, e.g. the car, will determine their mode choice. This assessment is a consequence of the passenger's experience, which has not been taken into account systematically in the design of public transport services so far.

A broad study carried out in trial sites across eight European countries plus the FIA network (Fédération Internationale de l'Automobile) has been conducted to shed light on passengers' experience with their journey in public transport and draw conclusions about the relevance for mobility demand and best practice of mobility service design. For that matter, satisfaction has been analysed taking manifold aspects which might be related to the experience into account. Socioeconomic aspects like income, phase of life, place of residence or household characteristics were considered as well as characteristics of the journey, such as trip purpose, length, mode etc.

Based on the different characteristics of a set of variables, types of passengers were identified. This typology should lead to a better understanding of service qualities which are important for different user groups and provide a basis to design alternative services meeting the specific needs of these groups – resulting in increased attractiveness of public transport in the end.

2. Survey and method

The survey providing the data for this empirical research was conducted within the project METPEX (MEasurement Tool to determine the quality of Passenger Experience), which was funded in the 7th EU-Framework Programme, aiming to develop and evaluate a standardised tool to measure the passenger experience throughout the whole journey. Related to the goal to develop a tool and to address passenger experience in a holistic sense as described above, research followed an explorative design by collecting a broad range of factors with potential influence on passengers' experience. Based on the project focus of applied research, results should serve to inform policy makers by providing inclusive, passenger-oriented, integrated transport systems that are accessible to everyone (for details on project and results see also Tovey, Woodcock, & Osmond 2017).

The METPEX tool was tested in, and provides data from, eight European cities (Bucharest, Coventry, Dublin, Geneva, Rome, Stockholm, Valencia and Vilnius) and out of the FIA (Federation Internationale de L'Automobile) network to evaluate passengers' experience related to quality in public transport. Characteristics of the interviewees and details of their level of satisfaction were analysed based on 69 questions in the survey, which contained 6,277 cases. Passengers were asked about their social and socio-economic background, information on their current trip, their satisfaction, and their mood in all its facets and how much they support different statements about the public transport system. To get a diversified database, the passengers were interviewed in five different ways:

- Paper-and-pencil questionnaire
- On-line questionnaire
- Real-time questionnaire, embedded in the SbNavi app
- Real-time questionnaire, embedded in the METPEX Game app
- Focus group interviews

Since the interviews took place both via app and online, as well as on paper, they reached the passengers everywhere. However, certain groups were consulted where they often reside, such as universities and schools for the group of trainees resulting in a sample with mixed use of different modes over the whole sample. The surveys took place from September 15, 2014 to October 27, 2014. The survey setup with different interview methods, a large sample of interviewees and an extensive questionnaire produced a large number of variables providing a comprehensive database with details about passengers' experience and related socio-economic factors as well as information about their living environment. This database allowed us to analyse relationships between passenger experience and the above-mentioned additional aspects, which allows us to gain insight into the different needs of specific groups of passengers.

To identify and characterize different user types, a cluster analysis has been carried out. The aim of this cluster analysis was to identify which factors are related to satisfaction with public transport. Nine features were selected for clustering with the selection based on the aim of integrating type of journey, socio-economic and residential background of passengers as well as satisfaction with the journey, considering different aspects:

1. Frequency of journey
2. Main reason for the journey
3. Occupation
4. Age
5. Type of living area
6. Origin of the journey
7. Destination of the journey
8. Type of residence
9. Overall satisfaction

A two-stage cluster analysis was carried out using the METPEX dataset. The number of clusters was not calculated by using the two-stage cluster analysis, but on the basis of the value of the size ratio and internal cohesion. In this case, the value of the size ratio is very close to the optimum and the internal cohesion is high. This could only be improved by a significant increase in the number of clusters, though as a disadvantage significance would be lost. Thus, creating the cluster and the size ratio of the cluster had to be balanced (for cluster parameters see Appendix A). Additional variables concerning socio-economic aspects and facets of satisfaction with services were analysed for each group using descriptive statistics.

3. Passengers' experience in research

Passenger experience is crucial to acceptance and use of public transport. Especially to increase competitiveness in relation to the car, public transport services need to meet the needs of people and to gain attractiveness. But needs, preferences and decisions about travel choice are not only influenced by quality of services but also by everyday life and the space, time and culture in which the passengers are situated (Schwanen & Ettema, 2009). Even if satisfaction of passengers on public transport was addressed in studies, only few of them took additional socio-economic and other characteristics of passengers into account so far. According to literature, especially cleanliness, comfort and waiting time define the quality of a public transport system. While cleanliness plays a subordinate role (especially for males), comfort is judged more important - in particular for the elderly. Waiting time plays an important role across all groups of passengers, because it is considered to be wasted time. In some studies the overcrowding of vehicles was not perceived as too disturbing, since the transport companies ensure that supply and demand is matched (e.g. dell'Olio, Ibeas & Cecin, 2011), while others reported a decrease of satisfaction levels related to crowded situations, unreliable services and long wait-times (Cantwell, Caulfield & O'Mahony, 2009). Passengers' concerns about quality aspects of public transport differ; they are related to their sex, age, riding frequency, and type of trip. Passengers show anxiety associated with "crowding," "delays," "accessibility to railway stations," "searching for the right train on a platform," and "transfer processes". Cheng (2010) and Mouwen (2015) state that both composition and level of satisfaction depend on customer characteristics, situational conditions and negative social safety experiences (see also Friman & Felleson, 2009). Explicitly, this means that on-time performance, travel speed and service frequency followed by personnel/ driver behaviour and vehicle tidiness are regarded as very important. Redman et al. (2013) conclude that in the case of attracting car users reliability and frequency of public transport are important, but are largely affective and they are linked to perception, motivation and context of individuals.

The satisfaction with public transport is also positively influenced by service frequency, interior noise and on-board information according to Mouwen (2015). Especially the information before and during the journey are considered to be very important. Therefore, there is a high level of requests and needs for integrated multi-modal public transport information systems. This is crucial in times of service disruptions, because passengers don't want to wait and waste their time and be left uninformed about their situation. For this reason, passengers require information to be updated in real-time, accurate and reliable most of the time (Bachok, 2007). The main determinants for public transport information systems are 1. time savings including travel and search time and 2. effort savings like physical, cognitive, and affective effort. In the whole travel process, travel time seems to be considered the most important saving – although perception varies depending on stage of trip. While search time and travel time savings are the most needed in the pre-trip stage, during the trip, catching the right vehicle is most important to the customers; orientation, planning and acquiring information on the remaining trip is less of a necessity. On-board, customers mainly need real time information to achieve a timely arrival, especially in order to catch a connecting mode (Grotenhuis, Wiegman, & Rietveld, 2007).

Users of public transport put special emphasis on the shortest possible waiting times and best connection times. Delays are perceived as more unpleasant than scheduled long waiting times. Users of public transport, who are used to short and well-adjusted waiting times, have a lower inhibition threshold to switch to motorized individual transport when waiting times are too long or delays are more common. (Ceder, Chowdhury, Taghipouran, & Olsen, 2013) Considering only non-local groups, factors such as lack of cars and general advantages of public transport promote the choice of public transport. Restrictions, personal preferences and lack of information facilitate a decision against public transport (Le-Klähn, Gerike, & Hall, 2014). In order to increase public transport usage, the service should be designed in a way that accommodates the levels of service required by customers. If the service is unreliable, has a low frequency or lack of comfort, people are likely to shift to using cars because they do not perceive public transport as a viable alternative. Certainly, car users have perceptions of lower service quality of public transport than public transport users, which means that public transport is actually better than they think (Beirão & Sarsfield Cabral, 2007).

Besides the described differences of passengers' perception of quality in public transport related to their sex, age and travel habits, the relationship between land use and public transport has been investigated as another related factor, although the results focus on general patterns of mobility behaviour related to specific land-use categories without linking it to particular passengers' trip experience. Since land-use and public transport are interdependent and depend upon many other factors, it is difficult to describe a precise relationship. In general, increasing population density leads to a decrease in the possession rate of cars and an increase in the proportion of public transport use and the scarcity of parking spaces (TRL, 2004). Households in areas with higher levels of neighbourhood access complete more tours and make fewer stops per tour. They make more simple tours for work and personal reasons, appointments, and shopping trip purposes. Many households, even those in high neighbourhood access areas, will continue to shop outside their immediate neighbourhood. A household's desired good at the desired price is often not located within walking distance from home. Households will travel farther than their neighbourhood centre for many basic shopping needs (Krizek, 2003).

Especially accessibility and land use aspects lead to trip-chaining. It was discovered that workers who trip-chain live farther from their workplaces than workers who do not, and accrue more annual vehicle miles of travel. In two-parent/ two-worker households who drop children at school, women are far more likely to incorporate that trip into their commute than men. Nearly all of the growth in trip-chaining was in the direction of home-to-work and men increased their trip-chaining more than women (McGuckin, Zmud, & Nakamoto, 2005). Non-work-based travel by public transport involved more trip legs per chain than car driving. However, work-based public transport modes had slightly fewer legs per chain than driving. The wide range of services and activities clustered in the city centre generates higher rates of shopping, social and recreational stops as a part of non-work-based public transport travel. Chaining is different depending on mode. The complexity of chains is larger for rail and tram than for car-based trips. Car commuting trip linking is more associated with 'picking up or dropping off someone' and with people who have children and child care responsibilities. Traffic congestion and parking are significant barriers to access for those with a car particularly to locations with a wide range of activities such as activity centres and city centres. (Currie & Delbosc, 2011)

As research shows, providing reliable service and comfortable travel is crucial for use and acceptance of public transport. Besides aspects of transport service and vehicle quality, the importance of time (savings) in travel as well as information to reduce uncertainty are stressed, although perception and rating of these factors vary between passengers. Research reveals satisfaction-related factors with variation depending on various characteristics of passengers such as sex, age and travel behaviour aspects. Land-use differentiation has been considered in some studies, but it was not linked with passenger experience of public transport services.

This leads to the question of how to include the findings in public transport service design, since the needs of passengers vary greatly. When it comes to the design of appealing services there is no "one size fits all". Different needs, perceptions and experiences build the basis for mobility decisions on mode choice, length and frequency of trips. In order to design attractive public transport services, these differing needs have to be taken into account. Thus, a comprehensive analysis of passenger experience that allows us to identify correlations with socio-economic and land-use related aspects can help to shed light on this issue. The METPEX study fills this gap by providing a first typology of user groups and describing their level of satisfaction. To provide such a typology, an explorative analysis was chosen to inductively build groups. However, due to the high number of potential variables, a preselection of characteristics was necessary, and we decided for a differentiation between experience (satisfaction with service) according to trip purpose, socio-economic factors as well as land-use aspects. Based on the typology, services can be adapted to the specific requirements of each group. On the other hand, the method can be used for following typologies with different focal points and for other trial sites (e.g. suburban or rural areas) or different areas (e.g. supra-regional instead of cities).

4. Passengers' experience across European cities

In order to improve public transport services, more details about satisfaction and related factors is necessary which can be provided by a group specific analysis – based on the assumption that passenger experience differs according to several factors. To better address these different experiences and needs, group-specific characteristics can provide a deeper understanding of satisfaction-related factors that allow us to address different needs more appropriately. This can lead to an overall increased quality of public transport, which in turn is needed to increase competitiveness compared to motorised individual transport. Out of an empirical survey based on extensive interviews of passengers in a large sample taking place in eight European cities and the FIA network, we identified six user groups. The groups reflect all stages of life and age segments and differ concerning their experience – operationalised as satisfaction with public transport quality - as well as concerning additional characteristics. Although it is likely that cities may vary concerning group characteristics, in this first step of building passenger typologies as presented here, the goal is to identify general types based on the whole sample of all cities. Further analysis should reveal more into detail how cities differ in that sense according to aspects of transport system, mobility culture etc. A variety of internal and external factors appeared to be related to passenger experience, allowing us to differentiate between the groups; however, all groups have something in common, which, interestingly, is a generally high level of satisfaction with public transport.

1.1. Typology of users

As a result of the cluster analysis, six groups appeared, differentiated by occupation, age, living situation as well as trip characteristics and purpose (table 1). Although the resulting groups are built on, and described by, the occurrence of these characteristics, they are not to be understood as a type of person necessarily. As clusters were built by a combination of personal characteristics and trip purpose, a person who appeared in the *urban leisure traveller* group (e.g. interviewed on a weekend within this survey) might belong to the *suburban commuter and traveller* group during working days.

Table 1. Typology of users with main characteristics as derived from cluster analysis

Main characteristics	Student commuter	Suburban commuter and traveller	(Sub)urban working commuter	Urban leisure traveller	Suburban (leisure) traveller	Pensioner
Age	91% < 24	85% = 25 - 54	84% = 25 - 54	79% = 25 - 54	77% = 25 - 54	71% > 65
Occupation	97% (working) student	59% full-time 19% part-time employment	82% full-time 11% part-time employment	49% full-time 8% part-time 22% un-employed	mixed employment structure	84% pensioner
Type of living area	mainly urbanised 69%	mainly suburban* 60%	mixed urban 56% suburban* 35%	urban 92%	Suburban* 76% rural 17%	urban 55% suburban* 32% rural 13%
Type of residence	large and medium buildings 57%	large and medium buildings 60%	large buildings 39% terraced and detached houses 44%	large and medium buildings 80%	terraced and detached houses 64%	large and medium buildings 63% terraced and detached houses 32%
Main reason for the journey	education	commuting	commuting	leisure, shopping, tourism	leisure, shopping, tourism (+Work related)	leisure, shopping appointments, escorting
Frequency of journey	daily or often† 74%	daily or often† 92%	daily or often† 95%	occasionally 53%	occasionally 65%	broad range daily 18% to occasionally 34%
Origin of journey	rather residential‡ 54%	mixed residential workplaces 53%	mainly residential 66%	mainly residential 58%	rather residential‡ 52%	rather residential‡ 59%
Destination of journey	rather workplaces 52%	mixed residential workplaces 47%	mainly workplaces 54%	mainly residential 37% to mainly workplaces 33%	all kind of areas	all kind of areas
Overall satisfaction	notably dissatisfied 18% (satisfied 51%)	notably dissatisfied 22% (satisfied 42%)	notably dissatisfied 20% (satisfied 54%)	notably satisfied 80% (dissatisfied 3%)	satisfied 63% (dissatisfied 11%)	notably satisfied 75% (dissatisfied 7%)

* Including categories of less rural, between rural and less urban

† Daily, twice a day or at least two times a week

‡ Including mainly and less residential

According to their main characteristics, the cluster can be described as follows – with labels reflecting main aspects (and neglecting less dominant aspects) of each specific group:

1. Student commuter
2. Suburban commuter and traveller
3. (Sub)urban working commuter
4. Urban leisure traveller
5. Suburban leisure traveller
6. Pensioner

Table 1 gives an overview of the main characteristics of the different groups of passengers resulting from the cluster analyses. Differences of the groups show that passenger experiences differ related to trip purpose combined with ‘phase of life’, occupational status as well as living conditions and mobility patterns, e.g. frequency of journey. It points to the fact that indeed ‘aspects of everyday life’ are important but analysing satisfaction as a function of quality of public transport as described in chapter 3. might lead to shortcomings in conclusions about source of passenger experiences. Besides the listed variables, which were used to form the clusters, additional variables were analysed for each group to get a more complete picture of their characteristics. These additional characteristics covered income, academic qualification, family background, availability of cars and detailed aspects of satisfaction with the trip concerning comfort, reliability, value for money, safety, connection of modes and ticketing. Descriptive statistics on these additional characteristics have been included to complete the characterisation of the six user groups as described in 1.2 to 1.7.

1.2. Student commuter

This group consists almost exclusively (97%) of students and working students. Around three quarters of them travel two or more times a week, 51% at least once a day with “education” as the main reason for their trips. Also, it is the youngest group and, together with the *pensioner* group, the one with the lowest share of working people. Their living area is mainly urbanised, and residential buildings are large and medium-sized buildings. Trips are preferably made from Monday to Friday and take place between living areas and areas with economic use. Their income is, according to self-estimation, below average and the academic qualification of 65% of the group is a high school certificate and of 15% a bachelor degree.

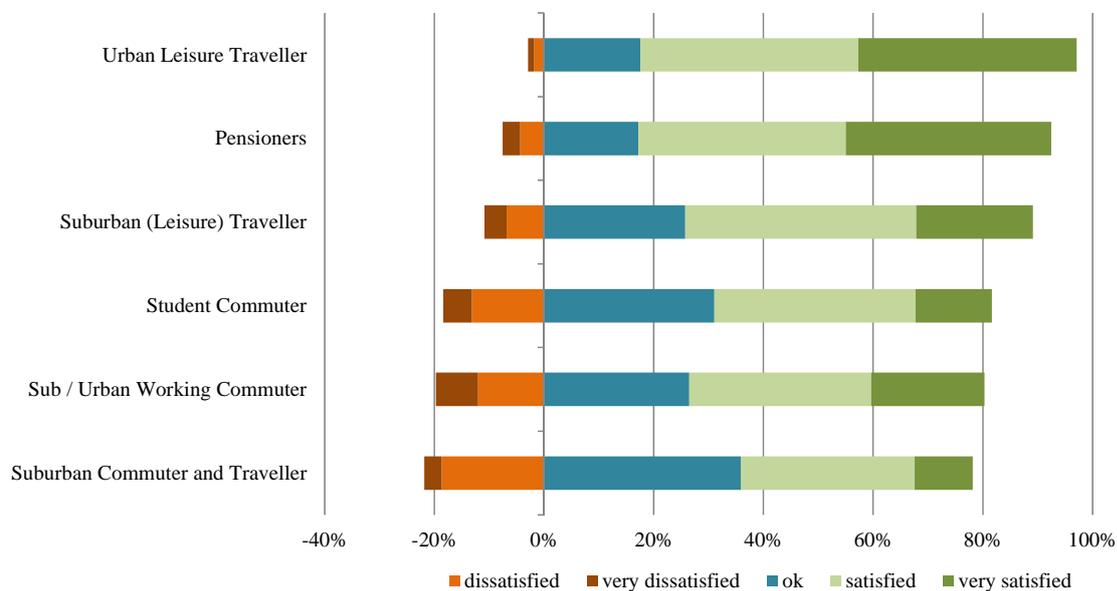


Fig. 1 User groups satisfaction with public transport services

Similar to other groups, the overall satisfaction with public transport is given as “satisfied” (37%) or “OK” (31%), but after the group of *suburban commuter and traveller* they have the second lowest share of respondents who are “very satisfied” (14%) with public transport and, with 18%, a large share of dissatisfied people (figure 1). Aspects contributing to satisfaction or dissatisfaction are rated differently. In order to gain insights into potential for improving public transport services, especially dissatisfying aspects are important. Related to this, the group of *student commuter* is one of the most critical groups, contributing with the highest share of dissatisfaction in most

of the subcategories of transport quality, such as “Comfort”, “Value for money”, “Connections between Modes” and “Ticketing” as well as “Reliability”. Even if in their general rating of satisfaction with transport services (which was used for cluster building) this group did not appear as the most dissatisfied one, they did when detailed quality aspects had to be rated.

1.3. Suburban commuter and traveller

This group is mainly characterised by the trip purpose of “commuting”, consisting of mainly commuters (62%) and work-related travellers (16%), with the rest distributed across education, shopping and escorting children. Household situation is mixed, with 42% families with one child or more, 32% living alone and 27% married without children. They are frequent travellers with 92% at least twice a week (or 60% daily). People in this cluster have mainly full-time jobs (59%) or are part-time workers (19%), have an average income and a high school certificate (43%) or bachelor (35%) degree. The living area is mixed, ranging from cities to suburbs, and the residential buildings are mainly large and medium-sized apartment buildings. The trips take place in areas with mixed use and are preferably made from Monday to Friday. Although the overall satisfaction with public transport is indicated with “OK” by 32%, the highest share of dissatisfaction (22%, including “very dissatisfied”) and lowest share of satisfied travellers (42%) is in this group; especially “Comfort”, “Reliability” and “Connections between transport modes” are dissatisfying for around 25% of this group.

1.4. (Sub)urban working commuter

Compared to the other commuter groups an even larger share of people (87%) commutes to work in this group; 82.5% are full time employees. Other differences are a high share of residence in urbanised areas (76%), higher frequency of travel with 83% commuting daily or more than two times a day, higher income and high education level with 57% bachelor or postgraduate degrees. In this group, the lowest share of people (25%) estimate their income below average and the same share above average. Their living area is mixed with more than half living in the city and the others in suburban to rural areas. Residential buildings are large buildings or family houses (together, 39%). The trips take place from living areas to areas with economic use and are preferably made from Monday to Friday. The overall satisfaction with public transport is “satisfied”, but around 20% are not satisfied or worse - especially concerning “Reliability” (25%) of public transport and “Value for money” (26.5%).

1.5. Urban leisure traveller

People in this group are mainly on leisure-related trips (58% including shopping plus 20% tourist trips) and they travel occasionally. Most of the people have full-time jobs, but unemployed (22%) and some housewives (6%) as well as self-employed people (10%) are included, too. After the pensioners, it is the group with the largest share of households without a car (22%) or only one car (57%). They live almost exclusively in cities and the residential buildings are for 80% large or medium-sized apartment buildings. The trips take place within residential areas and from residential areas to areas with economic use and are mainly made from Monday to Friday, but most of the people who have indicated “Saturday” or “Sunday” are in this cluster. This group consists mainly of people in relationships with children and with an average (44%) or below average (40%) income. The education level of this group is mainly high school (44%) or bachelor (31%). Also, most of the people who have indicated “partnered with more than one child” are in this cluster. The overall satisfaction with public transport is given as “very satisfied” and they are the most satisfied group. They are satisfied with “Safety” (77%), “Comfort” (72%), “Reliability” (74%) and “Connections” (71%). “Ticketing” and “Value for money” are considered as less satisfying with 10% of people dissatisfied with the former and 11% with the latter.

1.6. Suburban leisure traveller

This group travels only occasionally and has mixed purposes for travelling: shopping, leisure, medical reasons or city trips, but it also includes some work-related trips (23%). People in this group have mainly full-time (50%) or part-time (15%) jobs, and there are housewives (10%) and self-employed people (11%) within this cluster. They differ from *urban leisure traveller* since the average age is higher with fewer people between age 25 and 34. The living area is outside the city centre and residential buildings are mainly family houses or semi-detached houses. The trips take place between all categories of land use and are preferably made from Monday to Friday. The income is average (46%) or above average (22%) and the educational level is rather high with above average shares of high school certificate (40%), bachelor degree (33%) and postgraduate (22%) levels. The overall satisfaction with public transport is “satisfied”. They are satisfied with “Safety”, “Comfort”, “Reliability”, “Value for money” and “Connections” but “Ticketing” is rated as “OK”. This group has the highest car ownership rate

and the longest travel time. They are more willing to change the itinerary and travel longer to prevent a mode change but they are satisfied with the accessibility, in general.

1.7. Pensioner

This group mainly travels occasionally (weekly to monthly 58%) and their main reasons for travelling are shopping, leisure and medical (together 78%). Also, most of the people who have indicated “escorting dependents” are in this cluster as well as some “escorting children”. The group consists almost exclusively of pensioners and housewives. The living area for 55% is the city, and residential buildings are mainly large and medium sized apartment blocks (63%). Trips take place between all categories of land use and are preferably made from Monday to Friday. The income is below average for 52% and education level is mainly a minor or high school degree (both with around 38%). They have the lowest car ownership rate and the shortest travel time. The overall satisfaction with public transport is given as “satisfied” with a tendency to “very satisfied”. They are satisfied or very satisfied with “Safety”, “Comfort” and “Reliability” with 70-75%: for these three categories, only around 10% are dissatisfied or very dissatisfied. When it comes to “Value for money”, “Connections” and “Ticketing”, there seems to be more need for improvement as satisfaction rate here is under 70% and 10-20% are dissatisfied with these aspects.

1.8. General principles

One general characteristic of all groups is that a majority of respondents are satisfied with public transport services: In total, 60.6% of those interviewed were satisfied or very satisfied, and 26% are OK with public transport – with some differences between groups (figure 2). The least satisfied groups might be regarded as critical ones. Addressing the needs of these people by improving services would increase the attractiveness of public transport for them and for already satisfied passengers as well. As described above, the results of the survey show indeed there are notable differences between passenger groups, which appear by inductively analysing the given data in an explorative cluster analysis. Groups differ in their level of satisfaction, showing certain characteristics separating these groups from one another. In general, it seems that there is a correlation between satisfaction with public transport and stage of life as well as the related purpose of travel, more than with place of residences, which is in contrast to what previous research suggests. In Figure 2, we see the different employment status shares within each group, as well as the reason for the trip and overall satisfaction. Here, it can be seen that commuting professionals and students are less satisfied than groups on leisure trips.

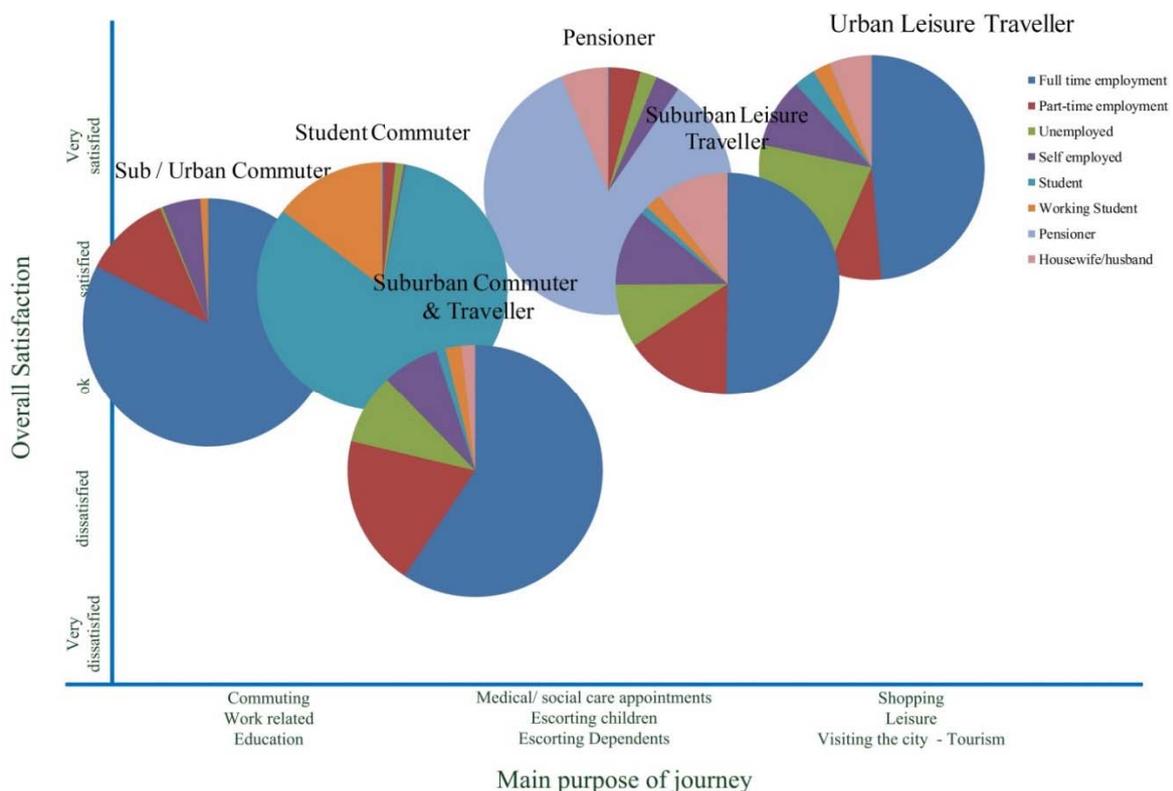


Fig. 2 User groups by overall satisfaction and main purpose of journey

5. Conclusions and implications for public transport design

One of the main results of the study was that passenger groups can be differentiated by their sensitivity to public transport quality – in relation to their trip purpose and stage in life – with less satisfied commuters on one side and leisure or non-work-related travellers on the other side. Also, when it comes to specific aspects of transport quality, the priorities are shifting according to stage in life, trip purpose and age. While young students were less happy about what they get for their money, the available connections and the ticketing procedures, this seems to change after entry into the professional world. For working commuters, the availability of connections is still critical, but also and especially reliable services and comfort of travelling; interestingly, this group is not easy to satisfy with what they get for their money, even if income (and educational level) is high.

Groups with leisure trip purposes were more satisfied and, when it comes to critical aspects, especially sensitive to value for money and connections (as well as ticketing), which reflects the situation of trips made from time to time. From the commuters' perspective, reliability and comfort are critical in the context of an everyday experience of, and dependence on, public transport. This is also true for student commuters, which is difficult in two ways: not only might dissatisfied students search for mobility alternatives, but their general mobility habits, preferences and behaviour – which are mainly established in youth and of high persistency – will influence their mobility choice in later life. They might be turned against public transport if dissatisfying experiences in this phase of life dominate. While most factors are dependent on age and life situation, it seems that ticketing procedures are always worse and rated critically. The supply of tickets – actually the most basic thing in contact with the customer – seems to be insufficient or not adapted to the needs of city people in the 21st century.

These results indicate that, in order to increase the acceptance and competitiveness of public transport by optimising passenger satisfaction, first of all ticketing procedures have to be simplified. Solutions like Mobility as a Service combining information and ticketing for door to door transfer by integrating different public transport modes with even private sharing options can support here. Second, the needs and problems of daily and regular commuting should be addressed by achieving the highest reliability and by providing travel comfort from the perspective of the passenger. Although details of what this could include were not analysed for the identified groups and more research is necessary on this, there are options to improve comfort – inspired by comparison with the car. For example, enhancing “privacy” by providing enough space, seats and reducing noise could increase the attractiveness of public transport, or providing additional services like wireless internet, (free) catering, entertainment, dedicated places to meet or work or any option to individualise the time during the trip. As improving these factors may conflict with peak hour demand, reorganizing transport and steering utilised capacity by dynamic ticket pricing should be part of a bundle of measures.

Third, when it comes to leisure-related trips, supporting orientation is the key. Due to the occasional nature of these trips, the main problem is a lack of information and orientation, which might be linked to feelings of uncertainty. Avoiding negative feelings is one of the main drivers of human behaviour in general. In the context of public transport, this means that exposing passengers to uncertainty by unreliable mobility services, intransparent connections and poor ticketing procedures increases the risk of losing them as public transport users. Easily available information, clear connections and travel alternatives, high reliability of services and good management of outages are of main importance here. This should not exclusively be provided by, and available through, electronic devices like smartphones, tablets and laptops. There is considerable potential to improve services and reduce uncertainty of passengers by providing information on-site (without need for devices) and customer care via contact persons able to react to specific needs of passengers. Mentioned aspects are relevant in general, but will have to be adapted and implemented according to specific regional situation.

There is a need for public transport to catch up with automobility, especially when it comes to emotions. While the car industry was using emotions to sell their products from the very beginning, in public transport emotions are something the user has to endure – ranging from feelings of stress and uncertainty to anxiety in the worst cases. Although different reasons might explain satisfaction or dissatisfaction with mobility services, emotions are one factor, underlying many decisions in all fields. As one additional aspect related to emotions, we analysed mood for our six user groups. The groups differ significantly in their mood (Figure 3). While especially commuting students and professionals are rather tired, unhappy and in a bad mood, pensioners and other leisure travellers report a better mood. Although it is hard to say if general mood (often related to the purpose of the trip) influences the experience of public transport or the other way around or both effects run in parallel, a focus on mood might inspire the development of passenger-experience-oriented strategies. Identifying and reducing factors affecting the mood in a negative way (e.g. stress due to feelings of uncertainty) or providing something to increase good feelings (e.g. design of vehicles, extra-services, supporting and friendly staff etc.) could be good starting points. However, this would mean a kind of paradigm shift: from optimising transport systems in a rather technical way towards improving public transport as a social system and an individual experience.

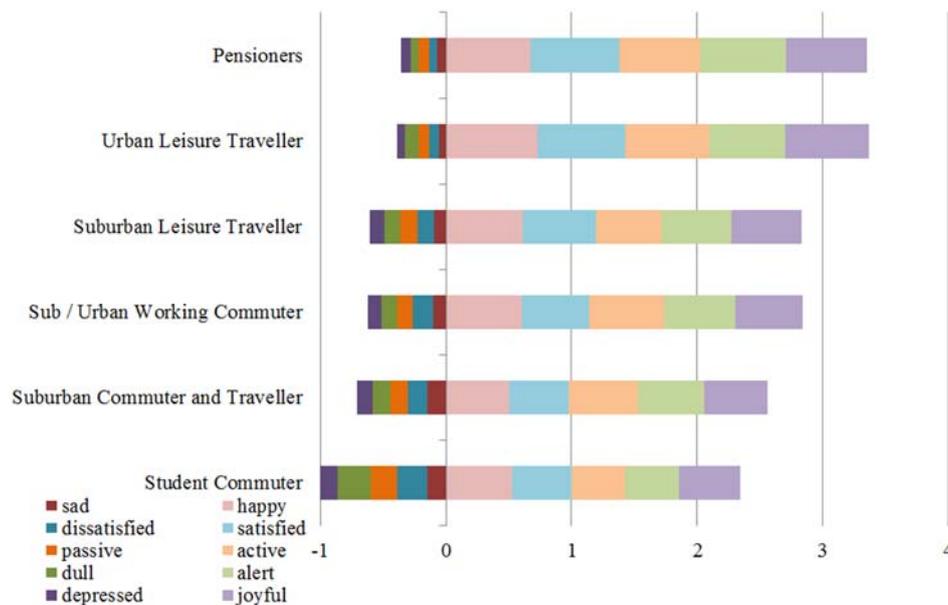


Fig. 3 User groups by mood facets (shares of each group agreeing on mood cumulated, 1 = 100%)

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Appendix A. Cluster Parameter

Size of smallest / biggest cluster	598 (13.1%) / 873 (19.1%)
Size ratio biggest/ smallest cluster	1.46
Inputs	9
Silhouettes measure for cohesion and separation	0.1

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