International Co-operation on Theories and Concepts in Traffic Safety

Naturalistic driving study to assess e-scooter and e-bicycle travel speeds

[1]*Naude, C., [1]Riahi, E., [1]Canu, B. & [1]Serre, T.
[1]claire.naude@univ-eiffel.fr, Gustave Eiffel University, France

Introduction

The shift towards sustainable urban mobility, fuelled by environmental awareness and policies for 'greener' cities, has opened the door to new forms of transportation. Traditional modes, such as bicycles and kick scooters, now coexist with electric vehicles like e-bicycles and e-scooters on the streets. This mix has altered travel speeds and user behaviours, leading to new safety risks. Recent data show a significant increase in accidents involving these emerging vehicles. Since speed is a critical factor in traffic accidents and road safety, understanding the typical speeds at which these road users travel is key to evaluating risks and identifying where safety measures or regulations can help reduce accidents and injuries.

Traditionally, Naturalistic Driving Studies (NDS) have focused on motorists and motorcyclists, collecting data from participants operating their vehicles in real-world conditions. This approach provides insights into natural responses to various road and traffic situations, as well as general driving behaviours. To fill the gap in electromobility research, we conducted a NDS on e-scooters and e-bicycles to gather authentic data on usage patterns and speeds, offering a unique perspective in a field where such studies are relatively rare.

Material and methods

A total of 121 users, consisting of 56 e-scooter users and 65 e-bicycle users, were tracked over two-month periods, covering all their daily journeys, in three different regions of France: South (Marseille and smaller surrounding cities, Oct-Nov 2022), East (Lyon, May-June 2023) and Centre (Paris, Nov-Dec 2023). The vehicles were equipped with removable smartphones as data recorders, mounted on the handlebars using 3D-printed holders. The data were collected by a dedicated application, recording speed and GPS position at a rate of one point per second, along with other metrics. The average distances and speeds for each type of vehicle were derived from the individual averages for each user for all their trips.

Results

Around 6,800 trips were recorded, covering a total distance of more than 26,000 km and a driving duration of more than 1,600 hours. On average, an e-scooter trip lasts 9.8 minutes [SD 5.5], while an e-bicycle trip has an average duration of 19 minutes [SD 9.6] (Figure 1, Left). The average distance per trip also differs significantly: 2.5 km for e-scooters [SD 1.7] and 5.3 km for e-bicycles [SD 2.8]. The average speeds per trip show less divergence-14.6 km/h for e-scooters [SD 3.2] versus 15.7 km/h for e-bicycles [SD 2.5].

The representation of the average speed distributions of users (Figure 1, Right) reveals that the averages values (represented by crosses) are closely aligned with the median values (indicated by horizontal lines). This suggests that the speed distributions are fairly symmetrical, with no outliers and few extreme values. Average speeds for each trip were also calculated without considering stops. The average speeds considered so far underestimate the actual speeds in traffic by 0.7 km/h for e-scooters and 0.8 km/h for e-bicycles.

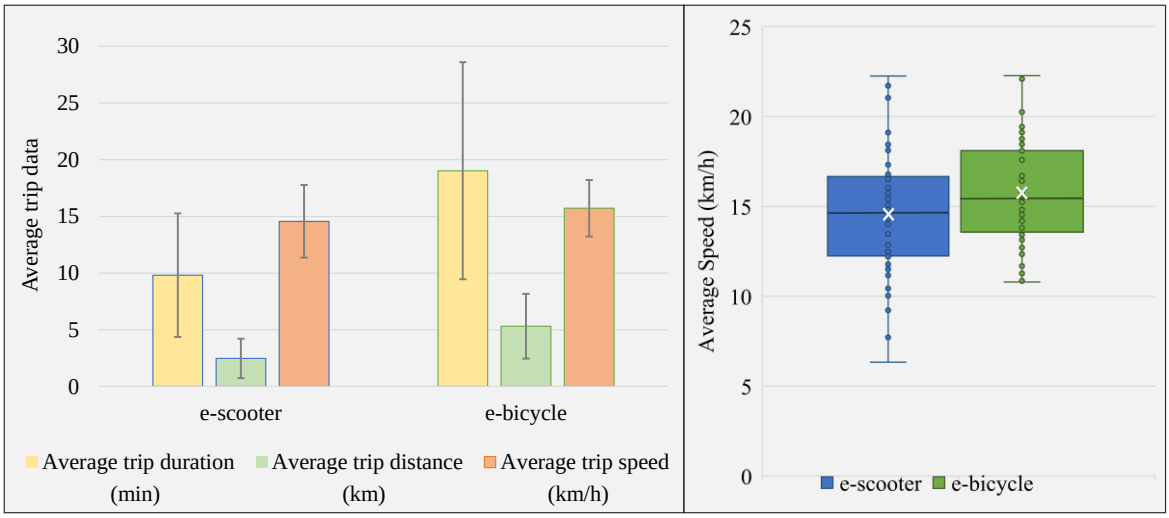

Figure 1. Average trip data

Discussion and conclusions

Dozza et al. (2015) conducted in Gothenburg (Sweden) a similar study with 410 trips in e-bicycles, and found an average speed of 16.9 km/h, slightly higher than the 15.7 km/h found in our study. Almannaa et al. (2021), in Austin (US) based on 6 million trips, reported lower average e-bicycle speeds, ranging from 10.8 to 12.4 km/h, but with higher standard deviations. For e-scooters, Almannaa et al. also reported significantly lower average speeds, ranging from 7.9 to 10 km/h, compared to our finding of 14.6 km/h.

The results of this study can inform public policy and guide decisions on urban planning and regulations for safer and more effective use of these new transportation modes. This naturalistic driving study will also be used to evaluate interactions with other road users and to identify risky situations encountered during trips, based on on-board data, real emergency manoeuvres measurements, front-facing video footage, and subjective feedback from participants.

References

Almannaa, M. H., Ashqar, H. I., Elhenawy, M., Masoud, M., Rakotonirainy, A., Rakha, H. 2021. A comparative analysis of e-scooter and e-bike usage patterns: Findings from the City of Austin, TX. International Journal of Sustainable Transportation, 15(7), 571–579.

Dozza, M., Bianchi Piccinini, G. F., Werneke, J. 2016. Using naturalistic data to assess e-cyclist behavior. Transportation Research Part F: Traffic Psychology and Behaviour, 41, 217–226.