# Influences of Service Quality on the Choice of Transport Mode in Regional Transport

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*Keywords: integrated choice experiments, hierarchical information integration, stated preference and choice analysis, service quality*

**Abstract**

Railway companies as well as public authorities are confronted with increasing customer expectations which concern not only fares and travel time but also many different service quality attributes. Better service quality is often seen as a means to increase the attractiveness of a transport mode but generally goes in line with higher costs and fares which in turn reduce the attractiveness.

The aim of the present paper is to determine the influences of service quality on mode choice between a regional train and a regional bus and to determine the trade-off between quality and fare by calculating willingness to pay for changes in service quality. To this end the method of 'Hierarchical Information Integration with Integrated Choice Experiments' is applied.

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This work was financed by the *FHprofUnd programme* of the German Federal Ministry of Education and Research and supported by three local railway companies in the Westphalia area.

## 1. Introduction

The improvement of service quality has become a major issue in the rail transport sector since it is commonly seen as a means to increase the share of rail transport (Regulation (EC) No. 1371/2007). Besides fare and time, service quality comprises a variety of different attributes. It has become common practice to measure customer satisfaction or service quality assuming that a higher service quality results in higher customer satisfaction and therefore in more trips, without considering alternative transport modes. Conversely, studies on transport mode choice which analyse different transport modes do not study the service quality in detail. This is due to the fact that studies on transport mode choice usually are based on common discrete choice analysis. This method only allows for a very restricted number of attributes. When there are too many attributes, respondents suffer from information overload which leads to high dropout rates or biased results.

One solution to handle a larger number of attributes is the method of 'Hierarchical Information Integration with Integrated Choice Experiments' (Oppewal, Louviere, and Timmermans, 1994). This approach is used in this paper. The authors have applied integrated choice experiments to analyse the choice between a regional train and a (notional) regional bus. The approach can also be extended to an individual transport mode. This paper detects which service quality attributes have a significant influence on the mode choice between the two transport modes. Willingness to pay for different levels of service quality is calculated.

## 2. Methodology

Discrete choice experiments are based on random utility theory. It is assumed that an individual derives utility from the attributes of a good i. This utility consists of two components: a systematic (or explainable) component $V_i$ and a random (or non-explainable) component $\varepsilon_i$:

$$U_i = V_i + \varepsilon_i.$$

The systematic component is described by:

$$V_i = X_i \beta,$$

where $X_i$ is the vector of attribute levels of the good and β the vector of taste parameters. It is assumed that in a given choice situation, the individual chooses the alternative with the highest utility. Therefore, the probability that the alternative i is chosen over the alternative j can be written as:

$$P_i = P(U_i > U_j) = P(V_i + \varepsilon_i > V_j + \varepsilon_j) = P(V_i - V_j > \varepsilon_j - \varepsilon_i) = P(X_i\beta - X_j\beta > \varepsilon_j - \varepsilon_i).$$

Under the assumption that the random components are independently and identically distributed (IID) as extreme value type I random variates, this equation results in

$$P_i = \frac{e^{\mu V_i}}{\sum_{j=1}^{J} e^{\mu V_j}} = \frac{e^{\mu(X_i\beta)}}{\sum_{j=1}^{J} e^{\mu(X_j\beta)}}, \quad j = 1, \dots, J,$$

where µ is a scale parameter that cannot be identified in a single data set and, therefore, is usually set to 1. The parameters of this multinomial logit (MNL) model can be estimated for example by maximum likelihood estimation (Ben-Akiva and Lerman, 1985, Hensher, Rose, and Greene, 2005, Louviere, Hensher, and Swait, 2000).

This model is restricted by the number of attributes that respondents are able to cope with simultaneously. Hierarchical Information Integration (HII) is an extension of the Information Integration Theory. It assumes that individuals group similar attributes into separate constructs to simplify the evaluation of alternatives when making (complex) decisions.[1] The original HII approach, proposed by Louviere (1984), analyses each construct separately in a rating sub-experiment, resulting in K different sub-experiments for K different constructs. A bridging experiment (which can be designed as a rating or choice experiment) in which overall construct ratings of the K constructs are included, connects attributes and constructs. Therefore, K+1 experiments are necessary in the original HII approach. One of the major disadvantages is that it is not possible to test the hierarchical structure of the original HII approach. This means that it cannot be tested if the constructs summarise the attributes correctly.

To overcome this problem, Oppewal, Louviere, and Timmermans (1994) proposed the Integrated HII (HII-I) approach. Instead of a bridging experiment they propose to conduct K integrated choice experiments when there are K constructs. In these sub-experiments besides the attributes of one construct the remaining other constructs are included. The exchange of a construct and its corresponding attributes should not affect the estimation results of the other parameters. Hence, it is possible to test if the constructs summarise the attributes correctly.

The systematic component of the utility can now be described as:

$$V_i = X_i \beta + G_i \gamma,$$

where G is the vector of the construct levels and γ the vector of the corresponding taste parameters.

[1] Each attribute is part of one and only one construct.

The probability function is extended to:

$$P_i = \frac{e^{\mu V_i}}{\sum_{j=1}^{J} e^{\mu V_j}} = \frac{e^{\mu(X_i \beta + G_i \gamma)}}{\sum_{j=1}^{J} e^{\mu(X_j \beta + G_j \gamma)}}, \quad j = 1, \dots, J.$$

The vectors of taste parameters β and γ can be estimated separately for each sub-experiment. When there are three or more constructs and consequently three or more sub-experiments, it is possible to test for process equality across sub-experiments (i.e. if γ is equal in the different experiments) using likelihood ratio statistics. Since the different sub-experiments may have different error distributions which go along with different scale parameters μ, these differences have to be taken into account (Swait and Louviere, 1993).

The methods of HII and HII-I have already been applied in different disciplines, for example to analyse shopping behaviour (Louviere and Gaeth, 1987, Oppewal, Louviere, and Timmermans, 1994, Oppewal, Timmermans, and Louviere, 1997), residential choices (Louviere and Timmermans, 1990, Molin, Oppewal, and Timmermans, 2001 and 2002), recreation destination choices (Louviere and Timmermans, 1990 and 1992), banking choices (Oppewal and Vriens, 2000), health care decisions (van Helvoort-Postulalart et al. 2008), choices of mobile phones (Ramírez-Hurtado, 2010), and choices in the transport sector. In the transport sector it was for example applied to choices in bus transport (Hensher, 1990), the choice of park and ride facilities (Bos et al. 2004), multimodal choices in public transport (Molin and van Gelder, 2008), freight mode choice (Norojono and Young, 2003), and long distant passenger mode choice (Chiang, Lu, and Chang, 2003).

## 3. Research design

The selection of attributes to be analysed in this study was based on literature and expert interviews. The clustering of attributes into the corresponding constructs was done in an empirical pre-study, where the approach proposed by Bos et al. (2002, 2003) was used. Respondents were asked to group similar attributes and to name these groups. The similarity data was analysed using the method of Multidimensional Scaling (MDS): When many respondents grouped a pair of attributes often in the same group, these two attributes were arranged close to each other in a multidimensional space. Conversely, when respondents seldom grouped a pair of attributes in the same group, these two attributes were arranged distant to each other. As a result of the pre-study with 500 respondents, three constructs have been selected, namely 'Quality of connection', 'Comfort' and 'Information' which were included in integrated choice experiments. Additionally, the fare and total travel time were included which can be interpreted either as an attribute or as a construct, since fare and total travel time can be disaggregated into separate price and time elements (such as access time, in-vehicle time, interchanging time and egress time).[2]

The relationship between the attributes and their corresponding constructs is illustrated in Figure 1. The grey shaded attributes and constructs were used in the sub-experiment 'Quality of connection'. Analogously, the sub-experiments 'Comfort' and 'Information' were created.

The attribute levels were selected by the authors and experts of the three railway companies. The attributes had two, three, and four levels, respectively (Table 1). The attribute levels of the fares were calculated individually for each respondent and represent 90%, 95%, 100%, 105%, and 100% of the respondent's current fare. The attribute levels of the time were calculated by adding/subtracting +10 minutes, +5 minutes, +0 minutes, -5 minutes, and -10 minutes to/from the current total travel time. The levels of the construct were '- -', '+ +', and '+ + + +' (on a scale ranging from '- - - - -' (very bad) to '+ + + + +' (very good)), respectively. All levels were varied randomly in the experiments.

[2] The authors did not focus on time and fare and refer to other publications (Wardman, 2001, 2004, Fosgerau et al., 2007).

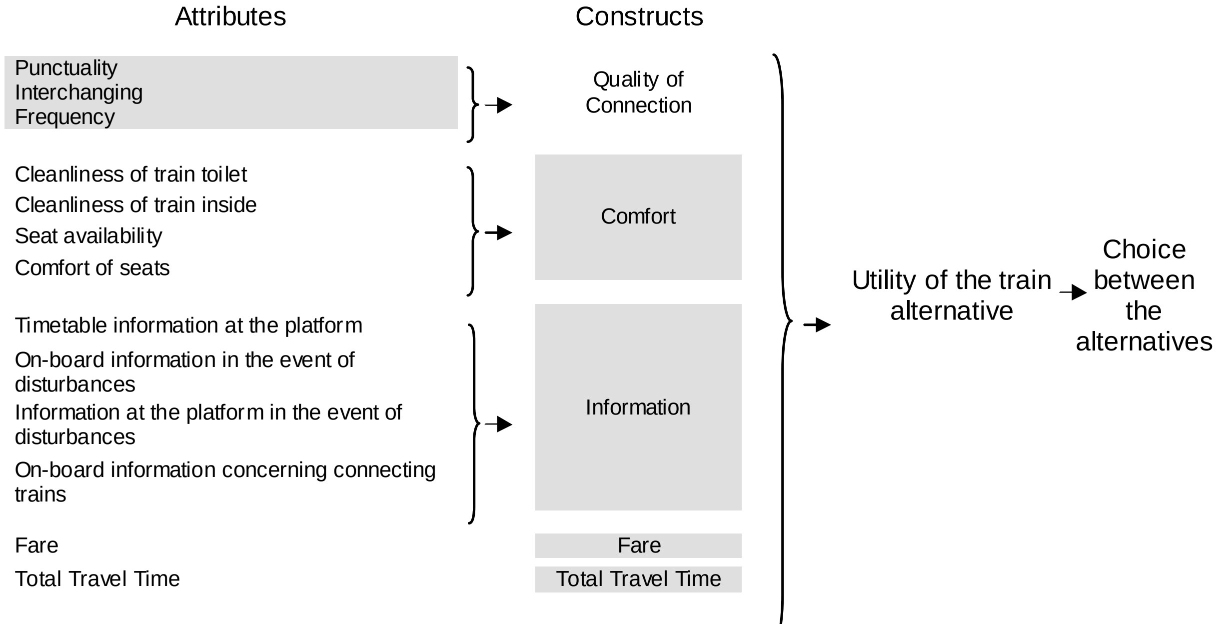


**Figure 1: Relationship between attributes and constructs in the sub-experiments for the train alternative**

| Construct | Attribute | 1st attribute level | 2nd attribute level | 3rd attribute level | 4th attribute level |
|---|---|---|---|---|---|
| Quality of Connection | Punctuality | on time or up to 3 minutes late | 3 to 10 minutes late | 10 to 20 minutes late | |
| | Interchanging | 0 interchanges | 1 interchange with guaranteed connection | 1 interchange without guaranteed connection | |
| | Frequency | every 30 minutes | every 60 minutes | every 120 minutes | |
| Comfort | Cleanliness of train/bus toilet | clean | dirty | no toilet | |
| | Cleanliness of train/bus inside | clean | floor is sticky, paper lies on the seats | | |
| | Seat availability | during the whole trip | during half of the trip | no free seat | |
| | Comfort of seats | comfortable | not comfortable | | |
| Information | Timetable information at the platform/bus stop | available | not available | | |
| | On-board information in the event of disturbances | announcements and display of reason and duration of disturbances | announcements of reason and duration of disturbances | display of reason and duration of disturbances | no information |
| | Information at the platform/bus stop in the event of disturbances | announcements and display of reason and duration of disturbances | announcements of reason and duration of disturbances | display of reason and duration of disturbances | no information |
| | On-board information concerning connecting trains/busses | announcements and display | announcements | display | no information |

**Table 1: Constructs, attributes, and their levels**

## 4. Data collection and Description of the sample

Data was collected in the Westphalia area/Germany on board on local trains of three private train operators by means of computer assisted personal interviews during May and October 2010. Train users were selected randomly by interviewers and asked if they were willing to participate in an interview during their current trip. In total over 2000 valid interviews were collected. In this paper a sample of 661 interviews was used. This sample was selected by the fare (smaller or equal to 15 €), the total travel time (more than 15 minutes and smaller or equal to 90 minutes) and the number of transport alternatives (only train and (notional) bus alternative available) and therefore represents regional captive riders.

The questionnaire was programmed in MS Access. Therefore, attribute levels in the sub-experiments could be created with reference to the attribute levels of the current journey of the respondents. This allowed for more realistic choice situations in the experiments in contrast to traditional questionnaires used in paper and pencil interviews.

Firstly, respondents were asked to describe their current journey, especially their current fare for the current (one-way) trip and the total travel time from origin to destination. If respondents had a car alternative for the current trip, they were also asked to estimate price and total travel time for the car trip. Secondly, respondents were familiarised with the levels of the constructs and their corresponding attributes. They were asked to rate three different profiles of attribute levels on a scale ranging from '- - - - -' (very bad) to '+ + + + +' (very good) for each construct. Thirdly, respondents were randomly assigned to a sub-experiment in which they had to make mode choices in five randomly created choice situations. Finally, respondents were asked some demographic questions and questions about their usual travel behaviour.

The characteristics of the respondents in the sample are listed in Table 2, showing that (1) nearly as many men as women participated in the interviews; (2) most of the respondents were between 18 and 30 years old; (3) three out of four respondents had a driving license; (4) three out of four respondents had a season ticket; (5) 70% of the respondents used the train a few times a week; and (6) there were nearly equal percentages of respondents that used the car a few times per week, a few times per month, and rarely. The characteristics of the three subgroups of respondents randomly assigned to the three sub-experiments were similar, therefore, the corresponding tables are omitted. The average total travel time was 55 minutes and the average fare 3.63 €.

## 5. Analysis and Results

Data derived from the three sub-experiments were analysed using separate MNL models with the NLOGIT software package (Version 4.0.1). The three construct values were coded on a linear scale as 4, 7, and, 9.[3] All attributes of the constructs had categorical levels which required a recording.

A very common coding scheme is dummy coding: An attribute with L qualitative levels is transformed into L-1 dummy variables. A dummy is set equal to 1 when the qualitative level is present and set equal to 0 otherwise. The *L*th level is excluded, since it is the reference level with all dummies being equal to 0. Unfortunately, this coding scheme poses problems when it is used in choice experiments with alternative specific constants because the reference level of attributes cannot be separated from the alternative specific constant (ASC) and the estimated parameters are correlated with the ASC (Bech and Gyrd-Hansen, 2005).

[3] Effect coding for the construct levels did not improve the models significantly.

| | Absolute (N=661) | Relative (%) |
|---|---|---|
| 1 Sex | | |
| Male | 319 | 48.3 |
| Female | 339 | 51.3 |
| Missing values | 3 | 0.5 |
| 2 Age (years) | | |
| <= 17 | 40 | 6.1 |
| 18 - 30 | 305 | 46.1 |
| 31 - 50 | 222 | 33.6 |
| >= 51 | 84 | 12.7 |
| Missing values | 10 | 1.5 |
| 3 Driving License | | |
| Yes | 493 | 74.6 |
| No | 165 | 25.0 |
| Missing values | 3 | 0.5 |
| 4 Season Ticket | | |
| Yes | 491 | 74.3 |
| No | 167 | 25.3 |
| Missing values | 3 | 0.5 |
| 5 Frequency of train use | | |
| A few times per week | 463 | 70.0 |
| A few times per month | 127 | 19.2 |
| Rarely | 62 | 9.4 |
| Never | 6 | 0.9 |
| Missing values | 3 | 0.5 |
| 6 Frequency of car use | | |
| A few times per week | 196 | 29.7 |
| A few times per month | 165 | 25.0 |
| Rarely | 212 | 32.1 |
| Never | 83 | 12.6 |
| Missing values | 5 | 0.8 |

**Table 2: Characteristics of the respondents of the sub-sample**

A more appropriate coding scheme is effect coding: Similar to dummy coding L-1 dummy variables are created but the reference level is assigned a value of -1 instead of 0. Thus, the effect coded variable for one qualitative level is set equal to 1 when the qualitative level is present, set equal to -1 when the reference level is present and 0 otherwise. Consequently, the reference level corresponds to the negative sum of the effect coded variables. When using effect coding the parameters are uncorrelated with the ASC (Bech and Gyrd-Hansen, 2005, Louviere, Hensher, and Swait, 2000). Therefore effect coding was used for all categorical variables.

Since the base level of an attribute is calculated by the negative sum of the other attributes it is controversial what to do if a parameter of a single attribute level is not estimated significantly different from 0. An omission of this attribute level would result in a change of the whole model. Hence, it is common practice to retain this variable in the calculation of the reference level.

Before pooling the three separate MNL models into an overall concatenated model, the equivalence of sub-experiments concerning the three constructs as well as the fare and time attributes and the alternative specific constant was tested using log-likelihood ratio test statistics (van de Vyvere, Oppewal, and Timmermans 1998, Swait and Louviere, 1993, Hensher, Louviere, and Swait, 1999). Within the margins of statistical error, no significant differences between sub-experiments were found.[4] Therefore, data of the three sub-experiments was pooled into an overall concatenated model. The values of the taste parameters, standard errors, t-values, and significance levels are presented in Table 3.

[4] $\lambda = -2 * [-2015.79 - (-654.25 -737.66 -616.23)] = 15.3 < 16.9$ (critical value for 9 degrees of freedom at 5 percent significance level). Scale factors (Swait and Louviere, 1993, Swait and Bernadino, 2000) were taken into account but no significant different scale factors were found between the sub-experiments.

| Attribute | | Parameter | Standard Error | t-value | Significance level |
|---|---|---|---|---|---|
| Train constant | | 0.61197 | 0.03969 | 15.4 | 0.000 |
| Time | | -0.06658 | 0.00408 | -16.3 | 0.000 |
| Fare | | -0.64927 | 0.09026 | -7.2 | 0.000 |
| Punctuality | | | | | |
| | on time or up to 3 minutes late | 0.32623 | | | |
| | 3 to 10 minutes late | 0.07257 | 0.07043 | 1.0 | 0.303 |
| | 10 to 20 minutes late | -0.39880 | 0.06980 | -5.7 | 0.000 |
| Interchanging | | | | | |
| | 0 interchanges | 0.40998 | | | |
| | 1 interchange with guaranteed connection | -0.10989 | 0.07044 | -1.6 | 0.119 |
| | 1 interchange without guaranteed connection | -0.30010 | 0.06977 | -4.3 | 0.000 |
| Frequency | | | | | |
| | every 30 minutes | 0.70145 | | | |
| | every 60 minutes | 0.02249 | 0.06913 | 0.3 | 0.745 |
| | every 120 minutes | -0.72394 | 0.07255 | -10.0 | 0.000 |
| Cleanliness of train/bus toilet | | | | | |
| | clean | 0.13399 | | | |
| | dirty | 0.04819 | 0.06421 | 0.8 | 0.453 |
| | no toilet | -0.18218 | 0.06292 | -2.9 | 0.004 |
| Cleanliness of train/bus inside | | | | | |
| | clean | 0.13019 | | | |
| | floor is sticky, paper lies on the seats | -0.13019 | 0.04461 | -2.9 | 0.004 |
| Seat availability | | | | | |
| | during the whole trip | 0.65834 | | | |
| | during half of the trip | 0.07526 | 0.06264 | 1.2 | 0.230 |
| | no free seat | -0.73360 | 0.06733 | -10.9 | 0.000 |
| Comfort of seats | | | | | |
| | comfortable | 0.01723 | | | |
| | not comfortable | -0.01723 | 0.04510 | -0.4 | 0.702 |
| Timetable information at the platform/bus stop | | | | | |
| | available | 0.11053 | | | |
| | not available | -0.11053 | 0.04771 | -2.3 | 0.021 |
| On-board information in the event of disturbances | | | | | |
| | announcement effect | 0.02002 | 0.04948 | -0.4 | 0.686 |
| | display effect | 0.08027 | 0.04855 | -1.7 | 0.098 |
| | interaction effect | 0.00324 | 0.04813 | 0.1 | 0.946 |
| Information at the platform/bus stop in the event of disturbances | | | | | |
| | announcement effect | 0.05239 | 0.04830 | -1.1 | 0.278 |
| | display effect | 0.13694 | 0.04885 | -2.8 | 0.005 |
| | interaction effect | -0.04870 | 0.04958 | -1.0 | 0.326 |
| On-board information concerning connecting trains/busses | | | | | |
| | announcement effect | 0.02368 | 0.04860 | -0.5 | 0.626 |
| | display effect | 0.03365 | 0.04869 | -0.7 | 0.490 |
| | interaction effect | -0.10341 | 0.04741 | -2.2 | 0.029 |
| Constructs: | | | | | |
| Quality of connection | | 0.19725 | 0.01684 | 11.7 | 0.000 |
| Comfort | | 0.17485 | 0.01746 | 10.0 | 0.000 |
| Information | | 0.07888 | 0.01576 | 5.0 | 0.000 |
| Log Likelihood value | | -2015.792 | | | |

**Table 3: Overall concatenated MNL model**

The alternative specific constant was linked to the train alternative. Since it is statistically significant and positive it can be assumed that all parameters being equal respondents preferred the train alternative over the bus alternative.

Concerning the constructs a change of one unit of the construct 'Quality of connection' has a slightly larger influence on utility and therefore on mode choice than a change of one unit of the construct 'Comfort'. A change of one unit of either of these constructs has a more than two times larger influence than a change of one unit of the construct 'Information'.

Among the attributes that describe the construct 'Quality of connection', frequency influences the mode choice the most, followed by punctuality and interchanging.[5]

A change in the frequency from 'every 120 minutes' to 'every 60 minutes' has a nearly comparable effect as a change from 'every 60 minutes' to 'every 30 minutes'. With regard to punctuality a change from '3 to 10 minutes late' to '10 to 20 minutes late' has a larger influence than a change from 'on time or up to 3 minutes late' to '3 to 10 minutes late'. An interchange in general influences mode choice more than the fact that the connection is guaranteed or not.

'Seat availability' is the most important attribute of the construct 'Comfort' followed by 'Cleanliness of the train/bus toilet' and 'Cleanliness of the train/bus inside'. The taste parameter for the attribute 'Comfort of seats' is not statistically significant nor an interaction with seat availability which was calculated in a different model.

Only the parameter estimates of the 'Timetable information at the platform/bus stop', the display effect of 'Information at the platform/bus stop in the event of disturbances' and the interaction between the display and the announcement effect of 'On-board information concerning connecting trains' are statistically significant.

In contrast to the two other constructs, the sub-experiment of the construct 'Information' was more complex since the attributes had more levels and respondents had to read more. Besides, already in the prestudy, the construct attributes were less coherent.

Internal validity of the estimated model can be described by the hit-rate, which indicates the percentage of correctly predicted choice data within the sample. When applying the estimated model to predict the choice situations 64% ((1628+773)/3753 = 64.0%) of the choices were predicted correctly (Table 4).

| | | Predicted choices | | |
|---|---|---|---|---|
| | | Train | Bus | Total |
| Actual choices in the experiments | Train | 1628 | 676 | 2304 |
| | Bus | 676 | 773 | 1449 |
| | Total | 2304 | 1449 | 3753 |

**Table 4: Actual Choices vs. Predicted Choices**

The parameter estimates can be used to calculate relative willingness to pay. Given that the whole model is based on differences in utility, mode choice does not change if the utility differences remain equal. That means when a higher level of service quality is proposed the fare may increase by a certain amount which corresponds to the willingness to pay. Conversely, when a lower level of service quality of is proposed the fare should decrease by a certain amount of money. In both cases utility does not change and consequently, mode choice is not affected.

[5] It should be kept in mind that the range of taste parameter values depends on the design of the experiments, i.e. the range covered by the attribute levels.

Willingness to pay is calculated by dividing the taste parameter estimates of the attribute levels by the fare parameter. Given that the attributes are effect coded the values indicate a deviation from the great mean. Differences between the willingness to pay between each successive level are calculated for all attributes and constructs except for the information attributes[6]. Results are presented in Table 5.

For example, each minute of travel time saving equals to 0.10€, whereas a change from a dirty to a clean toilet on-board equals to 0.13€.

| | | | |
|---|---|---|---|
| Train constant | 0.94 € | | |
| Time (per minute) | 0.10 € | | |
| Punctuality | | Cleanliness of train/bus toilet | |
| on time or up to 3 minutes late | | clean | |
| | 0.39 € | | 0.13 € |
| 3 to 10 minutes late | | dirty | |
| | 0.73 € | | 0.35 € |
| 10 to 20 minutes late | | no toilet | |
| Interchanging | | Cleanliness of train/bus inside | |
| 0 interchanges | | clean | |
| | 0.80 € | | 0.40 € |
| 1 interchange with guaranteed connection | | floor is sticky, paper lies on the seats | |
| | 0.29 € | | |
| 1 interchange without guaranteed connection | | Seat availability | |
| | | during the whole trip | |
| Frequency | | | 0.90 € |
| every 30 minutes | | during half of the trip | |
| | 1.05 € | | 1.25 € |
| every 60 minutes | | no free seat | |
| | 1.15 € | | |
| every 120 minutes | | Constructs (per unit): | |
| | | Quality of connection | 0.30 € |
| | | Comfort | 0.27 € |
| | | Information | 0.12 € |

**Table 5: Willingness to pay for changes of service quality**

## 6. Conclusion and Discussion

The aim of the present paper was to determine the influences of service quality on mode choice between a regional train and a regional bus and to determine the trade-off between quality and fare by calculating willingness to pay for changes in service quality.

The improvement of service quality is commonly seen as a means to increase the share of rail transport. On the one hand a higher level of service quality should make a transport mode more competitive and attract passengers. But on the other hand better services generally go in line with higher costs and therefore higher fares which reduce in turn the attractiveness of the transport mode. In order to analyse mode choice common discrete choice experiments are widely used in transportation research. Unfortunately, this method cannot be properly used when there are many attributes. Therefore, the method of 'Hierarchical Information Integration with Integrated Choice Experiments' was applied to analyse the mode choice between a regional train and a (notional) regional bus with regards to changes of fare, time and quality attributes concerning the quality of connection, comfort, and information. Interviews with train users were conducted.

It has been shown that the application of the integrated choice experiments was successful to model regional transport. Results for data of captive riders showed that many quality attributes had a significant influence on the mode choice. Willingness to pay for changes in service quality was calculated.

[6] The willingness to pay for the information attributes were omitted since the taste parameters were not significant.

The approach can be extended to a car alternative. When one is aware of the current ridership of the choice alternatives, it is possible to predict the number of additional train users due to an improvement of service quality. Potential earnings can be opposed to the spending which is necessary to implement the improvement of service equally. This information can prepare railway companies for further tenders.

The approach can also be applied to long distance transport for example to model the choice between a high-speed train, an airplane and a car.

**References**

Bech, M., Gyrd-Hansen, D., 2005. Effects coding in discrete choice experiments. Health Economics 14 (10), 1079–1083.

Ben-Akiva, M.E., Lerman, S.R., 1987. Discrete Choice Analysis. Theory and appliation to travel demand. MIT Pr., Cambridge, Mass.

Bos, D., Molin E.J.E, van der Heijden, R., 2002. User-based definition of higher-order decision constructs to model preferences for P&R transfer points. In: Sucharov, L.J. (Ed.), Urban transport VIII. Urban transport and the environment in the 21st century. WIT; Computational Mechanics, Southampton; Boston, Billerica, pp. 417–426.

Bos, I., Molin, E., Timmermans, H., van der Heijden, R., 2003. Cognition and Relative Importance Underlying Consumer Valuation of Park-and-Ride Facilities. Transportation Research Record 1835 (1), 121–127.

Bos, I.D.M., van der Heijden, R.E.C.M., Molin, E.J.E., Timmermans, H.J.P., 2004. The choice of park and ride facilities: an analysis using a context-dependent hierarchical choice experiment. Environment and Planning A 36 (9), 1673–1686.

Chiang, L.-S., Lu, J.-L., Chang, H.-C., 2003. Modeling the Effect of Destination Attributes on the Intercity Travelers' Mode Choice Behavior in Taiwan Area. Proceedings of the Eastern Asia Society for Transportation Studies 4, 717–730.

Fosgerau, M., Hjorth, K., Lyk-Jensen, S.V., 2007. The Danish Value of Time Study. Final Report.

Hensher David A., 1991. Hierarchical Stated Response Designs - An Application to Bus User Preferences. Logistics and Transportation Review 26 (4), 299–321.

Hensher, D., Louviere, J., Swait, J.D., 1998. Combining sources of preference data. Journal of Econometrics 89 (1-2), 197–221.

Hensher, D.A., Rose, J.M., Greene, W.H., 2005. Applied choice analysis. Cambridge University Press, Cambridge.

Louviere, J.J., 1984. Hierarchical Information Integration: A New Approach for the Design and Analysis of Complex Multiattribute Judgment Problems. Advances in Consumer Research 11, 148–155.

Louviere, J.J., Gaeth, G.J., 1987. Decomposing the Determinants of Retail Facility Choice Using the Methods of Hierarchical Information Integration: A Supermarket Illustration. Journal of Retailing 63 (1), 25–48.

Louviere, J.J., Hensher, D.A., Swait, J.D., Adamowicz, W., 2000. Stated choice methods. Analysis and applications. Cambridge University Press, Cambridge ; Madrid [etc.].

Louviere, J., Timmermans, H., 1990. Hierarchical Information Integration Applied to Residential Choice Behavior. Geographical Analysis 22 (2), 127–144.

Louviere, J.J., Timmermans, H.J.P., 1990. Using hierarchical information integration to model consumer responses to possible planning actions: recreation destination choice illustration. Environment and Planning A 22 (3), 291–308.

Louviere, J., Timmermans, H., 1992. Testing the external validity of hierarchical conjoint analysis models of recreational destination choice. Leisure Sciences 14 (3), 179–194.

Molin, E.J.E., Oppewal, H., Timmermans, H.J.P., 2001. Analyzing heterogeneity in conjoint estimates of residential preferences. Journal of Housing and the Built Environment 16, 267–284.

Molin, E.J.E., Oppewal, H., Timmermans, H.J.P., 2002. Conjoint modeling of residential group preferences: A comparison of the internal validity of hierarchical information integration approaches. Journal of Geographical Systems 4, 343–358.

Molin, E., Timmermans, H., 2009. Hierarchical Information Integration Experiments and Integrated Choice Experiments. Transport Reviews 29 (5), 635–655.

Molin, E., van Gelder, M., 2008. Freeway Access to Public Transport: A Hierarchical Multimodal Choice Model. Transportation Research Record: Journal of the Transportation Research Board 2076 (1), 106–113.

Norojono, O., Young, W., 2003. A Stated Preference Freight Mode Choice Model. Transportation Planning and Technology 26 (2), 195–212.

Oppewal, H., Louviere, J.J., Timmermans, H.J.P., 1994. Modeling Hierachical Conjoint Processes With Integrated Choice Experiments. Journal of Marketing Research 31, 92–105.

Oppewal, H., Timmermans, H.J.P., Louviere, J., 1997. Modelling the effects of shopping centre size and store variaty on consumer choice behaviour. Environment and Planning A 29, 1073–1090.

Oppewal, H., Vriens, M., 2000. Measuring perceived service quality using integrated conjoint experiments. International Journal of Bank Marketing 18 (4), 154–169.

Ramírez-Hurtado, J.M., 2010. Measuring Preferences: from Conjoint Analysis to Integrated Conjoint Experiments. Revista de Métodos Cuantitativos para la Economía y la Empresa 9, 28–43.

REGULATION (EC) No 1371/2007 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 October 2007 on rail passengers' rights and obligations. In: Official Journal of the European Union, pp. 14–41.

Swait, J., Bernardino, A., 2000. Distinguishing taste variation from error structure in discrete choice data. Transportation Research Part B: Methodological 34, 1–15.

Swait, J., Louviere, J., 1993. The Role of the Scale Parameter in the Estimation and Comparison of Multinomial Logit Models. Journal of Marketing Research 15, 305–314.

van de Vyvere, Y., Oppewal, H., Timmermans, H., 1998. The Validity of Hierarchical Information Integration Choice Experiments to Model Residential Preference and Choice. Geographical Analysis 30 (3), 254–272.

van Helvoort-Postulart, D., Dellaert, B.G.C., van der Weijden, T., Meyenfeldt, M.F. von, Dirksen, C.D., 2009. Discrete choice experiments for complex health-care decisions: does hierarchical information integration offer a solution? Health Economics 18 (8), 903–920.

Wardman, M., 2001. A review of British evidence on time and service quality valuations. Transportation Research Part E: Logistics and Transportation Review 37 (2-3), 107–128.

Wardman, M., 2004. Public transport values of time. Transport Policy 11 (4), 363–377.