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## Overcoming Barriers to Freight & Logistics Firm Collaboration with Urban Planning

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## ABSTRACT

This project gains on-the-ground insight into competition for curb space, what issues drivers face, and the circumstances that inform their parking choices and related behaviors. To do so, it uses data from Reddit to examine US parcel delivery driver perceptions and behavior, focusing on the following questions:

- What are some key challenges parcel delivery drivers encounter when delivering in urban areas?
- What strategies do drivers employ when parking their vehicles to make deliveries?
- What reasons do drivers cite for engaging in unauthorized or questionable parking practices?

The study uses “flexible” coding to analyze the collected comments, providing granular, qualitative understanding of driver behavior and thought processes.

Parking is a primary challenge drivers discussed as a concern while delivering in urban areas, especially because parking difficulties extend the time required to complete routes. Drivers in the collected sample preferred to park in authorized spaces, but generally accepted the practice of unauthorized parking was necessary to expeditiously complete their routes. Such parking was motivated by lack of supply of authorized spaces, but also by need for safety and/or expedience. Drivers also opined that parking enforcement personnel rarely issued tickets or other reprimands, acknowledging that for delivery vehicles, unauthorized parking is often necessary. Finally, drivers described concerns surrounding interactions with other road users while making deliveries, especially in terms of conflict and safety. Curb management policies and freight providers’ practices alike will need to adapt in the face of the changing landscape of the curb.

To that end, this project also engaged in synthesis of extant and emerging interventions and planning initiatives that may guide the future of urban freight delivery. Specifically, this report provides a brief examination of freight demand management initiatives, curb management initiatives, and safety initiatives. It concludes by discussing how these may complement one another and fit into the future of urban freight in the United States.

### Keywords:

urban freight, last mile, Reddit, delivery, parking

## EXECUTIVE SUMMARY

Urban freight delivery vehicles often must compete for curb space with other users, not only in large cities but in small to mid-sized urban areas as well. Curb space, however, is finite, and when a space is not available for a delivery vehicle to stand next to the destination, drivers must seek out alternatives. Such alternatives might include waiting for a space to become available, cruising the area to find a space further away, or parking in an unauthorized space. This competition, and its resulting effects on urban space and activity, are of interest to planners and logistics providers alike, given the demonstrated impacts on safety, traffic congestion, and shipping costs. These effects have only been amplified in recent years as the rise of e-commerce has sent more delivery vehicles into urban areas to perform “last mile” deliveries. What is more, the COVID-19 pandemic caused an unexpected and precipitous adoption of e-commerce, with US package volume rising from 14.7 packages in 2019 to 20.2 billion in 2020, and this trend is showing no signs of reversal.

Existing research has provided evidence that inadequate supply of freight loading spaces is a problem in the United States, that the practices for managing these spaces are often underdeveloped and vary widely, and that the resulting landscape produces several negative externalities for cities. Nevertheless, a missing component toward addressing these issues is an understanding of how drivers perceive and navigate them, a piece that would help craft effective solutions. This project pursues this component by examining commentary produced by urban delivery drivers to produce an understanding of what issues they view as most pressing and how they navigate these issues in their day-to-day work.

Through analyzing data collected from Reddit, an online content-sharing service, consisting of conversations between (mostly Amazon) delivery drivers, we examine driver perceptions of issues related to delivery routes in urban areas and the parking issues and practices they encounter and engage in.

We found that drivers generally dreaded downtown routes, mostly because of the time they took to complete. Parking, building access, and traffic were among the factors contributing to these delays. We also examined parking strategies drivers used, which revolved around taking as little time as possible, sometimes parking further away and delivering on foot, but quite frequently engaging in unauthorized parking. Commonly cited types of unauthorized parking included parking on the wrong side of the street, blocking the road, parking in a no parking zone, and parking on the sidewalk or curb. We also tracked the most discussed motivations for unauthorized parking, which included lack of available spaces, the time it would take to find an authorized space, and sometimes that drivers considered an authorized parking option less safe. Drivers also shared that parking enforcement tended not to bother them, acknowledging these practices are necessary to complete their routes. Finally, they also expressed concern about safety issues related to interactions with other road users when trying to park and/or make their deliveries, including potential crashes, conflicts, or being struck by a vehicle.

## 1.0 INTRODUCTION

The rise of e-commerce has put enormous strain on the “last mile” of the urban delivery system as more and more goods are delivered directly to homes and businesses. This stress has been exacerbated by the COVID-19 pandemic and the acceleration of online shopping that accompanied it: While 14.7 billion packages were delivered in the US in 2019, this figure jumped to 20.2 billion in 2020 (Pitney Bowes, 2021). These deliveries are largely handled by an increasing volume of trucks and vans that compete for a more or less static supply of loading zones, curb spaces, and traffic capacity.

This mismatch between the built environment and the expanding last mile has led to increasingly negative consequences, for example the growing prevalence of unauthorized parking by commercial vehicles, but cities have often lagged in devising responses, much less in terms of proactive solutions (Girón-Valderrama et al., 2019; McDonald & Yuan, 2021). Beyond mere inconvenience, these issues have ramifications for quality of life and safety. For one thing, the incidence of freight-related crashes resulting in injuries or fatalities has accelerated as ecommerce has grown in prevalence (McDonald et al., 2019). Moreover, conflicts arising from stress of the last mile of the urban delivery system result in inefficiencies that interfere with the distribution of goods and increase costs, negatively impacting logistics providers (Mangiaracina et al., 2019; Ranieri et al., 2018). Creating policy that addresses these issues requires understanding of how they manifest as deliveries are being made, but to date, little research has probed the issues and experiences that delivery personnel encounter in the course of making last-mile deliveries.

### 1.1 OBJECTIVE

This research has two primary objectives: First, we aim to develop granular understanding of many of the issues that some drivers encounter while making last-mile deliveries in urban areas. Second, we aim to synthesize tools and potential policies that municipalities and partners might use to mitigate or overcome some of these issues.

### 1.2 SCOPE

The background literature focuses on recent scholarship mostly covering the United States, focusing on emerging issues in the last mile, unauthorized parking, and driver behavior. The analysis of driver perceptions and behavior focuses primarily on the United States, targeting delivery providers that operate there. The research investigates the experiences drivers have while delivering in primarily urban areas, uncovers factors that contribute to unauthorized parking behavior, and reflects on the issues caused by these circumstances and behaviors. We close with a brief synthesis of strategies that may be employed to improve commercial vehicle delivery practices, parking, and

related externalities, and whose implementation could potentially be informed by the results generated here.

This report provides an extended abstract for the analysis of driver behavior and perceptions as well as the synthesis of potential solutions, as those materials are currently being reviewed by journals or are in press.

## 2.0 LITERATURE REVIEW

### Congestion, Delivery Costs, and Safety in Last Mile Delivery

Rising demand for limited curb space presents problems for multiple stakeholders. Pickup and delivery (PUD) activities are the third-leading cause of temporary loss of transportation capacity (TLC) events, behind only vehicular crashes and work zones (Han et al., 2005). For freight providers, the “last mile” is the costliest step in shipping, accounting for up to 28% of the total shipping costs, and delays like those caused by congestion increase these costs (Macioszek, 2018).

Congestion and pressure to deliver quickly also affect road user safety, particularly for vulnerable road users (VRUs). Both fatalities and non-fatal injuries related to freight vehicle crashes rose between 2009 and 2015, even while traffic-related injuries and fatalities in general trended downward (McDonald et al., 2019). Dense urban areas are the site of both increased freight traffic as well as increased VRU presence, which entails that increased concentration of bicyclists and pedestrians often coincides with increased presence of urban delivery vehicles, and thereby higher incidences of crashes. In New York City, for example bicycle collisions of all types occur in higher concentration on truck corridors than other areas (Conway et al., 2016).

### Impacts of Unauthorized Parking

The above issues are exacerbated by unauthorized commercial vehicle parking, affecting traffic, road user safety, and delivery costs. When the supply of loading zones and/or parking spaces for commercial vehicles is constrained (e.g., in dense downtown areas), illegal parking becomes unavoidable. In New York City alone, large delivery firms pay tens of millions of dollars in fines each year (Baker, 2020). A better understanding of the types of and motivations for unauthorized parking is vital to formulating solutions.

Some studies have estimated the prevalence of different types of illegal parking, using field observations (Jaller et al., 2013) and citation data (Kawamura et al., 2014; Wenneman et al., 2015). Nevertheless, these methods paint a limited picture, especially because, at least in some areas, most unauthorized parking occurrences are not cited (Conway et al., 2016). Most commercial vehicle stops are quite short, (i.e., less than 15 minutes) (Girón-Valderrama et al., 2019), increasing the likelihood that unauthorized stops go uncited. These stops, however short, nevertheless have traffic and safety impacts. Extant data, while helpful, may not give us

an accurate picture of prevalence or impact of the types of illegal parking that occur, but more crucially give us little insight as to *why* they occur.

## Driver Behavior

Understanding how drivers make decisions about parking, particularly under constrained parking conditions, is an important component that can inform future solutions. Parking constraints and corresponding strategies are not uniform everywhere, and evidence suggests that unauthorized parking varies across geographic areas and land use mixes (Girón-Valderrama et al., 2019; Kawamura et al., 2014). Nevertheless, unauthorized parking is an apparently widespread practice, but some studies suggest it is not a preferred practice, with drivers often spending time searching for legal parking (Dalla Chiara & Goodchild, 2020) and engaging in compensatory behaviors to avoid parking illegally (Dalla Chiara et al., 2021).

Recent increases in volume and speed of urban parcel delivery have increased stress on a system that was already overburdened. Prior work has demonstrated that these circumstances often lead to unauthorized parking, especially in dense urban areas, but solutions remain underdeveloped and under-implemented. A better understanding of the types of unauthorized parking that concern drivers and the motivations behind their occurrence will help inform solutions but is presently lacking. By using candid conversational data from drivers to understand delivery challenges in downtown areas, reported parking behaviors, and motivations for engaging in these behaviors, this study addresses this gap.

## 3.0 METHODOLOGY

The analysis of delivery driver experience, perception, and behavior included the assessment of 606 comments obtained through the Reddit online social content sharing site. The following sections describe the data collection and analysis.

### 3.1 Data Collection

To explore the challenges faced by urban delivery drivers and the strategies they use when they encounter parking difficulties, we captured conversational data from Reddit, a social content-sharing site where users post in forums called “subreddits” (Reddit Inc, 2020). Using a list of search terms developed through consulting existing literature, we searched subreddits dedicated to discussions among delivery drivers for three major last-mile carriers in the US (Amazon, FedEx, and UPS). This process resulted in a list of URLs for relevant threads to be examined in the study. Subsequently, we used RedditExtractoR, a package for the R programming language that interfaces with Reddit’s official API, to extract the contents of the associated threads along with relevant metadata (Rivera, 2019). Given the higher prevalence of conversations among

Amazon-affiliated drivers compared to other companies, the final set of comments focuses primarily on the experiences of these drivers.

### 3.1 Data Analysis

To analyze the data, we used a “flexible” coding process, which is designed to reliably, transparently, and expediently analyze large sets of unstructured data (Deterding & Waters, 2018). We first assigned indexical codes that mapped the contents of the data. After indexical coding, we assigned analytic codes which represent more granular concepts that revealed themes and relationships within the data. For instance, under the “parking” indexical code, we created an analytical coding hierarchy starting with “practices and strategies”. Under this we coded “unauthorized parking”, which then contained “types” and “motivations”. This process helped develop a systematic understanding of how and why drivers engaged in unauthorized parking behaviors.

## 4.0 RESULTS

This section describes key findings from the analysis of driver comments, focusing on the challenges they reported encountering in downtown areas, and subsequently types of and motivations for unauthorized parking.

### 4.1 Urban Delivery Challenges

The acceleration of urban goods delivery has severely augmented demand for curb space, and subsequently, competition for this limited space (Goodchild & Ivanov, 2018). These issues have been especially concentrated in dense urban cores, where less curb space is stretched across more users. Drivers that worked downtown routes found these routes to be challenging and often dreaded being assigned them. The primary challenges they identified are displayed in

Table 1.

**TABLE 1 CHALLENGES DELIVERING IN DOWNTOWNS**

Challenge	Number of Mentions	Percent of Mentioned Challenges
takes too long	25	24.0%
parking	24	23.1%
building access	19	18.3%
traffic	7	6.7%
unreachable customers	7	6.7%
finding apartments or lockers	6	5.8%
dangerous neighborhoods	5	4.8%
highrises	4	3.8%
impossible instructions	4	3.8%
one way streets	3	2.9%
Total	104	100.0%

A primary complaint drivers expressed was that downtown routes were difficult to complete quickly, which in turn increased their concerns about finishing on time. Some drivers described their rates of delivery downtown being about half as fast as they could accomplish in suburban areas. This decreased speed and increased route duration was largely the result of other challenges drivers identified, including finding parking, accessing buildings, and getting stuck in traffic. Of these challenges, parking was the most frequently mentioned. Common issues included not only difficulty finding parking to make a delivery, but also the time it could take drivers to walk to the delivery destination from the parked delivery vehicle. The prevalence of parking difficulty in many cases led to drivers engaging in unauthorized parking, which we analyzed and discuss in the next section.

## 4.2 Unauthorized Parking

Drivers regularly discussed engaging in unauthorized parking, the mentioned types of which are summarized in

Table 2.

**TABLE 2 TYPES OF UNAUTHORIZED PARKING DISCUSSED**

<b>Unauthorized Parking Type</b>	<b>Number of Mentions</b>	<b>Percent of Mentions</b>
wrong side of street	48	29.4%
block road	45	27.6%
wherever I want	18	11.0%
no parking zone	11	6.7%
sidewalk or curb	11	6.7%
double parking	8	4.9%
block driveway	4	2.5%
fire hydrant	3	1.8%
in driveway	3	1.8%
fire lane	3	1.8%
unpaid metered parking	2	1.2%
red curb	2	1.2%
handicap spot	2	1.2%
bus stop or lane	2	1.2%
reserved spot	1	0.6%
Total	163	100.0%

The most frequently mentioned types of unauthorized parking were “wrong side of street” and “block road” by quite a long way. “Double parking” is specifically mentioned separately from “block road” because it specifically denotes parking next to an occupied parking space, while drivers could block the road under a variety of circumstances. The distribution of mentions summarized above indicates driver concern about parking behaviors that could disrupt traffic. Rationales discussed for unauthorized parking are presented in

Table 3.

**TABLE 3 REASONS DISCUSSED FOR UNAUTHORIZED PARKING**

Reasons	Number of Mentions	Percent of Mentions
no place to park	20	35.7%
takes too long not to	15	26.8%
avoid crossing the street	5	8.9%
narrow street	5	8.9%
safer	4	7.1%
too much effort	2	3.6%
bad routing from app	2	3.6%
loading zone occupied	2	3.6%
let traffic pass	1	1.8%
Total	56	100.0%

In general, these reasons revolved around three themes: 1) That lack of legal options makes unauthorized parking unavoidable, 2) That parking legally would make routes take too long, and 3) That parking legally could make delivering less safe. In other words, two of the primary circumstances in which drivers parked in unauthorized spaces was when there were no proximate spaces available or when finding a space and delivering from it would add an unacceptable delay to their delivery. In terms of safety, drivers avoided behaviors they considered unsafe, even if this meant unauthorized parking. For example, drivers discussed parking on the wrong side of the street to make a delivery because they otherwise would need to cross the street on foot and risk being struck by a passing car.

Drivers also discussed interactions with other road users as well as encounters with parking enforcement. These interactions included concerns about disputes with other road users, concerns surrounding safety or potential crashes, or that delivery drivers could be harmed, e.g., by being struck by a vehicle when exiting their delivery vehicle. Finally, drivers described that traffic enforcement personnel typically did not concern themselves with unauthorized parking of delivery vehicles, acknowledging that it was a routine part of drivers completing their routes.

## 5.0 CONCLUSION

We find that US parcel delivery drivers, particularly those delivering for Amazon, perceive several challenges to delivering in dense, urban areas of the US, especially in downtowns. We complement and corroborate existing literature that suggests an undersupply of parking for urban delivery vehicles in such areas, which have typically used field observations, simulations, and citation data, by examining driver perceptions of these environments. The drivers we

sampled typically did not enjoy downtown delivery routes, describing them as difficult to navigate and taking a long time to complete. Inadequate and/or difficult parking was identified as a chief contributor to these challenges.

Unauthorized parking was frequently discussed as a strategy to overcome parking difficulties and viewed as a necessary component of the job, though most drivers preferred to avoid it if possible. While lack of available spaces was the primary motivation for unauthorized parking, drivers also relayed that unauthorized spaces were sometimes either safer, faster, or both as they completed their routes. These findings have implications both for planning urban infrastructure to accommodate freight vehicles as well as operating practices for delivery companies. For example, companies may consider constructing their routes in such a way that drivers are not required to cross the street to make a delivery.

This research offers important insights into the perceptions and decision-making processes of urban parcel delivery drivers. Though limited by available data, this effort provides granular illustration of issues hypothesized—though not directly observed—in other literature on the topic. As such, it provides a foundation for future efforts both to broaden understanding of emerging challenges in urban delivery and to inform solutions that might mitigate these challenges.

## 6.0 RECOMMENDATIONS

### Future Research

This study adds to a body of evidence suggesting that US cities, especially US downtowns, are suboptimally configured for the emerging reality of modern ecommerce. It also suggests that the operating procedures of some carriers, which prioritize fast and efficient delivery, may be at odds with the interests of some stakeholders in the areas where they deliver, particularly as regards parking and safety. These conclusions leave open several avenues of research, which include:

- Impacts of innovative solutions (e.g., freight demand management, curb management, safety initiatives) on unauthorized parking rates, driver perceptions
- Impacts of operating practices employed by different parcel carriers on driver safety, vulnerable road user safety, and other critical externalities
- Development of a consistent typology of hazards and externalities related to unauthorized parking that can give a better picture than localized citation data and categories
- Observational research to estimate the rates at which these externalities and hazards occur across different contexts

### Potential Policies and Interventions

One major goal of the above research has been to provide context and understanding that can inform implementation of interventions in cities to mitigate negative impacts of urban freight. As an additional component of this project, we provide a synthesis of some such interventions, focusing on curb and freight management options that may be used to address the issues discussed in this report (A full writeup of this synthesis is presently in press at a journal). We sort these into three major types: freight demand management initiatives, curb management initiatives, and safety initiatives.

#### Freight Demand Management

Freight demand management (FDM) initiatives work by changing patterns in freight demand to alleviate stress on freight systems (Holguín-Veras & Sánchez-Díaz, 2016). Often, these initiatives involve consolidating freight onto fewer vehicles and/or to fewer destinations, reducing the number of trips needed. For example, delivering many packages to a pick-up point or automated locker system obviates the need for a truck to visit the final destination for each package, allowing each recipient to collect them at their convenience (Katsela et al., 2022). Additionally, packages might be delivered by alternative modes, like cargo bicycles, for the last mile of delivery, reducing the needs for trucks, and therefore parking. These initiatives can even be combined into neighborhood microhubs, which locate multiple services at one location, allowing for delivery of packages to pick-up points, transfer to alternative modes for final

delivery, and combination with other services like urban kitchens for food delivery (Katsela et al., 2022).

### Curb Management Initiatives

Curb management initiatives help efficiently use limited curb space by prioritizing curb access by need, reducing dwell times, and combating externalities of inefficient curb use. Such initiatives include specific loading zone typologies corresponding to highest need and loading zones whose allowed uses change based on time of day (Miller, 2020). They also include curb reservation systems, which allow drivers to ensure available curb space in advance. In some cases, loading zone pricing may be appropriate, charging time-based fees at levels that ensure vehicles can find an open spot, but stay no longer than is absolutely necessary (Institute of Transportation Engineers, 2018).

### Safety Initiatives

Finally, initiatives that promote safety, both for drivers as well as other road users, are crucial components of the expanding urban freight system. First, vehicle design changes could result in delivery vehicles that are more appropriate and less hazardous in urban settings, specifically by using smaller vehicles with increased visibility and maneuverability (National Association of City Transportation Officials, 2019). More nimble vehicles also would allow for street design changes, like those that comprise complete streets initiatives, that protect vulnerable road users without burdening freight delivery vehicles.

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## 8.0 APPENDICES

### 8.1 Appendix A – Manuscript of Paper Submitted to Transport Policy

#### **Using Social Media to Understand Challenges Faced by US Urban Parcel Delivery Drivers: Reports from the Curb**

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## **Using Social Media to Understand Challenges Faced by US Urban Parcel Delivery Drivers: Reports from the Curb**

### **ABSTRACT**

While several studies have begun to quantify the problems presented by curb conflicts surrounding delivery vehicles, especially unauthorized parking behavior, fewer have specifically examined these issues through the lens of driver behavior. To gain on-the-ground insight into competition for curb space, what issues drivers face, and the circumstances that inform their parking choices and related behaviors, we use data from Reddit to examine US driver perceptions and behavior, posing the following questions: What are some key challenges parcel delivery drivers encounter when delivering in urban areas? What strategies do drivers employ when parking their vehicles to make deliveries? What reasons do drivers cite for engaging in unauthorized or questionable parking practices?

We find that parking is among the largest challenges drivers face while delivering in urban areas, largely because parking difficulties extend the time required to complete many routes. Drivers in our sample preferred to park in authorized spaces, but generally accepted the practice of unauthorized parking to complete their routes. Often, they did so due to lack of available parking, but also for safety and/or expedience. Moreover, drivers reported that parking enforcement personnel rarely issued tickets or other reprimands, acknowledging that for delivery vehicles, unauthorized parking is often necessary. Finally, drivers also described concerns surrounding interactions with other road users while making deliveries, especially in terms of conflict and safety. Curb management policies and freight providers' practices alike will need to adapt in the face of the changing landscape of the curb.

**Keywords:** urban freight, last mile, Reddit, Amazon, delivery, parking, parcel

## INTRODUCTION

Freight delivery vehicles often find themselves in competition with other road users for curb space, not only in large cities, but in small to mid-sized urban areas as well (Chatterjee et al., 2008). When a space is not immediately available adjacent the delivery destination, drivers must resort to an alternative, for example waiting for a space to become available (Dalla Chiara et al., 2021), cruising the area to find a spot further from the delivery point (Dalla Chiara & Goodchild, 2020), or unauthorized parking (Kawamura et al., 2014). These issues are of interest to planners and logistics providers alike, primarily for their undesirable impacts on safety (Conway et al., 2013), congestion (Han et al., 2005), and shipping costs (Ranieri et al., 2018).

The urgency of these issues has accelerated in recent years, largely due to the emergence and continued growth of rapid-delivery online retail (e.g., Amazon) as well as the onset of the COVID-19 pandemic, which intensified the adoption of such services. Between 2019 and 2020, as the pandemic encouraged people to stay at home and have goods delivered, the volume of small parcels delivered in the United States rose from around 14.7 billion to 20.2 billion (Pitney Bowes, 2021). A substantial amount of this growth was accounted for by Amazon, whose market share nearly doubled, moving from 13% to 21%, while other carriers' share either decreased or remained the same.

While increased traffic and parking demand related to deliveries may have been mitigated by reductions in personal travel early in the pandemic, freight volumes have not decreased as pandemic restrictions have eased, and experts expect the growth in ecommerce to continue (Charm et al., 2021). This continuing and rapid acceleration in parcel delivery volume promises to add stress to an already heated competition for curb space, in which space is demanded not only by urban freight, but by ridehailing, micromobility services, parking, outdoor dining, and a litany of other uses.

While freight vehicles increasingly are forced into unauthorized parking in space-constrained areas in order to make deliveries, communities in the US have often lagged behind in planning for solutions (Girón-Valderrama et al., 2019; McDonald & Yuan, 2021). Moreover, as the volume of last mile deliveries continues to expand, so has the volume of freight-related crashes in the US resulting in injuries or fatalities, outpacing the rate of such incidents in non-freight-related traffic (McDonald et al., 2019). From the perspective of the logistics industry, these issues often represent inefficiencies that interfere with the distribution of goods and increase costs (Mangiaracina et al., 2019; Ranieri et al., 2018).

The ways in which cities allocate and manage curb space and freight providers' practices alike will need to adapt in the face of this changing landscape, and their success will be contingent on understanding how these problems are unfolding at the curb. While several studies have begun to quantify the problems presented by curb conflicts surrounding delivery vehicles, especially unauthorized parking behavior, fewer have specifically examined these issues through the lens of driver behavior. With notable exceptions (e.g., Dalla Chiara et al., 2021), driver viewpoints are often missing from the literature, but are critical to understand since they are the ones operating where planning policies "hit the road". Moreover, to our knowledge, few studies have examined small parcel drivers specifically. To gain on-the-ground insight into competition for curb space, what issues drivers face, and the circumstances that inform their parking choices and related behaviors, we use data from Reddit, focused primarily on the United States, to examine driver perceptions and behavior.

Specifically, we pose the following research question(s):

- 1) *What are some key challenges parcel delivery drivers encounter when delivering in urban areas?*
- 2) *What strategies do drivers employ when parking their vehicles to make deliveries?*
- 3) *What reasons do drivers cite for engaging in unauthorized or questionable parking practices?*

In analyzing online conversations between drivers, we find that parking is among the largest challenges drivers face while delivering in urban areas, largely because parking difficulties extend the time required to complete many routes. While drivers in our sample preferred to park in authorized spaces, employing various strategies to do so, they generally accepted the practice of unauthorized parking to complete their routes. Often, they did so due to lack of available parking, but also for safety and/or expedience. Moreover, drivers reported that parking enforcement personnel rarely issued tickets or other reprimands, acknowledging that for delivery vehicles, unauthorized parking is often necessary. Finally, drivers also described concerns surrounding interactions with other road users while making deliveries, especially in terms of conflict and safety.

## BACKGROUND

### Efficiency, Congestion, and Safety in the “Last Mile”

Increased competition for curb space, as well as related issues surrounding freight vehicles navigating urban areas, are of critical importance to multiple stakeholders. For freight providers, parking difficulties, increased dwell times, and potential failed deliveries represent inefficiencies that increase their costs (Goodchild & Ivanov, 2018). For municipalities, residents, and people traveling through urban spaces, these issues produce externalities that include increased congestion, safety hazards, and environmental impacts. Residents and business owners also have vested interests both as recipients of freight and users of streets.

From the perspective of freight providers, the “last mile” is in most cases the costliest part of the delivery process, especially since deliveries are typically dispersed across a large area as parcels are delivered to individual addresses (Macioszek, 2018). In fact, the last mile can account for up to 28% of the total delivery cost (Ranieri et al., 2018). Some of the key costs involved in last-mile delivery are results of the distance travelled, driver labor costs, time spent delivering each package, time spent “problem solving” (e.g., navigating urban traffic, leaving failed delivery notice), time spent traveling, and the number of parcels delivered in a tour (Mangiaracina et al., 2019). When drivers encounter parking difficulties and are forced to engage in compensatory behaviors, like cruising, queuing for loading zones, or re-routing, these costs are likely to increase. Therefore, logistics firms have interest in reducing inefficiencies related to both parking difficulties as well as difficulties encountered once the vehicle is parked.

These inefficiencies also have impacts on communities in the forms of traffic congestion and decreased road safety. Han et al. (2005) estimated that pickup and delivery (PUD) activities ranked third in terms of temporary loss of transportation capacity (TLC) events in the US, behind only vehicular crashes and work zones. Moreover, some studies anticipate that the continuation

of trends toward increased online shopping may result in corresponding changes in traffic composition, with an increased share of traffic being accounted for by delivery vehicles (Le et al., 2021). This trend would suggest a corresponding increase in congestion related to pickup and delivery.

Taken together, the above phenomena raise serious concerns for road user safety, especially for vulnerable road users (VRUs). While US traffic-related injuries and fatalities trended steadily downward between 2009 and 2015, fatalities and especially non-fatal injuries related to crashes involving freight vehicles rose (McDonald et al., 2019). Notably, there was a 45% increase in freight-related non-fatal injury rates in urban areas, consistent with the involvement of slow-moving vehicles, like delivery vehicles.

Moreover, dense areas attract more pedestrian and bicycle traffic as well as more delivery traffic, meaning that concentration of VRU traffic often coincides with concentration of urban delivery vehicles, in turn leading to higher incidences of crashes. For instance, in New York City, bicycle collisions of all types are more highly concentrated on truck corridors than other areas (Conway et al., 2016). Recent research, using a simulator to control specifics of the urban environment, suggests that bicyclists alter their behavior (e.g., passing maneuvers) depending on how commercial vehicles (CVs) are parked, for example with parking in the bicycle lane causing bicyclists to pass CVs by diverting into a traffic lane (Jashami et al., 2020). Crucially, provision of commercial vehicle loading zones (CVLZs) was shown to reduce the propensity for cyclists to resort to risky maneuvers, which suggests that provision of adequate loading zones may help augment VRU safety in the presence of CVs.

### Unauthorized Parking Prevalence and Impact

Unauthorized parking of CVs can exacerbate the above issues, impeding traffic flows, presenting safety hazards, and adding to delivery costs. In situations where parking for delivery vehicles is undersupplied (e.g., in dense downtown areas), unauthorized parking becomes inevitable, with large delivery firms paying tens of millions of dollars in fines each year in New York City alone (Baker, 2020). Understanding the types of unauthorized parking that occur as well as the motivations for these behaviors is crucial to devising solutions. Policies that are effective for managing parking of personal vehicles, e.g., pricing strategies, are unlikely to be effective for managing freight parking, since deliveries must take place whether there is available parking proximate to their destination or not, and most delivery traffic cannot feasibly be shifted to modes other than delivery vehicles (Jaller et al., 2013).

Some estimates of the prevalence of different types of unauthorized parking have been produced through field observations and parking citation data for commercial vehicles. For example, Jaller et al. observed 324 vehicles on an average weekday in Manhattan, finding that around a quarter of them were illegally parked, with the types breaking down to "...expired or unpaid parking meter (45%), noncompliance with the requirements of a parking sign (20%), parking too close to a fire hydrant (18%), and double-parking (10%)" (Jaller et al., 2013, p. 48).

Other figures have been garnered from parking citation data. In Chicago, Kawamura et al. (2014) found the top three cited violations were "Vehicle type prohibited" (29.5%), "No parking zone" (17.6%), and "Expired meter" (12.9%), while Wenneman et al. (2015) found that in Toronto, the top three cited violations were "Parking during prohibited time or day" (52.8%), "Stopping during prohibited time or day" (21.5%), and "Standing during prohibited time or day" (8.0%).

The only offense to appear in the top three across more than one of these studies is “Expired meter”, which accounted for 45% of observed violations in NYC, but only 12.9% in Chicago. Moreover, concerning double parking, which is thought to have among the largest impacts on traffic and safety, the Chicago study found that double parking accounted for 1.3% of issued citations, while the Toronto study found 2.4% were issued for parking in the travel lane, which are both much lower than the 10% observed in the field exercise in Manhattan.

While the rates of infractions are undoubtedly not identical across these areas, the differences across these figures likely point to difficulties in accurately estimating incidences and types of unauthorized parking. Citation data likely suffer from selection bias, with the proportions obtained reflecting infractions that are *enforced*, rather than infractions that *occur*. In some areas of New York City, for instance, enforcement officers have been observed to opt *not* to issue citations for unauthorized CV parking *most* of the time (Conway et al., 2016). In other words, most incidences of unauthorized parking do not receive citations.

Parking regulations also differ from one municipality to the next, meaning that even if the occurrence of a particular behavior is similar across different areas, the proportion of citations that behavior makes up could vary. Moreover, the fact that a particular infraction, e.g., double parking, makes up a relatively small percentage of issued citations does not entail that its impact on congestion and safety issues is equally small. Since the majority of commercial vehicle stops tend to be short-term (i.e., less than 15 minutes) (Girón-Valderrama et al., 2019), much unauthorized parking during these stops likely goes uncited, but nevertheless has traffic and safety impacts. In other words, even if parking in the travel lane accounts for a comparatively small proportion of unauthorized parking instances, it may nevertheless account for a large share of externalities caused by unauthorized parking behavior.

## Driver Behavior

Understanding driver behavior, i.e., how drivers navigate different delivery situations and make decisions about parking, is key to developing solutions for problems related to unauthorized parking. Recent work has established that the incidence of unauthorized parking varies across geographic areas and is related to the mix of land uses in those areas (Girón-Valderrama et al., 2019; Kawamura et al., 2014). For example, across five study areas in Seattle, the incidence of unauthorized CV parking as a proportion of total observed CV parking ranged from 27% to 65% (Girón-Valderrama et al., 2019). Unauthorized parking incidence also seems to vary by vehicle type and purpose (Dalla Chiara et al., 2021). Service vehicles and delivery vehicles that supply stores and restaurants, for example, may be more likely to seek authorized parking since they occupy spaces for longer. Parcel delivery drivers, by contrast, may be more comfortable parking in unauthorized spots or in the travel lane, since dropping a package can take little time.

Despite the apparently widespread practice of unauthorized parking, there is evidence that drivers make efforts to avoid parking in unauthorized areas. Across 2,477 trips made by a fleet of delivery vehicles in Seattle, Dalla Chiara and Goodchild (2020) found that cruising for parking accounted for 28% of trip time on average. Dalla Chiara et al. (2021), in a Seattle-area study using ridealongs to observe drivers, also found that drivers engaged in compensatory behaviors, including cruising for parking, queuing for loading zones that were in use, and re-routing (i.e., leaving and performing other deliveries before returning to the currently occupied spot).

Dalla Chiara et al. (2021) also found that CV drivers mostly parked in authorized spaces, resorting to using unauthorized curb spaces 20.5% of the time, specifically parking in the travel lane 4.5% of the time, though these results may not be generalizable, given that the sample consisted of six ridealongs across three vehicle types belonging to different commercial carriers and delivering four different kinds of goods. Through these ridealongs, the authors found that drivers chose their parking locations primarily based on safety, working to avoid conflicts with other drivers and road users, and to avoid competition with other road users, especially other professionals. Additionally, drivers sometimes parked in unauthorized spaces even when authorized spaces were available, typically because they perceived this option as being safer.

### **Planning for the Future of Urban Delivery**

Increased parcel shipping volumes and speeds promise to overtax an already overstressed last mile of the urban freight delivery system. While it seems that drivers attempt to avoid unauthorized parking—and that most parking instances take place in authorized spaces—a substantial amount of unauthorized parking nonetheless takes place. Understanding this phenomenon, however, is difficult. Data from parking fines likely undercounts unauthorized parking instances. Simultaneously, studies of driver behavior sometimes rely on small sample sizes, and drivers who know they are being observed may, consciously or unconsciously, modify their behavior, and therefore may overrepresent their propensity to avoid unauthorized parking.

Existing studies have begun to establish that unauthorized parking among delivery vehicles occurs frequently and that it occurs in higher volumes in dense, mixed-use areas, but adequate solutions remain underdeveloped. In particular, the prevalence of different types of unauthorized parking and the motivations behind these behaviors demand additional scrutiny. This study addresses this gap by using conversational data directly from drivers to understand delivery challenges in downtown areas, reported parking behaviors, and motivations for engaging in these behaviors.

## **DATA COLLECTION**

To gain insight as to what drivers see as major challenges in urban delivery and how they deal with parking difficulties, we capture conversational data from Reddit, a social content-sharing site where users can post content in subject-specific forums called “subreddits” (Reddit Inc, 2020). Within these forums, people can ask questions, post photos or links, and/or share opinions, etc. Others can then respond to the original poster (OP), generating “threads” of conversation.

Reddit has recently emerged as a valuable resource for academic research, with the number of studies using it as a data source growing from two in 2010 to 230 in 2019 (Proferes et al., 2021). In particular, it has proven an effective way to reach populations that would be otherwise difficult to recruit, for example providing insight into health-related conversations, like vaping and mental health (Sharma et al., 2017) or those experiencing eating disorders but not seeking treatment (Sowles et al., 2018). It has also proven useful in transportation research, being recently used to explore how people make decisions about living car-free (Iacobucci, 2021). Reddit’s sheer size presents utility across a wide variety of topics, ranking sixth in terms of traffic among websites in the US (Alexa Internet Inc, 2020).

Compared to better-known services like Twitter or Facebook, Reddit provided a more productive avenue for research for a few key reasons. First, Reddit supports long posts (40,000 characters for posts, 10,000 for comments), compared to Twitter's 280-character limit, so conversations can be more developed than on a service like Twitter. Second, Reddit offers an official API that permits easy acquisition of data, unlike Facebook. Finally, and most crucially, Reddit's organization into subreddits that represent specific communities or interests allowed for identification and isolation of relevant conversations in ways that would have been difficult or impossible on other platforms, particularly Twitter.

Several subreddits exist dedicated to discussions between employees of major freight carriers. These discussions provide a venue to trade tips and tricks, share humorous content, vent about job-related issues, and to ask other employees about their experiences. Figure 1 shows an example of a thread in which a driver seeks advice about parking their delivery vehicle in downtown areas. Note that the term “thread” indicates the original post text and the comments that form a conversation below it.

**Figure 1 A Reddit Thread**

The screenshot shows a Reddit thread titled "Delivering in a downtown type area". The post has 8 comments and is 10 months old. It asks for tips on parking in downtown areas with limited space. The thread is sorted by top suggestions. One comment from a user named [REDACTED] discusses parking hazards and mentions DTPHX. Another user responds, stating they park where they want as long as they're not blocking entry or exit ways. The thread is marked as archived.

Posted by [REDACTED] 10 months ago

## 5 Delivering in a downtown type area

Have a question. If you have a route that's downtown, with only 2 lanes and no where to park near the delivery destination. Do you just pull over as far as you can and turn your hazards on or find parking that's like a mile away?

Please give me some tips or pointers. I've tried to see what the parking laws for delivery are but haven't had any luck. Maybe I'm overlooking.

8 Comments Share Save Hide Report 100% Upvoted

This thread is archived  
New comments cannot be posted and votes cannot be cast

Sort By: Top (Suggested) ▾

[REDACTED] 10mo  
Yeah- hazards on and I park where I want. As long as I'm not blocking entry and exit ways, someone's mailbox, someone's car.

I don't like downtown routes cause almost everything in DTPHX is one way and it [REDACTED] me off, or the [REDACTED] construction. Anyway, I once parked in a no parking zone in front of four cops and I didn't get in trouble. Threw my hazards on, ran to the door and ran back ..so they knew I was working and trying to get in and out.

I don't think anyone would have an issue, if they do, they should really not take it up with you hah

4 Share Report Save

We searched through content from four such subreddits (**Table 4**) to observe conversations about challenges in urban freight delivery, with a focus on parking.

**Table 4 Subreddits Used for Search**

Subreddit	Target Population	Number of Subscribers	Number of Drivers**
r/AmazonDSPDrivers	Amazon Delivery Service Partner Associates	14,878	115,000
r/AmazonFlexDrivers	Amazon Flex drivers	36,987	Unknown
r/FedExers	FedEx drivers*	4,798	165,685
r/UPSers	United Parcel Service drivers*	4,676	127,017

\*r/FedExers and r/UPSers include any employees, not just drivers

\*\* Estimate Sources: Amazon DSP (Schoolov, 2021), FedEx (Federal Motor Carrier Safety Administration, 2021a), UPS (Federal Motor Carrier Safety Administration, 2021b). Numbers for FedEx and UPS may include non-delivery drivers.

We selected these subreddits because they are specifically oriented toward parcel delivery employees and the companies represented account for the majority of US parcel delivery volume and revenue (Pitney Bowes, 2021). Amazon Delivery Service Partners (DSPs) are independent contractors who employ drivers to operate Amazon-branded vehicles, and account for most of Amazon's deliveries (Soper, 2018). Amazon announced its "Delivery Service Partner" (DSP) program in June 2018, and by mid 2020, was delivering 66% of its own packages directly to customers in the United States, largely through these DSPs (Solomon, 2020). By contrast, Amazon Flex drivers are gig economy workers who sign up to deliver Amazon packages using their own private vehicles, much in the way ridesharing services like Uber or Lyft do for passengers (Semuels, 2018).

The inclusion of Amazon DSP and Flex drivers is a specific focus of this study, as Amazon accounts for the bulk of increased shipping volume in recent years, including since the onset of the COVID-19 pandemic (Pitney Bowes, 2021). Moreover, as we conducted our searches, we found that the Amazon subreddits provided useful conversations to analyze, but that the UPS and FedEx subreddits provided little discussion about our topics of interest. This outcome may be due to their smaller size, as well as due to their inclusion of all employee types for those companies, while the selected Amazon subreddits exist exclusively for drivers. It is unclear why the Amazon subreddits are so much larger, though we speculate that youth, tech savviness, and comparatively abridged training practices that prompt drivers to seek online help and community may contribute (Bandler et al., 2019). Additionally, UPS employs a unionized workforce, which may contribute to longer-term contracts, longer employee retention, more experience, and older employees compared to others (Streeter, 2021). The results we report here, nevertheless, consist nearly exclusively of material from Amazon-related threads.

Moreover, while it is not possible to discern the location of each commenter unless they happened to mention it, the subreddits we searched are in English and appear to consist primarily of commenters from the United States, with some commenters from Canada. The analysis presented here, therefore, is necessarily US-centric, and may reflect circumstances different from other parts of the world. Similarly, it is not possible to ascertain sociodemographic information of commenters. There is no "typical" Reddit user, rather a diversity of users self-selects into subreddits by their interests. For example, existing work demonstrates extreme variation in gender makeup of subreddits based on subject (Burkhart, n.d.). Nevertheless, young, male, and tech-savvy users are historically overrepresented on Reddit as a whole (Pew Research Center, 2016).

To identify relevant threads, we used two search terms: ‘downtown’ and ‘parking’. These terms were the outcome of a series of pilot searches, in which we first developed a broad list of search terms designed to elicit conversations about parking, safety, interactions with the built environment, interactions with other road users, and other emerging obstacles in last mile delivery. We compiled this list by consulting the planning and logistics literatures to identify emerging issues in last mile delivery surrounding both safety and built environment accommodations for freight. Through the above pilot process, we determined that using the above terms provided the best balance in terms of achieving adequate depth of results while remaining within the scope of our research questions (i.e., focusing on parking in US urban areas).

With the above terms, we used Reddit’s search feature to comb each subreddit for appropriate threads. For each subreddit, we iterated through each search term, setting the results to display by “Relevant” threads. A researcher then examined each resulting thread for relevant content, compiling a list of candidate threads for inclusion in the analysis. Threads were then included or excluded according to a set of specific criteria (**Table 5**) to ensure relevance of the collected material.

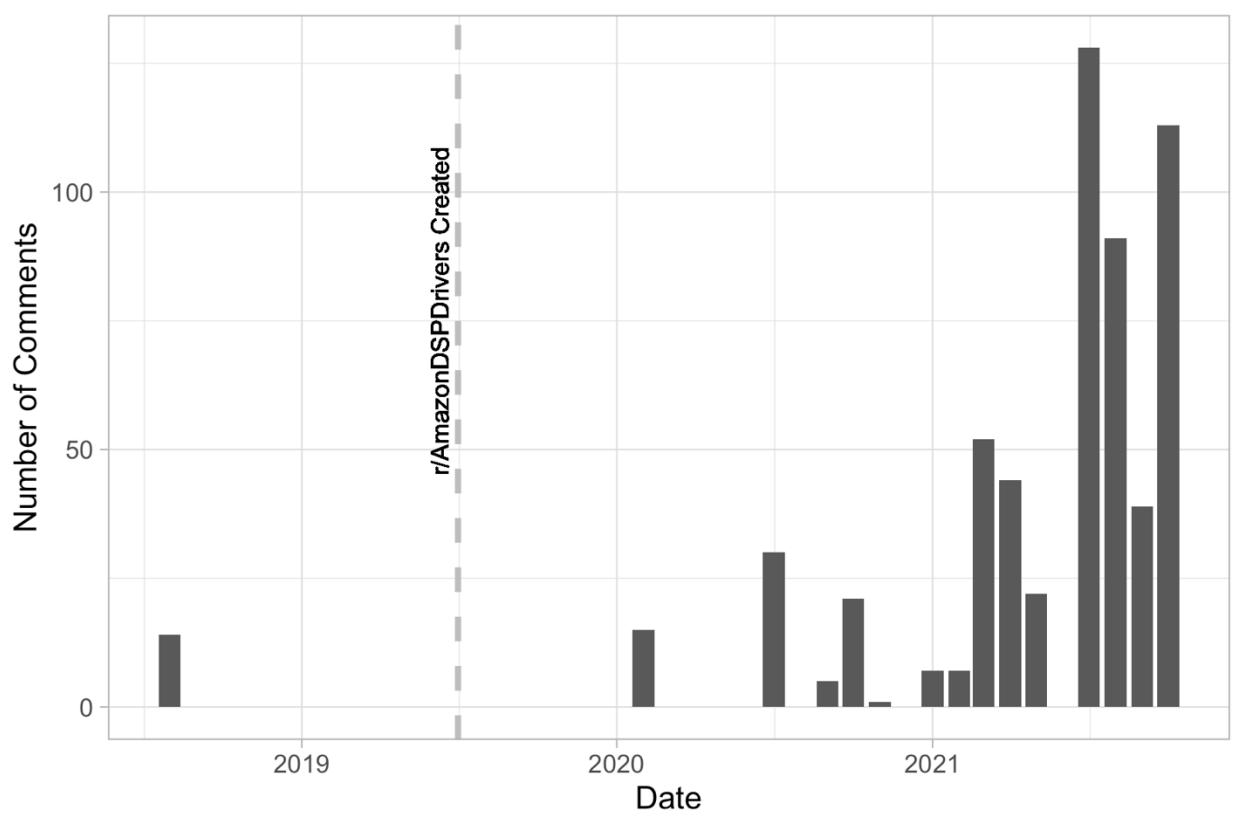
**Table 5 Inclusion and Exclusion Criteria**

Inclusion		Exclusion	
Criterion	Notes/Example	Criterion	Notes/Example
Conforms to intended meaning of term	Threads resulting from searching "downtown" that describe issues with navigating urban areas, congestion, parking difficulties	Other connotations of search term	Threads resulting from "downtown" that describe non-road incident mistakes, e.g., "My new favorite break spot when I deliver in Downtown Dallas."
Posts that substantively discuss an issue	A driver asking for advice about finding parking	Posts that are jokes	Comments referring to a picture of an Amazon van in a ditch as a bad parking job
Reply comments provide insight into issue, share personal experience, or otherwise add to knowledge about issue	e.g., <i>"Problem with this is that Amazon expects us to rush through our route as fast as possible and if we go door to door in every apartment complex, we will end up being behind."</i>	Reply comments are thin, insubstantial, irrelevant, or otherwise do not add to understanding	e.g., <i>"Ha! My whole route is apartments. You get used to it.", "I feel your pain."</i>

While we attempted to follow the criteria objectively, by its nature the search process relied to a certain extent on researcher discretion. For included threads, the title, topic/category, and URL of each were recorded. The result of this process was a curated list of URLs, each representing a post ( $n = 33$ ), that point to Reddit threads intended for analysis.

We then used RedditExtractor, a package for the R programming language, to extract the threads indicated by the recorded URLs (Rivera, 2019). This extraction process downloads each thread as a dataframe that includes the original post, all comments, and relevant metadata, such as the number of upvotes/downvotes, date posted, etc. The data search and collection process took place between Nov 5-12, 2021, just before the 2021 peak holiday season, and includes any posts from before this period. The timespan represented by the extracted posts and comments is displayed in **Figure 2**, in which each bar represents the number of comments posted by the month in which each post occurred.

**Figure 2 Volume of Collected Comments Over Time**



The collected comments ( $n=589$ ) were posted between 08/14/2018 and 10/31/2021, but as the above figure shows, the bulk of the comments were posted through the course of 2021. This pattern coincides with the growth of the subreddits from which the comments were sourced, which added the bulk of their subscribers during this time (Boe, 2022). As indicated in **Figure 2**, the r/AmazonDSPDrivers subreddit was founded June 30, 2019. Both the DSP and Flex subreddits experienced most of their growth to date in 2020 and beyond, which corresponds with the volume of comments we collected from our search. This process resulted in a final corpus of 589 comments on 33 posts, yielding 622 discrete chunks of text for analysis. The total number of commenters across these chunks was 371, with a mean of 1.6 comments per user, median of 1 comment per user, and maximum of 12 comments.

## ANALYTICAL APPROACH

The resulting threads were imported into NVivo, a computer-assisted qualitative data analysis software (CAQDAS) package (QSR International Pty Ltd., 2020), for coding and analysis. We use an adaptation of “flexible” coding, which is designed to reliably, transparently, and expediently analyze large sets of unstructured data (Deterding & Waters, 2018). This strategy combines deductive coding, derived from extant literature and theory, with inductive coding, derived from the collected data.

We began by assigning indexical codes that map the contents of the data. Initial indexical codes were defined by the search terms associated with each thread (i.e., comments that were found by searching for “parking” were autocoded as “parking”, while comments found by searching for “downtown” were coded as “downtown”). Crucially, comments could further be coded under multiple codes where multiple codes apply. For example, comments discussing parking in a downtown area would be coded under both codes.

Following indexical coding, we assigned analytic codes to the comments within each indexical code. Analytic codes represent finer grained concepts and are used to help understand emergent themes and relationships within the data. For example, under the “parking” indexical code, we developed an analytical coding hierarchy that began with “practices and strategies”, under which we coded “unauthorized parking”, which we further broke down into types and motivations. In this way, we were able to develop a systematic understanding of how and why drivers engaged in unauthorized parking behaviors. The results of these analyses are presented in the next section of the paper.

## FINDINGS

We organize the findings into three main parts. First, we present challenges drivers identified while delivering in dense, urban areas. We then focus on commonly reported parking strategies. Finally, we discuss unauthorized parking practices, including specific parking behaviors, reasons given for engaging in these behaviors, enforcement, and interactions with other road users while parking.

### Downtown Challenges

As urban goods delivery continues to accelerate, issues pertaining to curb use, particularly competition for curb space, have been exacerbated (Goodchild & Ivanov, 2018). These issues have been especially concentrated in dense urban cores, where less curb space is stretched across more users. Drivers who had experience with downtown routes indicated that they found these routes to be challenging and often dreaded being assigned them, as one Flex driver expressed:

Everybody who works this gig knows it's a gamble, and getting a downtown route is the opposite of hitting the jackpot. We have some overpopulated cities with horrible infrastructure and seemingly no accommodations for delivery personnel and their vehicles. [...] But honestly, what is to be done? (allPostsID54-Flex)

Other drivers, both for DSPs and Flex, corroborated this perception that dense areas are ill equipped to accommodate delivery personnel.

Drivers indicated a litany of challenges driving in urban areas (**Table 6**), chief among them that they took too long to complete, that parking was difficult, that they often did not have access to buildings where they needed to deliver, and that high volumes of traffic exacerbated these difficulties.

**Table 6 Challenges Delivering in Downtowns**

Challenge	Number of Mentions	Percent of Mentioned Challenges
takes too long	25	24%
parking	24	23%
building access	19	18%
traffic	7	7%
unreachable customers	7	7%
finding apartments or lockers	6	6%
dangerous neighborhoods	5	5%
highrises	4	4%
impossible instructions	4	4%
one way streets	3	3%
Total	104	100%

### *Takes Too Long*

A main complaint of drivers was that downtown routes were slow, and therefore more difficult to complete on time. AllPostsID28 expressed frustration at how much longer urban routes took, sharing:

I only average about 12 or 14 stops<sup>1</sup> an hour in the city. Wanna do better its really not an organization issue but more of a driving and distance from my van to the stop issue. I typically average 20-24 in the suburbs. (allPostsID28-DSP)

If allPostsID28's estimate is correct, they deliver at around half the speed in the city as they do in the suburbs, mostly because of how long it takes them to drive to each stop, park, and walk to the delivery site. AllPostsID54, a Flex driver, describes how each different challenge encountered can add time to a delivery, causing a snowball effect in terms of delay:

[...] Amazon completely overloads us on these downtown routes. Usually 40+ packages for a 4.5 hr block. So, traffic can make a 5 min distance turn into a 15 min distance, and the task of finding parking can add another 10 minutes. Then walking to the building would be some more. And then the story of gaining access. Amazon has been around for years, so why is it still so bad? Does anyone know if anything is even being done about this? (allPostsID54-Flex)

In this comment, they note four discrete steps where challenges specific to downtown added to their delivery time: traffic that made driving take longer, cruising for parking, walking to the building from the parking spot, and then gaining access to the building.

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<sup>1</sup> Note that the commenters appear to use the terms 'stop' and 'delivery' interchangeably. Typically, a stop denotes parking the vehicle to make deliveries, while a delivery entails dropping off a package. Drivers can perform multiple deliveries from a single stop.

### *Downtown Parking*

In the collected sample, however, drivers discussing delivering in downtown areas mentioned parking more often than any other challenge both in terms of contributing to the time their routes took and as a general difficulty. AllPostsID23, a DSP driver, expressed frustration with “[...] deliveries in downtown or other business districts, where finding parking spaces can be atrocious (excluding instances where there are designated loading docks!).” This difficulty in finding parking often left drivers in a conundrum, having to decide between finding legitimate parking further away from the delivery destination, which takes longer, or taking the risk of leaving their vehicle parked in a questionable location. AllPostsID26, another DSP driver, asked for help with precisely this dilemma, posting “If you have a route that’s downtown, with only 2 lanes and nowhere to park near the delivery destination. Do you just pull over as far as you can and turn your hazards on or find parking that’s like a mile away?”

Flex drivers faced similar concerns, but with the added worry that their cars would not be identifiable by others, including enforcement, as delivery vehicles. This was a significant source of stress for these drivers, like allPostsID61, who asked:

FedEx was parked in the only "delivery only" spot behind me followed by a police car. UPS was parked in front in a no parking zone. The only available spot for me was a metered parking spot. I parked in the metered spot and turned on my flashers. I have no identifiable sign on my car. Is risking a parking ticket just what we do or what do you think? (allPostsID61-Flex)

These issues presented an additional challenge for Flex drivers, who would be responsible for paying a ticket if they got one. AllPostsID56 described giving up on a route because of the difficulty parking downtown. “First few stops were annoying with the whole not being able to find parking”, they said, expressing a typical concern, before going on to say:

There was literally no parking for this next one that wasn’t paid from what I could tell; they even had a valet service. I decided to skip it and started pulling up the next stop when I saw the next 10 or so were in this same area and just said f\*\*\* it. Went back and returned pretty much everything. (allPostsID56-Flex)

Overall, drivers portrayed downtown parking as difficult and stressful, which caused them to move slowly and/or worry about the consequences of their parking practices.

Curiously, when UPS drivers discussed downtown routes, they did not appear to share these sentiments, which may indicate differences in logistics practices between the organizations. As one driver shared:

I love working in a city... Park in one spot, grab a dolly worth of one building or load the whole block on a dolly and walk around the whole thing. I’d take it over resi[dential] routes any day. (allThreadsID1826-UPS)

The few other comments in the thread seemed to corroborate this impression, mostly describing routes that involved only a few (~5-10) physical stops wherein drivers parked for a protracted period and delivered many packages to a single building or small area. These drivers opined that the learning curve for these routes was steep, but that after some practice they became easier. “I miss my downtown Dallas route,” said allThreadsID1825-UPS, “It was hell getting to learn it but

once I got it done, it was a piece of cake.” These comments point to another relevant contrast between the UPS drivers and Amazon DSP drivers, wherein the UPS drivers seemingly expected to drive consistent routes, while Amazon’s drivers seemed to expect major variation on the route that would be assembled for them each day.

With the few UPS counterexamples notwithstanding, parking difficulties, both downtown and across more broad delivery areas, precipitated a robust discussion of parking between drivers, including practices and strategies encountered while delivering.

### Parking Practices and Strategies

Drivers employed multiple strategies to address parking difficulties, some of which were designed to avoid—or at least minimize—the need for unauthorized parking. The most frequently mentioned strategy (n=34) was to use the delivery vehicle’s hazard lights. “Just toss those hazards on and be as quick as possible,” said allThreadsID683-DSP. This strategy was typical, and commonly given as advice. As allThreadsID714-DSP put it, “Put your park anywhere lights on and just do it. You’ll be quicker and more efficient.” These comments also highlight the common strategy of remaining parked for as short a time as possible (n=23).

Another common strategy was to find a place to park the delivery vehicle and deliver packages on foot (n=24). “I used to do a busy af<sup>2</sup> but smaller downtown area and I learned where all the loading zones were and just took the dolly with a tote and walked. It sucked but it took way less time overall than driving around looking for parking”, shared allThreadsID681-DSP. For some, they resorted to this strategy when they knew their stop could not be completed quickly or without disrupting traffic. “If there’s no way to [avoid blocking traffic], then I’ll park on a different street and walk over”, said allThreadsID1900-DSP. Some drivers also reported trying to use loading zones when possible (n=9) and making specific efforts to ensure cars could still pass when they did stop to make deliveries (n=9).

Specifically for Flex deliveries, some drivers reported paying for metered parking (n=7) and/or displaying unofficial Amazon markings (n=7) on their cars. These drivers faced unique challenges because their vehicles were otherwise indistinguishable from other personal vehicles, making their delivery stops indistinguishable from simple unauthorized parking.

### *Unauthorized Parking*

In the discussions we collected about parking, however, the most mentioned topic was unauthorized parking, either as a concern or as a parking strategy (n=153). We tracked how often drivers mentioned parking behaviors that drivers perceived<sup>3</sup> as illegal, which are displayed in

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<sup>2</sup> ‘AF’ is a slang term that roughly means “extremely”.

<sup>3</sup> Some behaviors that drivers and the public tend to view as illegal are sometimes not technically illegal. For example, double parking is explicitly allowed under certain conditions in New York City (Jaller et al., 2013).

**Table 7.** Note that we considered “unauthorized” parking to include any location where drivers are not explicitly allowed to park their vehicle. This categorization is slightly broader than others, e.g., Dalla Chiara et al. (2021), but is meant to capture the sentiment of the drivers leaving comments, i.e., that they left their vehicle somewhere they technically were not supposed to. Furthermore, the parking types shown in the table reflect types as described by drivers and may therefore differ from typologies given elsewhere in the literature.

**Table 7 Types of Unauthorized Parking Discussed**

Unauthorized Parking Type	Number of Mentions	Percent of Mentions
wrong side of street	48	29%
block road	45	28%
wherever i want	18	11%
no parking zone	11	7%
sidewalk or curb	11	7%
double parking	8	5%
block driveway	4	2%
fire hydrant	3	2%
in driveway	3	2%
fire lane	3	2%
unpaid metered parking	2	1%
red curb	2	1%
handicap spot	2	1%
bus stop or lane	2	1%
reserved spot	1	1%
Total	163	100%

The most mentioned types of unauthorized parking were by far “wrong side of street” and “block road”, at 48 and 45 mentions, respectively. These figures speak to an overall concern drivers had about parking behaviors that interfered with traffic. Drivers also specifically mentioned “double parking” 8 times, which indicates the vehicle blocking the road as well, but specifically in the context of being next to another vehicle already parked at the curb.

We also tracked the reasons that drivers mentioned for engaging in unauthorized parking behaviors, which are displayed in **Table 8**.

**Table 8 Reasons Discussed for Unauthorized Parking**

Reasons	Number of Mentions	Percent of Mentions
no place to park	20	36%
takes too long not to	15	27%
avoid crossing the street	5	9%
narrow street	5	9%
safer	4	7%
too much effort	2	4%
bad routing from app	2	4%
loading zone occupied	2	4%
let traffic pass	1	2%
Total	56	100%

The above reasons given for unauthorized parking fall into three general categories: 1) That lack of legal options makes unauthorized parking unavoidable, 2) That parking legally would make routes take too long, and 3) That parking legally could make delivering less safe. We discuss these in turn below, discussing examples of the types of parking involved.

AllPostsID54-Flex opined that dense urban areas lack adequate accommodation to park delivery vehicles, adding, “So in turn, many times we are forced to park illegally for Amazon's sake, which obviously is not right and feels horrible.” In these cases, a primary concern due to lack of space was impeding traffic, with drivers resorting to blocking the road (n=45), parking *on* the sidewalk or curb (n=11), double parking (n=8), or otherwise occupying unauthorized spaces. “Obviously if I can't [find parking] I am going to be forced to double park or whatever”, said allThreadsID1402-Flex. Concerning blocking the street, allThreadsID685 shared sentiments that echoed across many DSP drivers:

I don't even care about the laws. I've blocked the whole-a\*\* street before; anyone who has something to say about it can get lost. When I parallel park, I do it because it is the easiest option and I don't want to cart 30 packages down 2 city blocks. In a lot of cases it's the ONLY option. (allThreadsID685-DSP)

Several other drivers commenting in the observed threads expressed similar views on parking regulations.

Drivers came to these views not only because of lack of space, but because of the time constraints placed on their deliveries. AllThreadsID685-DSP, for example, went on to say “[U]sually I try to be a nice and courteous driver, but when I'm downtown I have to be an a\*\*hole or else I can't get everything delivered in time.” Similarly, allThreadsID1410-DSP said “If I parked legally every time I would always be going over.”

In part to speed up their delivery rate, drivers also reported parking on the wrong side of the street because it allowed them to park closer to their stops. In one thread, a driver admitted to doing so once through “an error in judgment”, and was worried they might get in trouble, to which allThreads1950-DSP responded “You mean you don't park in the opposite side? That's how you shave time off routes”. This practice seemed so common that allThreadsID1942-DSP remarked “If I had to take a shot for every time I parked on the wrong side of the street, today

alone I would die of alcohol poisoning”, and allThreadsID1990-DSP added “If I had a nickel for every time I parked on the wrong side of the street while delivering I wouldn’t need to work here anymore”.

Somewhat counterintuitively, in certain contexts, drivers also found it to be safer to park in an unauthorized space than an authorized space. AllThreadsID2092-DSP provided detailed insight about their priorities and the reasons why their parking strategy included regularly using unauthorized parking:

99% of the drivers I know will only block traffic if there is absolutely no other option. It's almost never done maliciously or for the driver's convenience. I will often break rules or inconvenience myself to ensure the safety of everyone on the road with me and have gotten a tongue lashing from customers/bystanders for it. Whether it's pulling into a driveway backwards or parking on the wrong side of the street in some cases, usually I'll give push back to anyone who gives me s\*\*\* for putting safety first. I'm just trying to do my job and get home like everyone else out there, the only difference is that my job takes place in places people often consider their own. (allThreadsID2092)

In short, despite sometimes flippant commentary, drivers described using unauthorized parking primarily for pragmatic reasons. For instance, drivers considered it safer to park on the wrong side of the street than to park on the correct side of the street when their delivery destination was on the opposite side. “I’ve almost been hit twice trying to cross a busy road. I would rather be fired or ticketed than die holding an Amazon package,” shared allThreadsID2010-DSP. This perception was echoed by allThreadsID2033-DSP, who said “I’m personally not interested in getting hit by some s\*\*\*head on their cellphone and the less time I spend crossing streets the less likely that is to happen.”

#### *Enforcement*

In general, drivers described parking enforcement personnel as being understanding of the circumstances described above and allowing them to go about their business. Across the comments that mentioned enforcement (n=42), 25 suggested that enforcement gave drivers leeway when it came to parking, 7 described instances of overzealous parking enforcement, and 5 mentioned inconsistent enforcement.

The predominating sentiment was that the police did not interfere with drivers using unauthorized parking to deliver packages. “I’ve been told by local PD they don’t give a f\*\*\* about us or where we park,” said allThreadsID1870-DSP. Similarly, allThreadsID1975-DSP felt that the police were not concerned with delivery drivers parking in unauthorized spaces, sharing “... they understand parking is a pain also you’re gonna be there for 2 minutes. I can park right in front of a no parking sign or park in a metered spot for like 10 mins while I go into an office building and cops do not care at all.”

Nevertheless, some drivers reported instances of enforcement being harsh on occasion or in their area. “I can’t even block one side of the street here in Hollywood, parking enforcement will ticket our a\*\* so fast, already racked up 3,” shared allThreadsID1906-DSP. Moreover, Flex drivers were generally more worried about enforcement, since it would not be obvious to enforcement personnel that they were delivering for Amazon. For example, allPostsID53-Flex described “quick draw parking enforcement” as a reason they despised downtown routes.

Overall, drivers described enforcement as generally lax, but with some inconsistency. AllThreadsID658-DSP advised another driver to ignore the inevitable occasional encounters with enforcement, saying “I’ve gotten two tickets in the past year and both were by p\*\*\*\* mall cops randomly enforcing me for doing the same stuff everyone does.” Overall, occasional encounters with enforcement seemed to be part of the job. As allThreadsID1852 put it:

Some of these traffic cops are just d\*\*\*s or new themselves. It’s just bad luck if someone decides to give you a ticket. Good thing is we don’t pay them anyway. (allThreadsID1852-DSP)

The above comment also implies that they should not worry because it is the carrier—and not the driver—who is responsible for paying the ticket. Overall, unauthorized parking was prevalent in the perceptions of the drivers observed here, and enforcement seemed to generally acknowledge that this behavior is necessary.

#### *Interactions with Other Road Users*

Drivers also described several instances of interactions with other road users, which have implications both for allocation of urban space as well as safety (**Table 9**).

**Table 9 Interactions with Other Road Users**

Interaction Type	Number of Mentions	Percent of Mentions
other driver blocked by delivery vehicle	11	23%
yelled at	9	19%
honked at	7	15%
potential crash	6	13%
verbal confrontation	5	10%
cars go around vehicle	4	8%
physical altercation	2	4%
angry at delivery driver	2	4%
potential physical altercation	1	2%
crash	1	2%
Total	48	100%

Most of the encounters with other road users revolved around a delivery vehicle temporarily blocking traffic, which provoked a response from a driver. For example, allThreadsID1888-DSP shared “I had a woman come out and shout at me for blocking her for literally about 20 seconds”. Drivers became accustomed to these encounters over time, dealing with other road users who yell, honk their horns, or even occasionally exit their vehicles to accost the delivery driver. “I’ve heard people say stuff to me and I say ok have a nice day,” said allThreadsID1982-DSP.

While these kinds of encounters, especially on the rare occasion where an encounter became physical, are unpleasant for drivers, they also point to potential increases in safety risks as delivery drivers occupy curb and road space and interact with other drivers. This concern was clear, for example, in a thread where a driver asked, “When you are parked on a busy road do

you ever think this could be the day a driver rear ends the van and kills me?" Several drivers confirmed that they worried about such issues, like allThreadsID1912-DSP, who said "I'm standing in the back of the van hearing cars and trucks whip past and praying I don't rag doll like an unsecured box," or allThreadsID1926-DSP, who replied "Nope. But, I did wonder if I would get hit by a car getting out of the van sometimes". Moreover, these concerns were not unfounded, with at least one driver reporting an incident that happened to someone at their DSP: "We actually had a guy who was getting a package in the back and someone hit the van from behind at ab[out] 40 mph" (allThreadsID1932-DSP).

## DISCUSSION AND CONCLUSION

Findings from this study suggest that parcel delivery drivers regularly face and adapt to a number of challenges in the current delivery landscape, with parking as a primary challenge. Extant work has begun to explore CV parking, relying primarily on field observations and citation data. These efforts have produced varying estimates of the prevalence of unauthorized parking behaviors, associating them with lack of parking supply and land use mixes that are accompanied by high demand for deliveries. Nevertheless, most efforts are not suited to understanding drivers' decision-making processes or their views on what elements of parking make their jobs more difficult to complete.

By analyzing comments shared by delivery personnel on Reddit, we discerned that parcel delivery drivers—primarily driving for Amazon—did not like being assigned downtown routes because they take too long to complete and are difficult to navigate. They identified inadequate parking as a main contributor to these difficulties. These perceptions corroborate extant work that suggests undersupply of CV parking contributes to unauthorized parking and corresponding negative externalities.

Unauthorized parking was a commonly discussed strategy. Specifically, parking in the travel lane and parking on the wrong side of the street were the most referenced types. In our view, the prevalence of these discussions implies that these are the parking types of highest concern to the drivers in our sample, even though prior studies suggest that other types might be more prevalent (Dalla Chiara & Goodchild, 2020). Moreover, while drivers did not describe these behaviors as default, they generally reported engaging in unauthorized parking without hesitation in contexts where deliveries were otherwise more difficult and encouraged newer drivers to do the same.

Concerning causes of unauthorized parking, we found, in line with other work, that drivers used unauthorized parking in cases where parking was undersupplied or otherwise unavailable. We also found, however, that drivers sometimes used unauthorized parking because they perceived the unauthorized option as safer than the available authorized option. Moreover, we found that in some cases Amazon's drivers do not feel they have time to search for an authorized spot and opt to briefly park in an unauthorized spot instead, reducing (though perhaps not eliminating) the time spent cruising for parking.

In conjunction with unauthorized parking, drivers also discussed navigating parking enforcement. While some mentioned being ticketed or harassed by enforcement personnel, the overwhelming sentiment was that parking enforcement practiced extreme lenience toward unauthorized parking of CVs. This finding suggests that enforcement personnel also may view unauthorized parking as an inevitable outcome of undersupplied parking. Moreover, this finding also suggests that citation data may be a poor representation of the occurrence of unauthorized

parking, representing infractions that are most likely to be *cited*, rather than infractions that are most likely to *occur*. This finding also suggests that citation data may not effectively inform the kinds of infractions that cause the most pressing problems for traffic and safety.

Drivers sometimes described concerns when interacting with other road users, both in terms of personal conflict and safety. These interactions included blocking other drivers on the road while parked in the travel lane, as well as cars passing around the delivery vehicle while the driver was making a delivery. Drivers worried that these circumstances could lead not only to crashes involving the delivery vehicle, but that they might be hit by another driver while exiting or entering their own vehicle during a delivery. These findings add an important layer to discussions of safety surrounding delivery vehicles, which typically revolve around how delivery vehicles affect other road users, especially vulnerable road users like pedestrians, cyclists, and children (Conway et al., 2013). The safety interests of drivers and other road users alike may therefore be simultaneously addressed by appropriate interventions and adequate, safe parking facilities. After all, the driver becomes a pedestrian, and therefore a VRU, as soon as they exit their vehicle to make a delivery.

One unexpected discovery was the overrepresentation of Amazon-affiliated personnel on Reddit compared to FedEx and UPS. We are unsure as to why Reddit appears to be a more attractive venue for Amazon-affiliated drivers. We speculate one contributor may be the comparatively abridged training that DSP drivers receive compared to their FedEx and UPS counterparts, leaving drivers seeking advice from peers online (Bandler et al., 2019). Each company provides social media guidelines to some extent, but we suspect these guidelines would be unlikely to dissuade drivers from conversing online, especially anonymously (*FedEx Social Media Guidelines*, 2018; *UPS Social Media Guidelines*, 2013; Kay, 2021). Other institutional practices around employment, training, and route assignment may contribute to the differences we observed, with UPS drivers, for example, seeming to have more consistent routes than DSP drivers. These differences may also help explain differences we observed among the small number of UPS comments we collected, wherein drivers reported enjoying their regular downtown routes.

Finally, the main novelty of this paper is its use of social media data, which complements and adds to the set of tools available to researchers interested in urban freight and driver behavior. While not representative, this method has given perspective and granularity not available from research using e.g., surveys, GPS data, or simulations. It also complements techniques like in-person interviews, focus groups, and/or ridealongs, which can provide granularity but can also be costly, difficult to implement and/or recruit partners for, and are at times prone to responses being affected since participants know they are being observed.

## Limitations

The main limitation in using Reddit comments is the limited capacity to systematically collect information about the commenters (e.g., demographic information, geography), much less to generate a sample representative of the target population. While the goal of this paper is not to generate a statistically representative sample of delivery drivers, it is crucial to acknowledge this limitation. Similarly, since we rely on comments that users volunteered, we are unable to ascertain the degree to which there may be non-response bias, i.e., that some viewpoints are missing or that certain experiences, e.g., complaints, are emphasized. Additionally, since subreddits can be joined by anyone with a Reddit account, there is no formal mechanism to bar

non-employees from joining. We found no evidence, however, to believe that any commenters were not employees, nor do we see motivation for non-employees to fabricate commentary on the minutiae of day-to-day parcel delivery tasks.

Given the nature of the data, then, we are not able to comment as to how the viewpoints here relate to the larger population of parcel delivery drivers. These findings also only describe perceptions of drivers within the study scope, and therefore may differ from those of non-parcel drivers as well as those who operate in different geographies or speak languages other than English. Nevertheless, our approach provides a level of access and granularity that is difficult to achieve by other means and is therefore appropriate within the scope of our research questions.

### Policy Recommendations

Our findings corroborate prior work suggesting that infrastructure and policy in US municipalities has lagged current and future needs in terms of freight delivery (McDonald & Yuan, 2021). We suggest that systemic, context-sensitive changes are needed to accommodate anticipated future freight needs and mitigate current issues. The need for such changes are most pressing in, though perhaps not exclusively limited to, dense areas like US downtowns, which both attract high delivery volumes and are more likely to experience externalities related to last mile delivery like traffic congestion, safety issues, and concentrated pollution. For example, zoning codes may be revised to require adequate loading/unloading zones. Better provision of dedicated space may help to ensure that authorized spaces are also the safest and most convenient spaces, addressing two of the primary motivations for unauthorized parking.

Enforcement may also play a key role in smoothing out delivery processes. Our results suggest that tightening enforcement of parking infractions on CVs without providing adequate CV parking will not likely alter driver behavior, and at worst may reduce safety, since drivers often have no safe alternatives within acceptable time constraints. Enforcement of loading zones and other freight-related policies, however, could help ensure spaces are available, mitigating unauthorized parking, cruising, and/or other compensatory behaviors used by drivers when loading zones are blocked. Additionally, cities may consider how their enforcement practices and fines stack up against delivery company motivations. Pressure to deliver quickly may mean that it is cheaper for the companies to allow drivers to park illegally and risk fines, occasionally having to pay them, than to mandate parking practices that avoid fines but take longer to deliver. Cities may examine enforcement and fine options that might change this rationale.

Innovative solutions may also play a role. Freight demand management initiatives, like pick-up points, lockers, and microhubs allow drivers to drop many deliveries at one stop, reducing the distance driven and cumulative dwell time. Recipients then collect their packages from a staffed pick-up point or automated locker at their convenience. In the case of microhubs, other services, like a neighborhood kitchen for food delivery, can be integrated at a central location. Moreover, microhubs can serve as a transfer point where packages are transferred to non-truck modes, like cargo cycles, for final delivery, eliminating truck dwell times, pollution, and truck parking needs (Katsela et al., 2022).

Similarly, the practice of portering, i.e., employing dedicated personnel to receive batches of packages from vehicles to deliver on foot, could help reduce the need for delivery vehicles to stand—authorized or unauthorized—while a driver makes deliveries (Allen et al., 2021). Drivers in our sample mentioned parking and making several deliveries on foot as a compensatory strategy that could on some occasions save them time of having to e.g., park several times.

Walking, however, can be time consuming and fatiguing, especially when drivers must carry heavy parcels. In areas with enough density and delivery demand, adding dedicated on-foot personnel may improve delivery efficiency and reduce parking needs. Curb reservation systems, which are currently being piloted in several US cities, can also ensure a space is available when a delivery vehicle arrives (curbFlow, 2020).

In any case, we suggest that these and other measures be implemented as part of comprehensive, well-communicated, and context-informed curb management strategies. These strategies should maintain a curb that is dynamic and adaptable, recognizing the need for different uses, and adapting to them based on e.g., time of day. These strategies may also allow increased interactivity, e.g., allowing reservation of loading zones by delivery companies (Mancini Nichols & Dorsett, 2022). We hope these strategies may shift the onus of adaptation to the curb and off the shoulders of drivers.

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## 8.2 Appendix B – Manuscript of Paper Submitted to ITE Journal

### **Stemming the Tide: Approaching Urban Freight in the Era of e-Commerce**

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## **ABSTRACT**

The relationship between cities and freight is undergoing an unprecedented transition as e-commerce accounts for increasing shares of goods movement. This paper contextualizes this issue in terms of curb management and safety, details several emerging solutions, and discusses the future landscape in which these initiatives may be implemented.

## EMERGING IMPACTS OF INCREASES IN URBAN FREIGHT

The relationship between cities and freight is undergoing an unprecedented and tumultuous transition. While e-commerce has long been chipping away at traditional flows of goods, the COVID-19 pandemic caused a massive acceleration of trends, with some experts estimating that ten years' worth of e-commerce adoption took place in the space of three months.<sup>1</sup>

This shift has had a profound effect on goods movement, and consequently, the transportation systems on which it depends. The number of small parcels delivered in the US rose from 14.7 billion in 2019 to 20.2 billion in 2020.<sup>2</sup> Crucially, a large portion of these parcels end up at individual residences rather than consolidated at retail locations. At the same time, customers expect goods to arrive faster than ever, often in two days or less. This rapid increase in volume, disaggregation, and speed requires a constant flow of delivery vehicles that manifests as urban truck traffic.

More freight vehicles require more places to load and unload and these activities often take place at the curb. Cities typically require off-street loading zones for some types of new construction, but these requirements vary widely and most freight is accounted for by extant buildings or areas where there is not space for off-street loading.<sup>3</sup> Management of on-street loading zones, meanwhile, is complex, with requirements, procedures, and issues varying widely across—and even within—different cities. In short, loading space is often inadequate and it can be exceedingly difficult to reallocate space for loading purposes. Demand for space, therefore, often outstrips supply, which leads to undesirable impacts, including freight vehicles parking illegally or cruising for parking.<sup>4</sup>

**Figure 3 - A UPS truck parks on the sidewalk to avoid blocking traffic**



Author photo

Urban delivery personnel regularly encounter issues resulting from inadequate loading facilities. In a recent study that analyzed online conversations among parcel delivery drivers on the Reddit social content sharing platform, we found that drivers struggle with parking, traffic, and a host of other issues that slow the completion of their routes. While drivers prefer to park legally, they regularly find themselves engaging in unauthorized parking. Reasons cited include lack of available parking, the time it would take to find legal parking, and crucially, avoiding situations drivers perceived as unsafe.

Increased traffic and curb competition contribute to road safety hazards. While traffic-related injuries and fatalities have recently trended downward, incidents involving freight vehicles—particularly in urban areas—have risen.<sup>5</sup> Vulnerable road users (VRU) are particularly at risk, since urban areas that attract the highest concentrations of freight often also attract the highest rates of bicycle and pedestrian activity.<sup>6</sup> Adequate provision of commercial vehicle loading zones (CVLZ) is associated with increased VRU safety, since legally parked vehicles are less likely to cause bicyclists and pedestrians to compensate, e.g., by leaving a bicycle lane and dipping into a travel lane.

As e-commerce continues to account for a larger proportion of urban goods flow, cities have an opportunity to set the tone for the future of the last mile of the urban delivery system. For their part, the logistics industry is evolving at breakneck speed to keep up with goods flows and anticipate new directions. For municipalities, a multitude of policy and technology innovations are emerging, but it will be up to cities to be deliberate, nimble, and comprehensive in setting the stage to maximize their effectiveness.

## INNOVATIVE PRACTICES IN URBAN DELIVERY AND CURB MANAGEMENT

While cities have lagged in updating their loading space provision practices, tools and initiatives are emerging that could help mitigate the continued surge in freight. No single policy solution or technology presents a magical cure to the complex issues related to freight, but each offers potential as part of a diverse set of actions communities can employ. Here, we describe several of these initiatives, grouping them into those that help manage freight demand, those that help more efficiently manage the curb, and those that directly address safety.

### Freight Demand Management Initiatives

Freight demand management (FDM) initiatives alter patterns of freight demand to reduce stress on freight transportation systems and the externalities they impose<sup>7</sup>. Common FDM options involve consolidating freight, either onto fewer vehicles and/or to fewer delivery destinations, reducing freight-related trips. They can also involve temporal shifts, allowing deliveries to take place at times when less stress is placed on transportation systems.

- *Urban Consolidation Centers (UCC)* - UCCs are facilities that reduce freight traffic by concentrating deliveries at a localized terminal where they are sorted into optimal loads and delivered by the UCC operator. Primary examples are operated in the Netherlands and in France. They require extensive cooperation and can be difficult to make profitable, drawing opposition from carriers and unions, and often requiring public subsidy.<sup>7</sup>
- *Microhubs* – Microhubs are like UCCs in principle but operate on a smaller, typically neighborhood scale. For example, the Seattle Neighborhood Delivery Hub allows packages to be delivered at one location before distribution via cargo bicycle to the surrounding neighborhood. The hub also hosts several value-add features, including a neighborhood kitchen and common carrier parcel lockers, which eliminate last-mile delivery entirely.<sup>8</sup>
- *Pick-Up Points / Lockers* – Another approach is to make delivery at a central location from which recipients collect their deliveries. Varieties include staffed pick-up points (e.g., at a parcel carrier retail location or a partner store) and common carrier lockers. In the latter, multiple carriers can deposit packages into lockers, and recipients receive a code via email or text to access their package. These services eliminate failed deliveries when recipients are not home or due to package theft.<sup>8</sup>

**Figure 4 - Common carrier lockers, such as Amazon's Hub lockers, allow many packages to be delivered at one stop**



By Masem - CC BY-SA 4.0, <https://commons.wikimedia.org/w/index.php?curid=77221739>

- *Shifting Delivery Modes* – Some areas are experimenting with shifting freight to non-truck delivery modes that take up less (or no) space on the street and/or at the curb.
  - Cargo bikes – Cargo bikes obviate the need for delivery trucks in the last mile in some contexts, alleviating traffic congestion and emissions. These bicycles are often electrically assisted and can be used in concert with other freight initiatives like microhubs.<sup>8</sup>

- Autonomous vehicles – Several companies are experimenting with self-driving vehicles that bring orders directly to recipients without human escort. These include droids, like FedEx’s Roxo,<sup>9</sup> a small robotic vehicle that uses the sidewalk or roadside, and drones, which airlift small packages short distances for final delivery.

## Curb Management Initiatives

Curb management initiatives maximize efficient use of limited curb space. These initiatives prioritize curb access by need, minimize the time users spend at the curb, and reduce externalities stemming from excess curb demand, like unauthorized parking.

- *Contextually specific loading zones* – Some cities have refined their curb zone typologies to accommodate diverse and growing needs. Seattle, a thought leader in urban freight, has four types: Passenger loading zones, loading zones, truck zones, and commercial vehicle loading zones (CVLZ).<sup>10</sup> San Francisco instituted a similar system in which curb sections are painted different colors that indicate permitted uses depending on time of day<sup>11</sup>. These programs allow for the curb to be used efficiently for the purposes for which its location is best suited and avoid ambiguity and competition.
- *Curb reservation systems* – Partnering with technology firms like Coord and curbFlow, which apply computer vision to curb management, some cities are piloting “smart” commercial loading zones that are reserved using an app. Reservations ensure a spot is available when a driver needs it, and monitoring technology aids enforcement of the spaces. Columbus, OH piloted such a program between 2019-2020, and is investigating potential expansion.<sup>12</sup> These programs promise additional features that include 1) Automated enforcement through computer vision, 2) Dynamic curb uses depending on time of day, conditions, etc., and 3) A digital platform to charge users for curb space<sup>10</sup>. Pilot cities with similar programs include Omaha, Washington, DC, and Nashville.
- *Loading zone pricing* – To promote efficient use of loading zones, some cities charge delivery vehicles to use these spaces, sometimes in conjunction with reservation systems. Time-based fees discourage vehicles from staying longer than they need to and dissuade unauthorized use. Loading zone pricing has been implemented in cities including Washington, DC, Chicago, and Seattle.<sup>10</sup> In Washington, DC, one such initiative saw the number of non-trucks in loading zones and double-parking violations cut by more than 50%.<sup>13</sup>

## Safety Initiatives

Improved safety is a component of each initiative mentioned above and is often mentioned as a goal. Indeed, insofar as poor safety conditions are caused by issues these programs mean to solve, addressing these issues should also improve safety. But specific safety implications are not always made explicit and can be overshadowed by discussion of freight trip reduction, dwell time reduction, or curb use rates, to name some examples.<sup>12</sup> Safety—for drivers and other road users alike—should be an explicit consideration, both as a component of freight mitigation strategies and through specific safety initiatives.

- *Vehicle Design Changes* – Many urban freight vehicles are heavy and high off the ground, presenting a hazard to other road users. Vehicle design changes can mitigate or eliminate many of these concerns.<sup>14</sup> Reducing vehicle cab heights, adding peep windows, and/or sloped hood or cab-over designs increase driver vision and reduce reaction times. London, for example, is requiring such changes through the Direct Vision Standard (DVS).<sup>15</sup> Moreover, reductions in vehicle size are possible, in many cases, with little to no loss of capacity. Reduced vehicle size allows for smaller turning radii and increased maneuverability, which are compatible with street designs that are safer for VRUs.

**Figure 5 – Downsized delivery vehicles can more easily navigate urban environments that prioritize vulnerable road users**



By Dzmzh - CC BY-SA 4.0, <https://commons.wikimedia.org/w/index.php?curid=64650304>

- *Street Design Changes* – Streets designed to accommodate freight and those that protect VRUs have traditionally been at odds. Wide streets and curb geometry that accommodates large turning radii are favored for freight vehicles.<sup>16</sup> Rethinking freight vehicles that serve cities, including implementing alternatives to trucks, will allow design changes that improve safety, like narrower lanes, tight corner radii, frequent pedestrian islands and stopping points, diverters, and mini roundabouts, all of which reduce traffic hazards and prioritize VRUs.<sup>17</sup>

- *Vision Zero and Freight* – Vision Zero, an international project working toward eliminating fatalities and injuries involving road traffic, is a central force in promoting road safety, with 52 US cities taking part to date<sup>18</sup>. Vision Zero plans may benefit from increased emphasis on freight, which remains an opportunity for some. While New York City’s Vision Zero effort, for example, recently created a Truck Safety Task Force<sup>19</sup>, many Vision Zero plans do not address freight at all.

## CHALLENGES AND THE FUTURE

While these initiatives offer promise, questions remain about future implementation and scaling. Many initiatives have been implemented as small pilots without concrete plans for expansion or remain proposed alternatives to status quo delivery systems and street designs. Innovative solutions, like smart loading zones and the Seattle microhub, largely remain proofs-of-concept.

Larger players in the freight space are unlikely to change their procedures—for instance having their drivers use a third-party app to reserve spaces—without strong incentive or policy that requires it. UCCs provide a cautionary tale: Without broad carrier participation—required to generate self-sustaining revenue—most UCCs have failed in absence of subsidy.<sup>8</sup> Moreover, regulation that would mandate the use of UCCs is a challenge. This difficulty in recruiting participants may foreshadow implementation of other initiatives: Only 10% of users of the Columbus smart loading zones pilot consisted of larger shipping carriers like UPS, FedEx, or Amazon, as these companies were reticent to change procedure for eight spaces in one area of the city.<sup>12</sup> A systemic approach is needed.

Cities, however, do not appear to be approaching these issues systemically.<sup>3</sup> Failing to get ahead of the situation will have substantial traffic, safety, and quality of life impacts as freight growth continues to accelerate. To stem the tide of urban freight—and avoid its worst emerging effects—cities must both leverage innovative solutions *and* consider holistic policy that systemically approaches freight and maximizes the potential for new tools to help. A first step is a vision for an urban future that explicitly considers freight, the curb, and vulnerable road users, and this means more conversations taking place between planners and freight industry professionals.

While planners often advocate for walkability and complete streets, they have historically allowed market forces to handle urban freight. This approach is reaching its limits and planning for safer, better streets should include planning for freight. Moreover, planning around status quo last mile delivery patterns, relying almost exclusively on trucks, gives little incentive to change streets and adopt innovative solutions. Planning for streets that favor people and smaller vehicles, however, will create market conditions in which freight innovations will be demanded and thrive.<sup>20</sup>

Freight providers may resist changes that require new investments, but streets that focus less on cars and dedicate space to freight vehicles can make deliveries faster, more efficient, and safer. Cities should cultivate conditions that maximize the potential that novel freight solutions will take hold. These interventions present costs to shipping companies, but these costs become worthwhile investments when they present the best, most efficient solutions to the problems of urban freight.

Finally, context is also crucial. Solutions appropriate for the challenges faced by a large, dense cities may not apply to smaller, less spatially constrained areas. For example, congestion may be too temporally and spatially focused in smaller cities to necessitate wholesale changes.

Nevertheless, big problems precipitate change, and for many cities, problems surrounding urban freight are set only to become larger.

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## 8.3 Appendix C – Summary of Accomplishments

Date	Type of Accomplishment	Detailed Description
12/21	Conference Presentation	McDonald, N. The Transport Agenda in the US. Chartered Institute of Highway and Transportation (UK) Young Professionals Conference. December 2021.
03/22	Other	Iacobucci, E. and D. Magliola. Reports from the Battle for the Curb: Using Social Media to Understand Safety Challenges Faced by Urban Delivery Drivers. Collaborative Sciences Center for Road Safety (CSCRS) Research to Practice Bytes Series. March 2022.
04/22	Other	Goodchild, A. and N. McDonald. The Relationship between Freight Movements and Land Use in Urban Areas. Institute of Transportation Engineers (ITE) Webinar. April 2022.
05/22	Conference Presentation	Iacobucci, E. (Presenter), N. McDonald, C.H.W. Edwards, R. Steiner. "Using Social Media to Understand Challenges Faced by US Urban Parcel Delivery Drivers: Reports from the Curb." 9 <sup>th</sup> International Urban Freight Conference. Long Beach, CA, May.
07/22	Publication	Iacobucci, E., N. McDonald, C.H.W. Edwards, R. Steiner. "Using Social Media to Understand Challenges Faced by US Urban Parcel Delivery Drivers: Reports from the Curb." <i>Transport Policy</i> . Volume 126, September 2022. <a href="https://doi.org/10.1016/j.tranpol.2022.07.013">https://doi.org/10.1016/j.tranpol.2022.07.013</a>
08/22	Publication	<b>Iacobucci, E., N. McDonald, C.H.W. Edwards, R. Steiner, and J. Griffith.</b> "Stemming the Tide: Approaching Urban Freight in the Era of e-Commerce." <i>ITE Journal</i> . Volume 92 Number 8.
11/22	Conference Presentation	Iacobucci, E. (Presenter), N. McDonald, C.H.W. Edwards, R. Steiner. "Using Social Media to Understand Challenges Faced by US Urban Parcel Delivery Drivers: Reports from the Curb."

	Association of Collegiate Schools of Planning Conference. Toronto, CA, November.
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