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Extended Abstract Submission

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Understanding multimodal mobility strategies of micromobility users in urban environments: Insights from Barcelona

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This work addresses the following topic(s) from the Call for Contributions:
(Please check at least one box)

☐ Placemaking to integrate urban spaces and mobility
☒ Promoting sustainable mobility choices in metropolitan regions
☐ Governing responsible mobility innovations
☐ Shaping the transition towards mobility justice
☐ System analysis, design, and evaluation
☐ other: ________________________

Extended Abstract

From here 700-1000 words, grouped by the following sections:

Problem statement

The advent of micromobility, comprising shared bicycles, e-scooters, and moped-style scooters, has added new dimensions to multimodal transportation. However, the extent of its influence and its integration into multimodal systems remain unclear. While prior studies have investigated specific aspects of micromobility, a comprehensive understanding of its weekly usage patterns and its role in shaping multimodal travel behavior is lacking. Studies show that micromobility, especially bike-sharing systems, predominantly integrates into first/last-mile trips for public transit users, amplifying accessibility while reducing congestion (Adnan et al., 2019; Hamidi et al., 2019). The substitution effect, explored through counterfactual scenarios, demonstrates micromobility's tendency to substitute active and public transportation rather than private cars, varying across regions due to contextual modal splits (Teixeira et al., 2020; Wang et al., 2022). Key questions persist: are micromobility users unimodal, relying solely on one mode, or do they exhibit flexibility, choosing modes based on specific trip needs? Additionally, what factors drive their adoption of multimodal travel patterns?

Research objectives

To bridge this gap, this study explores the intricate relationship between micromobility and traditional transport modes throughout an entire week. Specifically, we investigate how different micromobility modes impact users' weekly travel patterns and explore the extent to which these modes encourage or discourage multimodal travel behaviors. By extending the analysis timeframe, this research aims to provide a holistic understanding of micromobility's influence on multimodal travel behavior. Aiming to unravel micromobility users' behavior and its integration into urban transport networks, we can enhance our comprehension of urban commuters' decision-making processes and promote sustainable transport choices.

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Methodological approach

A comprehensive travel survey comprising 902 participants was conducted in Barcelona, Spain, gathering socioeconomic-related details, information on micromobility (i.e., s bicycle-sharing systems, private e-scooters, and moped-style scooter-sharing services) and several traditional transport modes usage, and built environment features. Utilizing cluster analysis techniques, micromobility users were categorized based on their frequency of using three distinct micromobility modes, resulting in six distinct clusters showing reasonable consistency. K-modes clustering was applied to micromobility usage data. Subsequentially, Cluster Bivariate Associations explored relationships between micromobility clusters and traditional transport modes, revealing varied modal mixes within each cluster. Finally, Multivariate Analysis were applied. Six binary logistic regression models were constructed, examining the odds ratios (OR) of belonging to specific clusters based on traditional transport usage. The models considered sociodemographic attributes and built environment features, ensuring a comprehensive analysis of micromobility user profiles.

(Expected) results

1. Cluster Analyses:

The study employed a six-cluster solution, offering a comprehensive insight into micromobility user behavior. The clusters exhibited a reasonable structure, as indicated by an average Silhouette width of 0.67. Each cluster's characteristics and micromobility usage frequency are detailed below:

- Cluster 1 (Bike-sharing lovers): This group comprises avid users of bicycle-sharing systems, showing minimal interest in private e-scooters or moped services.
- Cluster 2 (Trivial e-scooter lovers): Individuals in this cluster rarely use micromobility. When they do, it's primarily private e-scooters.
- Cluster 3 (E-scooter enthusiasts): These users frequently rely on private e-scooters, seldom opting for bicycle-sharing systems or mopeds.
- Cluster 4 (Casual bike-sharing users): This cluster consists of occasional bicycle-sharing users.
- Cluster 5 (Casual moped users): Individuals in this cluster occasionally use moped services and rarely other micromobility devices.
- Cluster 6 (Moped enthusiasts): These users heavily favor moped services, seldom engaging with other micromobility modes.

2. Cluster Bivariate Associations:

Them, bivariate associations were explored between the clusters and self-reported traditional transport mode usage (e.g. Table 1):

Table 1: Self-reported frequency of use of other traditional modes of transport.

	1. Bike-sharing lovers (22.2%)	2. Trivial e-scooter users (11.0%)	3. E-scooter enthusiasts (33.1%)	4. Casual bike-sharing users (11.2%)	5. Casual moped users (14.2%)	6. Moped enthusiasts (7.5%)	Sample average (99.2%)
Own bicycle							
Often	6.5	5.1	5.4	5.0	7.0	7.4	5.9
Sometimes	**4.5**	13.1	9.4	5.9	**14.1**	7.4	8.8
Never	89.0	81.8	85.3	89.1	**78.9**	85.3	85.3
Private vehicle							
Often	**4.5**	21.2	**10.7**	11.9	**47.7**	23.5	16.9
Sometimes	**13.0**	17.2	20.7	15.8	17.2	23.5	17.8

Never	**82.5**	61.6	68.6	72.3	**35.2**	**52.9**	65.4
Metro							
Often	19.5	**29.3**	14.0	**31.7**	15.6	**8.8**	18.8
Sometimes	**48.5**	35.4	**26.1**	33.7	**25.0**	29.4	33.1
Never	**32.0**	**35.4**	**59.9**	**34.7**	**59.4**	**61.8**	48.2
Bus							
Often	12.5	**16.2**	**6.4**	11.9	7.8	5.9	9.6
Sometimes	**32.0**	30.3	**19.4**	**33.7**	21.1	17.6	25.1
Never	**55.5**	**53.5**	**74.2**	**54.5**	71.1	**76.5**	65.3
Train							
Often	4.0	6.1	7.7	5.0	3.9	4.4	5.6
Sometimes	13.0	**20.2**	**7.0**	16.8	10.9	8.8	11.6
Never	83.0	**73.7**	85.3	78.2	85.2	86.8	82.8

Notes: Cluster shares are given in brackets. Numbers in bold indicate a statistically significant difference compared to the overall distribution of the sample.

Overall, two distinct travel behavior trends emerged:

- Monomodal Travelers: Clusters 3 (E-scooter enthusiasts) and 6 (Moped enthusiasts) predominantly rely on micromobility, constituting over 40% of the sample.

- Multimodal Travelers: Two sub-groups of multimodal users were identified. One sub-group relies heavily on public transport (Clusters 1, 2, and 4), integrating micromobility as a complementary mode. The second sub-group (Cluster 5) predominantly uses private transport, occasionally resorting to mopeds for supplementary mobility needs.

3. Micromobility Multivariate Analysis: Binary Logistic Regression Models

Finally, multivariate analyses consisted of six binary logistic models. The dependent variable was to belong to one of the identified clusters. Model 1 confirms that micromobility users occasionally using the metro are more likely to be Bike-sharing lovers, while regular and occasional usage of a private motorized vehicle is negatively associated with frequent use of bike-sharing. Also, those living within Barcelona city boundaries are almost three times more likely to be frequent bike-sharing users than those living in the metropolitan area. Women, students and highly-educated individuals are also more likely to belong to that cluster. Model 2 displays that the probability of being a Trivial e-scooter users, uncovering that the odds are higher among frequent subway users. Students are also found more likely to be classified as Trivial e-scooter users than employed people. Model 3 predicts membership of Cluster 3 (E-scooter enthusiasts), displaying that regular and occasional use of the metro and regular use of the bus decreases the odds of belonging to that group. Additionally, those men and employed micromobility users living outside the Barcelona city boundaries are more likely to be classified as E-scooter enthusiasts. Model 4 focuses on Cluster 4 (Casual bike-sharing users) and it finds that those using the metro on a regular basis are more likely to have and occasional use of bike-sharing systems than those never using the metro. Additionally, those living within the Barcelona city limits and those holding a university degree are much more likely to belong to this group than those living outside the city limits and those not holding a university degree. Model 5 predicts adherence to Cluster 5 (Casual moped users) and finds that driving a private motorized vehicle on a regular basis considerably increases the likelihood of belonging to this cluster. Those with access to a car are also more likely to be Casual moped users than those without access to a car. Finally, Model 6 finds that Cluster 6 (Moped enthusiasts) members are defined by a low use of the subway. Predominantly men, employed people, and those not holding a university degree are more likely to belong to this cluster than women, students, and those holding a university degree.

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