Parking Regulations to Harmonize Dockless E-scooters
An Empirical Analysis From Paris

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SHORT SUMMARY

The auto-oriented paradigm that dominated urban transport rose social and environmental concerns. In response, cities welcomed new micro-mobility services aiming to provide alternatives to reduce car-dependency and improve accessibility. However, how to articulate these services into a multimodal system is an open debate in the literature. We contribute providing empirical evidence from the introduction of dockless e-scooters in Paris. This paper seeks to investigate the effects of parking regulations on parking behavior and on the accessibility of e-scooters. The case of Paris is relevant because the city reallocate public spaces to park e-scooters. However, the effects of these parking bays are not evident and is a pending work in the literature. Using an original administrative dataset that geo-locates dockless e-scooters, we found that parking regulations in Paris helped to harmonize this service with the rest of the mobility mix at the expense of diminishing the accessibility of vehicles.

Keywords: Big data analytics; Dockless E-scooters; Micro-mobility management; Parking regulation; Shared-mobility.

1. INTRODUCTION

The auto-oriented paradigm that dominated urban transport during the last fifty years rose social and environmental concerns due to traffic congestion, local and global pollution, inequalities, and adverse health effects. In response, cities welcomed new micro-mobility services aiming to provide alternatives to reduce car-dependency, tackle travelers dilemmas, and improve accessibility while attaining economic growth (Shaheen, 2019). These services are based on smart technologies and sharing economy, including various transport modes such as (e)bikes, e-scooters, and mopeds, station-based (docked) or dockless. However, how to articulate these new services into a multimodal mobility system is an open debate in the literature far from over (Banister, 2008; Meng, et al., 2020).

This paper focuses on the introduction of dockless e-scooters in the city of Paris and the regulatory reforms that came along seeking to harmonize improper parking. It seeks to investigate the effects of said parking regulations on parking behavior and on the accessibility of e-scooters. In fact, misparking and cluttering (random parking) are considered as the main drawbacks in the adoption and acceptance of dockless modes, especially e-scooters (Gössling, 2020); e.g. cities such as Barcelona and Miami banned them from circulation on this basis. The case of Paris is of particular relevance because the city decided to reallocate public spaces to exclusively park e-scooters. However, the effects of these parking bays on parking behavior and accessibility of vehicles are not evident and, to the best of our knowledge, they have not been yet addressed in the literature. While parking bays could reduce cluttering and mis-parking, they might also make e-scooters less accessible by limiting pick-up and drop-off points and concentrating vehicles in certain spots. This paper intends to shed light on these issues using an original database that geo-locates e-scooters in the city.

Dockless e-scooters have received limited attention in the literature so far because they are a relatively recent innovation for shared-mobility. Some of the available academic studies have focused on users demand and adoption (McKenzie, 2020; Younes, et al., 2020), mode choice and spatial competition (Reck, et al., 2021), social concerns and regulation (Gössling, 2020; Moran, et al., 2020). In addition, we have identified few studies that explore the challenges regarding parking regulations. Brown (2021a) reviewed regulatory frameworks form 37 different US cities and found an important variation of practices across cities and a constant concern from authorities to improve parking behavior. For instance, in 95% of the cases parking on sidewalks is allowed, meanwhile parking against buildings is only forbidden in 11 cities (30%). Brown et al. (2021b) provided additional evidence about how bad e-scooters are parked in comparison to other mobility modes such as bikes and motor vehicles. They collected in-field data during three days from five US cities with a large micro-mobility mix in streets with high levels of transport activity. After defining micro-mobility parking violations as blocking crosswalks or reducing sidewalk spaces below the reglementary minimum, the authors found that improper parking among e-scooters happened in only 1.1% of the cases. Nevertheless, these studies fail to reconcile the intrinsic relationship between cluttering and improper parking. A cluttered distribution of vehicles gives the perception of mis-parking even when individually e-scooters are properly parked.

These papers are relevant in our study because they discuss how parking regulation might help to enhance the adoption of e-scooters at the expense of harming accessibility when implemented improperly. However, empirical evidence is currently either restricted to stated preferences, or limited by the low spatial extension and time depth of the collected dataset. We intend to fill this gap in the literature by using observational data with a high spatial and time coverage.

2. METHODOLOGY

The analysis is based on the spatial relationship between vehicles and parking bays and its evolution over time. We evaluate the effects of parking bays computing the following measures: the planar distance between each vehicle and the closest parking bay and the demand for parking bays. The latter includes both the share of the fleet-size using parking bays and the share of parking bays with at least one e-scooter. Furthermore, we have developed an original methodology to account for measurement errors due to potential GPS inaccuracies (not reported here). Because no information is available unfortunately on the exact date of construction of the parking bays, the analysis focuses more on the before-after comparison (by comparing the initial situation in mid-2019 to the situation by the end of 2020) than on the dynamic itself.

Regarding the effects on the accessibility of e-scooters, we produce two types of raster datasets at a spatial resolution of 2m by 2m each time the geo-location of the vehicle is observed. To produce comparable raster datasets over time, everyone was snapped and masked to a *basic raster* which cover a surface up to 1km away from the farthest parking bay in every direction of the city. The first type stores in each pixel the planar distance to the closest e-scooter while the second stores the number of vehicles within a radius of 100m. Zonal statistics were then extracted to compare the evolution over time. Furthermore, we are currently studying the evolution of e-scooters parked outside parking bays. The objective is to understand the conditions under which some users still mis-park to help policy makers in their future endeavors.

3. RESULTS AND DISCUSSION

Dockless e-scooters circulated the Parisian streets for the first time on the summer of 2018 and a social debate immediately arose. Some argued in favor of clean and ludic alternatives to commute to ease transport-related concerns. On the contrary, others highlighted the chaos and the lack of security mainly caused by irresponsible riding, mis-parking, cluttering, and vandalism. In response, the city implemented a plan in an attempt to harmonize this service with the rest of the mobility mix. First, in April 2019, the city announced the construction of 2,500 parking bays (painted corrals) for the exclusive use of e-scooters. According to the authorities, half of these were built the last months of 2019 and the rest during 2020. The target distance between two parking bays is around 150m and the total capacity is enough to allocate the whole fleet (15,000) from the three firms that operate in the city: Lime, Tier, and Dott.[1] Second, in July and October 2019 the city issued a series of reforms in line with the aforementioned objectives.[2] These reforms clarified the regulatory framework to delineate the characteristics and rules to ride and park micro-mobility vehicles powered by non-thermic engines (or Engins de Déplacement Personnel Motorisé in French).

In order to investigate the effects of parking regulations in Paris, we use an original administrative dataset that geo-locates dockless e-scooters parked in the city. The information ranges from August 2019 to December 2020, and is available on a daily basis with a frequency of three hours. The geo-location of parking bays was collected from the city's open data site.

Parking regulations in Paris had a positive effect on harmonizing dockless e-scooters parked in the city. Before the construction of parking bays, the average distance between e-scooters and their virtual location was close to 100m, once they were built the distance falls to around 20m (a percentage decrease of 80%). The evolution over the whole timespan scaled by the daily fleet size is documented in Figure 1 (a). The comparison among districts also revealed interesting results. Figure 1 (c) shows the district variation in this measure in December 2020. As noticed, e-scooters are located closer to parking bays in the southern districts. Regarding the evolution in the demand for parking bays, we found positive results. As observed in Figure 1 (b), considering a spatial tolerance of 30 meters around parking bays (defined after a GPS accuracy analysis not shown here), in August 2019, around 25% of the space later used for parking bays had at least one vehicle raising up until 85% after their implementation (60 pp. increase). In terms of coverage, in December 2020, parking bays allocated almost 85% of the fleet-size (not shown here).

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[1] Initially, 12 operators had permits to deployed dockless e-scooters in the city and the fleet-size was close to 20,000 vehicles. Nonetheless, in July 2020, after a public tender, the city granted permits only to Lime, Dott, and Tier to operate 5,000 vehicles each. Winners were selected on the promises of implement sustainable and environmentally responsible business practices, improve user safety, and on their ability to manage the maintenance, removal, and parking of e-scooters (Sands R., 2020. How to Win a Mobility Tender: Insights from the Paris Scooter Operators. Autonomy, accessed September 2020. Accessible at: https://www.autonomy.paris/en/how-to-win-a-mobility-tender-insights-from-the-paris-scooter-operators).
[2] See Arrêté No 2019 P 16391 and Décret No 2019-1082 for further details.

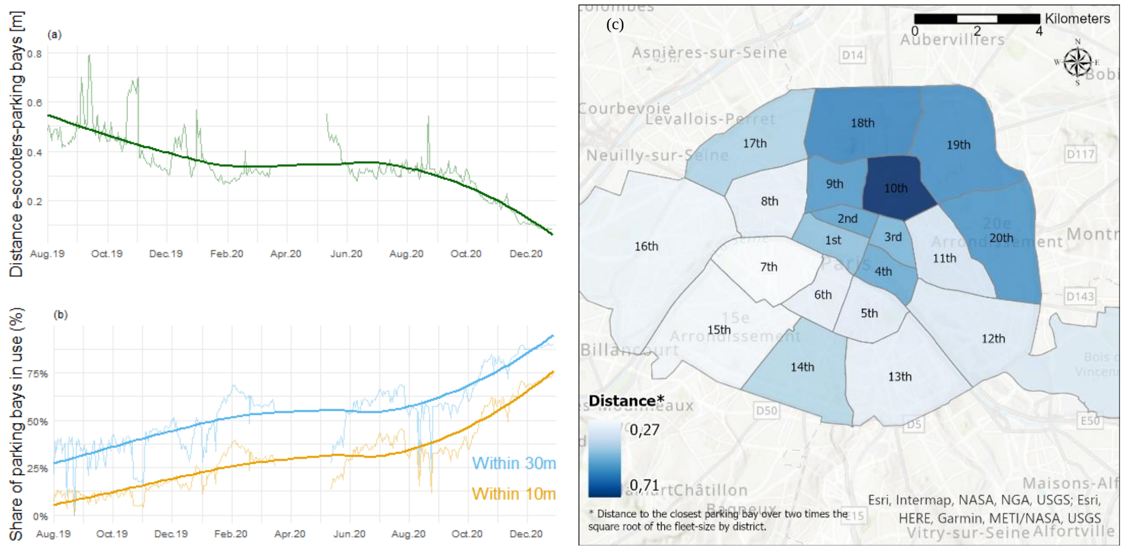

Figure 1. Impact of parking regulations on the harmonization of dockless e-scooters

The construction of parking bays also had an effect on the spatial distribution of e-scooters. In August 2019, the average distance to find an e-scooter was about 180m reaching almost 250m at the end of 2020. In consequence, parking regulations in Paris have a negative effect on the travel time which might harm the demand for this service, an open question that remained to be answered in future work. Finally, the measure of the average density of e-scooters showed no changes along the timespan. However, the results showed that parking bays redistributed the number of vehicles across the city improving the coverage in regions with a low provision before their construction (not shown here). In other words, the regulation improved the accessibility in outer regions of the city.

4. CONCLUSIONS

This analysis reveals that parking regulations in Paris have helped to harmonize this service with the rest of the mobility mix. The evolution of the measures we have developed here shows that, on average, 85% of parked e-scooters are located inside parking bays. However, we have shown evidence that the location of the parking bays has an impact on the accessibility of dockless e-scooters measured as the average distance to find a vehicle in any location of the city. Our work has important policy implications for urban planning, the evidence shown here might help policy makers to decide the optimal number of parking bays as well as their optimal location to find a balance in the threshold between harmonization and accessibility.

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