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Congested sidewalks: The effects of the built environment on e-scooter parking compliance

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Abstract: With the proliferation of electric scooters (e-scooters) in cities across the world, concerns continue to arise about their parking spots on sidewalks and other public spaces. Research has looked at e-scooter parking compliance and compared compliance to other mobility devices, but research has not yet examined the impacts of the built environment on parking compliance. Using a field observation dataset in Portland, Oregon, and novel GIS data, we attempt to understand the spatial distribution of e-scooter parking and the impact of built features on parking compliance, offering recommendations for policymakers and future research. The results of our study show that 76% of e-scooters observed fail at least one of the Portland's parking compliance requirements and 59% fail at least two criteria. However, compliance varies spatially and by violation type, indicating that parking compliance (or non-compliance) is dependent on features of the built environment. Parking compliance is significantly higher on blocks with designated e-scooter parking than blocks without designated e-scooter parking. A statistically significant relationship is observed between the amount of legally parkable area on a city block and parking compliance. Parking compliance increases with larger percentages of legally parkable area. This finding can help policymakers prioritize dedicated e-scooter parking for blocks with limited legally parkable area.

Keywords: Micromobility, e-scooters, shared, land use, parking, compliance

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1 Introduction

When electric standing scooters (e-scooters) began appearing in cities in 2017, their abrupt ubiquity surprised residents and regulators alike. In some cities, e-scooters appeared on streets overnight. In others, the cities pre-emptively were able to regulate the deployment and usage. Parking concerns about the e-scooters emerged immediately and persist today. While existing research has looked at parking compliance rates and comparison with other mobility devices including automobiles, research has not yet examined the impact of built environment characteristics on parking compliance (Brown et al., 2020; Fang et al., 2018).

In Portland, e-scooters face extensive parking regulations, making it ideal to examine the effect of built environment features on parking compliance (PBOT, 2018a). The city of Portland offers a useful study because the city preemptively prohibited e-scooters to get ahead of concerns around the deployment of the devices in other cities. Only through a tightly regulated pilot were companies allowed to operate an e-scooter fleet, and the city not only went to great lengths to publicize the rules but ticketed riders and fined companies for improper usage, primarily parking. Thus, the results of the parking compliance in the face of these regulations offers insights into user behavior and frameworks for policymakers to learn about the impact of the built environment on parking compliance. In Portland, like many cities, scooters are required to be parked and deployed in special areas such as the furnishing zone of the street or in dedicated scooter parking areas and not within buffer areas of an extensive list of sidewalk features. This paper examines the results of a field survey conducted during the city of Portland's second e-scooter pilot in 2019, in which researchers observed parked e-scooters in three areas of downtown Portland and evaluated their compliance with city regulations. We present the results of that survey as well as offer a spatial analysis that answers the following questions:

1. What were e-scooter parking compliance rates and where did that vary spatially?
2. Does dedicated e-scooter parking affect parking compliance rates?
3. How does the amount of legally parkable area on a city block impact e-scooter parking compliance?

2 Background

Cities have regulated car parking for decades, with extensive regulations included in zoning and city codes (Shoup, 2017). Similarly, the sidewalk zone shares its own set of regulations. The emergence of micromobility devices such as e-scooters requires a new set of regulations for their use and parking. E-scooter popularity skyrocketed from the moment of their release, and within 14 months from the launch date (NACTO, 2019; Teale, 2018). According to North American Bikeshare Association (NABSA), North Americans took an estimated 88 million trips on 112 thousand shared e-scooters in 2019 (NABSA, 2020). Micromobility presented in the right framework can achieve sustainable and equitable outcomes many cities are trying to meet (McQueen et al., 2021).

The proliferation of e-scooters immediately generated spatial conflicts on streets and sidewalks. News articles and social media postings (@birdgraveyard and #scootersbehavingbadly) highlighted with concerns over e-scooters and where and how they were parked (Thomas & KATU staff, 2019). During the first e-scooter pilot in Portland, 14% of the complaints mentioned misplaced scooters (KATU, 2019).

Still, e-scooters offer an intriguing examination into parking as part of destination choice (Merlin, et al., 2021; Zhang, et al., 2021). The high level of maneuverability changes the calculus for users in choosing parking, and individuals can more easily leave an e-scooter parked anywhere compared to an automobile (Kopplin, et al., 2021). E-scooter users have more capability to just leave an e-scooter anywhere they like to optimize their access to a destination. And with fewer established norms nationally and locally, this flexibility to park anywhere creates a unique set of conflicts for space on the sidewalk.

The city of Portland's response to concerns over improper e-scooter parking led the city to develop an extensive set of regulations to prevent impacts of parked scooters on sidewalk users as well as access to sidewalk features, as shown in Table 1 (PBOT, 2018b). The regulations address both how and where e-scooters are to be parked. Many are in place to ensure Americans with Disabilities Act (ADA) accessibility, but others are present for the protection of features such as street trees. Cumulatively, these regulations significantly limit the amount of parkable area on a blockface.

With the proliferation of e-scooters there has been a growing body of research about these vehicles (Bozzi & Aguilera, 2021). Researchers have examined parking trends broadly. In San Jose, researchers found that 90% of scooters were parked on the sidewalk and only 10% of sidewalk-parked scooters failed to be parked in the furnishing zone (Fang et al., 2018). However, only 2% of the scooters actually obstructed pedestrian movement. In a study of five different cities that compared scooter parking with bicycle and automobile parking, researchers found that scooters were parked in violation less than 2% of the time, while in comparison, motor vehicles were parked so that they impeded access 24.7% of the time (Brown et al., 2020). These pieces of research suggest that while there are issues with e-scooter parking compliance, especially as it might related to people with disabilities and other pedestrians, the rates are low and generate a disproportionate outcry compared to the parking compliance issues with automobiles.

Geofencing offers an intriguing role in e-scooter usage and parking as compared with automobiles and personal bicycles. Geofencing refers to the use of the e-scooter's GPS system to limit operations and parking in certain areas. For example, e-scooters are prohibited from operating within city of Portland parks. Users are given an audible warning when operating an e-scooter in these areas and are unable to park/lock the e-scooter within a park's boundaries. To date, no city is known to try to regulate e-scooter parking more granularly using geofencing on a block face (Moran, 2021). GPS is shown to have an average margin of error of 16.9ft, making it useful for large areas such as limiting operation in parks (GPS.gov, 2021).

However, these pieces of research may not tell the whole story. First, both the Fang and Brown studies use more generalized definitions of proper parking. Neither base the scooter's parking compliance with a corresponding city code or infraction. Second, these studies do not examine other factors that may impact parking compliance such as the accompanying built environment. Cities are struggling to balance overly prescribing parking and use requirements for emerging technology and vehicles with the ability to monitor compliance and provide the opportunity for the safe use of these vehicles.

Figure 1 shows examples of e-scooters parked in areas that don not meet the city of Portland's permit requirements. Figure 2 shows e-scooters properly parked and a designated parking area.

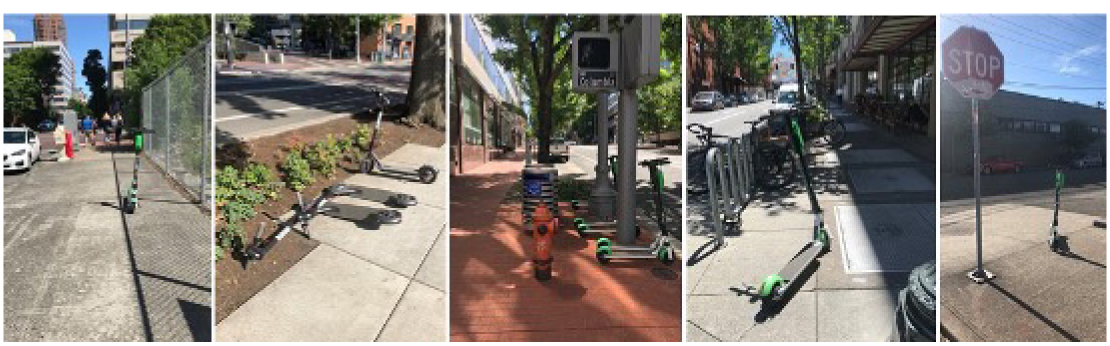

Figure 1. E-scooters parking in undesignated areas

Figure 2. Designated e-scooter parking

3 Methods

3.1 Field observation methodology

From July 3-July 27, 2019, a team of student researchers from Portland State University conducted a field survey observing parked scooters. The team documented e-scooters parked in three downtown zones in Portland: the Pearl, northwest, and downtown zones (Figure 3). The three zones were chosen for their high density of e-scooters, dense commercial and residential land uses, and variation in street width and furniture.

Figure 3. Block segments where e-scooters were observed in field survey

The evaluation method and evaluation tool were augmented from Fang, et al., 2018, to include the city of Portland permit regulations of use and parking (PBOT, 2018b). Using a predesigned Qualtrics survey and tablets, the team observed and documented 576 e-scooters — either in groups or individually — during July 2019 and recorded data on parking compliance and if non-compliant, which city codes were violated. Additionally, the research teams completed observations on block segments where an e-scooter was parked. All the data, including pictures and videos of the blocks observed, was aggregated and coded for analysis.

Using this methodology enabled researchers to capture all of the e-scooters in the survey area and assess their parking compliance. Relying on crowdsourcing or police reports would likely omit properly parked e-scooters and only identify the most egregious violations of parking regulations (Bai & Jiao, 2020). Instead, this methodology allowed researchers to examine each e-scooter against the extensive parking requirements.

The city of Portland's compliance rules are extensive. Compliance rules are divided into three categories: place-based, obstruction-based, and sidewalk-based violations with multiple requirements. The research teams checked each observed parked scooter against the entire list and documented compliance or non-compliance. Parking compliance was measured against all of the city of Portland's rules for e-scooters, summarized in Table 1 (PBOT, 2018b). These requirements were grouped by researchers into three categories in order to analyze trends among violations, termed here as: Place-based, Obstruction-based, and Sidewalk-based.

Table 1. Requirements for e-scooter parking

Place-based		**Obstruction-based**	
Furnishing Zone	Compliant	ADA ramp (w/in 5ft)	Not Compliant
Through Pedestrian Zone	Not Compliant	Fire hydrant (w/in 5ft)	Not Compliant
Curb Zone	Not Compliant	Drinking fountain (w/in 5ft)	Not Compliant
Frontage Zone/Private Property	Not Compliant	Public art (w/in 5ft)	Not Compliant
Driveway, Alley, or Curb cut (w/in 5ft)	Not Compliant	Any fixed regulatory/info sign (w/in 5ft)	Not Compliant
On a corner	Not Compliant	Grating, manhole cover, or access lid	Not Compliant
On landscaping or vegetation	Not Compliant	Light, signal, or utility pole	Not Compliant
At a bicycle rack (w/in 5ft)	Not Compliant	Street trees	Not Compliant
At a designated e-scooter parking area	Compliant	Sidewalk-based	
Loading/taxi zone (w/in 5ft)	Not Compliant	Sidewalk doesn't have a furnishing zone	Not Compliant
Disabled parking space (w/in 5ft)	Not Compliant	Furnishing zone is less than 3ft	Not Compliant
Crosswalk (w/in 5ft)	Not Compliant	Through pedestrian zone is less than 6ft	Not Compliant
Traffic Island, median or Traffic circle	Not Compliant		
Transit platform	Not Compliant		
Bus stop (w/in 30ft)	Not Compliant		
PBOT designated "No Parking Zone"	Not Compliant		
Within a City Park	Not Compliant		
Within a Pedestrian Plaza	Not Compliant		

Note: Table 1 is adapted from city of Portland Administrative Rule TRN-15.01

3.2 Spatial analysis methodology

To spatially map results of the field observations, we utilized a curb layer from the city of Portland and merged the appropriate curb vectors to create a single curb per block face. Next, we assigned a unique Block ID to each curb that corresponded to the Block ID used in the field survey (which contained the compliance evaluation), in order to join the two data sets. Once the compliance data was geocoded to its corresponding curb, we were able to carry out the rest of the spatial analysis to answer our third research question.

In order to determine how the amount of legally parkable area on a block impacts e-scooter parking compliance, we needed to create a Furnishing Zone GIS layer to correspond with space where scooters are parking-compliant, and a Non-Compliant Parking Layer comprised of GIS data corresponding with city parking regulations. Neither existed prior to this paper. Figure 4 demonstrated the process for the creating these GIS layers. The ratio between the two areas provides a percentage of legally parkable area for each block face in the survey area.

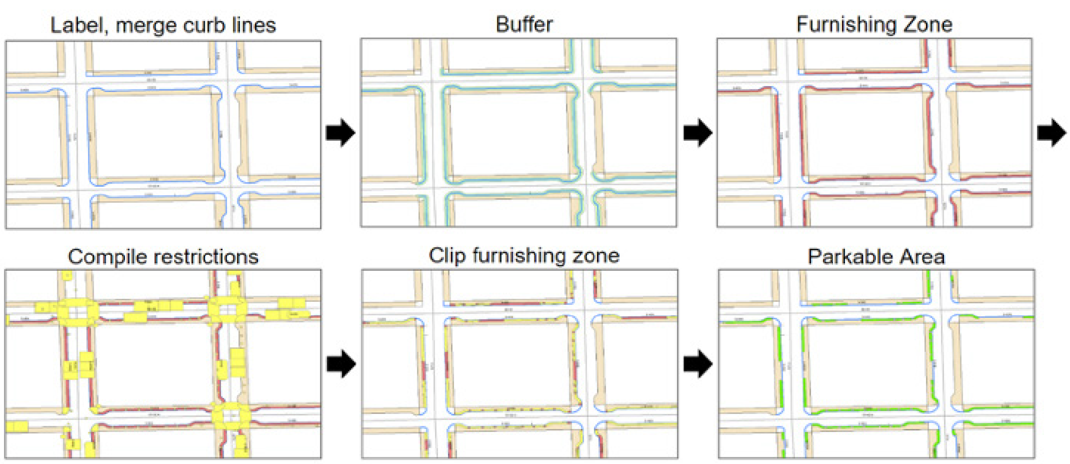

Figure 4. Overview of process for determining legally parkable area

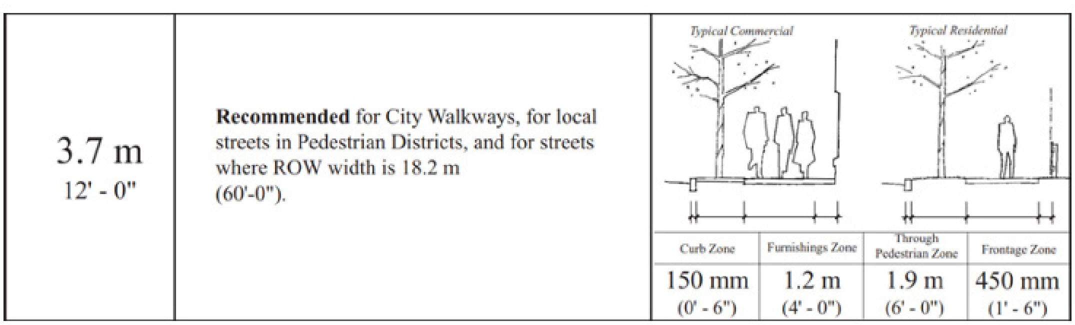

Figure 5. Basis for determining the curb buffer distance (Murase et al., 1998)

4 Findings

4.1 E-Scooter density and designated parking comparison

First, we present the locations of the observed e-scooters in the survey, aggregated to the corresponding block segment, for the Pearl District (Figure 6).

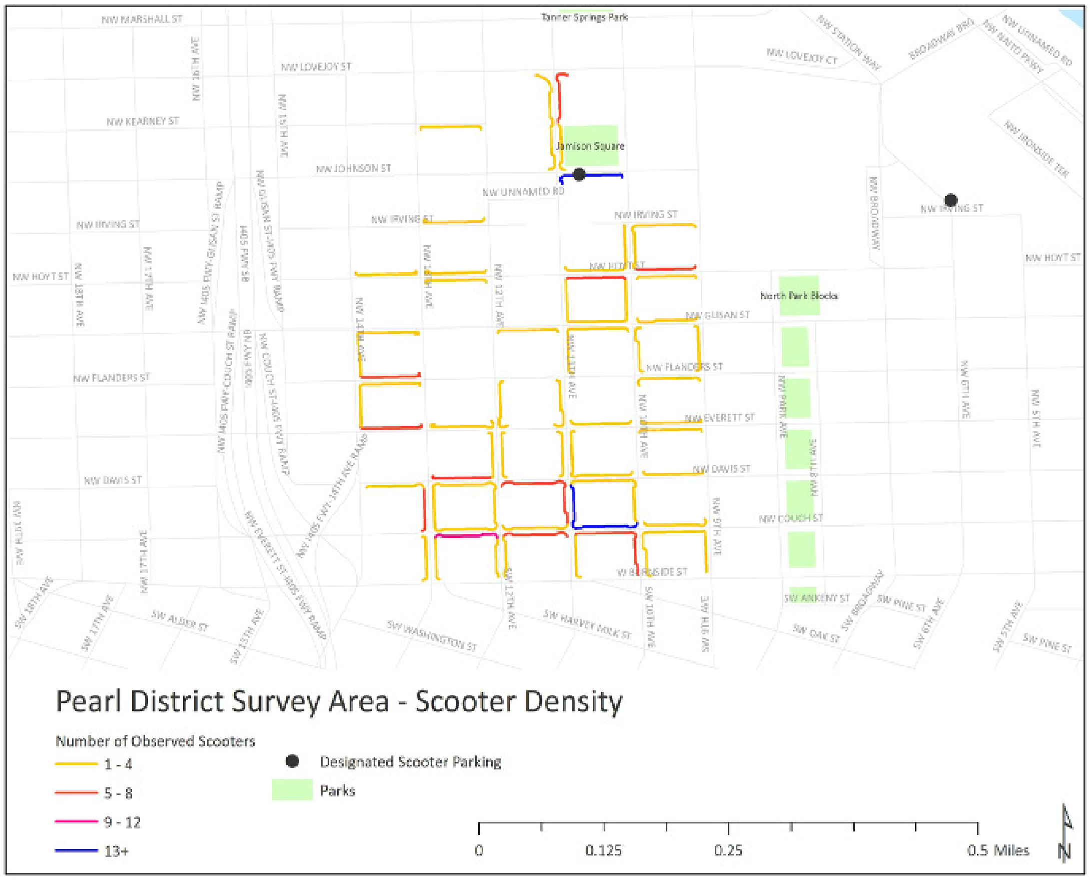

Figure 6. Density of e-scooters in the Pearl District survey area

A key takeaway the maps highlight is e-scooters are not distributed everywhere within the zone of study but non-randomly distributed. The greatest parking needs fall in only a small number of places where e-scooters tended to congregate.

4.2 Descriptive statistics of parking compliance

Unlike the results of other e-scooter research, our survey found that only 28% of scooters were parked in compliance with all of the city codes; 72% were non-compliant with at least one code. Parking compliance improved slightly when e-scooters were parked in groups of two or more, increasing to 35%, while individually parked scooters were compliant only 24% of the time.

Using a chi-square test, we establish that there is not a significant difference between the three e-scooter companies in their rate of parking compliance ($\chi 2 = 3.029$, $p = 0.39$, $N = 576$). This may support the notion that the built environment is a greater factor in user parking behavior than any in-app nudges or encouragement to park correctly from companies.

Given that each e-scooter had to satisfy 28 requirements to comply with city regulations, many of the e-scooters that were improperly parked were found in violation of multiple requirements. Indeed, 243 (59%) of the 412 improperly parked e-scooters were found to be in violation of more than one city requirement.

Among those with only one violation, the vast majority (72%) were place-based violations; that is, their location in the public realm was in violation of city requirements, compared with obstruction-based (20%) and sidewalk-based (17%). For scooters with multiple violations, this trend is more apparent. E-scooters with multiple violations were more likely to have two place-based violations than to have an additional obstruction-based or sidewalk-based violation (76%), while obstruction-based (10%) and sidewalk-based (14%) declined.

Looking more closely at place-based violations, the breakdown shows that three violations accounted for more than half of all violations: outside the furnishing zone, at a bicycle rack, or through a pedestrian zone (Table 2).

Table 2. Place-based violations by type

Violation	**[%]**
Outside Furnishing Zone	31
At a bicycle rack (w/in 5ft)	21
Through Pedestrian Zone	16
Frontage Zone/Private Property	8
Loading/taxi zone (w/in 5ft)	6
PBOT designated “No Parking Zone”	4
On a corner	3
Crosswalk (w/in 5ft)	2
Curb Zone	2
On landscaping or vegetation	2
Bus stop (w/in 30ft)	1
Disabled parking space (w/in 5ft)	1
Driveway, Alley, or Curb cut (w/in 5ft)	1
Transit platform	1
Within a City park	1
Traffic Island, median or Traffic circle	0
Within a Pedestrian Plaza	0

n=588

Obstruction-based violations comprised 12% of all violations and were more evenly split among four codes: grating, manhole cover, access lid obstruction, fire hydrant obstruction, fixed sign obstruction, and ADA ramp obstruction.

Table 3. Obstruction-based violations by type

Violation	[%]
Grating, manhole cover, access lid Obstruction	33
Fire Hydrant Obstruction	26
Fixed Sign Obstruction	21
ADA Ramp Obstruction	15
Leaning/Fastening Obstruction	4
Public Art Obstruction	1
Drinking Fountain Obstruction	0

n=98

Sidewalk-based violations comprised 15% of all violations. The most common violation observed was a e-scooter parked on a street whose through pedestrian zone is less than 6ft (Table 4). On these areas, there is no furnishing zone within which a scooter can be legally parked.

Table 4. Sidewalk-based violations by type

Violation	[%]
Through pedestrian zone is less than 6ft	67
Furnishing zone is less than 3ft	20
Sidewalk doesn't have a furnishing zone	12

n=132 (This total is greater than the total number of sidewalk-based violations reported earlier (117), because these violations have overlapping parameters and some scooters were counted twice. In other words, those scooters that were parked where the sidewalk does not have a furnishing zone were also parked where the furnishing zone is less than 3ft.)*

While there are many small insights to be gleaned from this data set, we highlight three: (1) parking e-scooters within five feet of a bike rack is a common violation. This could be user misconception that bike racks seem as logical place to park vehicles. The removal of this rule would increase the overall compliance rate by 16%; (2) e-scooters parked in groups tended to be more compliant than those parked individually, which could mean that companies who deploy in batches are indeed trying to follow city regulations or that one correctly parked e-scooter has the effect of inducing compliance for subsequent e-scooters; and (3) it appears the most common issue with e-scooter parking is not that they are not parked upright, or obstructing other city infrastructure but that users do not - or are not able to- distinguish the furnishing zone from the pedestrian through zone.

4.3 Spatial distribution of parking compliance

We present maps that detail the spatial variability of parking compliance across the three survey areas. Due to the large number of blocks where only one e-scooter was observed, we only display blocks where two or more e-scooters were evaluated in order to better distinguish those places with higher compliance rates than others. Figure 7 is a map of the Pearl District, and the other survey areas show similar patterns but were omitted for the sake of publication.

The maps demonstrate how parking compliance varies spatially across the three surveyed areas. Using a chi-square test, we establish that parking compliance on blocks with designated on-street e-scooter parking is significantly greater than blocks without designated e-scooter parking ($\chi2 = 15.35$, $p < 0.001$, $V = 0.16$). Visually, the maps confirm this notion.

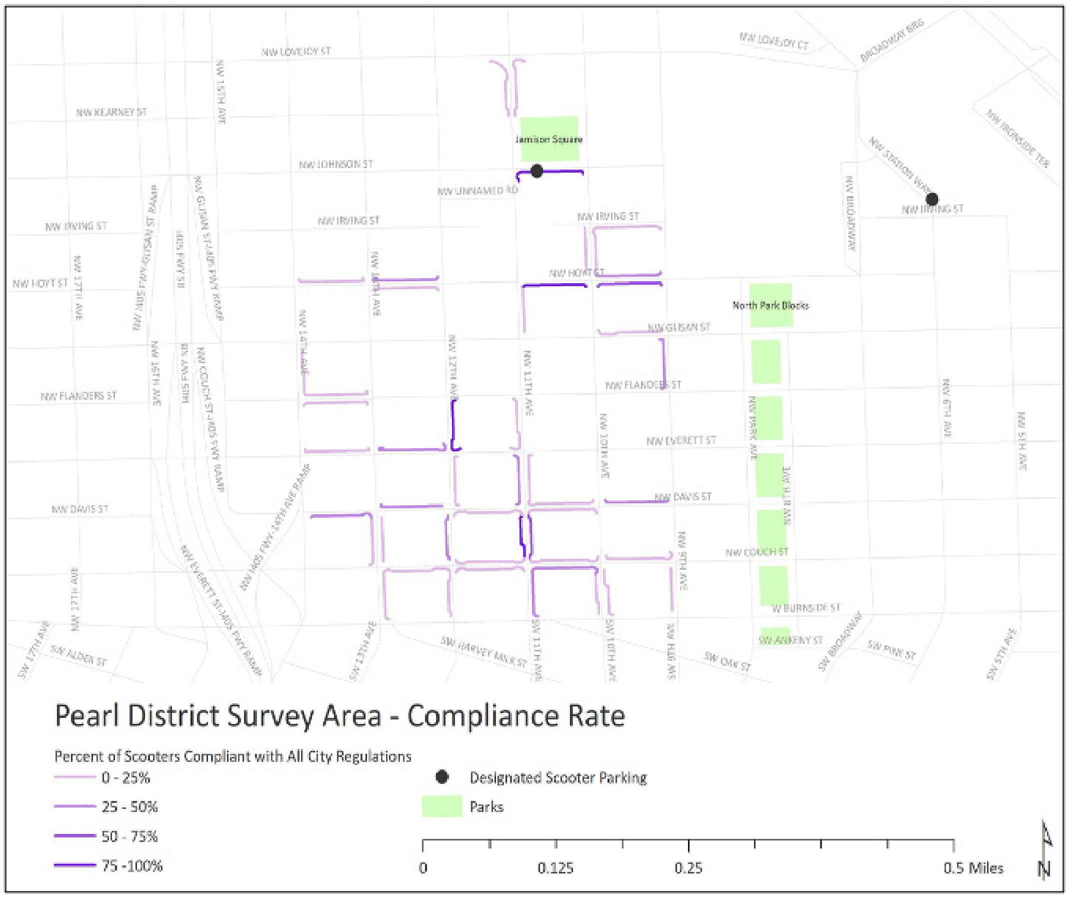

Figure 7. Observed e-scooter parking compliance in the Pearl District survey area for blocks with two or more e-scooters

4.4 Total legal parkable area in furnishing zone

The Legal Parkable Area is a novel GIS layer that combines all of the e-scooter parking requirements to determine a square footage on each block where e-scooters can be legally parked. After building the Furnishing Zone and parkable area layers, we were able to obtain the area of these polygons broken down by Block ID. From that, we calculated a percent parkable area for each block.

Then, we looked at every scooter observation that was recorded, its parking compliance status, and the percent parkable area for that block in an analysis of means two-variable T-test. The null hypothesis is that parkable area does not affect parking compliance. T-test results show that the difference in percent parkable area for compliant observations (N=164, M=80.2%, SD=16.8%) significantly higher ($p<0.001$), as compared with the non-compliant observations (N=408, M=72.7%, SD=22.1%). We find that scooters compliantly parked were on blocks with an average parkable area 7.5% larger than non-compliantly parked scooters.

Full view of the results is also shown in Figure 8, with example normal curves for the two samples shown. In reviewing this figure, one item that stands out is that, with one exception, very few scooters are compliantly parked when parkable area drops below 60%. While parking compliance will always be an individual action, these results show that the built environment impacts parking compliance. A crowded furnishing zone contributes to the ability or inability to park an e-scooter compliantly.

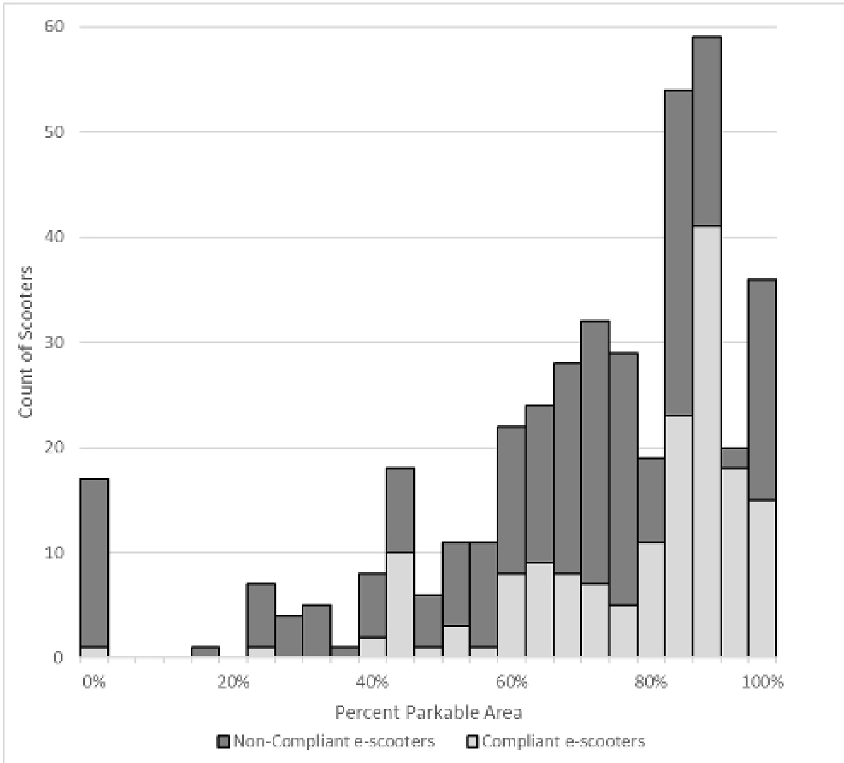

Figure 8. Histogram of percent parkable area and count of scooters parked by compliance

5 Discussion

The analysis from this paper adds critical context to the contesting of public spaces by micromobility devices. Where previous research did not specifically examine city parking requirements or the built environment, we find that despite the Portland's extensive parking regulations for e-scooters, few users successfully comply with every requirement. However, the built environment is shown to affect the parking compliance, from the increased compliance with dedicated e-scooter parking to the impact on compliance depending on the amount of legally parkable square footage on a block face. While cities are within their rights and the interest of all sidewalk users to regulate e-scooter parking, a balance will need to be struck to encourage stronger compliance and the sharing of space. From the results throughout this paper, we can make the following recommendations for policymakers in an effort to improve parking compliance.

First, re-examine compliance rules to ensure that they all make sense to users and for accomplishing goals and outcomes. For example, the restriction against parking within 5' of bicycle parking not only can cause confusion but runs contrary to other messaging about e-scooters; e-scooters are encouraged to use bicycle lanes but not bicycle parking? Bicycle parking was a top violation among e-scooters and removing this violation would help improve compliance by 16%. Often bicycle racks are located in areas on the block where there is enough room to park vehicles without blocking pedestrians. We were not able to obtain the number of citations given to users or to operators for improper parking. Future studies could examine the enforcement of these regulations.

Second, the paper demonstrates the positive impact of dedicated on-street e-scooter parking. By knowing more about scooter usage density as well as the impact of parkable area percentage, we can provide the outlines of a decision matrix for deployment of future e-scooter parking; new dedicated parking should be placed on blocks with higher usage and lower parkable area.

Third, in combination with existing research, policymakers may consider a less stringent set of parking regulations. The high levels of non-compliance in the Portland, in comparison with observations in other cities, suggests that overly prescriptive regulations do not lead to compliance, and using more "common sense" views of scooter parking show high rates of compliance, higher than automobiles. Therefore, policymakers may be better served by focusing on a couple key requirements for parking regulation – as well as offering strategically-placed dedicated scooter parking.

While e-scooters are equipped with GPS devices that can be utilized in unique ways from urban transportation modes such as automobiles and personal bicycles, geofencing alone does not appear to be a solution to sidewalk congestion. GPS devices' margin of error of 16.9 feet far exceeds the space constraints on a sidewalk whose total width may be half that length. The city of Portland has worked e-scooter operators to provide Portland-specific rules in their apps, creating a citation mechanism to warn and fine companies and users for improperly parked e-scooters. In addition, operators are required to respond quickly to public complaints about improperly parked e-scooters. In addition to technological solutions, policymakers should to focus on common sense regulations, education, and strategic deployment of dedicated parking.

The city of Portland has developed an outreach program for users to learn about the rules applicable to e-scooters and how to safely navigate streets. The program includes YouTube videos, social media postings, handbills and other materials. The program provides a broad level of safe operational information including parking: "Park scooters on the sidewalk, close to the curb, or in designated scooter parking areas. If a scooter is parked in a way that prevents access to the sidewalk, curb ramps, bike lanes, or vehicle travel lanes, you may be fined or your account suspended (PBOT, 2019)." Though this information is very useful to users, it certainly does not cover nuances of the extensive parking requirements. The city has installed 25 dedicated e-scooter parking corrals across the city and have experimented with different signage and markings.

There are significant options for future study. First, we are interested in developing a regression of furnishing zone features to identify if certain features have significant impact in scooter compliance. Second, further exploration is called for understanding the role of grouped scooters in compliance, as they represent a unique subset of data. Third, the non-compliant GIS layer could be further refined with additional data on objects in the furnishing zone as well as better confirmation of the accuracy of the GIS data provided by the city of Portland, TriMet, and Metro to yield a more-complete dataset for analysis.

In all, these findings can help policymakers and researchers in cities across the world in addressing the conflicts between the built environment, scooters, and our shared urban infrastructure. This data is most applicable to urban areas with scooters and with paved furnishing zones but could apply to any mobility device that has the potential to impact other sidewalk users. Building dedicated e-scooter parking increases parking compliance and putting e-scooters in conflict with busy furnishing zones increases the likelihood of non-compliant parking. As we appreciate the impact the built environment has on e-scooter parking compliance, we can make changes that improve shared spaces for all.

6 Limitations

The observation data for this research comes from field researchers who did a one-time pass through each observation area. As such, the documented scooters do not represent a totality of e-scooter parking in that area. In the creation of the GIS layers for analysis, six months passed between the completion of the field survey and the compilation of GIS layers. It is unknown if there were changes to block faces in that timeframe. Additionally, there were blocks undergoing construction at the time of the survey which affects the already limited snapshot of e-scooter parking in downtown Portland.

The city of Portland identifies 29 different compliance requirements for e-scooter parking. We were able to identify GIS data for nearly all, but we were unable to find data for the following requirements:

- Within 5 feet of public art
- Where the Shared Scooter may cause damage to or interfere with the use of pipes, vault areas, telephone or electrical cables/wires or other utility facilities - there is a GIS layer from the city for certain poles but examination of the layer suggested it would not meet fully meet this criterion.

In addition, there were two compliance codes that we believe did not apply to our area or were captured in the other data and as such were not included

- Where the unobstructed Through Pedestrian Zone is less than 6 feet
- Within Pedestrian Plazas - To our knowledge, this data is included in the Parks layer, covering places like Pioneer Courthouse Square. We did not identify Pedestrian Plazas intersecting with sidewalks. Further, because we only were examining the effect of parkable area in the furnishing zone, we do not believe Pedestrian Plazas would have impacted this.

The parkable area GIS Layer is highly dependent on the GIS data provided by the city of Portland, TriMet and Metro. Based on known layout of the survey areas and confirmation with satellite and Google Map imagery, much of the placement of the topographical features appears to be fairly accurate, but it is unknown exactly how accurate. There may be objects missing and existing objects may be in the wrong location by small or large margins.

While the GIS layers feature nearly all the items relevant for parking compliance, there are sidewalk features that do not affect parking compliance and for which a GIS layer does not exist. For example, while there is GIS data on tree locations, no data was found about planter boxes that exist in the furnishing zone. Some of these features are significant and would impact the parkable area percentage. Similarly, there is no compliance violation about parking meters, but there is parking meter GIS data.

Lastly, for the creation of non-compliant buffers around objects (such as within 5' of a bike rack), some of the buffers may represent imperfect assumptions. For example, crosswalks are supposed to have a 5' buffer around them to represent the non-compliant area. The dataset from the city of Portland was a single vector line for crosswalks, when in the physical world we know they have a width. Therefore, we created a 10' buffer from that vector to include the crosswalk width and the noncompliant area around the corner of the sidewalk. That amount may not fully capture the true width of the crosswalk and the actual differences between a single line being buffered 10' versus a rectangle being buffered 5'. However, this error should be negligible given that street corners are also non-compliant parking areas. Similarly, bike parking was provided as a point, which then received the 5' buffer. However, most bike parking has a length to it in the physical world (the standard Portland Bureau of Transportation bike rack is 30" long). Therefore, the buffer of 5' from the center of the bike rack undercounts the total non-parkable area. Cumulatively, these findings would affect results like the parkable area and may affect the statistical findings.

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