The image of bus and tram: first results

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Conference paper STRC 2011

STRC | **11th Swiss Transport Research Conference**
Monte Verità, Ascona, May 11 - 13, 2011

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30. April 2011

Abstract

Since findings about a rail factor or rail bonus are controversial, sources of potential higher preference of rail based systems compared to bus systems are investigated. The image of the two most common urban public transport modes in Switzerland, bus and tram, is explored without drawing conclusions on mobility behaviour so far. In the current study the image is based on 22 attributions toward public transport that were judged by 663 respondents for bus and tram. The goal of the study was to identify differences in images and attributions by applying the semantic differential method and a factor analysis.

The image of a tram was found not to differ significantly from the image of a bus. Only the group of frequent public transport user show significant better scores towards a tram compared to a bus. Regarding the mean scores of occasional public transport users and non-users of public transport no significant differences in judgements could be ascertained. The analysis of the scores of the specific attributions showed, that especially the aspect of free flow and environmental friendliness were rated significantly more positive for a tram than for a bus across all user groups.

Keywords

Image – Bus and Tram – Factor analysis – Semantic differential – Rail Bonus – Rail factor

1. Introduction

Extensions and upgrades of the public transport network are part of the measures to cope with growing transport problems in urban areas. In cases where a bus system operates at its capacity limits, the discussion about the implementation of a tram system is often raised. Nevertheless not only capacity reasons are likely to be an argument to favour a tram system but also the so-called “rail factor” or “rail bonus” is a repeated argument. The rail factor summarizes assumed stronger effects of rail-based systems compared to bus systems (under equal service conditions) on different aspects, such as demand and spatial development.

Findings in the literature about a rail factor are controversial. Considering decision making for transport investments some authors such as Mackett and Edwards (1996, 1998) Babalik-Suttcliffe (2002) and Cohen-Blankshtain and Feitelson (2011) found that expectations of decision makers towards new tram and LRT systems were hardly met after the implementation of such systems whereas other authors found throughout positive effects derived from new tram systems (Hass-Klau et al. 2004, 2007).

Regarding public transport demand of bus and tram, findings vary as well. Axhausen et al. (2001) found a slight preference for tram in their stated preference survey, and Ben-Akiva and Morikawa (2002) could not ascertain a preference for rail-based systems in their SP/RP analysis. Also before- and-after comparisons of demand do not lead to clear evidence for a higher rail preference (e.g. Kottenhoff and Lindh (1996), Kasch and Vogts (2002)). However, it has proven very difficult to evaluate and determine the rail factor precisely. There are three main types of studies that have been done to compare the demand of rail-based compared to bus-based public transport. The first uses modelling based on stated preference evaluations, the second is based on before- and-after ridership data analyses of newly-implemented systems, and the third consists of a combination of stated and revealed preference data analysis.

The idea of a rail factor is consistent with statements that the image of a transport system has an impact on demand. According to Hensher, the image of a transport system, “may ultimately be an important influence on preference formation, especially for new means of transport” (Hensher 2005, p63). To our knowledge, only a few studies applied qualitative methods to explore an assumed rail factor. Cain et al. (2009) used focus groups discussions to quantify the importance of image and perception of different public transport lines in Los Angeles. They found that intangible service attributes (attributes that are abstract, subjective and thus difficult to measure) have a significant influence on modal perception. Furthermore they conclude that in the perception of general public Bus Rapid Transit can compete with Light Rail.

The schemata approach is a further approach to investigate the perception of public transport modes and is based on cognitive psychology. It was applied in the field of regional bus and regional rail by Megel (2001) and later enhanced to urban public transport by Scherer et al. (2011). Both found a relatively high share between 20-50% of emotional and social attributions on the schemata of rail, tram and bus and a significant preference for rail-based systems in a hypothetical setting. Schemata represent the image of these public transport systems since they are based on the picture in mind that individuals have of specific concepts. These images are partly based on experiences, perceptions and beliefs (Scherer et al. 2011).

However, to it is not conclusively answered to what extend schemata or images influence mobility behavior and hence public transport demand. Because schemata respectively images are heuristics that allows people to save cognitive effort in an everyday situation such as the use of transport modes, cognitive shortcuts are expected to serve as a basis for travel decisions to a certain extend.

In a nutshell, the studies reviewed show mixed results regarding the question whether a rail factor exists on various levels and whether the image of a public transport mode affects travel behaviour. While some studies ascertained a rail factor, methodological problems call into question these findings. More specifically, modelling studies based on stated preference data depend highly on the attributes applied in the experiments. In this case, sources of a rail preference may, in fact, be the result of neglected attributes.

The aim of the current paper is to apply another approach to investigate the image of bus and tram in order to avoid the detected methodological problems. Images of bus and tram are here explored in detail with the semantic differential. The method is applied on data from residents of Berne, Lucerne and Zurich in order to identify differences in images of public transport system (bus and trams) as perceived by public transport users and inhabitants. The focus lies on the question how tram and bus are represented in the residents' minds? The main goal of the study is to examine groups of attributions and their relative influence on the judgement of bus and tram. Furthermore different dimensions behind the judgements of bus and tram are identified and compared. Considering the debate of a rail bonus it is of special interest to explore the sight of non-users of public transport since this is the group that is mainly expected to change their mode choice behaviour when implementing a tram. These different images will serve as a basis for further analysis of impact of images and attitudes on mobility behaviour.

2. Method

The image of a specific concept is reflected in a subject's attitude towards this concept. Attitudes are generally composed of three elements: Beliefs about the concept, emotional feelings such as appraisals, and readiness to respond to the concept in terms of using/buying it. For the measurement of attitudes and thus images, several techniques are common. In addition to the schemata approach that was used in previous studies to investigate differences in perception of bus and tram systems (Scherer and Dziekan 2011), the semantic differential is applied in the current study. This explorative measurement is appropriate for the data collection for attitudes/beliefs towards bus and tram based on attributions towards these two modes.

2.1 Background

Osgood et al. (1957) developed the semantic differential for the measurement of meaning in linguistics and psychology. It is a rating scale that allows measuring connotative meanings of various kinds of objects and concepts. The resulting meanings are used to express attitudes towards the concept to be analyzed. This measurement can be applied to any concept and is therefore suitable to explore the connotative meaning of bus and tram in order to deduce the image respectively attitudes towards these two public transport modes. Nowadays this instrument is applied in various fields such as cultural studies and marketing research but also for mobility behaviour (e.g. motives for car use: Steg et al. 2001).

The rating scale of the semantic differential is based on bipolar adjectives or attributions towards the concept to be tested. In the present case, a five point likert scale was used in a written questionnaire. The respondents are asked to choose their position of the concept (e.g. bus) on the five-point scale between the given attributions such as old-new vehicle, spacious-cramped vehicle. The battery of adjectives and attributions was adapted to the concept of public transport modes.

2.2 Analysis

The advantage of the semantic differential is that it provides a fast graphical overview of the judgement of the concepts. The analysis of the ratings within the likert scale is a first step towards the exploration of the image of bus and tram. Three different analyses are made:

- Computation of means of scores for bus and tram for single attributions to identify average ratings. Furthermore aspects of the image constituted of the attributions can be explored.

- Computation of the difference of the mean category score between bus and tram per subject to identify the distribution of the ratings. This allows for user-type specific analysis of the rail factor and its single attributions.

- Finally a factor analysis was conducted to examine dimensions of latent variables that can summarise the judgement about the attributions of both public transport modes. By checking which attributions are highly loaded on any factor, the resulting factors are interpreted for bus and tram.

2.3 Methodological limitations

Similar to the studies reviewed, the findings highly depend on the attributes used in the study. Although a broad literature study to collect attributions regarding the image of bus and tram and a preliminary web-based survey among over 500 Swiss residents to specify the attributions for Swiss cities were conducted, there might be aspects of the image that are neglected due to limitations of the item batteries.

Nevertheless the chosen attributions (compare Table 6 in the Appendix) account at least partly for all aspects that were found in the previous studies to be relevant components of the schemata or image of bus and tram in Switzerland. Another source for biases is whether the respondents do have a common understanding of the attributions. However, since subjective judgements of the specific attributions are requested, this aspect is accepted because it considers the variation of subjective beliefs and perceptions.

3. Data

The data source is based on a paper-and-pencil survey that was conducted in autumn 2010 among 1000 residents in each of the cities Berne, Lucerne and Zurich. Two precedent studies that are concerned with the evaluation of attributions of public transport systems in Switzerland (Scherer 2010) and first analyses of mobility behaviour of residents living in bus and tram corridors in Berne, Lucerne and Zurich (Scherer and Weidmann 2011) serve as a background for this study.

The resulting response rate of the main survey was 23%, 663 questionnaires out of 2881 delivered questionnaires were returned (for details see the field report Scherer (2011)). From each of the three cities, about 220 questionnaires were obtained. The ratio of public transport users is within the range of urban averages. Derived from the ownership of different public transport cards, 52% of the respondents are regular public transport users, 23% are optional users, and 25% are classified as non-users.

A part of the questionnaire was dedicated to measure the semantic differential of bus and tram. The respondents were asked to rate a bus and a tram on 26 attributions towards public transport systems. The selection of attributions is based on an extensive literature study and the precedent studies. The number of aspects was reduced to 26 with respect to the response burden and the layout of the questionnaire. Furthermore the aspects were roughly classified to allow for better orientation of the respondents. The items for both concepts, bus and tram, are placed on opposite sides of a page in the questionnaire what made it difficult to manipulate of compare ratings for tram and those for bus easily. Finally 22 attributions were used for further analysis.

4. Results

Firstly, the mean scores regarding the judgement of the single attributions were computed for both concepts bus and tram and displayed as semantic differential. Second, the single ratings were computed across respondents. Lastly, a factor analysis was conducted to identify dimensions that summarise the judgements about the aspects related to bus and tram.

4.1 Semantic differential of attributions

The judgements on the bipolar five point rating scale were recoded according to positive and negative end of scales. Low scores correspond with more positive ratings and high scores with negative ratings of the respective attribution (e.g reliable:1; not reliable: 5). This means that the lower the score the more positive was the judgement of the respective aspect. Details on the mean score and standard deviation for each attribution of bus and tram are displayed in Table 6 in the Appendix. The mean score for a bus is 2.26 (Std. dev. = 0.470) and the mean score for a tram is 2.15 (Std. dev. = 0.532). The difference of the means of the scores between bus and tram is 0.107 (Std. dev. = 0.539). A t-test of the difference of the means shows that the mean score of a tram is significantly higher (Sig.=0.000) in the dataset than the mean score of a bus.

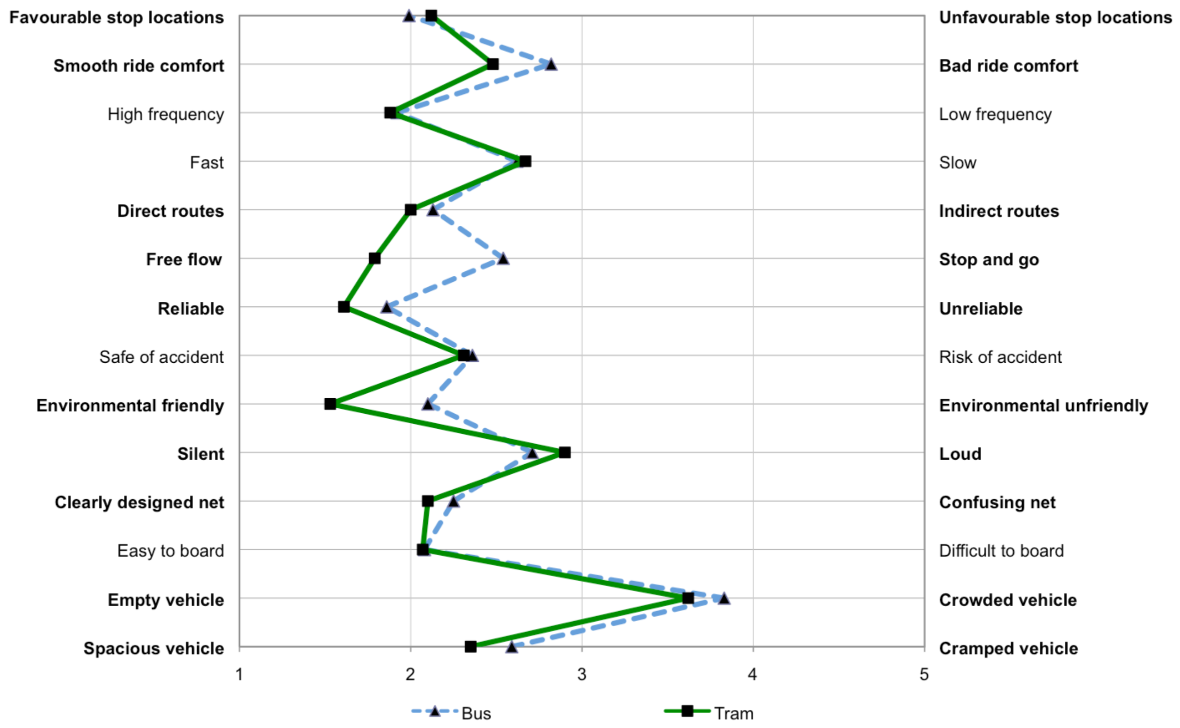
The best scores for buses are found on the three variables: *Importance, value and ease-of-use*. These attributions are affective emotional and express the appraisal of the mode. In contrast, the best scores for trams target rather rational attributions: *environmental friendliness, reliability and value*. A tram gets on average better (lower) scores on most of the attributions than a bus, except on the following attributions where a bus was rated better than a tram (compare Figure 1):

- Stop locations
- Noise
- Pace

The calculated differences were tested for significance between each bus and tram attributions (t-test). Judgements of 12 attributions turned out to differ significantly a 5% level (bold in Figure 1 and Figure 2). The aspects with the highest difference in judgements concern *traffic flow, environmental friendliness and ride comfort* in favour for tram (compare Table 7 in Appendix). The first two attributions represent rational attributions that are mainly affected by the dedicated right of way and the electrification of the tram.

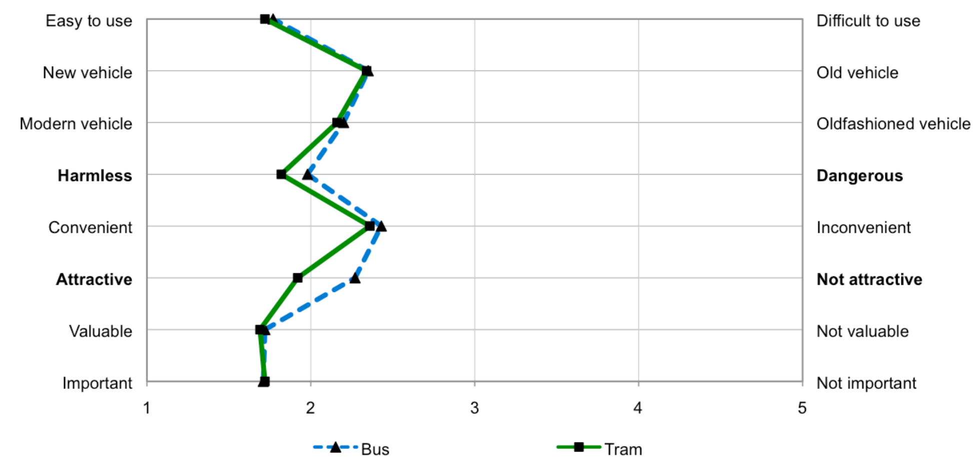
The following figures show the semantic differential of bus and tram on two dimensions. Similarly to Steg et al. (2001) the figures are divided into aspects that are rather rational-reasonable and descriptive (Figure 1) and into attributions classified as affective-emotional that are rather subjective (Figure 2).

Figure 1 Semantic differential for bus and tram: rational- reasonable aspects



It can be seen that rational-reasonable attributions (Figure 1) differ more between the two modes than affective-emotional aspects (Figure 2). There seem to be a higher consistency in attitudes on affective-emotional aspects towards bus and tram than on the specific rational-reasoned aspects such as environmental friendliness, traffic flow, reliability, and ride comfort.

Figure 2 Semantic differential for bus and tram: affective-emotional aspects



Against the background, that e.g. the environmental friendliness is due to the electrification what can also be the case for trolleybuses and free flow is dependent on dedicated ways some reasoned-instrumental attributions are partly not system immanent for a tram but they reflect general public's sense of these systems.

4.2 Subjects

The mean scores of a bus and a tram are computed across each subject p to investigate the distribution of the images and whether the image of a bus and a tram differ between user types. The image that a subject has of a mode is represented as mean score of attributions per subject.

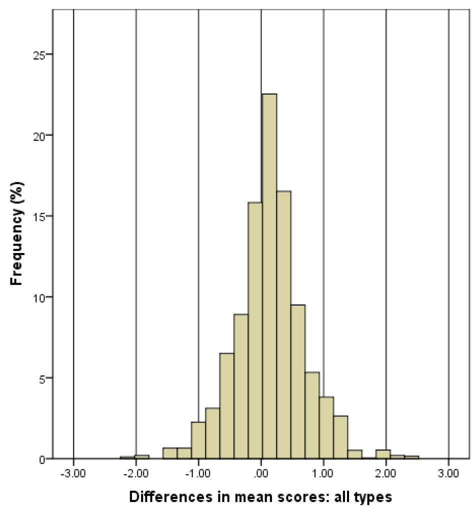
$$MeanScoreBus_p = \frac{\sum_1^n ScoreAttributionBus_j}{n},$$

$$MeanScoreTram_p = \frac{\sum_1^n ScoreAttributionTram_j}{n}, \qquad \text{(with n= number of attributions)}$$

$$Difference_p = MeanScoreBus_p - MeanScoreTram_p$$

A positive difference value represents a better judgement of tram compared to a bus and is interpreted as more positive image of a tram. The distribution of the difference of mean scores is displayed in Figure 3. There is a slight better image of a tram (mean>0) across respondents. Considering the chosen attributions as representative for the image of each public transport mode, this results that 12% of the respondents have a more positive image of a tram compared to their image of a bus.

Figure 3 Differences of mean scores



Mean = .1416
Std. Dev. = .56031
-: 38%
+: 62%
12% have a better image of tram

As Scherer et al. (2011) found that perception and beliefs towards transport modes vary depending on experiences and locations, the subjects are classified for further analysis. Subsequently the judgements of bus and tram are analyzed regarding public transport usage. Therefore three groups were composed according to ownership of different public transport ticket types:

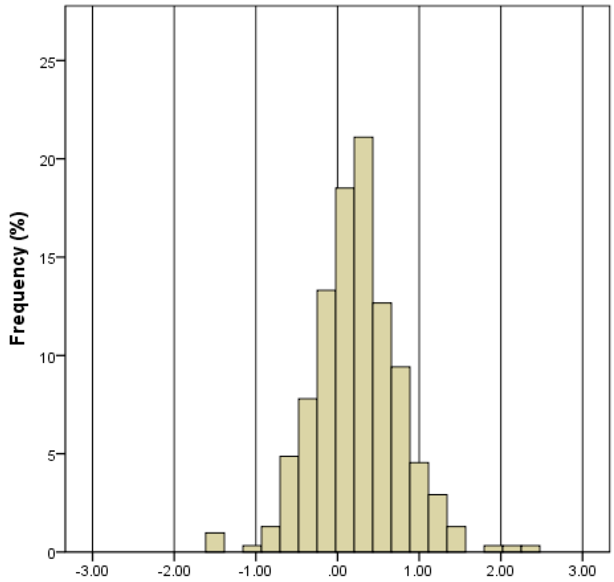
- Frequent user: Annual/monthly pass, pass for specific relations (Streckenabonnement);
- Occasional user: half fare card, multi-trip tickets;
- Non-user: no kind of pubic transport card.

4.2.1 Scores per user type

With regard to different user types of public transport, the difference of the mean scores of bus and tram decreases (compare Figure 3). Whereas frequent user show the highest mean score difference with 0.24 in favour for tram attributions, the difference is 0.05 for occasional users and 0.00 for non-user of public transport. This results in a variation of a more positive image for tram compared to bus of 3%-18% depending on the user type. The higher the public transport use, the better is the judgement for attributions that form the image of a tram. A t-test revealed that the difference of mean scores are significant on a 5% level for frequent users (Sign.=0.000) whereas the difference in mean scores of occasional users (Sign.=0.224) and non-users (Sign.= 0.983) turned out not to be significant. As a consequence the image of bus and tram differ less than previously expected for the two user groups of occasional users and non-users of public transport.

In contrast to public transport user where the difference of mean scores follows a normal distributions, the distribution of differences of non-users show a tendency for two peaks (Figure 4). This might be a reference for two classes of non-users comparable to the distinction between captive (car) drivers and choice drivers as potential public transport users (Krizek et al. 2007).

Figure 4 Distribution of differences of mean scores depending on user type



Difference of mean scores:

frequent user

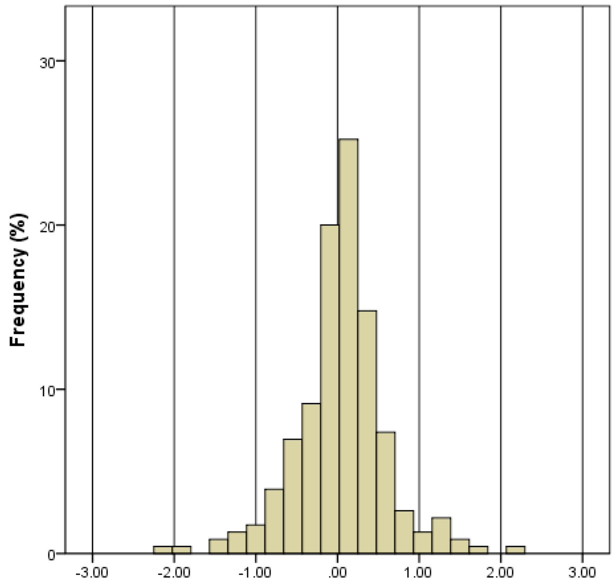
Mean = .2442

Std. dev. = .5295

- : 32%

+: 68%

Image of tram significant better than image of bus



Difference of mean scores:

occasional user

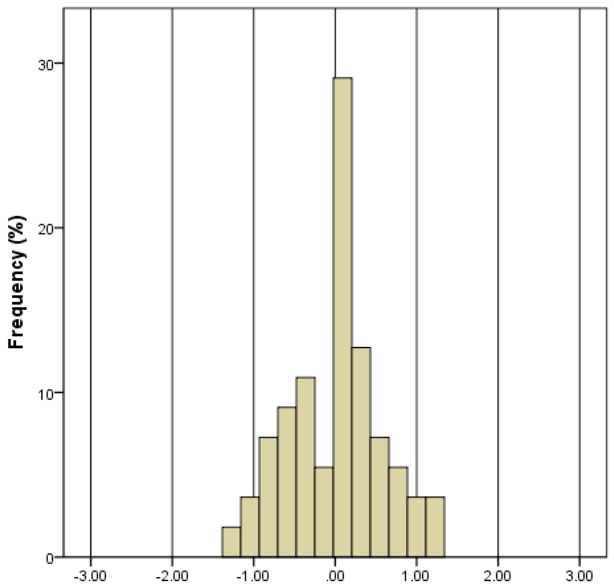
Mean = .0451

Std. dev.= .5602

-: 45%

+: 55%

NO significant difference of image scores of tram and bus



Difference of mean scores:

non-user

Mean = .0017

Std. dev. = .5758

-: 47%

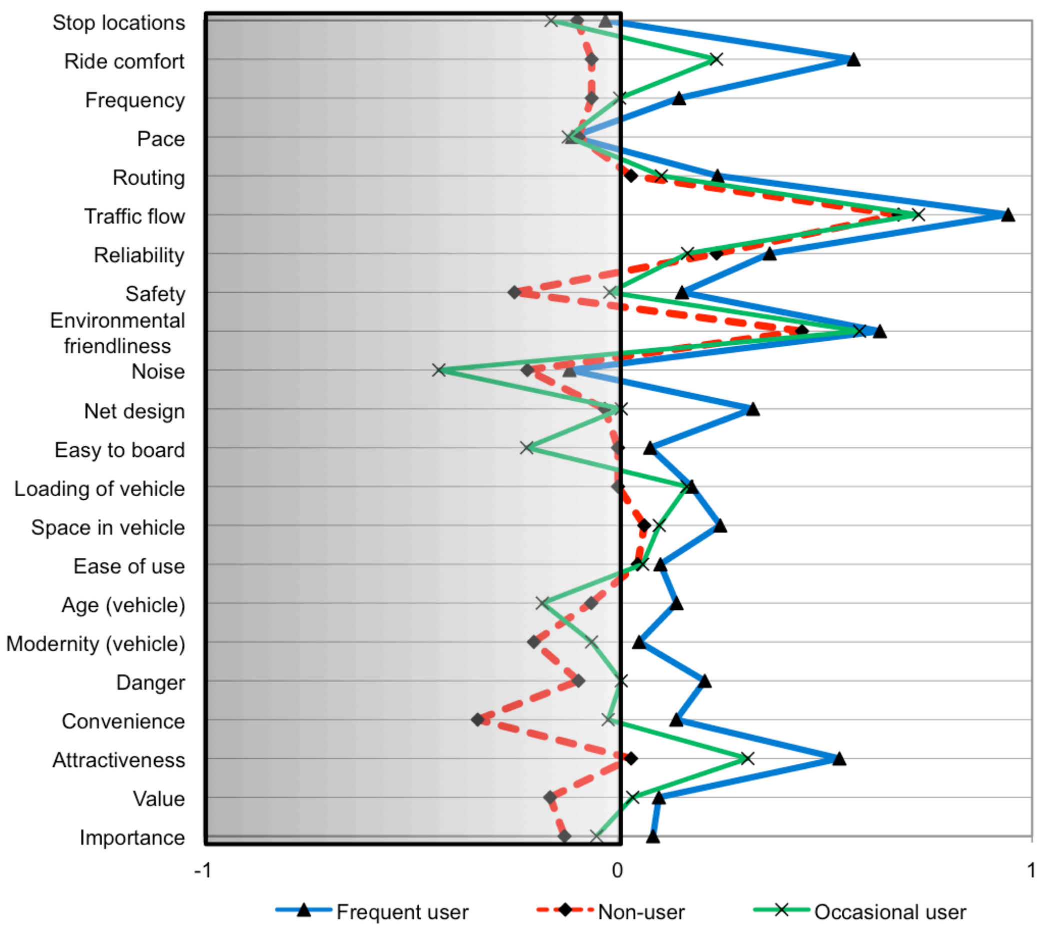
+: 53%

NO significant difference of image scores of tram and bus

The next step is to identify the sources of differences in the mean scores of bus and tram on a user type basis. Differences in scores for the specific attributes are computed and tested for significance on a 5% level on a subject basis in the different user groups that are discussed in the subsequent section. According to the hypothesis that there is a difference between the judgements of attributions of a tram and a bus the test score was Difference $Score_{Bus} - Score_{Tram} = 0$. The resulting difference of score of bus and tram per user type is displayed in Figure 5.

On the first sight it can be seen that frequent users have higher scores for trams than for buses on most of the attributions. In contrast, non-users of public transport tend to score both modes equally or more positive for buses. Interesting is the difference of scores between bus and tram of occasional users. Against the expectation to find their scores between those of the frequent user and non-user there are some remarkable outliers on the attribution of stop locations, pace, reliability, noise, easy to board, and age of vehicle.

Figure 5 Differences of scores per attributions depending on user type



Negative difference score (left part): Mean bus judgement better than tram judgement on this attribution
Positive difference score (right part): Mean tram judgement better than bus judgement on this attribution

4.2.2 Frequent public transport user

Regarding the rating of frequent public transport users, the significance of the differences in scores between bus and tram (compare Table 1). Since the mean scores of bus and tram differ significantly, it is of interest what attributions have a high impact on this result. By far the highest impact is due to the free flow of a tram, followed by the environmental friendliness. Those attributions that got better scores for buses turned out to be not significant.

Table 1 Difference in scores of frequent users

Attribution	T	df	Sign. (2-sided)	Mean difference
Traffic flow	12.898	328	.000	.94
Environmental friendliness	10.548	331	.000	.63
Attractiveness	7.933	330	.000	.53
Ride comfort	7.895	331	.000	.57
Reliabiliy	7.018	332	.000	.37
Net design	4.267	330	.000	.33
Danger	3.806	333	.000	.21
Routing	3.796	332	.000	.24
Space in vehicle	3.473	331	.001	.25
Loading of vehicle	3.444	331	.001	.18
Frequency	2.874	331	.004	.15
Age (vehicle)	2.345	331	.020	.14
Convenience	2.106	333	.036	.14
Safety	2.105	329	.036	.15
Ease of use	1.958	331	.051	.10
Value	1.923	333	.055	.10
Pace	-1.788	333	.075	**-.11**
Noise	-1.363	332	.174	**-.12**
Importance	1.358	330	.175	.08
Easy to board	1.249	334	.213	.08
Modernity (vehicle)	.880	333	.380	.05
Stop locations	-.608	331	.544	**-.03**

4.2.3 Occasional user

Considering the judgement of occasional user the picture differs from the one of the frequent users. The difference of mean score of bus and tram is 0.045 and was tested to be not significant on a 5% level. Regarding single attributions, there are four variables that are rated higher for a bus than for a tram on a significance level of 5% (compare Table 2): *Age of vehicle, noise, easy to board and stop locations*. From an occasional user perspective there are throughout aspects that are scored more positive for a bus than for a tram. Nevertheless the positive aspects of free flow and environmental friendliness have the highest impact on the difference in mean scores of bus and tram.

Table 2 Difference in scores of occasional users

Attribution	T	df	Sign. (2-sided)	Mean difference
Traffic flow	9.868	247	.000	.73
Environmental friendliness	8.160	251	.000	.58
Noise	-4.301	251	.000	**-.43**
Attractiveness	3.941	251	.000	.31
Reliabiliy	3.206	249	.002	.17
Loading of vehicle	2.820	251	.005	.17
Easy to board	-2.665	253	.008	**-.22**
Ride comfort	2.600	247	.010	.24
Stop locations	-2.507	247	.013	**-.16**
Age (vehicle)	-2.469	251	.014	**-.18**
Pace	-1.705	249	.089	**-.12**
Routing	1.466	247	.144	.10
Space in vehicle	1.333	250	.184	.10
Ease of use	.970	251	.333	.06
Modernity (vehicle)	-.872	250	.384	**-.06**
Importance	-.744	251	.458	**-.05**
Value	.492	252	.623	.04
Convenience	-.306	252	.760	**-.02**
Safety	-.202	249	.840	**-.02**
Danger	.113	251	.910	.01
Net design	.095	246	.924	.01
Frequency	.062	248	.950	.00

4.2.4 Non-user

For non-users the mean score for bus and tram was tested not to differ significantly. Interestingly, the differences in ratings of single attributions for bus and tram are only significant for the four variables in Table 5. Thereof three attributions (traffic flow, environmental friendliness, and reliability) get significant higher ratings for a tram and one attribution gets significant higher scores for a bus (convenience).

Table 3 Difference in scores of occasional users

Attribution	T	df	Sign. (2-sided)	Mean difference
Traffic flow	4.558	61	.000	.68
Environmental friendliness	3.196	62	.002	.44
Convenience	-2.197	61	.032	**-.34**
Reliability	2.161	62	.035	.24
Safety	-1.673	63	.099	**-.25**
Modernity (vehicle)	-1.476	63	.145	**-.20**
Value	-1.277	60	.207	**-.16**
Noise	-1.178	63	.243	**-.22**
Importance	-.760	61	.450	**-.13**
Stop locations	-.695	60	.490	**-.10**
Danger	-.652	62	.517	**-.10**
Pace	-.603	62	.549	**-.10**
Frequency	-.505	62	.615	**-.06**
Space in vehicle	.429	62	.670	.06
Ride comfort	-.397	62	.692	**-.06**
Age (vehicle)	-.393	61	.695	**-.06**
Ease of use	.273	62	.786	.05
Routing	.195	62	.846	.03
Net design	-.169	62	.866	**-.03**
Attractiveness	.157	62	.876	.03
Loading of vehicle	.000	61	1.000	.00
Easy to board	.000	63	1.000	.00

4.3 Factor analysis of bus and tram

Participant's ratings of the attributions of bus and tram were subjected to a factor analysis (principle components analysis) using a varimax rotation. Considering only the eigenvalues higher than 1, a five dimensional solution appeared to be most appropriate for both transport modes. The first five factors account for 54 % of the variance of the judgements of attributions for a bus and 57% of the variance for the judgements of attributions for a tram. Subsequently only variables with loadings >0.35 are listed in the respective tables.

4.3.1 Bus

The five resulting factors for bus are composed as following (compare Table 4):

- Factor 1 (eigenvalue 2.897, 13% of variance) reflects **affective emotional aspects and concerns towards bus use**.
- Factor 2 (eigenvalue 2.634, 12% of variance) shows high loadings on **rational vehicle aspects**.
- Factor 3 (eigenvalue 2.584, 12% of variance) has high loadings on **rational service characteristics**.
- Factor 4 (eigenvalue 2.327, 11% of variance) represents mainly **impacts from the bus on others (incl. general public) and users** with high loadings on *noise, and environmental friendliness, ride comfort and safety/security*.
- Factor 5 (eigenvalue 1.329, 6% of variance) accounts for impacts on the user **on the way**.

Five attributions show loadings higher than 0.35 on more than one factor. This is convenience what is classified in the dimension of affective emotional aspects and in the factor that describes impacts on the user on his way. The perception of the space in the vehicle affects on one hand vehicle aspects but also impacts on others (F4). Furthermore reliability and traffic flow load on the factors F3 (service characteristics) and F4 (impacts on others/users). And finally the loading of the vehicle targets the dimension of impacts on others/users and impacts the user itself on his ride. For the judgements of a bus, mainly rational factors (F2-F5) share several attributions.

Table 4 Factor loadings of attributions of bus

Attribution	F1: Affective emotions/ concerns	F2: Vehicle aspects	F3: Service char.	F4: Impacts on others/user	F5: Impacts on the way
Importance	.812				
Value	.764				
Ease of use	.580				
Attractiveness	.530				
Security	.508				
Convenience (vehicle)	.461				.403
Age (vehicle)		.842			
Modernity (vehicle)		.774			
Space (vehicle)		.640		.391	
Easy to board		.601			
Routing			.725		
Frequency			.712		
Stop locations			.667		
Reliability			.541	.394	
Traffic flow			.459	.499	
Noise				.656	
Ride comfort				.610	
Environmental friendliness				.489	
Loading (vehicle)				.459	.492
Net design (orientation)					.677
Pace					-.443
Safety					

4.3.2 Tram

The five resulting factors for tram are similar to those of the bus and are composed as following (compare Table 5):

- Factor 1 (eigenvalue 3.201, 15% of variance) reflects **rational vehicle aspects**.
- Factor 2 (eigenvalue 3.169, 14% of variance) shows high loadings on **affective emotional aspects and concerns towards tram use.**

- Factor 3 (eigenvalue 2.296, 10% of variance) has high loadings on **rational service characteristics**.
- Factor 4 (eigenvalue 2.221, 10% of variance) represents mainly (expected positive) **impacts from the tram on others and users** and is partly loaded with affective emotional aspects (value, attractiveness).
- Factor 5 (eigenvalue 1.762, 8% of variance) accounts for impacts on the user **on the way**.

Six attributions load on more than one factor higher than 0.35. Space in the vehicle is dedicated to vehicle aspects and impacts the user on his way. The subjective attribution reliablity is for a tram loaded on the factor of affective emotions but also on impacts on others/users (F4). Two further attributions are rather emotional are loaded on both factors emotional aspects and impacts on others: value and attractiveness. Safety is dedicated to the factors affective emotions/concerns and impacts on the user on his way. Lastly, the aspect of net design/orientation is loaded on service characteristics and affective emotions/concerns. Rational factors are partly loaded with attributions that are dedicated as well to affective emotional aspects (F2).

Table 5 Factor loadings of attributions of tram

Attribution	F1: Vehicle aspects	F2: Affective emotions/ concerns	F3: Service char.	F4: Impacts on others/user	F5: Impacts on the way
Age (vehicle)	.815				
Modernity (vehicle)	.811				
Easy to board	.764				
Space (vehicle)	.664				.399
Convenience (vehicle)	.570				
Importance		.736			
Value		.669		.387	
Ease of use		.651			
Attractiveness		.603		.443	
Security		.541			
Safety		.496			.385
Reliablity		.397		.564	
Net design (orientation)		.371	.569		
Frequency			.701		
Routing			.765		
Stop locations			.554		
Traffic flow				.705	
Pace				.647	
Environmental friendliness				.399	
Loading (vehicle)					.746
Noise					.617
Ride comfort					.531

4.3.3 Comparison

Assuming that there is no difference in the image of the two transport modes, it would be expected that the result of the factor analysis for bus and tram is equal. In fact, there is a high consistency and comparability of the resulting dimensions for bus and tram judgements. The factor solution accounts explanatory power of about 55% of the variance of the judgements for bus and tram. The different factors are similar in attributions and they account for similar percentages of the variance within a range of +/- 2%. For a tram, vehicle aspects and affective emotional aspects get a slightly higher explanatory power of the variance than the same factors for a bus. The factor solutions show a structure for public transport attributions that is applicable for both modes, bus and tram.

Comparing the attributions of the different factors it can be seen, that subjective attributions are strictly dedicated to affective emotional aspects and concerns for a bus whereas these aspects also load on rational factors such as service characteristics and impacts on others and users. This leads to the assumption that judgements for a tram are less rational than those for a bus because they are mixed with subjective emotional aspects.

Interesting is the dedication of the attributions reliability and traffic flow besides on the factor F4 to the factor considering service characteristics for a bus in contrast to the tram where reliability is loaded additionally on affective emotions. The aspect of safety has for a bus no loading >0.35 and thus can not be dedicated to one of the dimensions whereas this attribution load on affective emotions and impacts on the users for a tram.

Regarding the attributions that were found to differ significantly in judgements in the previous chapters, environmental friendliness and traffic flow, they are dedicated for bus and tram into the dimension of impacts on others/users with traffic flow having also high loadings on service characteristics of a bus.

5. Conclusions

The image of bus and tram constituted of 22 attributions was analyzed in dept in order to detect differences by using judgements from 663 respondents of a survey. The mean score of the bus and tram image over all respondents turned out to differ on a 5% significance level although the difference is small. As it is known from other studies that the image is influenced by experiences, the mean score differences where analyzed depending on public transport usage of the respondents. The better image of a tram compared to those of a bus is then only found in the group of frequent public transport users. The less the respondents use public transport modes the less is the difference in images. From this standpoint no possible rail factor in terms of a better image of a tram can be ascertained from the data.

The attributions that got significant higher scores for tram than for bus are mainly traffic flow and environmental friendliness, and some more depending on the user type. There seem to be a general belief that electrified public transport systems are more environmental friendly than motorized ones. This aspect is related to the traction and not to the tram itself so it is generally possible to provide environmental friendly public transport service by buses. Nevertheless the image in terms of the picture in mind turns out that the majority of people rather combine a tram with environmental friendliness than a bus.

Considering the aspect of traffic flow the better rating for a tram is explained by its right of way and its dedicated guideway. This is a rational advantage in cases where there are no bus lanes and no pedestrian crossings, since a tram does not operate according the rules of road traffic but has special rules. This is an aspect that targets the law and is dependent on the legislation and not strictly system specific for a tram.

In a nutshell, we could not ascertain a better image of a tram compared to the image of a bus in general. The two modes are judged similarly whereas a bus is rated more rational than a tram, which shows higher affective emotional attributions that are mixed with rational aspects. This is especially the case for attributions that target the general public and public transport users. We found that for a tram this dimension is partly affected with aspects that are subjective and emotional.

Similar to the findings of Cain et al. (2009), Steg et al. (2001), and Scherer and Dziekan (2011) we found that affective emotional aspects are relevant for the image and hence are expected to influence mobility behaviour. In contrast to the affective emotional aspects it is doubtful whether the aspect of environmental friendliness affects mobility behaviour in terms of bus or tram usage. As it is known from the literature that respondents tend to give answers that are politically correct, and hence respondents rather pretend to act environmental friendly it is not clear whether this is a motive for tram use instead of bus use. Nevertheless more research is needed to explore the relation between images, respectively affective emotional aspects and mobility behaviour in order to deduce conclusions about a rail factor.

Since the repeating argument of a rail factor is often used by decision makers to support a modal switch towards public transport use by implementing a tram, the image of bus and tram of the group of occasional users and non users is highly relevant. With the current study we could show, that this user groups do not have significant better images of a tram than of a bus so it is questionable whether they would change their mobility behaviour in cases where all other service characteristics remain the same.

To our knowledge this is the first study that investigated the image of urban public transport systems of different user groups. With the growing traffic problems in urban areas it becomes more and more important to understand the attitudes of different stakeholder groups that are affected by traffic. This allows for providing transport solutions that correspond with these stakeholder groups. Therefore we recommend for further research enhancements with different segmentations of public transport users and non-users.

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Appendix

Table 6 Mean score and standard deviation of bus and tram attributions (Anhang)

	Bus		Tram	
Attributes	Mean	Std.dev.	Mean	Std.dev.
Important – not important	1.71	.972	1.72	1.023
Valuable – not-valuable	1.72	.871	**1.69**	.966
Easy to use – difficult to use	1.77	.931	1.72	.972
Reliable - unreliable	1.86	.820	**1.61**	.653
High frequency – low frequency	1.92	.875	1.88	.820
Security: Harmless - dangerous	1.98	.931	1.82	.976
Favourable – unfavourable stop locations	**1.99**	.858	2.12	.872
Easy to board – difficult to board	2.08	.932	2.07	1.007
Environmental friendly – environmental unfriendly	2.10	.992	**1.53**	.798
Direct routes – indirect routes	2.13	.997	2.00	.983
Vehicle: modern - oldfashioned	2.20	.844	2.16	.987
Orientation: Clearly designed net – confusing net	2.25	1.164	2.10	1.194
Attractive – not attractive	2.27	1.006	1.92	1.006
Vehicle: new - old	2.35	.849	2.34	.987
Safety: Safe of accident – risk of accident	2.36	1.129	2.31	1.253
Vehicle: Convenient - inconvenient	2.43	1.025	2.36	1.048
Free flow – stop and go	2.54	1.017	1.79	.817
Vehicle: spacious - cramped	2.59	.969	2.35	1.024
Fast - slow	**2.62**	.791	2.67	1.008
Silent - loud	**2.71**	1.106	2.90	1.218
Smooth ride comfort – bad ride comfort	2.82	1.106	2.48	1.094
Vehicle: empty - crowded	3.83	.815	3.62	.814
Average total	**2.26**	**.470**	**2.15**	**.532**

Scale ranging from most positive (1) to most negative (5)

Table 7 Attributions with significant different scores on bus and tram (5% level)

Attribution	T	df	Sign. (2-sided)	Mean difference
Traffic flow	15.676	639	.000	**.74951**
Environmental friendliness	13.256	645	.000	**.57200**
Reliability	7.188	645	.000	.23660
Attractiveness	6.939	646	.000	.34100
Ride comfort	6.096	642	.000	.34162
Loading (vehicle)	5.558	639	.000	.20825
Space (vehicle)	4.729	647	.000	.23495
Security	3.460	649	.001	.14941
Stop locations	-3.185	637	.002	**-.11845**
Routing	3.154	645	.002	.14126
Noise	-3.131	649	.002	**-.19192**
Net design (orientation)	2.944	644	.003	.15827