

Understanding satisfaction and travel behavior of nationwide Fare-Free Public Transport in Luxembourg

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Introduction

Public transport (PT) is a key component of sustainable mobility, playing a fundamental role in mitigating congestion, reducing greenhouse gas emissions, and promoting social inclusion (e.g., Porru et al., 2021; Ceder, 2021). The quality of PT systems, as perceived by users, influences not only satisfaction but also future behavioral intentions. Attributes such as travel time, frequency, cleanliness, comfort, safety, and aesthetics significantly shape passenger experience and can either encourage or deter regular use (e.g., Eboli and Mazzulla, 2007; Tyrinopoulos and Antoniou, 2008; dell’Olio et al., 2011; de Oña et al., 2013).

In recent years, various governments and local authorities have introduced free or affordable fares through heavily subsidized PT policies to promote modal shift from private cars to collective transport, with the dual aim of addressing environmental challenges and improving equity in access to mobility (Cats et al., 2017; Hess, 2017; Van Goeverden et al., 2006; Loder et al. 2023; Inturri et al., 2020; Guzman and Cantillo-Garcia, 2024). In this context, Luxembourg represents a unique case. In March 2020, the country became the first in the world to introduce nationwide fare-free public transport (FFPT), granting all users free access to buses, trams and second-class train services (Ministry of Mobility and Public Works, 2020). The policy was implemented as part of a broader strategy to improve sustainability, reduce car dependency, and enhance social equity. Despite widespread international attention, there is still little evidence in literature about its long-term impact, especially when it comes to how satisfied people are with their trips and whether they actually change their travel behavior. Some studies have found that simply removing fares might not be enough to get people to switch to public transport, unless service quality and infrastructure also improve. Starting from these considerations, the aim of the study is to investigate how FFPT influences passengers’ satisfaction and changes in their travel behavior. This study purposes to fill that gap by analyzing the impact of FFPT in Luxembourg through the comparison of two large-scale surveys: a survey conducted in 2020 before the introduction of the policy and a ex-post survey carried out from December 2024 onward. The research explores two key questions: (1) How does FFPT affect passengers’ satisfaction with public transport services? (2) To what extent does satisfaction influence the intention to continue using and recommending public transport?.

Body

The research compares two surveys: an ex-ante survey conducted in 2020 by Institute of Socio-Economic Research (LISER) and University of Luxembourg (uni.lu), with 1,964

respondents (Luxembourg residents and cross-border workers from Belgium, France, and Germany) (Maciejewska et al., 2023) and an ex-post survey, launched in December 2024 and still ongoing, designed and disseminated by University of Luxembourg and University of Campania "Luigi Vanvitelli".

The latter was structured as a national online questionnaire, distributed through social media, institutional newsletters and flyers. It targeted adults (>16 years) who regularly travel to Luxembourg for work/study. The survey includes four main sections aiming at collecting information of socio-demographics, travel habits, satisfaction and service quality perceptions (e.g., cleanliness, comfort, punctuality, safety, cost), behavioral intention. Respondents answered satisfaction and intention questions on a 5-point Likert scale from "very dissatisfied"/"strongly disagree" to "very satisfied"/"strongly agree". As of June 2025, 503 valid responses were collected in the ex-post survey. An initial descriptive analysis compared satisfaction scores and behavioral motivations between the two surveys. To explore latent relationships, an Exploratory Factor Analysis (EFA) was conducted, identifying consistent underlying constructs (e.g., comfort, safety, cleanliness). Subsequently, a PLS-SEM was calibrated with SmartPLS software to test the following hypothesis: H¹⁺: Satisfaction with PT service quality has a positive effect on behavioral intention (future use and recommendation). The socio-demographic composition remained stable between surveys, with a majority of respondents residing in Luxembourg (76% in 2020; 78.1% in 2025). The age distribution shifted slightly toward younger users (18–34), who represent 69.4% of the ex-post sample (see Table 1).

A notable change occurred in the motivations for using public transport. Before FFPT, the top reasons included: "I don't own a car" (20.0%); "environmental benefits" (18.7%); "less stressful than driving" (15.8%). In contrast, free access emerged as the top reason in the post-FFPT survey (21.4%), followed by environmental benefits (15.6%) and the ability to multitask (12.0%). Among cross-border commuters, free access also gained importance (13.8%), after environmental and practical considerations. These findings confirm that FFPT served as a strong incentive, particularly for new or previously discouraged users.

Both surveys assessed satisfaction with key PT attributes. The 2020 results already showed relatively high satisfaction with price, due to previously low fares. However, punctuality and frequency were recurring weaknesses, especially on bus lines. The ex-post survey confirmed that cleanliness and comfort remain the most appreciated attributes; punctuality and frequency, while slightly improved, continue to be the lowest-rated factors; the perception of value for money improved significantly due to free access (see Figure 1 and Figure 2).

The PLS-SEM model confirms H¹⁺, suggesting that satisfaction significantly enhances the intention to continue using PT and to recommend it to others. Moreover, free access shows both a direct and indirect effect (via satisfaction) on behavioral intention.

Luxembourg's nationwide FFPT policy has positively impacted travel behavior and user perception. Free access has become a primary driver of PT use, especially for younger and lower-income populations. The improved perceived value of services has contributed to increased satisfaction, while operational weaknesses (e.g., frequency and punctuality) remain areas for attention.

This research provides empirical evidence supporting the role of FFPT as a behavioral lever for modal shift. However, fare abolition alone is not sufficient: it must be complemented by service improvements to ensure long-term success. Recommendations for further study include the collection of new data to achieve greater sample representativeness, longitudinal tracking to assess whether behavioral changes are sustained over time, segment analysis by age, income, and residence to identify differential impacts. Furthermore it is planned to extend the SEM model to Luxembourg's case offers valuable insights for other cities and countries considering FFPT, illustrating both its potential and its limitations within broader sustainable mobility policies.

Table 1 : Socio-economic characteristics

	2020	2024
Residence		
Resident of Luxembourg	76.0%	78.1%
Cross-border commuter (BE, FR and DE)	24.0%	21.9%
Gender		
Female	48.5%	47.9%
Male	51.5%	49.3%
Non-binary		1.4%
Prefer not to say		1.4%
Age		
18-24	7.7%	31.2%
25-34	31.9%	38.2%
35-49	39.5%	18.8%
50-64	17.4%	11.8%

*Due to missing values, most variables have less than 1,964 responses.

** The age percentages for 2020 do not sum to 100% because only age groups shared with the 2024 survey were included.

Figure 1 : Level of satisfaction with different attributes of bus services in Luxembourg

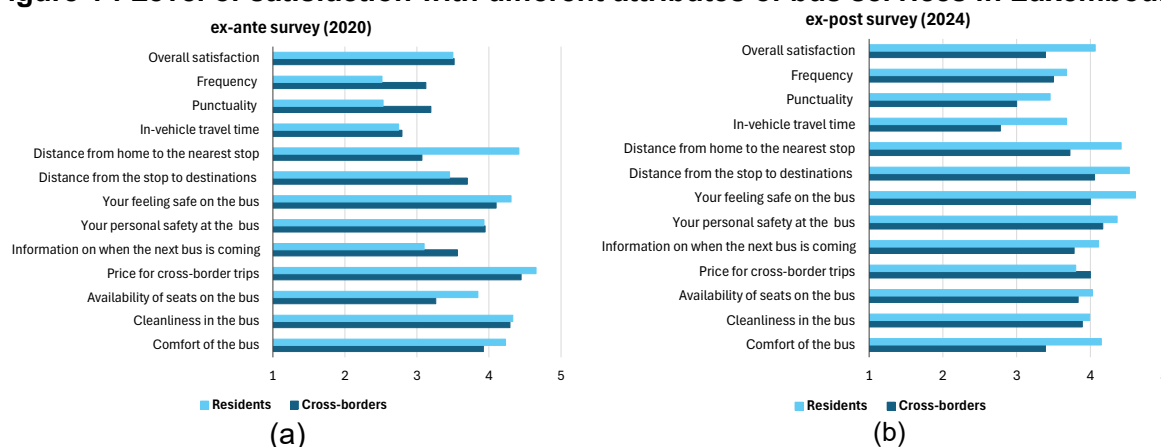
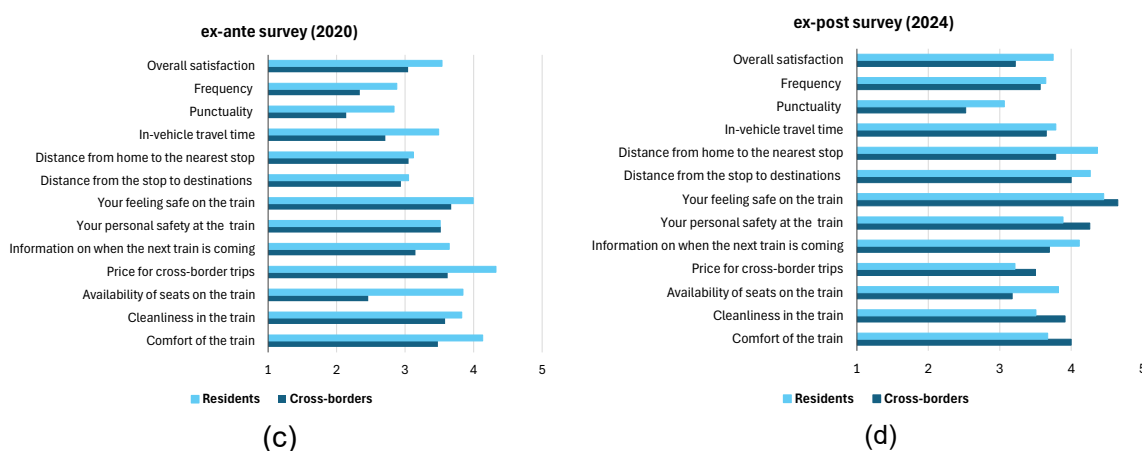


Figure 2 : Level of satisfaction with different attributes of train services in Luxembourg



References

- Cats, O., Susilo, Y. O., and Reimal, T., 2017. The prospects of fare-free public transport: evidence from Tallinn. *Transportation*, 44, 1083-1104. <https://doi.org/10.1007/s11116-016-9695-5>
- de Oña J., de Oña R., Eboli L., Mazzulla G. (2013). Perceived service quality in bus transit service: A structural equation approach. *Transport Policy* 29, 219-226. <https://doi.org/10.1016/j.tranpol.2013.07.001>
- Dell'Olio, L., Ibeas, A., and Cecin, P., 2011. The quality of service desired by public transport users. *Transport Policy*, 18(1), 217-227. <https://doi.org/10.1016/j.tranpol.2010.08.005>
- Eboli, L., and Mazzulla, G., 2007. Service quality attributes affecting customer satisfaction for bus transit. *Journal of public transportation*, 10(3), 21-34. <https://doi.org/10.5038/2375-0901.10.3.2>
- Guzman, L. A., & Cantillo-Garcia, V. A. (2024). Exploring the effects of public transport subsidies on satisfaction and ridership. *Research in Transportation Business & Management*, 56, 101168.
- Hess, D. B., 2017. Decrypting fare-free public transport in Tallinn, Estonia. *Case studies on transport policy*, 5(4), 690-698. <https://doi.org/10.1016/j.cstp.2017.10.002>
- Inturri, G., Fiore, S., Ignaccolo, M., Capri, S., and Le Pira, M., 2020. "You study, you travel free": when mobility management strategies meet social objectives. *Transportation Research Procedia*, 45, 193-200.
- Loder, A., Cantner, F., Adenaw, L., and Bogenberger, K., 2023. The 9 Euro Ticket: A Nation-Wide Experiment: Almost Fare-Free Public Transport for 3 Months in Germany: First Findings. In *102nd Annual Meeting of the Transportation Research Board (TRB 2023)*. DOI: 10.13140/RG.2.2.30900.12164
- Maciejewska, M., Boussauw, K., Kęłowski, W., and Van Acker, V., 2023. Assessing public transport loyalty in a car-dominated society: The case of Luxembourg. *Journal of Public Transportation*, 25, 100061. <https://doi.org/10.1016/j.jpubtr.2023.100061>
- Ministry of Mobility and Public Works, Luxembourg, 2020. *Free Public Transport in Luxembourg*
- Porru, S., Misso, F. E., Pani, F. E., and Repetto, C., 2020. Smart mobility and public transport: Opportunities and challenges in rural and urban areas. *Journal of traffic and transportation engineering (English edition)*, 7(1), 88-97. <https://doi.org/10.1016/j.jtte.2019.10.002>
- Tyrinopoulos, Y., and Antoniou, C., 2008. Public transit user satisfaction: Variability and policy implications. *Transport Policy*, 15(4), pp.260-272. <https://doi.org/10.1016/j.tranpol.2008.06.002>