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Playing in Traffic? Exploring the Intersection of Platforms, Agency, and Space in Bicycle Courier Mobilities

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ABSTRACT

This article explores change in the mobile geographies of bicycle courier work as a result of platform economy influences, with a focus on how agency of movement characteristic of messenger culture is maintained or altered through the use of algorithmic routing and management of the delivery process. A mixed-methods approach based in Amsterdam and Oslo uses participatory geographic Information systems (PGIS) to map bicycle couriers' spatial preferences in their working environment; semi-structured interviews to approach mobile decision making; and (auto)ethnographic data to consider the embodiment of movement across both case studies. This article provides an updated empirical understanding of couriers' mobile, urban geography compared with pre-platform messenger work, while examining the role of new organizational technologies on movement using a Lefebvrian spatial framework, emphasizing the gaps between spaces as exploitable by different actors in the delivery work sphere. The results show both a new, extended spatiality of bicycle-based work enabled by associated technologies, alongside both the loss and adoption of new means of appropriating urban and digital spaces resulting from algorithmic control of the delivery process.



KEYWORDS

bicycle couriers; platforms; spatial appropriation; navigation; algorithmic control

Introduction

It makes a lot of sense to deliver a burger from Løkka to Tøyen or Grønland, by bike. It makes very little sense to deliver a burger from Storo to Grefsen by bike. It just doesn't make any sense. So a lot of the expansion of the zone is stupid because it doesn't make sense to deliver food on bikes in the suburbs. (Foodora rider "Oa," Oslo)

With the growth of start-up companies promising delivery of all manner of goods in a matter of minutes, the position of the bicycle courier in European urban economies has never been more visible. Among the shift to platform, gig-based labor, bicycle delivery workers have evolved to symbolize the urban precariat, an informalized yet

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professionalized version of a workforce previously fitting inconspicuously into the flows of urban business (Fincham, 2008; Popan, 2021). As a line of work which has relied upon internal and embodied knowledges and experiences for moving through the city, questions can be raised into how platform economy organization—mediated by digital automation and location data (Tallyn et al., 2021; Kenney and Zysman, 2020)—has affected tactical means of moving through cities.

Logistical uses for bicycles remain underrepresented in academic and policy discussions of velomobility, which tend to revolve around a typology of recreational, commuter and utilitarian cycling as the three distinct types based on function (Jensen, 1999), or around a cyclist's experience or infrastructure preference (Damant-Sirois et al., 2014). In recent years, courier work has seen the most attention from an economic or labor lens in response to concerns about influence from the gig economy (Lee et al., 2016; Ilsøe and Jesnes, 2020; Heiland, 2021). Research of this kind has only hinted towards the implications for platform-based, algorithmic influence on the nature of courier movement within cities, despite earlier work which identifies the specific mobile characteristics which distinguish commercial cycling from other types (Kidder, 2009, 2011). This comes despite a renewed interest in bicycle delivery from an urban policy perspective, as a means of achieving local sustainability and livability goals in a shift away from motorized traffic in dense urban centers.

Earlier research into changing labor relations has highlighted the appropriation of digital technologies in organizing independent workers (Heiland, 2021; Tassinari and Maccarrone, 2020). Several scholars have drawn attention to the use of WhatsApp group connections between freelance meal-delivery couriers across Europe to organize spontaneous direct action against working conditions (Popan, 2021; Briziarelli, 2019; Tassinari and Maccarrone, 2020; Waters and Woodcock, 2022)—recreating the same dynamics of strike action but for a digital, decentralized workplace. Developing an understanding of digital appropriation in studies of bicycle courier work furthers earlier characterizations of pre-platform messaging based on appropriation of urban space through mobility. Extending this concept of digital appropriation helps to contextualize how mobility is performed among networks of platform technologies which both enable and constrict agency at work. Simultaneously, there is space to evaluate whether couriers continue to appropriate street space in movement. Spatial and digital appropriation form the conceptual framework to better compare and understand bicycle courier mobility.

As noted by Drahokoupil and Piasna (2017), successful platforms “have reorganized sectors that were already reliant on some form of self-employment” (p. 336). Often the platform economy is seen as interchangeable with piecemeal work; however this work recognizes a recent trend in European courier work towards offering employment contracts and the accompanying benefits, led in part by the new wave of start-up grocery delivery companies. Indeed, as is discussed later, bicycle couriers maintain varying levels of interaction with their company, and as such, dialectics of control and responsibility inherent in the employer-worker relationship vary across diverging means of structuring the work (Oppegaard, 2020). Mobile labor has long been associated with independence and precarity, while creating challenges for collective organization due to the dispersed nature of its workers reducing the ability for workplace connections to form (Lenaerts et al., 2018).

The aims of this article are as follows. First, it explores the factors which differentiate the experiences of bicycle courier mobility across different urban contexts, highlighting the role of external factors which affect the suitability of bicycle-based transport, with the goal of contributing consideration of these particularities in discussions of planning for logistics in the cycling city. Second, the article furthers the understanding of the role platform technologies and organizational systems play on travel behavior through a comparison to pre-platform bike messenger work, which is discussed in the next section. Earlier research on messenger mobility is used to position the points of comparison as research questions, addressed through empirical research into spatial relations and practices. An updated outlook on informal vélomobilities is a necessary step in understanding bicycle routing involving platform technologies, in wide use for navigation beyond delivery work.

Literature Review

From the 1990s through to the early 2010s, a wealth of ethnographic work approached the mobile practices of bicycle messengers based upon a specific set of practices that permit fluid movement through congested urban centers more efficiently than their motorized counterparts (Downey, 2002; Fincham, 2006; Kidder, 2009, 2011; Wehr, 2009). Inherent to this work are analyses of couriers' relationship with space, culminating in a theoretical language centering on means of subverting space, termed spatial appropriation (Kidder, 2011, 2016). In this context, spatial appropriation is used to describe movement through largely public spaces using informal, often illegal means beyond socially contracted uses for the street network. Kidder (2009) drew attention to this disconnect between the designed, physical environment and messengers' social interaction with it in a call for understanding mobility as processes of spatial interaction. More recently, the addition of a new interpretation and representation of space, embedded within platforms themselves, has seen interest from the perspective of labor organization (Brizarelli, 2019; Brizarelli and Armano, 2020). Through a lens of a tripartite of space—social, physical, and now digital—an updated understanding of couriers' produced mobile spaces can be built with attention to the mobile worlds produced through engagement with such abstractions.

One useful means of understanding mobile decision-making inherent to courier work is through Kidder's (2009, 2011) distinction between macro- and micro-routing, developed in the context of messenger work. Macro-routing incorporates choices and knowledge involved in wider navigation—which streets to take, which streets are closed, where to turn, how far to travel—recognizable to all cyclists. For messengers, fine-grained knowledge of a city's (or CBD's) street network has been imperative to being a messenger, as such knowledge enables a high average speed over the course of a delivery, finding routes that reduce the need to stop or slow down (Lyng, 2005; Kidder, 2006). Macro-routing for messengers differs from other cyclists as it is influenced by the goals and pressures of the work, including the challenges of navigation and the challenges of spending many hours in the saddle.

Micro-routing decisions are those that make messenger mobility behavior particularly unique and recognizable, considering choice about positioning within the street space. Rather than viewing journeys as constricted to the expected or otherwise legal channels

of travel, messengers exploit all parts of the environment as open for interpretation. In part, the position of the bicycle in a gray-area in many societies enables this, as the *place* of bicycles is not concrete. Micro-routing decisions often involve appropriation of space: on pavements, through private property, gaps between vehicles, pedestrian crossings, road closures, among others. Perhaps most controversially, micro-routing can involve more liberal interpretations of traffic law. It is here where a reputation for “reckless” behavior is reported (Kidder, 2005; Fincham, 2006, 2007), though messengers regard their movement as highly calculated, a necessity for completing tasks within required timeframes, maximizing low pay, or as a means of incorporating elements of play into otherwise mundane sequences of tasks.

Bicycle messengers, as part of completing delivery tasks, are constantly in search of opportunities which appear as “breaks” in mobile space (Lefebvre 1991: 14). Here arises the exploitable discrepancy between the physical and the social. As described by Bauman (1998, 1999), cities, through design, attempt to “push space into objectively measurable units” (Koglin, 2017: 113), leading to “space wars” as a result of the impossibility of reaching true consensus as to how it should be used. In the case of messengers, this also leads to a reputation for disruptive and reckless behavior, deviating from the assumed social contract. In turn, that map is enforced through policing of courier’s behavior.

Studies of mobility have long analyzed this relationship through the lens of structure and agency. Structures at play include the physical space of the street, strategically limiting agency through design. Beyond this, policy enforcing a wider transport regime led by automobility regime creates social structures enforced in the everyday experience of cycling, oft appearing in the (in)formal policing of cyclist behavior or the choice to cycle (Kidder, 2005). Agency appears in the reinterpretation and appropriation of space beyond its hegemonically determined, socio-physical structure. When viewed through De Certeau’s (1984) complimentary concept of strategy and tactic, powerful structures such as city governments or platform delivery companies can limit agency by mobilizing strategies in planning physical and digital infrastructures while weaker actors—such as bike messengers—use subversive and creative tactics to manipulate their way out of assumed patterns of behavior (Kidder, 2016).

Maps and navigation software challenge this relation by abstracting space form above, reproducing it in a reductive image to remove subjectivity from its desired interpretation. Jon Day, in his ethnographic portrait of life as a London bike courier, notes that: “maps divorce people from the world they inhabit ... reducing the landscape to a series of easily navigable coordinates” and that maps “record official versions of the world, telling us where to go and how to get there, and in doing so they maintain control” (Day, 2016: 103). By design, transportation maps simplify the world to a network of (legally) navigable transport corridors which are easily interpretable during journeys. Effective bicycle routing using static (paper) maps requires interpretation and translation of this network, coupling it with implicit knowledge of physical space and its potential impacts on navigability—slope, infrastructure among temporary hazards and weather are all considerations for routing by bicycle.

Platform navigation using mapping software takes this relationship several steps further by presenting one or more pre-calculated routes based on sometimes real-time information and turn-by-turn directions. In this case, steps of translation—from aerial

to eye-level representation and situation of the self in context, are negated with the addition of constant GPS localization. Navigation apps typically offer a variation of modes which apply differing networks of access to the routing engine, alongside applying costs such as speed limits, one-way restrictions and congestion data where relevant. Routes are calculated to minimize costs between input waypoints, typically corresponding to addresses in this context. It's likely that *Google Maps*, for example, uses A* search and/or Dijkstra's algorithm, two variations of calculating shortest paths between points. In calculating cycling directions, paths of least (distance) cost are also weighed against elevation gains and the number of turns to present a set of routes for the user to choose from (Haria et al. 2019). Delivery platforms use variations of this pattern to calculate ETAs as timeframes based on assumptions of average speed, working to communicate updates to the consumer and provide a metric that courier performance can be measured against. The limitations of this approach to navigation are clear, in that only a limited set of fairly static costs to travel, whereas both pedestrian and bicycle travel have the ability to cross between or even outside the assumed networks of travel, while also being vulnerable to alterations in the network requiring manual update to account for in machine routing. Certain factors which affect navigability are in constant flux and are not yet accounted for in routing software. As a result, a level of interpretation is still required when employing GPS-based real-time routing.

An alternative view is that as a resource, maps can allow courier work across a wider area, as fine-grained knowledge of interconnected street space is not a requirement for conducting the work. In addition, other developments associated with the platform economy permit expansion of delivery zones beyond business districts. E-bike technology has become more accessible in tandem with platform technology, reducing the physical burden of moving by bicycle. Finally, the organization of work into a centralized, online platform allows companies to streamline the management of tasks and workers without having a physical presence locally. Finally, the organization of work into a centralized, online platform allows companies to streamline the management of tasks and workers without having a physical presence locally (Casilli and Posada, 2019). Indeed, while pre-platform messengers were tied to a hub in the same city with orders radioed manually between dispatcher and rider, platform companies reduce overhead costs by centralizing operations to a single point in the region. For, example, while Foodora services operate in eight countries across Europe, the in-app accessible customer and rider services offer this coverage from Germany (Delivery Hero, 2023). Each of these developments has the potential to result in a much more diverse population of bicycle delivery workers, along with a wider urban geography of bicycle work.

This work builds upon a Lefebvrian understanding of space as produced through a tripartite, relational framework, outlined here in context of the research aims (Lefebvre 1991). The first, that Lefebvre terms *abstract space*, are the *spaces of representation*; the dominant conception of space produced through symbolic abstractions, found in master plans and, critically here, maps and their despatialized metrics used to structure the workflow (Lefebvre, 1991: 49–50; Watkins, 2005). This is hereafter referred to as *digital space* in order to place emphasis upon its connection to platform technologies. Such space combines with *spatial practices* that come as a result of the courier's experiences and decisions made during the workday. Finally, *lived spaces* or *representational spaces* encompass the spaces “directly lived through its associated images and

symbols” (Lefebvre, 1991: 39) overlaying physical space and subject to appropriation. All three spaces exist in dialectical tension, subject to constant alteration, to form the produced social space. Analyzing the evolving relationship between these spaces allows identification of gaps which permit or necessitate each conceptual space to dominate at any one time during travel.

Such a framework is well established in concerns surrounding the organization of a platform economy. Briziarelli (2019) mentions how the inherent differences between the digital space communicated through maps and the lived space of the existing urban fabric requires a degree of translation. It is this gap which prompts the desire for better understanding of how platform courier mobility is orchestrated. With an existing understanding of the spatial dynamics of pre-platform messengers, the article questions how the urban geography of courier work has evolved before asking how the spatial practices of couriers have evolved with influence from digital representations of space.

The two main research questions are represented below alongside the methodology used to approach them. While RQ1 is highly associated with participatory geographical information systems (PGIS) and RQ2 with the ethnographic methods, they are not discrete. Both questions fall under the main research question: *how have associated platform technologies altered the mobile-spatial characteristics of bicycle couriers in comparison to pre-platform messengers?*

Methodology

A range of in-depth data were collected between spring 2021 and early summer 2022, with fieldwork time equally split between Amsterdam, during which the main author took jobs with on-demand grocery delivery company Flink and cargo bike package delivery service Cycloon—and Oslo, where the author worked for meal-delivery service Foodora. PGIS data were collected from participants using a purpose-built web-app, while data for the ethnographic sections were recorded as semi-structured interviews with participants and personal fieldnotes. Both participatory mapping methods and ethnographic research have been used in cycling research, with the former used to evaluate the route choices of larger cycling groups such as commuters, while (auto)ethnographic data collection is well established in studies of courier work. Combining the two is done with the intent of providing a more complete picture of the mobile geographies of the work. While the datasets provide different viewpoints, there is a level of data triangulation resulting in mutually supporting interpretations. While ethnographic data are proven to function as stand-alone sources (Larsen, 2014), achieving reliable results from PGIS alone in this context would be more difficult without a larger pool of responses.

In this section, the methodological choices made in this research are detailed. As it is a new method in the realm of studying commercial cycling, the bulk of the explanation focuses on the PGIS section, as (auto)ethnographic methods are well established in this area.

Sampling and Recruitment of Participants

Having an ethnographic basis to the project was imperative in securing participation from working bicycle couriers, as the internal viewpoint to the topic gave access to easily get into

contact with potential participants. Working for Foodora enabled membership in the workplace union, Foodoraklubben, and the associated social group, Riders Club Norway. There was no equivalent group in Amsterdam (a reflection of the difference between labor union structures in Norway and the Netherlands), though the main author participated as a member of the now-defunct grassroots union Radical Riders, which represented platform couriers across the Netherlands (Jesnes et al., 2019; Oppegaard, 2020). The independent nature of most working cyclists does create sampling difficulties, as strategies based around snowballing participants are less effective. In Oslo, encounters at work with other couriers were brief and limited to waiting times at restaurants, though some conversations later extended to the online space. In Amsterdam, working out of two hubs permitted more discussion with co-workers who then participated in the research.

Participatory Mapping

Participatory methods for collecting spatial data have seen increased use within the social sciences, as it allows for an emancipatory representation of mapped areas based directly on user experience, providing spatial data for analysis and visualization (Pánek, 2016). Participatory GIS can be orchestrated in multiple ways. Paper maps can be digitized, or using purpose-built digital infrastructure, such as the web-app used here, developed by Jirka Pánek (see Pánek and Benediktsson, 2017) which allows users to input geodata directly, using a street-based basemap for context. In both cases, participants input spatial data directly through drawing and labelling features, rather than relying on a subjective interpretation by the researcher to spatialize reported phenomena. In this research, a web-app was particularly useful as participants could input data from anywhere with an Internet connection, with the link to the app shared on courier message boards.

Within the app, participants were able to input data in the form of points, lines, and polygons, across a rubric of “Negative,” “Mixed,” or “Positive” feelings associated with places and spaces. The addition of “Mixed Feelings” was offered with the assumption that feelings associated with some places are temporally dependent, especially considering the role of seasons and time of day, so this option was offered as a means of accounting for the gray area discussed earlier. This addition reduces the ability to assign numerical values to categories, complicating use for statistical analysis, however.

Participants were also able to attach a comment to each piece of data plotted in order to explain their choice, stored in the attribute tables of each data type and then exported into a spreadsheet for coding. Participants were given the option of writing in Norwegian, Dutch, or English. Prior to submitting, participants could also give their demographic information, including the company/companies they work for and the type of bike they used for work. Most participants left this section blank, or only answered some questions, as it was not required for submission. The decision was made to keep this section optional in order to reduce the time required to complete the survey, maximizing responses.

Many participants found the openness of the rubric difficult and required further discussion of the goals of the research while avoiding directing the contribution down particular channels, as might be the case if data examples were provided. In many cases, the participatory mapping section was completed directly following interviews as the

participant had a better understanding after discussing their experiences. In future, this issue could be combatted with more specific headings such as “danger” or “efficient” rather than vague categories used here.

Input data were able to be downloaded into geoJSON format and processed in ArcGIS Pro with the aim of spatially visualizing areas of repeated, common experience. More responses would be required for any meaningful statistical analysis.

Semi-Structured Interviewing

Interviews with bicycle couriers were conducted in both cities. All interviews were conducted in English. A list of questions covering topics of job experience, spatial preferences, navigation, decision making, use of digital infrastructures, risk, and behavior in traffic. Interviewees were encouraged to speak freely and informally with intervention if the conversation deviated away from courier work. Interviews lasted on average one hour.

Where possible, interviews were consciously planned within a day of the last time the courier worked. This allowed the participants to recall specific experiences. In some cases, this meant that interviews were held via Zoom, which also allowed for audio-visual recording. In all cases, interviews were audio recorded and transcribed for the automatic coding in ATLAS.ti.

Autoethnographic Recordings

The final method involved the recording of personal experience working in bicycle courier roles in the form of fieldnotes. The autoethnographic method has long been employed in studies of embodied and affective experience (Larsen, 2014; Timko and

Table 1. Demographic data gathered from PGIS

Participant	City	Age	Gender	Company/ies	Bicycle(s)
O1	Oslo	27	Male	Foodora	E-bike
O2	Oslo	38	Male	Foodora	Road bike
O3	Oslo	36	Male	Foodora	Gravel
O4	Oslo	36	Female	N/A	E-bike
O5	Oslo	N/A	N/A	Foodora	E-bike
O6	Oslo	N/A	N/A	Foodora	Road bike
O7	Oslo	35	Male	Foodora	E-bike
O8	Oslo	52	Male	Foodora	E-bike
O9	Oslo	26	Male	Foodora, Wolt	Road bike
A1	Amsterdam	23	Male	Thuisbezorgd	E-bike
A2	Amsterdam	51	Male	Cycloon	Cargo bike with e-trailer
A3	Amsterdam	25	Male	Cycloon	Road bike, cargo
A4	Amsterdam	23	Female	Flink	E-bike
A5	Amsterdam	N/A	Male	N/A	Cargo bike
A6	Amsterdam	49	Male	Cycloon	E-bike (cargo)
A7	Amsterdam	38	Male	Cycloon	E-bike (cargo)
A8	Amsterdam	22	Male	Thuisbezorgd	E-bike
A9	Amsterdam	16	Male	Takeaway.com (Thuisbezorgd)	E-bike
A10	Amsterdam	28	Male	Thuisbezorgd	E-bike
A11	Amsterdam	24	Male	Randstad.nl	E-bike
A12	Amsterdam	17	Male	Youngcapital	E-bike
A13	Amsterdam	22	Male	Thuisbezorgd	E-bike
A14	Amsterdam	17	Male	Thuisbezorgd	E-bike
A15	Amsterdam	34	Male	Gorillas	E-bike
A16	Amsterdam	22	Male	Thuisbezorgd	E-bike

Table 2. Interviewee demographic information

Participant	City	Gender	Company/ies	Bicycle(s)
Oa	Oslo	Male	Foodora	Road/Mountain
Ob	Oslo	Male	Foodora	E-bike
Oc	Oslo	Male	Foodora (contractor)	Gravel
Od	Oslo	Female	Foodora	E-bike
Oe	Oslo	Male	Foodora, independent non-food delivery company	Road/gravel (non-electric, personal), cargo (electric, employer owned)
Of	Oslo	Male	Foodora	E-bike
Og	Oslo	Female	Foodora	E-bike
Oh	Oslo	Male	Foodora, Wolt	E-bike
Oi	Oslo	Male	Foodora	E-bike
Oj	Oslo	Female	Foodora	E-bike
Aa	Amsterdam	Male	Cycloon	Cargo bike (non-electric and electric)
Ab	Amsterdam	Male	Thuisbezorgd	E-bike
Ac	Amsterdam	Male	Cycloon	Cargo bike (electric)
Ad	Amsterdam	Female	Flink	E-bike
Ae	Amsterdam	Male	Gorillas	E-bike
Af	Amsterdam	Male	Thuisbezorgd	E-bike
Ag	Amsterdam	Male	CoolBlue	Cargo bike (electric)
Ah	Amsterdam	Male	Cycloon	Cargo bike (electric)
Ai	Amsterdam	Male	Gorillas	E-bike
Aj	Amsterdam	Male	Cycloon	Cargo bike (electric)

van Melik, 2021). Cycling, by default, is a deeply embodied experience dependent on maintaining a particular relationship with the external (physical) environment, the body, and the materials being travelled with (bicycle, equipment and, in this case, cargo). As described in the discussed literature, much of the behavior characteristic of bicycle messengers appears as seemingly implicit bodily responses to external influences that are calculated behaviors as the result of repeated experience.

Fieldnotes were recorded during and following shifts working in Amsterdam and Oslo. Emphasis was placed on recording *in situ* (Larsen, 2014). On occasion, voice

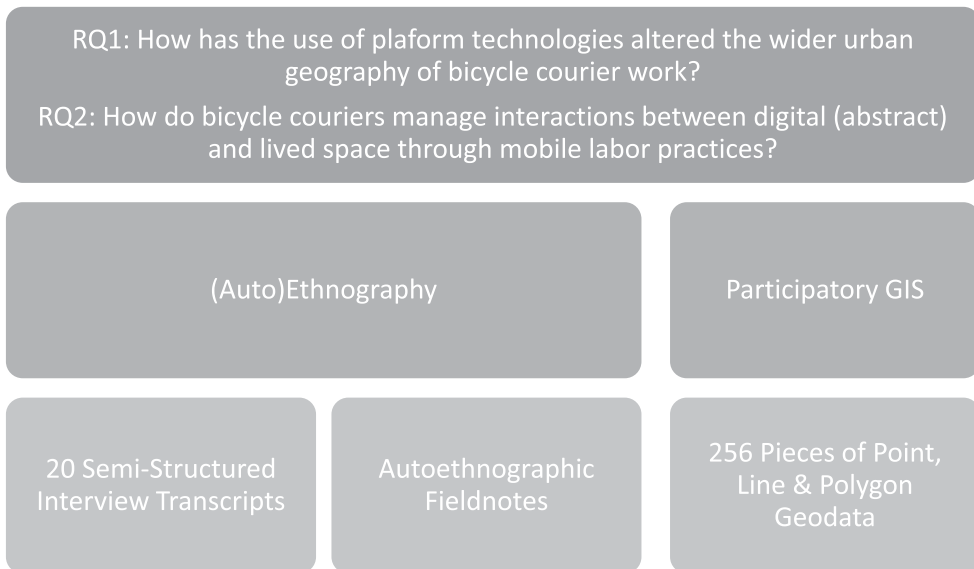


Figure 1. Methodology and data types gathered

notes could be taken while moving to be transcribed later, but most were written during pauses in movement.

Participants and Data

The mean age for reporting couriers in Oslo was much higher than in Amsterdam, 35.7 compared to 27.4, respectively. This is perhaps reflective of Amsterdam's position as a student city, with courier work being a popular and reliable part-time job with little investment required. This contrasts with Oslo, where courier work typically requires initial investment in essential equipment—a bicycle, most clothing, studded tires—as it is not provided by the dominant delivery companies, Foodora and Wolt.

In total, participants plotted 256 pieces of geographic data into the GIS, most with an attached comment explaining their choice for marking it. Some data management was required, where it was clear the participant had attempted to mark an area using the line tool, rather than drawing it as a polygon. In Oslo this appeared where a participant had drawn an almost complete circle, including over the fjord, using the line tool. As it was not plotted over a possibly navigable path, the two close end points were connected and converted to a polygon. All other data were represented as they were input by the participant.

Ten semi-structured interviews were conducted in each city. All interviewees in Oslo worked for Foodora (some also worked for Wolt and an independent courier company), while in Amsterdam the pool was more diverse, with many working in flash delivery, meal delivery, messenger roles, and post/scheduled goods delivery.

The Changing Geography of Bicycle Courier Work

Figure 2 shows the areas of each case study described as being associated with “negative feelings.” While in Amsterdam, couriers tended to plot negative associations as larger polygons, in Oslo, couriers tended to plot points and lines (See Figure 5) to represent this, suggesting that they were less willing to demarcate the entire area as negative, when their view was the result of specific intersections, squares, or streets. Indeed, this is reflected in mapping of “positive feelings” (See Figure 4): generally incorporating the area within the outer Ring 3, but with special attention to denser, more profitable and more navigable neighborhoods within Ring 2. For Oslo couriers, the negative aspects of working in the center were often outweighed by the quality (shorter, simpler, with little elevation) of deliveries, while in Amsterdam, couriers would often avoid the area altogether unless the job required it.

Bike messengering has traditionally centered on the central business districts of financial centers (Fincham, 2008; Kidder, 2011; Day, 2016), serving clients in congested areas where the value of skilled bicycle delivery services is most acute. However, the new wave of platform bicycle courier work has extended to provide services directly to consumers by connecting them with businesses via a third-party platform, a practice which has altered the wider urban geography of the work. While dense areas still represent the ideal environment, bicycle couriers now inhabit residential areas of various distance from city centers, carrying food, medicines, and other consumer goods from neighborhood centers to individual residential addresses.

Bicycle Couriers Reporting Areas Associated with "Negative Feelings"

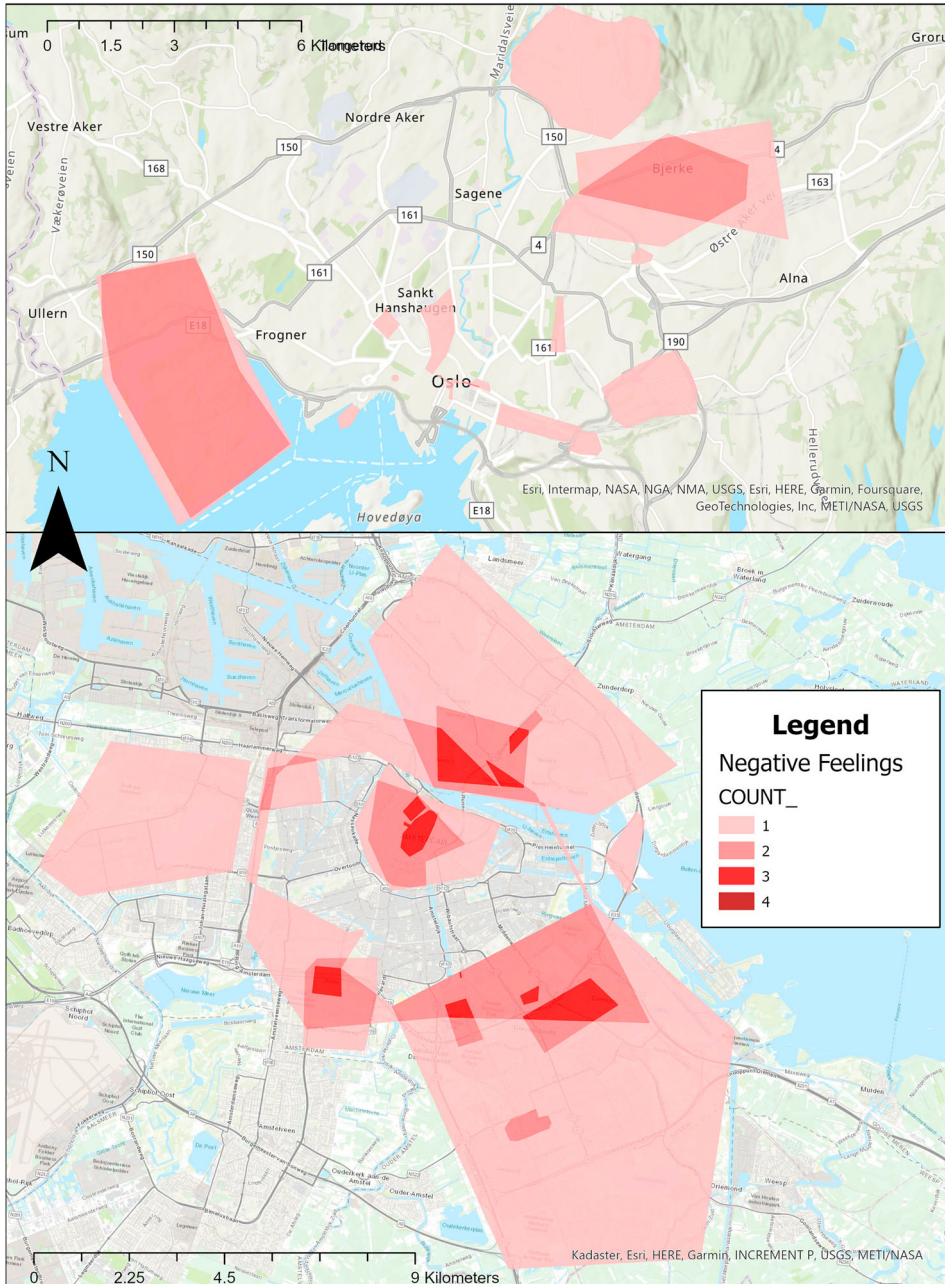


Figure 2. Areas plotted as associated with “negative feelings”

In Amsterdam, the De Wallen area, known internationally as the Red Light District, is consistently viewed negatively as a consequence of tourism. Participants cite busyness and issues with working around pedestrian crowds—particularly among couriers that use large cargo bikes: “crazy amounts of tourists on bikes, hard to navigate” (See Figure 2). Some also mark the entire Centrum district negatively instead—“Confusing,

Bicycle Couriers Reporting Areas Associated with "Mixed Feelings"

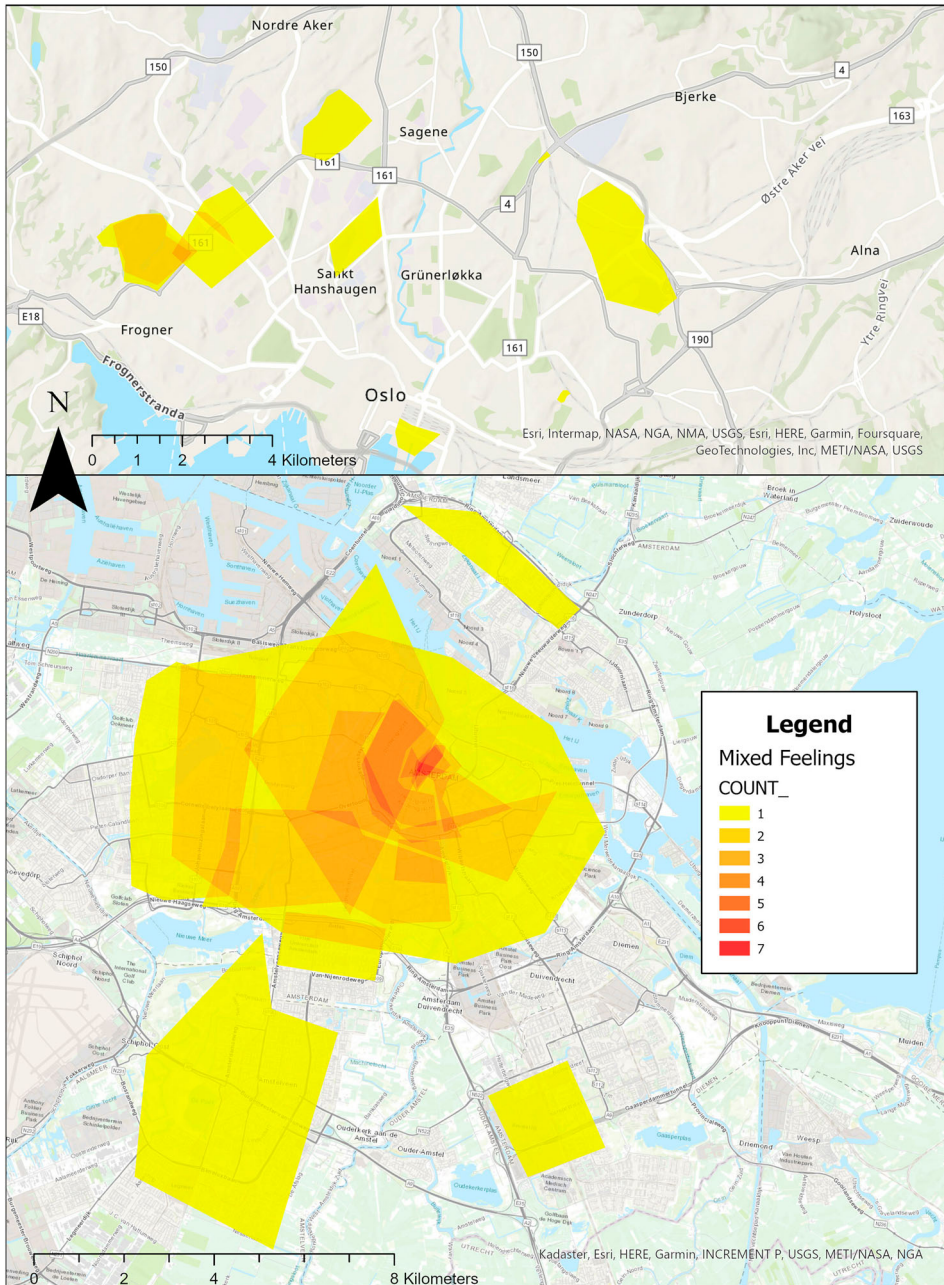


Figure 3. Areas plotted as associated with “mixed feelings”

hard to find a specific address. Really busy with tourists and drunk people walking in the road too”—along the same points of concern. In Oslo, users leaned more towards using the point and line tools (See Figure 5) to label issues in the center, showing a high density of negative “points” plotted in the Sentrum/Kvadraturen area. In the coordinating

Bicycle Couriers Reporting Areas Associated with "Positive Feelings"

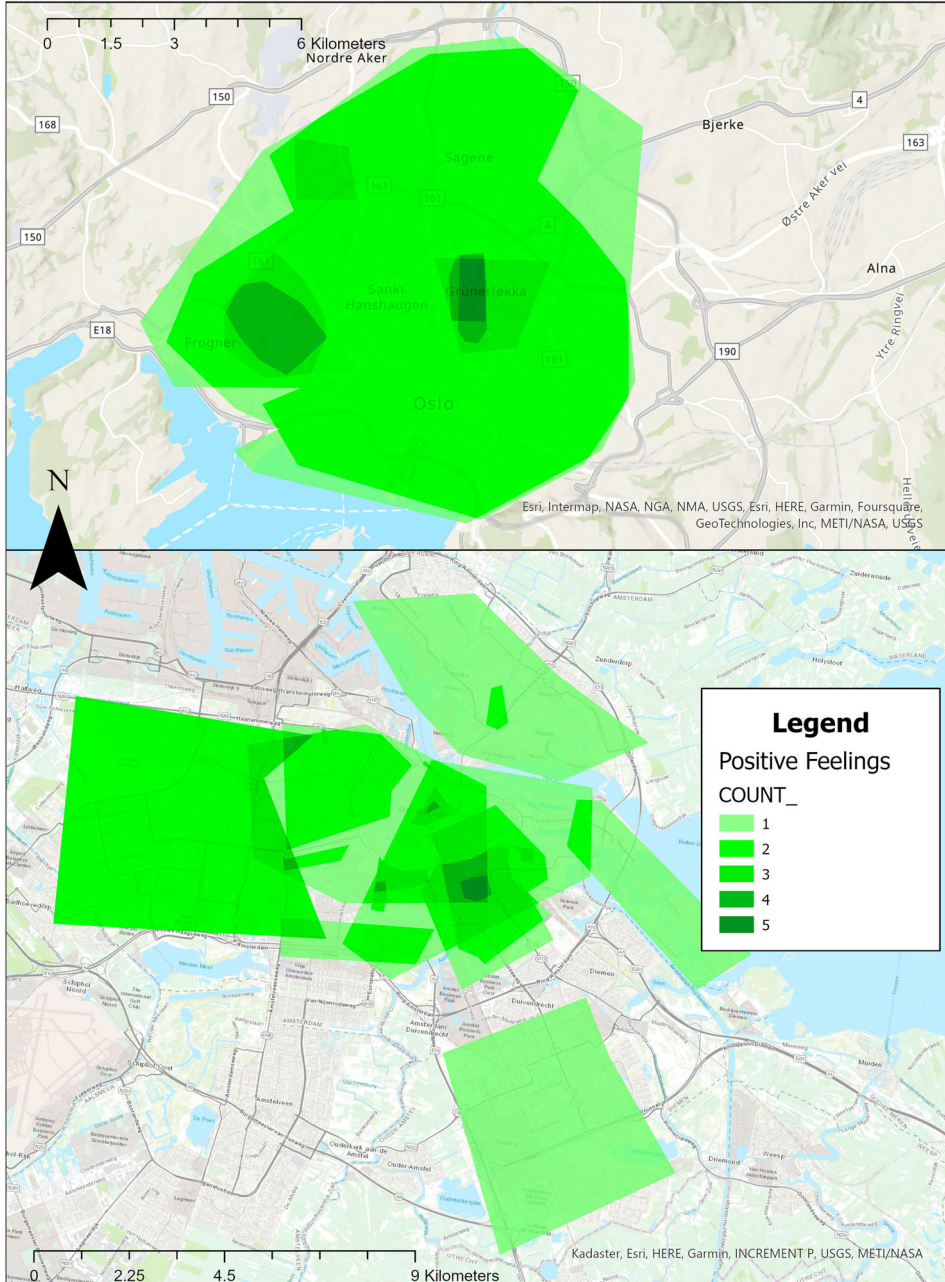


Figure 4. Areas plotted as associated with "positive feelings"

comments, participants cite environmental issues with particular streets and intersections ("Cobbles," "lots of tram lines," plus areas of considerable conflict with car traffic: "have to watch out for cars at every corner," but do not feel negatively about the area as a whole enough to dismiss it entirely as an undesirable place to work. Comments attached to points in the suburbs also shed light on the issues delivering to outer

neighborhoods: “very steep, like a wall. very little money for effort,” “why do you send us up here when there is almost a 100 percent chance of getting sent back to city centre and then out again?” “always redispach for car, because bike is too far.” Environmental concerns surrounding infrastructure and street design were far more common in Oslo than Amsterdam. The necessity of riding among tram tracks to reach certain destinations was a consistent point of concern in Oslo’s center, whereas Amsterdam’s street network disallows bicycle travel on links where it would mix with tram traffic (Zacharias, 1999). Though this does not necessarily mean couriers avoided these streets, tram tracks were not reported as an issue. Rather, it is likely that alternative routes are sufficient enough to make taking the risk unnecessary.

Overall, platform couriers in both cities typically prefer working in inner suburban neighborhoods where there is a high density of businesses and residences—such as Grünerløkka and Majorstuen in Oslo, and Oost (East) in Amsterdam—areas where there is a higher perceived likelihood that deliveries will be short and frequent, increasing earning potential and lowering energy expenditure. In Amsterdam, the benefits of working centrally are weighed against the discussed drawbacks far more than in Oslo, as displayed in Figure 3 (“mixed feelings”). Here, comments left allude to busyness: “nice roads, more cars to deal with,” within the canal ring, versus concerns about travel time weighed against lower stress levels in suburbs within the A10 ring-road: “Kinda far away with not a lot of work,” or simply “slightly less bad than the center” [wat minder erg dan centrum]. Couriers are largely pragmatic about their views on urban space, choosing areas and paths based on profitability and navigable quality, in contrast to non-commercial cyclists who are more likely to deviate from shortest-path routes based on perceived safety and associated environmental factors such as street lighting (Chen et al., 2018).

The extended geography of bicycle delivery within cities comes into conflict with couriers’ hesitancy to work in more suburban areas. In both cases, these less dense neighborhoods were correlated with a perceived lower profitability, along with the additional physical challenge experienced outside the outer ring road in Oslo. In addition, the difficulty and danger of working on a bike only increases during the winter. This is consistent with case study research into electric cargo bike distribution in Norwegian cities, where the most valuable use is found in: (1) dense areas where there are short and frequent stops; (2) where traffic delays for motor vehicles are high; and (3) where motor vehicle routes are less direct (Ørving et al., 2020). Winter conditions increase difficulty and risk to couriers and present challenges to battery capacity, particularly in combination with repeated hill-climbing.

In Amsterdam, the spatial preferences of bicycle couriers relate less to the physical environment. Issues center on challenges inherent in navigating busy bicycle infrastructure, where conflict between users travelling at different speeds is most acute, a subject of local planning policy for some years (Gemeente Amsterdam, 2021). Traveling through the most central, pedestrianized areas prompts a choice between dismounting or risking a fine and further conflict by continuing to cycle. These risks alongside the stress and delays associated with high footfall make the center of Amsterdam an undesirable area for the surveyed bicycle couriers to work in but considered in a personal weighting against the profitability of the neighborhood for couriers subject to piecemeal payment structures.

Bicycle Couriers' Reported Emotional Responses (Points and Lines)

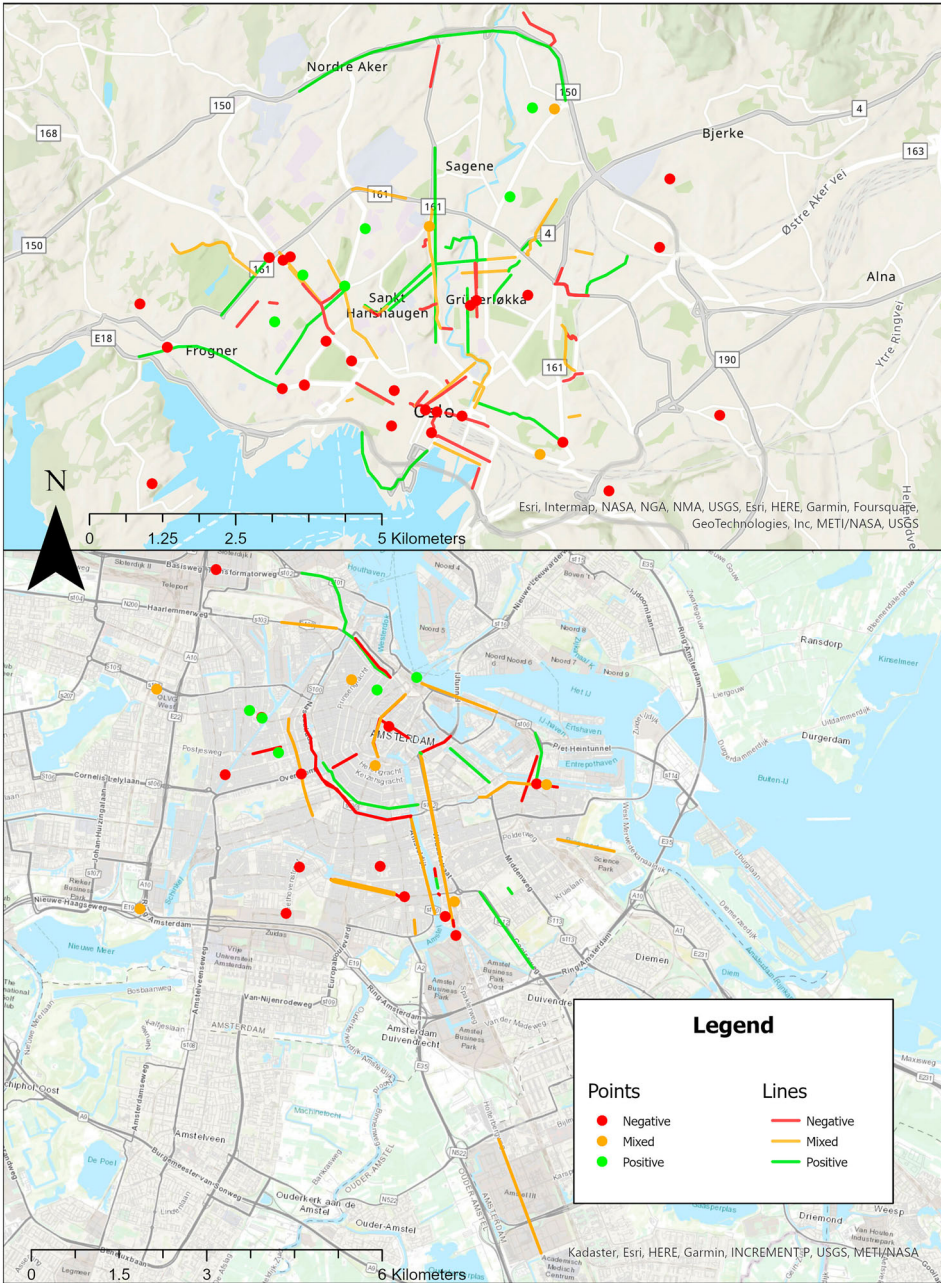


Figure 5. Emotional responses plotted as points and lines

The Changing Mobile Behavior of Bicycle Couriers

This section outlines the findings from interviews with couriers in Amsterdam and Oslo. The results are evaluated in relation to the mobile-spatial skills discussed earlier as inherent to messenger mobility. While a reliance on platform abstractions is observed,

it is not a linear progression. Rather, adherence to the automated routing and workflow highlights the deficiencies in this system, making visible the “breaks” in the relations between abstract and lived space (Lefebvre, 1991). As a result, new, hybrid digital-spatial skills emerge in the utilization of technology at strategic points in the process. In addition, the use of algorithmic control methods prompts the creation of tactics which exploit the weaknesses in surveillance, referred to here as digital appropriation.

Commercial cycling of all kinds, by virtue of taking place in the streetscape, is a matter of constant (re)evaluating a set of constantly developing puzzles. Knowledge of the city’s streets and topography is perceived to be correlated to experience in the job. For many interviewees, the knowledge they had was perceived to be implicit, resulting in seemingly automatic bodily responses to opportunities and dangers. Conversely, all riders expressed that being in the mobile environment involves constant attention to balancing the body, the load, the equipment and the external environment.

While spatial appropriation does not prove necessary in the completion of many platform delivery tasks themselves, it is described as being essential to doing it *well*, in a complete performance (Watkins, 2005). For many, breaking traffic rules aid in finding shortcuts and increasing efficiency, while for others, the reflexivity of finding informal ways to complete tasks adds elements of play in an otherwise mundane job, otherwise prone to deskilling (Newlands, 2022; Schaupp, 2022). In response to platform control, the emergence of digital appropriation within work itself is also visible, a reaction against designed control, automation and supervision. While control is elicited through platforms’ algorithms, GPS tracking and by integrating navigation software, riders make choices of how much they have their mobile behavior administered by technology. In some cases, they appropriate the platforms themselves and their associated (navigation) apps, learning the process through experience to find exploitable gaps, or basing behavior on speculations of how the algorithm and platform functions internally.

Platforms and Macro-Routing

Utilization of navigation apps—principally *Google Maps*—to navigate while on shift was present in both cities, but differences were apparent in the patterns of use across the cases. In Oslo, couriers, particularly those with several years of experience, place value on their ability to navigate using their own knowledge of the city. Several couriers stated that they only look at the map for fine-grained detail when in the direct vicinity of the address, relying on their knowledge to travel between neighborhoods more generally. These couriers tend to value their cognitive spatial knowledge as more reliable as it is gained through consistent and repetitive travel, adapting to alterations in access quicker than navigation apps. In the case of Foodora, a small map of the immediate area around the address is contained within the app, negating the need for redirecting to additional platforms:

If it’s inside Ring 2, then I pretty much know all the names of the roads, but I don’t know the numbers so I typically look at the little map like when I get closer. (Foodora and independent cargo bike rider “Oe,” Oslo).

Alternatively, some used real-time navigation aids more passively, trusting their own instincts to a degree, but preferring to have it running in the background as a reassurance in case their cognitive map failed:

Well, it's ... it's taken me a year now to get a mental map of Oslo. So now most of the time I know where I'm going, but I still like to have the, the verbal directions coming through my headphones so that you know if I do get a bit lost in thought sometimes then like, oh turn right, OK, I'll turn right, so yeah I do. I initially relied on it a lot, now it's kind of background as a safety kind of thing, just in case I do get a bit side-tracked. (Foodora rider "Od," Oslo)

Couriers who had been employed by Foodora for several years often expressed frustration in how the app used to organize tasks functions within the delivery process. This centered on the app's interpretation of what the delivery process looks on the ground: conflict between digital and physical space. The Roadrunner app is used by Foodora riders across multiple countries where the company operates, a choice which lowers overhead operational costs, but, according to couriers, results in an app that "doesn't know what it looks like in reality," i.e., it does not account for local conditions. In a city where weather and topography are variable, ETAs communicated to customers can differ greatly from what is possible in physical space.

Several couriers in Oslo reported using walking directions, rather than the bicycle-specific option in their navigation app. This is a tactic which exploits the cyclist's ability to jump between or beyond visualized mobile networks, while remaining within standards of acceptable behavior, as cycling is permitted on pedestrian infrastructure in Norway (Trafikkregler, 1986: § 17). It allows for the cyclist to vary their micro-routing, occupying different spaces on a pedestrian-car spectrum depending on convenience.

One challenging puzzle which urban cyclists contend with are alterations to the street networks caused by redevelopment, experienced negatively where links were not added or removed from digital networks used to compute routes. Couriers were forced to refer to their own cognitive maps for routing in these instances. A necessarily reflexive attitude to changes in access was similar in Amsterdam, though couriers were more open to taking a longer route around obstructions rather than attempting to find an informal way through, as there was less concern around time and energy expenditure.

In Amsterdam, reported adherence to mapping apps was more prevalent, but this was primarily among flash delivery riders, where the delivery process, including integration of *Google Maps*, is highly streamlined within the platform:

You see the customer's name you see their number and you see their address and then when you click on navigation it takes you to *Google Maps*, which takes you to the bike thing and then that does it ... but like, I'm quite happy to cycle over like pedestrian crossings or something, especially if like there's no one there. (Flink rider "Ad," Amsterdam)

In following the intended design of the process, these couriers move in ways predictable by the algorithm, reducing the likelihood that their behavior will be called into question by the platform or human supervisor, a likelihood most acute in this form of bicycle delivery work. However, even then, all riders in Amsterdam remained reflexive to failures in the apps' ability to route cycling and were able to pinpoint particular places or links where they would deviate to an alternate route. Experienced couriers who had moved through multiple delivery jobs were more open to trusting instinctive or cognitive knowledge of the street network, even to the degree of avoiding navigational aids as a point of challenge to break from the mundanity of the work.

Cargo bike couriers most of all expressed orientation as a necessary skill for their work, as much of the reflexivity associated with cycling is lost from the size and

encumbrance of the load and equipment. Cycloon employees laid much weight on anticipating the steps in the process of a route, making use of a feature within the platform that redirects to sets of 10 stops routed within *Google Maps*. With multiple stops visualized, alterations in the order can more easily be made on the fly. In this case, splitting and ordering of routes was done algorithmically, after which a planner would check each manually for mistakes, though this was not without fault:

You have some streets where the planner sends you against the traffic and then you're stuck. I actually had to uncouple my Carla [a brand of large bicycle trailer] once because we were stuck. Right, the guy in front was angry, we were yelling at each other. Which happens a lot. (Cycloon rider "Ac," Amsterdam).

In this, the break between the representation of space and the lived reality of the mobile environment take place even where there is human intervention attempting to account for its known incongruity. The courier describes an experienced consequence where they were unable to account for the discrepancy using anticipatory practices, leading to conflict with others inhabiting the same space.

Spatial Appropriation

This next section considers the role of spatial appropriation as a response to the challenges of the work in further depth. As mentioned, bicycles have the exploitable benefit of existing in a legal and moral gray area when occupying street space, depending on context. The diversity of bicycles used for delivery across the two cases adds a variable element to this conception. For example, while couriers riding regular bicycles exploit the size and nimbleness of their total unit to occupy small spaces—on pavements, between cars, between pedestrians or even other cyclists—cargo bike couriers are prompted to find alternative means of positioning in response to the challenges of managing a larger total unit. All types of couriers were found to share a similar desire in maintaining momentum and flow (Kidder, 2011), often achieved by means of appropriation. While e-assist may aid in abating some of the physical challenges of the work, e-bike couriers in Oslo also described the necessary development of spatial tactics surrounding energy use, as they found that the combination of cold weather and steep inclines would run down their battery quickly. Tactical behavior in this case included storage of a spare battery at a convenient location or means of limiting journeys that use larger amounts of energy, similar to their colleagues on manual bikes. Cargo bike couriers in Amsterdam expressed similar concerns about energy use during long routes, but rather chose to carry a spare battery in the storage compartment or ration the e-assist to key stages of the route.

Couriers in both cities shared consistent views about their adherence to traffic laws, viewed as subject to personal interpretation. In Oslo, this was mainly attributed to safety, where being a passive actor around cars carries risks, but tactics of being visible break the law:

I don't always follow laws because I feel it's safer to do it that way, like to be ahead of the traffic or to be visible ... I've heard of things like the Idaho stop and like, if there's no traffic and like if you, if you, as long as you're like, you're considerate, you shouldn't have to wait for like every single light or every single thing (Foodora and independent cargo bike rider "Oe," Oslo)

Others viewed street space as more open as a means of doing the job more effectively, choosing equipment which enabled reflexivity to move between different domains:

I use a gravel bike, which is really good for, for working as a courier I think because I can jump around up and down sidewalks (Foodora rider “Oc,” Oslo)

In Amsterdam, speed and efficiency was the most common justification for rule breaking among couriers, though cargo bike couriers rationalized the choice as a necessity resulting from the different spatial relationship held, compared to an environment built for “standard” bicycles. One cargo bike courier recalled an instance of being fined by a police officer for running a red light:

I asked him if he lived in Amsterdam. He didn’t and I talked about how you know, we bend the rules a little bit here, because otherwise it’s, it’s not, it doesn’t work. So I told him I’m a bike messenger, I know what I’m doing right? Also, I had the trailer behind me, so that’s a lot of weight, so if I stop and I have to get the whole thing going again, right? (Cycloon rider “Aa,” Amsterdam).

Here, the challenges of maneuvering heavy loads in heavy bicycle traffic is seen as justification for bending the rules and relying on a personal set of standards, something which non-couriers sharing the space interpret as lawless or reckless. In both cases, the importance of maintaining momentum and flow prompts the courier to look for ways to keep moving (Lachapelle et al., 2021). Momentum is an important resource for cyclists, as continuous stopping and starting takes effort, especially when challenges of topography, time and cargo are introduced.

Digital Appropriation

Intensities of algorithmic supervision were not consistent across platforms. In the case of Amsterdam cargo cyclists interviewed, riders are given a window of time to complete their route, and an order of delivery is predetermined by the planner. However, this is not concrete as in the on-demand cases, where stacked orders have their sequence of delivery ensured by the design of the app, not revealing subsequent addresses until the previous is marked as delivered. However, there remains a lack of direct supervision until a discrepancy is determined by the algorithm, after which human contact is established.

Algorithmic measurement and supervision create exploitable gaps in the digital infrastructure. While digital appropriation has previously been discussed in relation to collective action (see: Popan, 2021; Briziarelli, 2019), the concept is used here to emphasize how platforms are exploited by workers in completion of the tasks themselves.

As discussed in the previous section, some deliveries are more desirable than others, but freedom of choice when accepting tasks varies greatly by company. In Oslo, meal delivery workers have options when a delivery is considered more suitable to driving couriers beyond Ring 3:

More than three and a half kilometer with like, just climbing I go “fuck it” ... if I get like deliveries to Gaustad or Kjelsås I might ask to have it redispached, but usually it’s fine. (Foodora rider “Oa,” Oslo)

The relative lack of subjective supervision opens gaps in the platform abstraction-lived experience relationship in a similar dynamic to that discussed involving third-party

navigation apps. Breaks could be tactically requested when offered undesirable deliveries to avoid the penalty of a low acceptance rate and scolding message within the app. Riders even used in-app breaks briefly ended their Internet connection with the app to cycle back to preferable, central areas if they were being assigned orders that took them increasingly further out. There was no reported use of external apps to manipulate GPS signals, as found by Heiland (2021), instead the infrastructure created by delivery companies themselves was subject to appropriation.

Repeated experience led to speculation on how certain functionalities in-app are calculated, whereby empirically derived assumptions influenced choices about behavior. For example, one Foodora courier posited that being faster would lead to them being assigned longer deliveries. Certain speculations would be debated among couriers in online message spaces, citing personal experience that could corroborate or negate suggestions about internal algorithmic design.

The same is similar for freelance meal delivery workers in Amsterdam, who expressed that they would turn down orders based on distance and the fee offered. For meal and flash delivery couriers in Amsterdam, no means of avoiding undesirable orders was reported, though these riders, by virtue of working out of a central hub, are also subject to human supervision during the process of assigning tasks. Human supervision then, works to close gaps created in the “algorithmic panopticon” (Woodcock, 2020).

Representing Space

In summary, platforms and their corresponding digital representations of space have variable implications for how space is interpreted and moved through as part of the bicycle courier’s job. For less experienced couriers, navigation aids make entry into the job possible, as “the knowledge” is no longer a prerequisite for completing tasks as required. However, purpose-built and third-party apps create challenges through their representations of space which prompt couriers to find alternative solutions, often by means of appropriation. Deficiencies in navigation apps’ cycling directions even *necessitate* the use of personal navigation skills in certain cases, such as travelling by cargo bike. Beyond pragmatism, more experienced couriers view such spatial skills as essential to enjoying the work or deriving a sense of professional pride from their ability to develop navigational skills progressively. Incorporating elements of active mobile decision making not only provides challenges as a source of professional pride, but also takes away from the inherent mundanity of the tasks.

The Changing Embodiment of Courier Mobility

Cycling itself is a deeply embodied experience (Larsen, 2014). Moving by bike is a calculated balance between the body, mind, and the physical materiality inherent to both the external environment and the equipment that travels alongside the cyclist. The rider’s equipment and cargo alters the way they interact with the surrounding environment, while the environment itself becomes etched on the body, applying varying pressures that are then later anticipated through repeated experience of moving through a space. This section builds on the previous through attention to the smallest scale at which movement is enacted, in order to better understand “micro-routing” choices (Kidder,

2011). As stated earlier, these aspects of courier movement are best identified using auto-ethnographical method, as the often implicit nature of mobile decision-making can be challenging to identify and discuss retrospectively in an interview. This section, then, also builds on the understanding of spatial appropriation described in interviews, but from the perspective of “from the bike saddle.”

The design of the platforms and the metrics they record about performance affected how decisions were made about movement and the work itself. While working as a flash delivery rider, micro-management of movement led to interrogations on routing choices during runs subject to slim 10-minute delivery windows. Ironically, this caused further delays, having to stop and answer questions when deviating from the expected route or timeframe. Here, the addition of a supervisor role while retaining platform-based performance metrics shifted responsibilities for staying within guidelines from the rider to the hub leader.

Foodora, as an example of a classic meal delivery platform, offered certain freedoms in designing a larger, city-wide delivery zone, but consequently made shifts unpredictable. Based on advice from other riders, a preferred starting (“log in”) location was chosen through trial and error in an effort to receive manageable, more central deliveries. After some experimentation, Bislett plass, a square in Oslo, was chosen as a “gateway” to the western, inner suburbs around Frogner and Majorstuen: areas with a high density of restaurants and more consistent gradients. Riding a non-electric bike, it was acutely necessary to build a cognitive map based on the physical effect of routing decisions, knowing which gradients would be most exhausting, or even those where it would be necessary to dismount and walk, as this had a significant effect on speed.

Predictability and anticipation, emphasized in interviews as essential skills for this work, feature heavily on the subject of embodiment and materiality. In Oslo, working in winter involved relearning the embodied practice of cycling based on reactions to snow and ice:

The easiest snows are the absolute freshest, with a consistent texture that doesn't risk throwing your wheels off course and is more akin to cycling through shallow water. Ploughed, compacted snow with gravel added is best to ride on, but takes time to appear in most corners of the city, typically several days after the snowfall. Brown, slushy snow that characterizes a main road is relatively easy, as your wheel makes contact with the asphalt, but sprays freezing, dirty water back up on you. The worst is the thick, icy snow which knocks your wheels off balance. (Fieldnotes, Oslo, 08.01.2022).

Considerations of micro- and macro-routing changed based on weather conditions. Following days of consistent melting and refreezing, it became safer to travel on roads more frequented by cars, as their tires create navigable paths through consistent compaction and turnover. Bike lanes often proved unusable until ploughing, forcing a micro-routing decision to use the road. In November, it was essential to switch to studded tires, provoking a sensory response which changed as snow set in. Beforehand, the sound of metal studs hitting asphalt was a constant reminder of the increased rolling resistance making it more difficult to move, but this sound changed meaning later, as a reassurance that the studs were making contact with solid ground.

In Amsterdam, there are fewer physical-environmental considerations that force the rider to make tactical adaptations in their movement. Unlike Oslo, the main

challenge of moving through Amsterdam as a working cyclist lies in managing interaction with others occupying the same space. Here, the goal remains in anticipation of conflict, and subsequent mitigation. With a larger cargo bicycle and the addition of a trailer, as is often used for package collection and delivery, there is an added affective requirement, as much of the length and space taken up by the bike is behind and not in visible range.

In this type of work, making space to be stationary becomes as much a challenge as making space in movement. Making frequent stops on a cargo bike requires finding spaces to park the bike while allowing traffic to still flow freely. In the small, dense streets of inner-Amsterdam this is a challenge which requires weighing various risks:

I stopped to make a delivery, as far to the side as I could be so that cars could still pass by, and a driver became very irate before realizing he could still pass with a bit of extra care. There was no space to park on the pavement, but if I parked further from each address, I would never complete every stop in the time allotted. How can I win? (Fieldnotes, Amsterdam, 10.02.2022)

Making space to be stationary, then, became as essential to avoiding conflict and maintaining a low profile within the flow of traffic as the decisions made while moving. Appropriation of common street features became essential to this, finding space not designed for parking but serving the purpose: gaps made in diagonal car parking space or utilizing the space at the top of a T-junction based on a prediction of how traffic will flow. Again, the gray area held by bicycles in mobile space aids in efficiency by allowing for the occupation of gray spaces—those without distinct assumed uses that can be occupied with little interference in the travel patterns of others.

Choices about how to occupy physical space are a key component of contemporary courier work which have not seen noticeable influence from digital infrastructures. This can be attributed to the difference in scale which platforms guide movement from. The spatial fix central to platform control operates on the “macro” level, from which value can be derived via GPS localization of riders (Kidder, 2011; Heiland, 2021). However, much of the skillset which allows courier work to function in dense, complex urban areas comes at this “micro” scale.

Discussion

The findings show significant differences in the spatial relationships exhibited by platform bicycle couriers compared with their pre-platform predecessors. Firstly, while courier work was previously a means of transporting goods most suited to dense, urban centers where the benefits of bicycles in bypassing traffic are most acute, the geographic data provided by couriers in Amsterdam and in Oslo display a more diverse geography to delivery work by bike (Kidder, 2009, 2011). For couriers delivering business-to-consumer (B2C) particularly food goods, the most favorable areas for work are the inner-suburbs, where the density of relevant businesses and consumers are highest, offering shorter and faster trips. City centers, while offering these characteristics, lose favor largely due to the characteristics that made them ideal for messaging. However, the data also suggests a strong role of contextual factors in both physical characteristics and rolling stresses associated with certain spaces at variable times.

Mobilizing a Lefebvrian framework helps to make sense of this difference, which provides both difficulties in the unrealistic expectations placed upon the courier and opportunities for moving beyond platform-designed travel patterns. A similar dynamic is present in Watkins' (2005) Lefebvrian analysis of planning a play, whereby the abstract space provided in a script exists as an incomplete force which gives structure to the performance, being available to fall back on during periods of uncertainty, just as navigation tools fill gaps in cognitive maps or provide support when mental mapping consumes too much energy. However, it is ultimately incomplete, failing to capture the fullness of performing the play or mobility in space. Diverting brings meaning and skill to mobility through creative appropriation, necessary for managing a presence in chaotic urban space (Fincham, 2007).

Developing the means of managing this inherent chaos remains characteristic to performing delivery work effectively prior to the introduction of platform technologies in both navigation and the organization of tasks (Kenney and Zysman, 2016). While the pure necessity for certain skills is negated with the availability of supporting tools, developments in technology and the expanded geography of the work bring about the generation of new skills. For example, a spatial tactic aimed at energy conservation also finds place in electric bicycle use, where remaining weaknesses in the technology necessitate tactical battery planning. Where delivery ETAs are calculated in-platform with reference to the existing street network, it may seem that spatial appropriation is less necessary to performing tasks than in messenger work. However, new pressures brought about by platforms necessitate creative solutions to mobile problems. Transnational platforms fail to account for local conditions in their ETA and routing algorithms, projecting a homogenized digital representation of mobility on a diverse series of contexts. In addition, the complications from using larger cargo bicycles necessitates the development of additional spatial skillsets both in movement and when stopped. Planning and policy would do well to integrate the particularities of moving via cargo bike in planning for sustainable logistics, as cargo bikes see a significant renewed interest in sustainable city systems, particularly with the increased range and carrying capacities enabled by e-assist technology (Harms et al., 2014).

This work also further develops the more recent contribution on bicycle couriers' reactions to algorithmic control of their labor, previously discussed by Popan (2021) and Briziarelli (2019), by providing insight into how digital appropriation manifests as part of the delivery process itself. The rationale of efficiency articulated through platform management of mobile labor gives way to the weaknesses of a hands-off, homogenized representation of urban space, creating room for informal exploitation when supervision is exclusively through performance metrics (Timko and van Melik, 2021). Platform couriers regularly exhibit agency over their work, resisting algorithmic control through various tactics.

Finally, there are some flaws that can be alleviated in further research. As mentioned, further use of PGIS methodologies on this topic would do well to incorporate more data for statistical analysis, which could be achieved through moving away from more abstract questions of emotional responses and instead towards specific questions that prompt participants to draw from direct experiences. Further research could also weigh the role of working as an employee versus as a contractor on appropriative behavior. This work involved primarily couriers employed by European bicycle delivery companies affected

by the wave of legal recognition that many food delivery workers do not meet the requirements to be recognized as self-employed. Recent restructuring by companies such as Deliveroo and Foodora in the face of unsustainable losses call into question the long-term viability of on-demand delivery (Fredriksen and Kvitstein, 2018; Bradshaw, 2022).

Conclusion

This article connected an emerging literature on spatial, algorithmic control and bicycle courier work with emphasis on performance of the labor itself as mobility in urban space. It builds upon analyses of “digital Taylorist” control through platform organization as that which provokes tactical appropriation (Altenried, 2019), extending the concept as inherent to bicycle delivery work more generally. Authors such as Briziarelli (2019) have hinted towards this idea when looking further into organized resistance techniques, while this article provides empirical data which analyses everyday examples of resistance and agency through the movement which constitutes the work itself.

The article provokes some questions about the role of spatial representations in determining and predicting routing based upon limited cost variables and a relatively static navigable topology. The use of crowdsourced, real-time data adds further temporal accuracy of metrics like congestion in the case of car travel but is not well established in walking and bicycling routing. The recently developed Garmin Trendline tool plots waypoint-based courses whereby navigable paths are created based on repeated use in GPS-recordings uploaded to Garmin’s own platform, going beyond a pre-existing network generated by official producers of representations, or “a certain type of artist with a scientific bent,” as described by Lefebvre (1991: 38). Unlike generalized route planning tools, experience of travel itself is considered over algorithms hoping to minimize costs in distance, turns, and time. Though developed with off-road sport in mind, a similar tool could account for the freedoms active travelers have in appropriating (non-)mobile space even in urban areas, as described in this article. Combination with crowdsourced information on the favorability of routes or single links, as raised here through PGIS among bicycle couriers, can account for the suitability of routes when considering the diversity of contemporary bicycles and their spatial requirements, not least in considering cargo bike routing (Liu et al., 2020).

Finally, it can be questioned in context as to whether such an “improvement” would be desirable. On the citizen-user side, more accurate and realistic routing of the possibilities for mobility at any present time are clear, removing much uncertainty and risk from bicycle travel. However, from the perspective of the delivery company the current status quo offers some benefits as described as algorithmic control and the pressures exhibited on workers through metrics often unattainable without risk or illegality (Lachapelle et al., 2021). From the worker’s side, the gaps described offer this potential for creativity and agency, which may be lost in further deskilling enabled through closer tracking.

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