CARING FOR PEOPLE SAVES OUR PLANET:

Transport's Contribution to Sustainability

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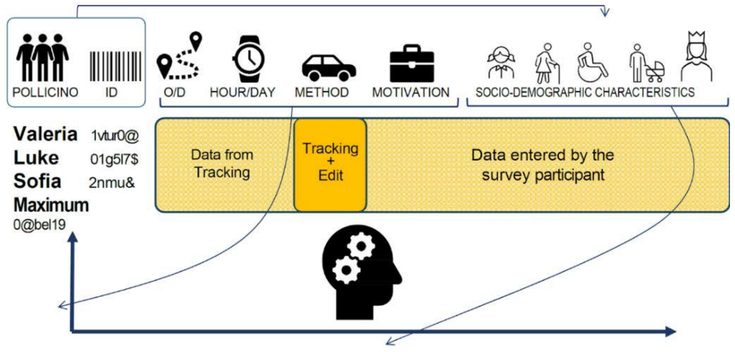
ABSTRACT

Transport and **mobility** services are essential **factors for urban** functionality and **livability**, with public transportation playing **a critical role** in reaching more **sustainable** mobility **systems**. This paper presents two **Behavioral Change Models**, derived from data obtained under the Horizon EU-funded project SPINE. Its aims to identify sociodemographic and **social factors** influencing **individuals' travel behavior** and decision-making in two European cities, **Valladolid** (Spain) and **Bologna** (Italy). Based on bus service data collected in Valladolid, this research focuses on understanding the **relationship between passenger satisfaction** and the frequency of **public transport use**. Through the estimation of an Ordered Logit regression, it was found that satisfaction with service-related attributes, such as accessibility, duration, and comfort, are negatively correlated with the frequency of use. However, **satisfaction is not the main aspect** to look at **for** attracting **more people**, other aspects such as the characteristics and the profile of people such as gender play a major role. This result is compared to a similar case study in Bologna, where the relationship between the choice of transportation mode, and a set of sociodemographic and trip characteristic variables was analyzed, within the perspective of the mobility of care framework, through a Multinomial logit model. The analysis highlights the complex interplay between sociodemographic factors, satisfaction levels, and transportation mode choice, providing **insights for future transport** policy **recommendations and potential strategies** to enhance the use of public transport.

DATA AND METHODS

This research employed data from two case studies in European cities: Valladolid and Bologna. **In Valladolid**, a survey of 1,095 public transport users captured detailed sociodemographic data, including variables such as age, gender, income, and household size, as well as satisfaction levels with different aspects of the bus service, including accessibility, duration, comfort, security, and available information. This data was analyzed using an **Ordered Logit Model**, chosen for its suitability in handling ordinal dependent variables such as the frequency of PT use, categorized into ranges from "practically never" to "daily". The model allowed for the examination of how satisfaction with service attributes influenced PT use while controlling for sociodemographic factors.

Taxonomy of Bologna's Data, Pollicino (M. Ciuffini et al, 2023)



In Bologna, mobility data were collected from 750 participants using the Pollicino app, which provided detailed tracking of daily mobility behaviors across various transportation modes such as buses, cars, bicycles, and walking. The data included trip characteristics, such as trip duration and purpose (e.g., work, shopping, leisure), and sociodemographic factors like age, gender, income, and household size. A **Multinomial Logit Model** was applied to assess the probability of choosing different transportation modes based on these factors. The model explored the role of gender, particularly within the "mobility of care" framework.

Both models provided a framework to explore the role of demographic variables in shaping mobility patterns in these cities.

RESULTS

The analysis results for Valladolid and Bologna provide a detailed understanding of the factors influencing public transport (PT) usage and modal choice, with a strong focus on socio-demographic factors and satisfaction levels.

In Valladolid, satisfaction with PT attributes such as comfort, accessibility and duration showed a counterintuitive negative relationship with frequent PT use. The Ordered Logit Model showed that individuals who reported high satisfaction were 62.25% less likely to use PT frequently, suggesting that satisfied users may be occasional rather than regular users. This underscores that satisfaction is not the primary driver of increased PT use. Instead, socio-demographic characteristics such as gender and income played a more important role. Women were found to be 42.8% more likely to use PT frequently than men, likely due to mobility patterns related to caregiving and household responsibilities. Low-income individuals were also more dependent on PT, with a 33.62% higher likelihood of frequent use, highlighting economic constraints as a key determinant.

Output Ordered Logit Models A.2, and B.2, Valladolid

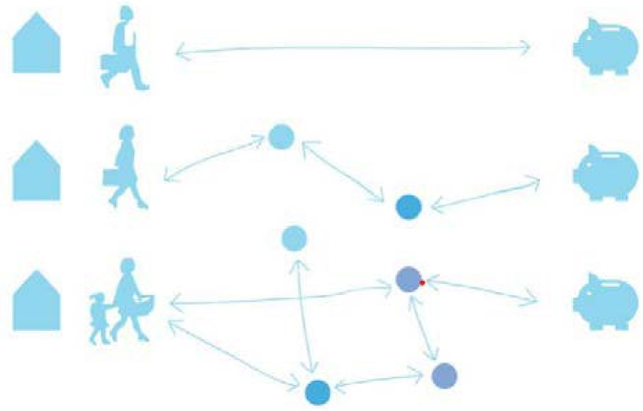
	female	between25_44	over65	low_income	medium_income	high_income	car	unemployed
Model A.2	0.44**	0.36*	1.06***	0.94***	-0.32	-0.57*	-0.64***	-1.15***
	(0.20)	(0.22)	(0.31)	(0.33)	(0.27)	(0.30)	(0.21)	(0.36)
	dur_comf_inf	cs_service	sec_acc_sus	1—2	2—3	3—4	4—5	
	-0.51***	0.20	0.60***	-2.30***	-2.27***	-1.37**	2.80***	
	(0.13)	(0.18)	(0.20)	(0.54)	(0.50)	(0.53)	(0.58)	

	female	over65	low_income	car	bike	household	unemployed	am_scooter
Model B.2	0.29**	-1.02***	0.32**	-0.42***	-0.32**	-0.55**	-0.58***	0.93**
	(0.14)	(0.20)	(0.20)	(0.14)	(0.14)	(0.27)	(0.24)	(0.44)
	dur_comf_acc	1—2	2—3	3—4	4—5			
	-0.51***	-2.92***	-3.00***	-2.17***	2.28***			
	(0.12)	(0.34)	(0.33)	(0.33)	(0.37)			

In Bologna, the multinomial logit model provided insights into mode choice based on trip purpose and demographic factors. Trip motives were critical: for example, work-related trips showed a 93.3% higher probability of using a motorcycle compared to a bus, while leisure trips favored active modes such as cycling or walking with a 78.6% and 91% increase in probability, respectively. Younger people showed a 76.1% preference for bykes over buses, a trend that increased to 99.8% for older adults, possibly due to lifestyle or health considerations. The availability of private cars significantly reduced PT use, with a 91% preference for cars over buses in households with access to private cars. Similarly, larger households were more likely to use PT, with the likelihood ranging from 59.9% to 69%.Both cities underscore that socio-demographic factors, rather than satisfaction with service attributes, determine PT use and mode choice.

The findings suggest that strategies to improve PT should go beyond improving service quality and address broader contextual factors such as car availability, income inequality, and mobility needs of caregivers. Interventions aimed at reducing reliance on private vehicles and promoting inclusive, active and human-centered modes may be more impactful than focusing solely on satisfaction metrics. These findings argue for targeted interventions that address the unique demographic and trip-related needs of PT users and contribute to sustainable urban mobility goals.

Graphic representation of the Mobility of Care framework (Col·lectiu Punt 6 ,2014)



DISCUSSION

The analysis of mobility patterns in both cities provides significant insights into the factors influencing individuals' choice of transportation mode and frequency of PT use.

In Valladolid, the results highlight the importance of sociodemographic and social factors in shaping passenger travel behavior, revealing a complex interaction between these factors and passenger satisfaction. A notable finding is the negative relationship between the frequency of PT use and user satisfaction with service-related attributes, suggesting the need to consider concepts like the loyalty penalization effect, experience calibration, and non-linear relationships between satisfaction and usage. Highly satisfied individuals appear to be occasional users with positive experiences who do not frequently require or choose the service. Furthermore, demographic variables such as gender, age, and income levels significantly influence PT usage, with females and low-income individuals more likely to use PT frequently.

In Bologna, transportation mode preferences are significantly shaped by trip motives, with distinct differences in mode choice based on trip purpose. The Mobility of Care framework offers a nuanced, intersectional characterization of users, showing that females primarily undertake trips for purchasing purposes, while males tend to accompany dependents. The multinomial logit model reveals substantial differences in mode choice driven by sociodemographic factors and trip characteristics, such as a strong preference for bicycles among younger individuals and a reliance on PT among low-income groups. Additional factors, including household size, car availability, and professional status, also influence transportation mode choice, underscoring the importance of designing tailored interventions to meet diverse demographic needs.

CONCLUSIONS

The analysis of transportation behavior in Valladolid and Bologna underscores the need for a multifaceted approach to increasing public transport usage. Satisfaction with service-related attributes such as comfort and accessibility, while important, does not suffice to drive frequent usage. Instead, sociodemographic factors like gender, income, and household size significantly shape mobility patterns. For instance, women and low-income individuals in Valladolid are more likely to rely on PT, often due to caregiving or economic constraints, rather than satisfaction with the service itself. In Bologna, trip motives and access to private vehicles strongly influence mode choice, with car ownership consistently reducing PT reliance. This underscores the need for policies that target private vehicle usage, promote active and human-centered modes of transport, and address the specific needs of underserved demographic groups. Considering frameworks like the mobility of care, which highlights the unique travel demands of women, is crucial for developing equitable and sustainable transportation systems. These findings suggest that future policies should integrate these broader contextual and demographic factors to foster inclusive and sustainable mobility solutions

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