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A systematic comparison and evaluation of the Satisfaction with Travel Scale (STS) and existing customer satisfaction scales

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Abstract

Despite the central role of travel satisfaction in transport research, debates remain regarding the optimal instruments for its measurement, balancing conceptual depth with operational simplicity. This study delivers the first direct comparison of three established scales: the Satisfaction with Travel Scale (STS) and two concise measures, the Net Promoter Score (NPS) and Customer Satisfaction Score (CSAT), within a unified empirical framework. Drawing on a large-scale, post-pandemic survey of bus and train users in Flanders, Belgium, we systematically evaluate scale reliability, dimensionality, and explanatory power across 25 service quality indicators and socio-demographic controls. Findings reveal the STS operates as a single-factor construct in this context, questioning the necessity of its multidimensional framing. NPS and CSAT exhibit strong internal alignment and higher sensitivity to key service attributes, such as punctuality and reliability, with CSAT explaining the greatest variance in satisfaction outcomes. These results indicate that while STS remains valuable for capturing the cognitive and affective underlying nuances of travel, NPS and CSAT provide effective and lower-burden alternatives for routine satisfaction monitoring. This study offers new empirical evidence to guide the choice of satisfaction measures in transport research and policy evaluation.

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1. Introduction

Satisfaction reflects individuals' subjective evaluation of how well an experience, product, or service meets their expectations (Dolan and Metcalfe, 2012; Evans, 1997; Oliver, 2013). Its application spans sociology, psychology, urban planning, transportation, and marketing. In marketing, it gauges customer satisfaction and loyalty (Kotler and Levy, 1969); in well-being research, it underpins life satisfaction (Diener et al., 2013); and in transport, it measures satisfaction with travel experiences (Ettema et al., 2011). To operationalise this concept, researchers have developed multiple scales. In marketing and transport, the Net Promoter Score (NPS) (Reichheld, 2003) and the Customer Sat-

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isfaction (CSAT) scale (Anderson et al., 1994) are widely used for their simplicity where both rely on single-item measures capturing loyalty or satisfaction with specific interactions. Other notable instruments include the American Customer Satisfaction Index (ACSI) and ServQual (Fornell et al., 1996; Parasuraman et al., 1998).

In well-being studies, psychometric tools such as the Positive and Negative Affect Scale (PANAS) (Watson et al., 1988), the Satisfaction with Life Scale (SLS) (Diener et al., 1985), and the Flourishing and SPANE scales (Diener et al., 2010) assess different dimensions of Subjective Well-Being (SWB). Adapted versions of these instruments have been applied to travel contexts, including daily travel (Bergstad et al., 2011; Zarabi et al., 2019), commuting (Maheshwari et al., 2022, 2024), leisure (De Vos, 2019; De Vos et al., 2019), and undirected travel (Hook et al., 2023). The most commonly applied instrument in transport is the Satisfaction with Travel Scale (STS).

Developed by Ettema et al. (2011), the STS comprises three dimensions—*affective well-being* (activation–deactivation), *valence* (positive–negative), and *cognitive evaluation* (e.g., best/worst trip, high/low standard, worked/did not work well)—operationalised through nine items. Activation reflects engagement during travel; valence captures pleasure or displeasure; and cognitive evaluation represents rational trip assessment. Inspired by SWB frameworks (Diener et al., 2013), the STS positions travel satisfaction as a component of broader well-being (Ettema et al., 2011; Ye and Titheridge, 2017). Although the strength of the STS scale lies in its nine-item design capturing emotional and evaluative travel experiences, its efficiency and reliability have been repeatedly questioned, prompting several adaptations. Olsson et al. (2013) found a seven-item version better fit Swedish commuter data than the original. Friman et al. (2013) observed no significant variation in STS scores across modes. Acharya et al. (2023) improved model robustness for Portland commuters by rewording items and shifting one loading from positive deactivation to cognitive evaluation. De Vos et al. (2015) reported a better two-factor fit in Ghent, while Smith (2017) and Ye and Titheridge (2017) dropped two items in studies from Portland and Xi'an. Other studies have simply averaged the nine-item, three-factor scores (Ettema et al., 2013; Friman et al., 2013; Maheshwari et al., 2024).

The persistent efforts to test and modify the STS scale raise concerns about its efficiency and reliability, largely due to its nine-item structure, which increases respondent burden, especially in extensive travel surveys covering multiple modes or trips (De Vos et al., 2015). Repetitive items and grading may also reduce response quality, as travel surveys often lack the stringent checks of psychological instruments. This underscores the need to evaluate the STS against alternative scales. Ettema et al. (2011) notably called for comparing STS with established customer satisfaction measures to clarify its relationship with broader SWB metrics. Building on this foundation, the present study critically assesses STS alongside two widely used industry metrics such as NPS and CSAT. Unlike the multidimensional, travel-specific STS, NPS and CSAT are brief, simple, and increasingly applied in transport contexts, offering practical advantages where survey length and efficiency are critical. This study systematically examines satisfaction, loyalty, and related outcomes across these scales through a dedicated survey instrument. Although all three measure satisfaction, their emphases differ: NPS captures loyalty and advocacy, CSAT assesses interaction-level satisfaction, and STS evaluates travel experiences holistically. A comparative survey enables understanding of how respondents perceive these dimensions, supporting a more precise evaluation of their effectiveness and practical value in transport research.

This analysis provides conceptual clarity for researchers and practitioners, guiding the selection of standardised scales to better capture user preferences and improve transport services. While this study offers actionable insights, further validation with representative samples could strengthen their policy relevance. Ultimately, selecting the most appropriate satisfaction scale can enhance understanding of travel behaviour and support more informed mobility planning.

The remainder of the paper details the survey design, questions, and analytical methods, followed by a comparative discussion of the STS, NPS, and CSAT, their limitations, and directions for future research.

2. Methods

2.1. Sample

This paper uses an online survey to investigate the effectiveness and applicability of the STS scale compared to other customer satisfaction measures using data collected in Flanders, the Dutch-speaking northern region of Belgium. The survey, titled "Customer Satisfaction with Public Transport," was conducted online in Dutch using Qualtrics.

Before launching the survey, a pilot study was conducted to ensure the clarity of the questions and the acceptability of the survey's length. Respondents for the final survey were randomly recruited through a Facebook campaign targeting adults (18+) living in Flanders. We ensured a broad reach of respondents using Facebook's ad targeting tools. The campaign ran from February 20, 2022, to March 14, 2022. Responses were collected directly through the survey link, ensuring anonymity and ease of access.

Respondents were asked about their satisfaction with two public transport providers operating in Flanders: SNCB/NMBS (rail transport) and De Lijn (bus/tram/metro). Specifically, respondents were asked to indicate their satisfaction with NMBS and De Lijn using the NPS, CSAT, and STS scales. This approach allowed for a comparison between the scales, emphasised the importance of each scale, and identified potential complementarity in assessing satisfaction with public transport.

The survey modules, which differentiated between bus (De Lijn) users and train (NMBS) users, were randomised. Within each module, respondents rated their satisfaction using the three scales: first, the NPS scale, then the STS scale, and finally, the CSAT scale. The items on the STS scale were also randomised. Respondents who used both bus and train services answered both modules, starting with the one they were randomised to first. The randomisation did not extend to the order of the three scales within each module to avoid excessive variation. It was important to strike a balance in randomising parts of the questionnaire to prevent unnecessary burdens on the respondents, which could arise from continuous variations. This approach helped maintain the quality of responses and ensured accurate and reliable data collection. Moreover, it minimised biases by preventing respondents from forming preconceived notions about their satisfaction before completing the entire survey.

A total of 388 respondents agreed to participate in the online survey and completed the questionnaire. These respondents were adults (aged 18 and above) residing in the Flanders region. Respondents who had not used SNCB or De Lijn services at least once in the past year were screened out of the survey. Of the 388 respondents, 71.1% used services from both public transit operators at least a few times per year, 18.6% used only the services from De Lijn, and the remaining 10.3% used the services from SNCB.

Table 1 presents the respondents' socio-demographic characteristics compared to the Flanders region to give an idea of the population groups and their travel habits (Statistics Flanders, 2023). Most of the respondents in our sample are young, between the ages of 18 and 35, likely because they are more active on Facebook. Men are slightly underrepresented in our survey compared to the average in Flanders. This gender difference in the averages could be attributed to the active participation of females in responding to online surveys during the pandemic (Becker, 2022). Public transport usage in our sample closely aligns with the average in Flanders.

Table 1. Descriptive Statistics of the Sample of Respondents.

Variable		Sample (n=388)	Population (n=5,399,620)
Age	18 to 35	60.3%	26.3%
	36 to 64	28.2%	47.8%
	65 and over	11.5%	18.7%
Gender	Man	39.2%	49.1%
	Woman	60.0%	50.9%
Train users (NMBS)		10.3%	16.0%
Bus users (De Lijn)		18.6%	13%
Both train and bus users		71.1%	-

2.2. Measurement of Key Variables

The survey comprised four modules. In the first module, respondents were asked about their mode of transport (weekly use of bus/tram/metro, train, foot, bike, micro-mobility, car as driver or passenger), possession of a driving license (yes or no), ownership of a season ticket (yes or no), availability of different bikes and micro-mobility devices, car ownership within the household (yes or no), activities undertaken during the trip (dreaming/resting/sleeping, reading, working/studying, playing a game, talking to someone on the phone, texting/chatting/checking social media, listening to radio or music, watching a film or a video, or looking outside/at other people on public transport), and mo-

tivation for using public transport. These travel-related questions aid in understanding the travel habits of respondents, specifically their use of trains and buses for various daily activities.

In the second module, respondents were asked to indicate their satisfaction with trains and buses using three different satisfaction/loyalty scales: the Net Promoter Scale (NPS), the Customer Satisfaction Scale (CSAT), and the Satisfaction with Travel Scale (STS). These questions, corresponding to the satisfaction scales, are central to our analysis and form the basis of this study. To calculate NPS, a typical one-item question was used, asking respondents, “How likely are you to recommend this service to a friend or a colleague?” for both buses and trains, rated on a scale of 0 to 10. The NPS calculation assumes respondents who score between 9 and 10 are categorised as ‘promoters’ (loyal customers who would recommend the service). Respondents scoring between 7 and 8 are deemed ‘passive’ (satisfied customers but not avid advocates). Those scoring between 0 and 6 are considered ‘detractors’ (unhappy customers who might speak negatively about the service). The NPS score is calculated by subtracting the percentage of detractors from the percentage of promoters, resulting in a score between -100 and +100 (Reichheld, 2003).

Similarly, to calculate CSAT, another one-item question was asked: “On a scale of 1 to 7, with 1 indicating high dissatisfaction and 7 indicating high satisfaction, how satisfied are you generally with the services of De Lijn/ NMBS”. This question was posed to respondents who used buses and/or trains. The STS scale, developed based on the measurement of Subjective Well-Being (SWB), considers travel a domain of life satisfaction (Ettema et al., 2011). This nine-item scale includes questions about the affective and cognitive components of daily travel. The first three items pertain to positive deactivation and negative activation during travel. Respondents were asked how ‘time-pressed’ or ‘relaxed’, ‘worried’ or ‘confident’, and ‘stressed’ or ‘calm’ they felt during their travel experience. The next three items relate to positive activation and negative deactivation, asking the respondents how ‘tired’ or ‘alert’, ‘bored’ or ‘enthusiastic’, and ‘fed up’ or ‘engaged’ they felt. These items assess the emotions experienced during travel. The last three items evaluate the cognitive aspect of travel, asking whether the ‘travel was the worst’ or ‘best I can think of’, whether it was of ‘low’ or ‘high standard’, and whether it ‘worked well’ or ‘worked poorly’. Each item was rated on a scale from -3 to +3.

The third module collected data on twenty-five perceived service quality indicators for both trains and buses. Respondents were asked to rate these indicators based on their importance for each mode of transportation. The selection of these indicators is detailed in van Gaans (2022), drawing from previous studies on public transport perception (Roos et al., 2020; Friman et al., 2020; Nordfjærn and Rundmo, 2018; Chowdhury and van Wee, 2020; Delbosc and Currie, 2012; Barabino et al., 2020; Redman et al., 2013). These quality indicators encompass various aspects such as sense of safety on board, sense of safety at a stop, travel speed, punctuality, reliability, frequency, cleanliness on board, comfort on board, sufficient seats on board, information on board, information at a stop, friendly staff, easy access to a stop, directness of connection, ease of transferring to another line, ease of switching to another mode of transport, ease of bringing a bicycle, convenience of taking luggage, convenience of buying a valid ticket, convenience of reaching customer service, smooth handling of problems by customer service, weather protection at a stop, lighting at a stop, and availability of facilities at a stop.

In the final module, respondents were asked about their socioeconomic and demographic characteristics, including age categories (18 to 35 and 36 and above), gender (male and female), education level (no higher education and higher education), profession (student, employed, and unemployed), and net household income per month. These questions aimed to understand the characteristics of our sample and evaluate its representativeness.

It is important to note that respondents were recruited randomly through a Facebook campaign, which likely contributed to a sample skewed towards younger individuals and a higher proportion of women, as reflected in the age and gender distribution presented in Table 1. Individuals residing in Flanders who used public transportation but did not have access to Facebook were not represented, which may limit the generalisability of the findings. Additionally, the survey may have attracted respondents with stronger opinions, particularly those dissatisfied with public transport, potentially introducing self-selection bias. Moreover, the data was collected in early 2022, a period still influenced by the aftermath of pandemic-related travel restrictions, which could have shaped satisfaction ratings. Notwithstanding, this study is an important contribution to the current literature on travel satisfaction by being the first study to administer and compare satisfaction loyalty questions for three established scales within a single survey, offering valuable insights into their comparative applicability.

2.3. Modelling Methodology

This study employs a quantitative approach to compare the effectiveness of the STS scale against existing customer satisfaction measures. The methodology consists of four key steps: First, Cronbach's alpha scores were computed for each scale to determine the internal consistency between the items. This step ensured that the items within each scale measure the same underlying construct. Without this validity check, comparing the scales would be challenging due to potential measurement errors. Second, Pearson correlation coefficients were calculated to analyse the relationship between the scales. This helped to understand the strength of the relationship between the scales, indicating whether they measure satisfaction similarly or differently. A strong and positive correlation would indicate agreement in measuring satisfaction, while a weak or negative correlation would suggest discrepancies between the scales.

Third, a factor analysis was conducted specifically for the STS scale, which comprises nine items. This analysis determined whether the items within the STS scale load onto a single factor or multiple factors. It helped to investigate whether the STS scale collectively measures a single construct or multiple constructs across its nine items. In the final step, three regression analyses were conducted for each scale (NPS, CSAT, and STS) to verify which factors play a significant role in predicting NPS, CSAT and STS, while controlling for the service quality indicators, socio-demographics such as age and gender, and travel characteristics such as mood during travel, trip motivation and activities during travel.

3. Results and Discussion

This research contends that the conventional NPS and CSAT scales, with their single constructs, measure similar underlying constructs as the multi-dimensional STS scale proposed by [Ettema et al. \(2011\)](#) and [Friman et al. \(2013\)](#). We will demonstrate this using overall mean scores, Cronbach's alpha, Pearson correlation, factor and regression analysis.

3.1. Overall Scores

The overall NPS scores are -34.81 for train users (NMBS) and -50.29 for bus users (De Lijn), indicating that most respondents are detractors. Low NPS values reflect weak affective loyalty and low likelihood of recommending these services, pointing to a broader image problem in public transport.

The mean NPS scores are 6.06 (train) and 5.49 (bus), classifying both groups as detractors under the traditional 0–10 scale. However, under the revised classification by [Biesok and Wyród-Wróbel \(2021\)](#) (0–3 = detractors; 4–7 = passives; 8–10 = promoters), these users shift to the passive category. CSAT scores average 3.4 for trains and 3.1 for buses, indicating neutral satisfaction, while STS scores of 4.6 and 4.5 on a 1–7 scale suggest similar neutrality.

Across all three scales, scores cluster around neutral levels, implying they may capture a common satisfaction/loyalty construct and that simpler NPS and CSAT measures could suffice. After normalising to a 0–100 scale, train users score 60.6 (NPS), 59.8 (CSAT), and 60.6 (STS), while bus users score 54.9, 53.2, and 57.7, respectively. Trains slightly outperform buses, likely reflecting perceptions of greater reliability, comfort, and punctuality. Addressing these image issues may help improve public transport satisfaction.

3.2. Reliability Tests

The results of Cronbach's alpha indicated high internal consistency among the nine items on the STS scale, with scores of 0.88 for train users and 0.87 for bus users. Typically, alpha values above 0.7 suggest that the items are interrelated and measure the same construct. Previous studies have used Cronbach's alpha scores to assess the internal consistency of the STS scale items. Due to the high consistency, researchers have often chosen a single-factor model for their analyses instead of a multi-factor model [Ettema et al. \(2013\)](#); [Friman et al. \(2013\)](#); [Maheshwari et al. \(2024\)](#). Note that NPS and CSAT scales are single-item scales, so alpha values cannot be computed.

3.3. Correlation Analysis

The results of Pearson correlation coefficients show a strong association between the scales, especially between the NPS and CSAT scales ($r = 0.73$ for trains and $r = 0.69$ for buses, $p < 0.001$). This indicates that higher satisfaction levels measured by the NPS scale are closely linked to higher satisfaction levels measured by the CSAT scale, suggesting that these two scales may measure the same underlying construct due to their strong convergent validity. However, the NPS scale shows a weaker correlation with the STS scale ($r = 0.36$ for trains and $r = 0.44$ for buses, $p < 0.001$). Similarly, the CSAT scale also has a weaker correlation with the STS scale ($r = 0.38$ for trains and $r = 0.43$ for buses, $p < 0.001$).

3.4. Factor Analysis

In the next step, we conducted a factor analysis to gain additional insights into the dimensionality of the STS scale. The results of this analysis provide robust evidence of the scale's efficiency and applicability compared to the conventional NPS and CSAT scales.

We performed the factor analysis using varimax rotation, resulting in a single-factor solution for both train users (eigenvalue of 4.7) and bus users (eigenvalue of 4.5). This suggests that the items in the STS scale are highly correlated and represent a single construct ($MSA = 0.89$ for both train and bus transport). Separating these items does not provide additional insights. The total variance explained by this one factor is 52% for train (NMBS) users and 50% for bus (De Lijn) users. This indicates that the STS is a unidimensional concept when applied to public transport systems. Thus, our data does not support the original idea of the STS being composed of three underlying dimensions and instead provides evidence of a single underlying dimension that explains both the emotional and cognitive evaluations of travel.

3.5. Regression analysis

Regression models were developed to identify significant predictors of NPS, CSAT, and STS using 25 perceived service quality indicators for trains and 24 for buses. Backward selection retained only significant variables, and all VIF values were below 4, indicating no multicollinearity.

For trains (Table 2), five indicators such as punctuality, reliability, onboard comfort, onboard information, and ease of transfer—significantly predicted CSAT, explaining 56 % of the variance. For NPS, seven factors (onboard and platform safety, travel speed, reliability, cleanliness, staff friendliness, and lighting) explained 36 %. For STS, three indicators (platform safety, travel speed, and reliability) accounted for 16 %.

For buses (Table 3), six indicators such as punctuality, reliability, comfort, directness, ease of transfer, and customer service—explained 57 % of CSAT variation. NPS was driven by seven factors (speed, punctuality, reliability, friendliness, ticket purchase, problem handling, and amenities), explaining 39 %. STS was explained by three indicators (punctuality, directness, and ease of carrying luggage), accounting for 19 %.

Punctuality and reliability emerged as common predictors for both modes. Service quality explained the largest share of variance in CSAT but less in STS, highlighting CSAT's stronger link with service attributes. NPS, CSAT, and STS captured different facets of satisfaction, underscoring their complementary roles.

Socio-demographic and trip variables were also included: age, gender, education, profession, income, household size, access to and use of transport modes, driving license or season ticket, micromobility ownership, distance to stops, trip purpose, onboard activities, and negative experiences.

For trains, adding mood improved CSAT's R^2 to 57 %. For NPS, age, proximity to the station, possession of a season ticket or bike, and leisure travel were significant, increasing R^2 to 44 %. For STS, age and mood effects raised R^2 to 56 %, suggesting the scale is sensitive to personal context as well as service quality.

For buses, adding more variables increased R^2 to 61 % for CSAT. Less frequent carpoolers and those reading during travel were more satisfied. For NPS, mood, reading, younger age, season ticket ownership, and regular e-bike use raised R^2 to 51 %. For STS, age, proximity to stops, bike ownership, and leisure trip purpose increased R^2 to 56 %.

Overall, R^2 values ranged from 0.16 to 0.57 with service indicators alone and from 0.44 to 0.61 with all variables. Even the lowest R^2 is acceptable for behavioural research focused on identifying significant predictors (Ozili, 2022).

Table 2. Linear Regression Models Predicting Satisfaction with NMBS (Train Users.)

	CSAT		NPS		STS	
Parameter	Est.	S.E.	Est.	S.E.	Est.	S.E.
Model With Perceived Service Quality Indicators Only						
Intercept	0.648	0.156	-0.014	0.663	2.948	0.229
Satisfaction w.r.t. sense of safety on board			-0.348	0.153		
Satisfaction w.r.t. sense of safety at the platform			0.414	0.148	0.135	0.055
Satisfaction w.r.t. travel speed			0.379	0.134	0.202	0.057
Satisfaction w.r.t. punctuality	0.193	0.047				
Satisfaction w.r.t. reliability	0.219	0.047	0.795	0.118	0.164	0.052
Satisfaction w.r.t. cleanliness on board			0.477	0.136		
Satisfaction w.r.t. comfort on board	0.161	0.040				
Satisfaction w.r.t. information on board	0.119	0.038				
Satisfaction w.r.t. friendliness of staff			0.415	0.143		
Satisfaction w.r.t. ease to transfer to another line	0.153	0.043				
Satisfaction w.r.t. lighting at the station			-0.317	0.155		
R-square	56.37%		35.88%		16.29%	
Full Model						
Intercept	0.444	0.175	0.693	0.672	0.945	0.212
Satisfaction w.r.t. punctuality	0.186	0.046				
Satisfaction w.r.t. reliability	0.209	0.047	0.849	0.113		
Satisfaction w.r.t. cleanliness on board			0.507	0.119		
Satisfaction w.r.t. comfort on board	0.153	0.040				
Satisfaction w.r.t. information on board	0.122	0.038				
Satisfaction w.r.t. ease to transfer to another line	0.152	0.043	0.413	0.134		
Satisfaction w.r.t. ease to transfer to another mode					0.125	0.039
Satisfaction w.r.t. ease of buying a valid ticket					0.124	0.039
Declared noise during the last trip					0.125	0.034
Declared boarding ease during the last trip					0.141	0.034
Declared mood during the last trip	0.076	0.030			0.449	0.035
Trip motive: leisure travel			0.845	0.245		
Activity during travel: call someone					0.244	0.103
Distance residence to train station: 0 to 499m			0.000	Ref.		
Distance residence to train station: 500m or more			-0.789	0.393		
Distance residence to train station: I don't know			-7.610	1.975		
Age: 18 to 35 years			0.000	Ref.		
Age: 36 years and more			1.017	0.224	0.463	0.079
Possession of a PT season ticket			0.922	0.223		
Household with child's bike(s)			1.218	0.331		
Household with micro-mobility device(s)			1.091	0.409		
R-square	57.24%		44.10%		55.95%	

Estimates in italic indicate p-value ≥ 0.05

Ref.: Reference category

Type III tests for all categorical variables are significant at the 5% level of significance

4. Conclusion

This study offered a comprehensive comparison of the three scales and provided indepth insights into the relationship between general STS measures and more specific customer satisfaction measures.

The results revealed that the data for the Flemish region fits the conventional NPS and CSAT scales satisfactorily, similar to the single-dimensional STS scale. NPS and CSAT scales seem to be more practical than the STS scale, especially for large-scale research involving multiple questions on travel satisfaction. Implementing NPS and CSAT scales in travel satisfaction studies could reduce respondents' burden, increase response rates by shortening the ques-

Table 3. Linear Regression Models Predicting Satisfaction with De Lijn (Bus Users)

	CSAT		NPS		STS	
Parameter	Est.	S.E.	Est.	S.E.	Est.	S.E.
Model With Perceived Service Quality Indicators Only						
Intercept	0.339	0.145	-0.375	0.512	2.876	0.190
Satisfaction w.r.t. travel speed			0.394	0.128		
Satisfaction w.r.t. punctuality	0.264	0.046	0.711	0.146	0.150	0.052
Satisfaction w.r.t. reliability	0.178	0.046	0.360	0.147		
Satisfaction w.r.t. comfort on board	0.146	0.042				
Satisfaction w.r.t. friendliness of staff			0.259	0.130		
Satisfaction w.r.t. directness of connection	0.104	0.043			0.211	0.055
Satisfaction w.r.t. ease to transfer to another line	0.115	0.044				
Satisfaction w.r.t. ease of carrying luggage					0.167	0.055
Satisfaction w.r.t. ease of buying a valid ticket			0.230	0.112		
Satisfaction w.r.t. problem handling by customer service	0.145	0.040	0.324	0.132		
Satisfaction w.r.t. availability of amenities at the stop			-0.403	0.120		
R-square	57.44%		38.96%		18.56%	
Full Model						
Intercept	0.019	0.162	-2.345	0.485	1.267	0.186
Satisfaction w.r.t. travel speed	0.109	0.041	0.438	0.116		
Satisfaction w.r.t. punctuality	0.226	0.045	0.520	0.134		
Satisfaction w.r.t. reliability	0.171	0.044	0.399	0.133		
Satisfaction w.r.t. comfort on board	0.131	0.041				
Satisfaction w.r.t. directness of connection					0.136	0.037
Satisfaction w.r.t. ease to transfer to another line	0.130	0.040				
Satisfaction w.r.t. problem handling by customer service	0.124	0.039	0.356	0.113		
Declared noise during the last trip					0.166	0.034
Declared boarding ease during the last trip					0.138	0.038
Declared mood during the last trip	0.144	0.032	0.410	0.099	0.388	0.038
Trip motive: regular hobby			0.744	0.310	0.334	0.105
Trip motive: visit family/friends			0.746	0.234		
Activity during travel: reading	0.219	0.085	0.646	0.258		
Distance residence to bus stop: 0 to 499m					0.000	Ref.
Distance residence to bus stop: 500m or more					-0.171	0.075
Distance residence to bus stop: I don't know					-1.041	0.349
Age: 18 to 35 years			0.000	Ref.	0.000	Ref.
Age: 36 years and more			0.651	0.228	0.290	0.082
Possession of a PT season ticket			0.851	0.220		
Household with non-electric bike(s)					0.294	0.109
Use of an electric bike: less than weekly			0.000	Ref.		
Use of an electric bike: weekly or more frequent			0.803	0.325		
Use of a car as a passenger (carpooling): less than weekly	0.000	Ref.				
Use of a car as a passenger (carpooling): weekly or more frequent	-0.177	0.068				
R-square	61.33%		50.51%		56.16%	

Estimates in italic indicate p -value ≥ 0.05

Ref.: Reference category

Type III tests for all categorical variables are significant at the 5% level of significance

tionnaire, and make surveys more appealing. This approach could lead to more meaningful responses by eliminating the need for respondents to select a neutral answer to expedite survey completion, as required by the nine-item STS scale. Such concise assessments would be valuable when evaluating satisfaction with different modes of transport or across various types of trips (De Vos et al., 2015). That being said, the STS scale does offer distinct advantages that should not be overlooked. While simpler scales like NPS and CSAT provide valuable insights into overall satisfaction

and loyalty, the STS scale captures more nuanced dimensions of travel satisfaction, such as emotional and cognitive aspects of the experience, which can be crucial for understanding the factors driving satisfaction.

Punctuality and reliability were highlighted as important factors, guiding policymakers to prioritise these critical aspects based on user perspectives. Additionally, individuals who reported being in a good mood during travel indicated higher satisfaction. This variable was significant in all three models, underscoring its importance in future travel surveys and studies. However, longitudinal research is needed to determine whether mood influences satisfaction or vice versa. Factor analysis revealed that the questions in the STS scale converge into a single factor, prompting us to reconsider its efficacy, especially due to the burden placed on respondents. Our results suggest that NPS and CSAT scales effectively capture respondents' opinions about their satisfaction with the transport mode, loyalty to that mode, and propensity to switch to another mode if available. Despite their simplicity, these scales provide concise assessments of satisfaction and loyalty, presenting an attractive alternative for measuring travel satisfaction.

We invite further research to explore the implementation of NPS and CSAT scales alongside the STS scale to validate their effectiveness and establish parity across travel satisfaction research. Future research could also investigate differences across transport modes, trip purposes, and geographical contexts.

Findings of this study offer relevant insights for practitioners, researchers, and policymakers by highlighting the strengths and limitations of different satisfaction measurement scales. Selecting an appropriate scale, whether the multidimensional STS or the more concise and simplistic NPS and CSAT, can help policymakers gain timely and actionable feedback on user satisfaction and loyalty. Incorporating such measures into regular public transport monitoring frameworks can enable quicker identification of service shortcomings, inform targeted improvements, and support evidence-based decision-making.

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References

- Acharya, S., Mekker, M., Singleton, P.A., 2023. Validating the satisfaction with travel scale and measuring long-distance recreational travel satisfaction. *Transportation Research Part F: Traffic Psychology and Behaviour* 95, 1–17. doi:[10.1016/j.trf.2023.03.015](https://doi.org/10.1016/j.trf.2023.03.015).
- Anderson, E.W., Fornell, C., Lehmann, D.R., 1994. Customer Satisfaction, Market Share, and Profitability: Findings From Sweden. *Journal of Marketing* 58, 53–66.
- Barabino, B., Cabras, N.A., Conversano, C., Olivo, A., 2020. An Integrated Approach to Select Key Quality Indicators in Transit Services. *Social Indicators Research* 149, 1045–1080. doi:[10.1007/s11205-020-02284-0](https://doi.org/10.1007/s11205-020-02284-0).
- Becker, R., 2022. Gender and Survey Participation. An Event History Analysis of the Gender Effects of Survey Participation in a Probability-based Multi-wave Panel Study with a Sequential Mixed-mode Design. *Methods, Data, Analyses* 16, 3–32. doi:[10.12758/mda.2021.08](https://doi.org/10.12758/mda.2021.08).
- Bergstad, C.J., Gamble, A., Garling, T., Hagman, O., Polk, M., Ettema, D., Friman, M., Olsson, L.E., 2011. Subjective well-being related to satisfaction with daily travel. *Transportation* 38, 1–15. doi:[10.1007/s11116-010-9283-z](https://doi.org/10.1007/s11116-010-9283-z).
- Biesok, G., Wyród-Wróbel, J., 2021. Net Promoters Score (NPS) and its relation to other marketing customer satisfaction measures, in: *Proceedings of the 37th International Business Information Management Association (IBIMA)*, pp. 3543–3550. URL: <https://www.researchgate.net/publication/351841299>.
- Chowdhury, S., van Wee, B., 2020. Examining women's perception of safety during waiting times at public transport terminals. *Transport Policy* 94, 102–108. doi:[10.1016/j.tranpol.2020.05.009](https://doi.org/10.1016/j.tranpol.2020.05.009).
- De Vos, J., 2019. Analysing the effect of trip satisfaction on satisfaction with the leisure activity at the destination of the trip, in relationship with life satisfaction. *Transportation* 46, 623–645. doi:[10.1007/s11116-017-9812-0](https://doi.org/10.1007/s11116-017-9812-0).
- De Vos, J., Ettema, D., Witlox, F., 2019. Effects of changing travel patterns on travel satisfaction: A focus on recently relocated residents. *Travel Behaviour and Society* 16, 42–49. doi:[10.1016/j.tbs.2019.04.001](https://doi.org/10.1016/j.tbs.2019.04.001).
- De Vos, J., Schwanen, T., Van Acker, V., Witlox, F., 2015. How satisfying is the scale for travel satisfaction? *Transportation Research Part F: Traffic Psychology and Behaviour* 29, 121–130. doi:[10.1016/j.trf.2015.01.007](https://doi.org/10.1016/j.trf.2015.01.007).

- Delbosch, A., Currie, G., 2012. Modelling the causes and impacts of personal safety perceptions on public transport ridership. *Transport Policy* 24, 302–309. doi:[10.1016/j.tranpol.2012.09.009](https://doi.org/10.1016/j.tranpol.2012.09.009).
- Diener, E., Emmons, R.A., Larsen, R.J., Griffin, S., 1985. The Satisfaction With Life Scale. *Journal of Personality Assessment* 49, 71–75. doi:[10.1207/s15327752jpa4901](https://doi.org/10.1207/s15327752jpa4901).
- Diener, E., Inglehart, R., Tay, L., 2013. Theory and Validity of Life Satisfaction Scales. *Social Indicators Research* 112, 497–527. doi:[10.1007/s11205-012-0076-y](https://doi.org/10.1007/s11205-012-0076-y).
- Diener, E., Wirtz, D., Tov, W., 2010. New well-being measures: Short scales to assess flourishing and positive and negative feelings. *Social Indicators Research* 97, 143–156. doi:[10.1007/s11205-009-9493-y](https://doi.org/10.1007/s11205-009-9493-y).
- Dolan, P., Metcalfe, R., 2012. Measuring subjective wellbeing: Recommendations on measures for use by national governments. *Journal of Social Policy* 41, 409–427. doi:[10.1017/S0047279411000833](https://doi.org/10.1017/S0047279411000833).
- Ettema, D., Gärling, T., Eriksson, L., Friman, M., Olsson, L.E., Fujii, S., 2011. Satisfaction with travel and subjective well-being: Development and test of a measurement tool. *Transportation Research Part F* 14, 167–175. URL: <http://dx.doi.org/10.1016/j.trf.2010.11.002>, doi:[10.1016/j.trf.2010.11.002](https://doi.org/10.1016/j.trf.2010.11.002).
- Ettema, D., Gärling, T., Olsson, L.E., Friman, M., Moerdijk, S., 2013. The road to happiness: Measuring Dutch car drivers' satisfaction with travel. *Transport Policy* 27, 171–178. doi:[10.1016/j.tranpol.2012.12.006](https://doi.org/10.1016/j.tranpol.2012.12.006).
- Evans, L., 1997. Addressing problems of conceptualization and construct validity in researching teachers' job satisfaction. *Educational Research* 39, 319–331. doi:[10.1080/0013188970390307](https://doi.org/10.1080/0013188970390307).
- Fornell, C., Johnson, M.D., Anderson, E.W., Cha, J., Bryant, B.E., 1996. The American Customer Satisfaction Index: Nature, Purpose, and Findings. Source: *Journal of Marketing* 60, 7–18.
- Friman, M., Fujii, S., Ettema, D., Gärling, T., Olsson, L.E., 2013. Psychometric analysis of the satisfaction with travel scale. *Transportation Research Part A* 48, 132–145. URL: <http://dx.doi.org/10.1016/j.tra.2012.10.012>, doi:[10.1016/j.tra.2012.10.012](https://doi.org/10.1016/j.tra.2012.10.012).
- Friman, M., Lättman, K., Olsson, L.E., 2020. Public transport quality, safety, and perceived accessibility. *Sustainability (Switzerland)* 12. doi:[10.3390/SU12093563](https://doi.org/10.3390/SU12093563).
- van Gaans, L., 2022. Measuring customer satisfaction as a function of modal shift to De Lijn (Dissertation). Ph.D. thesis. University of Hasselt. Hasselt.
- Hook, H., Vos, J.D., Acker, V.V., Witlox, F., 2023. Evolutions in undirected travel (satisfaction) during the COVID-19 pandemic. *Transportation Research Part F*, 99–113.
- Kotler, P., Levy, S.J., 1969. Broadening the Concept of Marketing. *Journal of Marketing* 33, 10–15.
- Maheshwari, R., Van Acker, V., De Vos, J., Witlox, F., 2022. Analyzing the association between satisfaction with commuting time and satisfaction with life domains: A comparison of 32 European countries. *Journal of Transport and Land Use* 15, 231–248. doi:<https://doi.org/10.5198/jtlu.2022.2121>.
- Maheshwari, R., Van Acker, V., Gerber, P., 2024. Commuting vs Teleworking: How does it impact the relationships between commuting satisfaction and subjective well-being. *Transportation Research Part A: Policy and Practice* 182. URL: <https://doi.org/10.1016/j.tra.2024.104041>, doi:<https://doi.org/10.1016/j.tra.2024.104041>.
- Nordfjærn, T., Rundmo, T., 2018. Transport risk evaluations associated with past exposure to adverse security events in public transport. *Transportation Research Part F: Traffic Psychology and Behaviour* 53, 14–23. doi:[10.1016/j.trf.2017.12.014](https://doi.org/10.1016/j.trf.2017.12.014).
- Oliver, R.L., 2013. A cognitive model of the antecedents and consequences of satisfaction decisions. *American Marketing Association* 17, 460–469.
- Olsson, L.E., Gärling, T., Ettema, D., Friman, M., Fujii, S., 2013. Happiness and Satisfaction with Work Commute. *Social Indicators Research* 111, 255–263. doi:[10.1007/s11205-012-0003-2](https://doi.org/10.1007/s11205-012-0003-2).
- Ozili, P., 2022. The acceptable r-square in empirical modelling for social science research. *SSRN Electronic Journal* doi:[10.2139/ssrn.4128165](https://doi.org/10.2139/ssrn.4128165).
- Parasuraman, P.A., Zeithaml, V.A., Berry, L.L., 1998. SERVQUAL: A multiple-Item Scale for measuring consumer perceptions of service quality. *Journal of Retailing* URL: <https://www.researchgate.net/publication/225083802>.
- Redman, L., Friman, M., Gärling, T., Hartig, T., 2013. Quality attributes of public transport that attract car users: A research review. *Transport Policy* 25, 119–127. doi:[10.1016/j.tranpol.2012.11.005](https://doi.org/10.1016/j.tranpol.2012.11.005).
- Reichheld, F.F., 2003. The One Number You Need to Grow. *Harvard Business Review* 81, 46–54.
- Roos, J.M., Sprei, F., Holmberg, U., 2020. Sociodemography, geography, and personality as determinants of car driving and use of public transportation. *Behavioral Sciences* 10. doi:[10.3390/BS10060093](https://doi.org/10.3390/BS10060093).
- Smith, O., 2017. Commute well-being differences by mode: Evidence from Portland, Oregon, USA. *Journal of Transport and Health* 4, 246–254. doi:[10.1016/j.jth.2016.08.005](https://doi.org/10.1016/j.jth.2016.08.005).
- Statistics Flanders, 2023. Flanders in Figures. Technical Report. Statistics Flanders. Flanders.
- Watson, D., Clark, L.A., Tellegen, A., 1988. Development and Validation of Brief Measures of Positive and Negative Affect: The PANAS Scales. *Journal of Personality and Social Psychology* 54, 1063–1070. doi:[10.1051/epjconf/201714006017](https://doi.org/10.1051/epjconf/201714006017).
- Ye, R., Titheridge, H., 2017. Satisfaction with the commute: The role of travel mode choice, built environment and attitudes. *Transportation Research Part D: Transport and Environment* 52, 535–547. doi:[10.1016/j.trd.2016.06.011](https://doi.org/10.1016/j.trd.2016.06.011).
- Zarabi, Z., Gerber, P., Lord, S., 2019. Travel satisfaction vs. life satisfaction: A weighted decision-making approach. *Sustainability* 11, 1–28. doi:[10.3390/su11195309](https://doi.org/10.3390/su11195309).