TIME IS OF THE ESSENCE: SPATIOTEMPORALITIES OF FOOD DELIVERY PLATFORM WORK IN CHINA

Research paper

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Abstract

Spatiotemporality has never been so prominent in the gig economy, where the mantra is to harness individual persons' "spare time" across large geographical areas to create economic value with scale. The time-sensitive nature of food delivery service and the spatial distribution of a large number of delivery workers require intensive algorithmic coordination and control. In this paper, we report findings from a qualitative study conducted in Beijing with food-delivery platform workers and managers. By taking a critical, sociomaterial perspective, the study shows how the workers are tethered to and simultaneously co-construct multiple spatiotemporalities in their daily work to meet the demand of speed defined by platform algorithms. We further argue that the algorithms are not creating so-called "atomized" workers in the gig economy, but interconnected and co-dependent collective agencies in space and time.

Keywords: Platform Work, Algorithmic Control, Gig Economy, Spatiotemporality, Sociomateriality

1 Introduction

There is a growing body of literature across academic disciplines on "gig work", "gig economy", and "platform economy". An efficient management of the gig workforce requires a powerful digital platform that constantly monitors the distribution and undertaking of tasks in space and time by a large number of on-demand workers. We refer to this type of on-demand labour provided through digital platforms in exchange for payment as platform work. Empirical case studies of platform work reveal intricate nuances of platform-worker interaction, algorithmic workforce management, as well as workers' coping mechanisms and resistance strategies (Chen, 2018; Malin and Chandler, 2017; Petriglieri et al., 2018; Shapiro, 2018). While management researchers tend to focus on business models and operational practices of Western digital platforms such as Uber and Deliveroo (e.g. Burtch et al., 2018)), critical scholars have been interrogating precarious work arrangements in platform work that have led to worrying labour rights issues across the globe (Aloisi, 2015; Graham et al., 2017; Moisander et al., 2018).

In the Information Systems (IS) field, a handful of publications in recent years examined platform work from a variety of perspectives. Gol et al. (2019) conducted a literature review of "crowdwork" publications in IS and adjoining disciplines to understand crowdwork platform governance. They argue that platform owners and job providers on the platforms need to strategically think about the effectiveness of two governance mechanisms – control and coordination – to support different value propositions. Whilst discussing similar concepts of organizational governance and value configuration, a position paper by Marton and Ekbia (2019) advocates a political economy approach in understanding value extraction and labour-machine relationship in gig economy. Empirical studies of platform work by IS scholars have focused on digital labour platforms such as Amazon Mechanical Turk (MTurk).

For example, Deng et al. (2016) explore how MTurk workers experience a duality of empowerment and marginalisation, and call for ethical platform design for greater worker empowerment.

Regardless of academic discipline and theoretical perspective taken by platform researchers, central to the discussions of platform work is the algorithm-driven labour management. Indeed, the economy of scale in platform economy depends on a large on-demand workforce that is geographically distributed yet remotely controllable with minimal cost. Much has been written lately about algorithmic control of platform workers. For example, both academics and journalists have reported how Uber's algorithmic dispatch system nudges and sometimes forces drivers to accept trips they might otherwise reject, through a combination of financial rewards and psychological tricks (Calo and Rosenblat, 2017; Scheiber, 2017). Shapiro (2018) found similar algorithm-based incentives and asymmetrical provision of information on worker-facing apps designed by courier platforms, which extend "soft" surveillance and control over their on-demand workers. In a multi-country study of online platform workers in Southeast Asia and Sub-Saharan Africa, Wood et al. (2019) concluded that algorithmic management in the form of rating and ranking systems is highly effective in disciplining workforce behavior and controlling work quality.

What is less explored in the extant literature, however, is the *spatiotemporality* of platform work in the *enactment* of algorithmic management. By spatiotemporality, we refer to both spatial and temporal aspects of human action as it occurs in practice. This compound word also implies that space and time are not experienced separately by human actors (Lee and Sawyer, 2010). Spatiotemporality is a surprising omission in the literature for two reasons. First, spatiotemporality is central to analysing platform work because the mantra of the platform-based gig economy is to harness people's "spare time" across large geographical space to create economic value with scale. Second, IS and social science researchers have long recognised the emergent, temporal nature of sociotechnical phenomena (Boland et al., 2004; Venters et al, 2014). Yet, the notion of "algorithmic control" seems to convey a one-directional power dominance, leaving little room for accounting for "ongoing reconfigurings of the world" (Barad, 2003, p. 818) in space and time.

Hence, through a case study of food-delivery platform work in China, this paper intends to move beyond the ontological independence of "algorithm as codes" and "algorithm as sociotechnical reality" by focusing on the spatiotemporality of day-to-day performance of the platform work. The time-sensitive nature of food delivery service and the spatial distribution of a large number of workers require intensive algorithmic coordination. Enactment of such algorithmic management involves humans, objects, organisations, and a myriad of other sociomaterial elements. Drawing upon a multidisciplinary set of literatures on spatiotemporality, we aim to answer the research question: *How is spatiotemporality actively performed and (re)configured in the platform work?*

2 Spatiotemporality in Platform Work

Spatiotemporality of on-demand platform work has been documented in a handful of academic studies. For example, in Sharma's (2008) study of Toronto taxi drivers, she observed how the drivers had to synchronise their work to multiple spatiotemporalities beyond their control. A more recent study by Chan and Humphreys (2018) shows that, despite some flexibility and the socialized practice in navigating space, Uber drivers' spatial movement is largely managed by the platform through the app. Similarly, Wood et al. (2018) report that online platform workers in Asia and Africa had to synchronise their time to that of clients all over the world, which led to irregular and unpredictable work schedules. In these cases, spatiotemporal flexibility of workers – often hailed as the hallmark of gig economy – is actually tethered to the spatiotemporal demands imposed by the platform company, the customers, and the sociotechnical processes in performing the work.

The interconnectedness of multiple spatiotemporalities in these cases illustrates a central tenet in contemporary theories of space and time: both spatiality and temporality are relational, performed, and

pluralistic (Georgiou, 2010; Massey, 1999, 2005). The concept of space has evolved from the notion of a container for human activities, mappable and with clear boundaries, to that of assemblage of material elements and human interactions situated in and produced through everyday practices (Lefebvre, 1991; Dale 2005). Similarly, the concept of time has moved from being linear, chunkable, clockwork to being fluid, multiple, and non-linear. Furthermore, space and time are co-constitutive and do not exist independently of each other. As Massey (2005) argues, place is an event, i.e. a configuration of temporal-spatiality, a "throw-togetherness" of the "here and now" (ibid., p. 139).

As spatiality and temporality are socially produced and performed in practice, they are entangled with power relations that structure human activities, knowledge, and distribution of resources. Orlikowski and Yates (2002), for example, state that people produce and being guided by the very temporal structures they produce in their engagement in the world. These temporal structures, manifested as calendars, schedules, deadlines etc., give rhythm and form to work and life; by following these rhythms, human activities reinforce and legitimize the temporal structures, which can then become taken for granted. Likewise, Sharma (2011, 2014) sees temporality as a "structuring relation of power"; she argues that as individuals, groups, and social institutions each produce and reproduce their own temporalities, these multiple, entangled temporalities lead to synchronization, mismatch, recalibration, and ultimately differentiated and inequitable temporal worth. Therefore, the time-space compression and acceleration of speed as a result of digitisation (Wajcman and Dodd, 2017) is differentially experienced among different group of population, and manifested through intersectional lines of class, gender, age and other social divisions.

We believe that a sociomaterial perspective is useful for addressing the multiplicity, co-production, and power relations of spatiotemporality in platform work. By sociomaterial, we mean that the material elements in platform work (e.g., information systems, algorithms, physical space) and the social elements (e.g., workers' actions) are inseparable. As proprietary algorithms are opaque to users and researchers, a sociomaterial perspective is particularly suitable for a "real-time understanding of practice" (Pickering, 1995, p. 2) in which human and algorithmic agencies temporally intertwine. In the practice, the social and the material become "constitutively entangled" (Orlikowski 2007) in the sense that: a) the capacities for action only materialize when the material (technology) and the social (human) interlock in performing the action, and b) the patterns of practice are both medium and outcome of the sociomaterial entanglement.

For example, each Uber ride is an emergent sociomaterial phenomenon: the customer, the driver, the platform, and a myriad of other factors (time, location, weather, traffic, past ride histories and reputations of both parties etc.) intertwine in the very moment of ride hailing to determine the practice on the fly; then, the actual ride performed in space and time will contribute to the structural conditions for future practice. Worth noting here is that the "practice" is not individual behavior but interconnected activities of individuals in doing their day-to-day work (Cook and Brown 1999).

In summary, by considering the spatiotemporality of platform work with a sociomaterial lens, we can see that platform algorithms are not mechanistic control and automation of workers' movement but part of the sociomaterial reality that are enacted in the everyday negotiation of multiple spatiotemporalities. The work and the technology components of "a composite assemblage" that are constantly becoming and influx. This means that we need to look beyond the top-down "algorithmic control" imposed by digital platforms and consider the temporal and spatial orders of platform work. In the empirical case reported below, we tease out the sociomateriality of platform work in multiple layers of space and time by describing the lived experience of food-delivery gig workers (known as "riders") in China.

3 Research Methodology

This is an interpretivist case study (Walsham, 1993) focusing on food delivery workers on one of the largest O2O (online-to-offline) service platforms in China – Meituan Dianping (美团点评) – that mobilizes around 2.7 million food-delivery riders, delivering as many as 160 million food orders on a single day (Lee, 2019). Using the platform app, customers can search restaurants, browse food menus, order dishes, and have the food delivered to their location. According to a report by the company in 2018, 90% of the riders were men; 82% aged between 23-38 years old; 75% of the riders came from rural areas and 68% were migrant workers. More than 60% were married and most of them carried the financial responsibility to support their family.

There are two main types of employment contracts in the food-delivery business: Platform Exclusive (专送) and Externally Crowdsourced (外包). Platform Exclusive riders work in shifts and have regular work hours. They deliver orders assigned by the platform and collect a base salary. They are organized in stations and managed by a station manager, to whom they have to report every day. On the other hand, Externally Crowdsourced riders are real "gig workers" who are paid by each completed delivery (henceforth referred to as "gig riders"). In principle, anyone in China can register through an app to become a gig rider on the platform, by uploading their identity card and a health certificate. Once registered, a gig rider can then switch on their app and start taking orders right away. Gig riders compete with one another to "snatch orders" from the platform, i.e., the first person tapping on the "accept order" button in the app gets the order. There is no limit to how many hours a day a crowdsourced rider can work; a rider can take as many as 12 orders simultaneously as long as all the deliveries can be completed in time. Coordination of these riders is through the platform app and the station manager who oversees a particular delivery zone. Even though the gig riders are not in any contractual relationship with the platform itself, they are required to wear a uniform of the company when on the job.

The empirical research was conducted in July 2018 in Beijing. We started recruiting participants first through our personal contacts and followed with a snowballing method. A total of 30 interviews were conducted: 27 riders (23 gig riders and four platform-exclusive riders; 5 were women) and three station managers. The interviews were semi-structured and lasted between 30 minutes to 1.5 hours (average length was approximately 60 minutes). Interviews with riders were conducted in public spaces such as a restaurant or a cafe at a location convenient to the worker. 28 interviews were audio-recorded, and two were documented with extensive notes. The rider interviewees were given 100 yuan (about 12 GBP) as compensation for their lost work time. All interviews were conducted in Chinese, which were transcribed by professional transcribers and then imported into NVivo for data analysis.

The researchers also joined two Wechat groups of gig riders, where riders discuss their work experience, compare earnings, make complaints, seek help from other workers, and most frequently, try to buy or sell mopeds and other job-related equipment. The station managers also use the channel to make announcements, e.g. adjust payrate in bad weather conditions, answer queries from riders, and broadcast platform policies. Occasionally, after-work social gatherings were organized in the group. Observing these online conversations and interactions provided a rich contextual understanding to the riders' lived experience.

Data analysis of the study largely followed the guidelines of grounded theory approach in Information Systems as suggested by Urquhart et al. (2010): constant comparison, iterative conceptualization, theoretical sampling, scaling up and theoretical integration. Empirical materials for this study comprise transcripts of 30 interviews, screenshots and photos of the rider's app interface, archived messages of the Wechat group discussions, as well as media reports about the platform and the platform company's official documents. We started our analysis by conducting open coding on the interview transcripts in Nvivo, with each researcher independently coding half of the transcripts, which generated over 100 preliminary codes. The two researchers then examined each other's codes, discussed discrepancies and

overlaps in coding, and began to do focused coding, i.e. consolidating and distilling codes to form higher-level categories. We also utilised other tools in Nvivo, such as nodes clustering analysis and mind maps to explore patterns and relations in the codes. Spatial and temporal dimensions of the algorithmic work emerged to be the strongest themes, which were treated as conceptual focus of the study. An iterative process between the data and the literature of space and time constituted the subsequent thematic coding, which included theoretical sampling and integration, until saturation was reached. In the following section, we use spatiotemporality as a framing device to report our empirical findings, with interview data supplemented and triangulated by other sources of data.

4 Findings: Multiple Spatiotemporalities of Platform Work

It is of no surprise that for food delivery work, time is of the essence. In the words of a rider interviewee: "A good rider knows how to manage delivery times". The unfolding of a delivery event in time, however, is contingent upon the rider's constant negotiation with various spatial and material aspects of the world. Each delivery job is embedded in a complex web of dynamic relationships among a number of actors and actants, including: the rider, the customer, the restaurant, the station manager, co-workers, technological artefacts (mobile phone, apps, GPS devices), motorbikes, spatial conditions (roads, traffic, buildings, architecture, entry points), weather, and even the packaging material of the food. The delivery work therefore requires intricate tacit knowledge and speedy decision-making in sociomaterial negotiations in space and time.

4.1 Spatiotemporality of Migrant Workers' Life

Geographic economic inequality in China drives millions of rural residents to urban areas to seek employment opportunities. Due to the Hukou (household registration) system, these migrant workers are not considered local residents in the cities they work and thus not entitled to the same level of social welfare such as healthcare and education as the urban residents (Wong et al., 2007). Employers in manufacturing, construction, and service sector see these migrant workers as cheap labour who are willing to work under harsh employment conditions in exchange for cash income.

These displaced workers are referred to as the "floating population" (Gao and Smyth, 2011) across space and time. Most of them spend decades moving between their hometown and various cities, changing from job to job for higher pay or better work condition, and living in poor-quality and cramped accommodation in order to build up savings to support family and eventually return to their hometown to settle down (Wong et al., 2007). Therefore, most migrant workers take up temporary employment and have no long-term career plan (Swider, 2015), working long hours in favour of cash income. As such, exchanging labour for income through digital platforms with few strings attached could be seen as "flexible" and appealing to many migrant workers.

During the time as migrant workers in cities where they are considered outsiders, short-term and temporary work is the dominant mode of employment for them. Many of the riders we interviewed have taken up multiple jobs before, e.g. as construction workers, truck drivers, factory workers. Some have family business back home and came out to the city to earn some extra cash in slow seasons. To this end, the very existence and experience of rural migrant workers in China's urban areas are a unique spatiotemporal phenomenon. Not only are they displaced from their hometown, many of them also tend to 'float' across space and time in a rootless, transient condition.

4.2 Spatiotemporality of Riders' Work Routines

Food delivery is a seasonal job, with summer and winter being peak months when temperatures are unpleasant and more people tend to stay indoors. Some gig riders turn on the app and start running on their motorbike only when there are plenty of orders to take on. In slow seasons of spring and autumn, they either switch to other jobs or take deliveries from time to time as a supplementary source of income. This flexibility of employment was often referred to as "freedom" when asked about the reasons

they chose to be a rider. For platform-exclusive riders, the minimal required on-duty days per month are 28 days. However, both types of riders rarely take days off during peak seasons even if they have the presumed freedom to do so. On a normal workday, most riders work between 8 to 14 hours. Longer hours usually means higher income: an experienced and extremely hardworking (consistently work for more than 12 hours a day) gig rider can make as much as 15,000 yuan (1900 euro) per month, which is equivalent or even better than the average pay of junior white collar workers. Migrant workers flock to the food-delivery platform because of high earnings:
"I used to have a job in eastern part of the city, but the salary is quite low, 5000 yuan, and not providing accommodation and food. I have to commute 2 hours to go to work every day. So when food delivery work started, I thought it may have space to grow. It is tiring but better wage."

To achieve high income, some gig riders strategically plan their work hours. For example, some choose to start in late morning just before lunch and continuously work until small hours of the next day, so as to cover the peak hours of lunch and dinner as well as the late night snack orders. A rider talks about the advantage of working in small hours:

"There is less traffic at night. If you have to take the lift (in apartment buildings), you don't have to wait too long… Also the unit price is higher. You see, sometimes there is nobody on the road, just me riding freely, and it's cooler – too hot during the day."

Furthermore, a small subsidy may be added to an order in certain circumstances, e.g. when there is heavy rain or snow. However, this is at the discretion of the station managers, who often use it to incentivise gig riders in order to meet higher demands in bad weather. Bad weather can trigger delays and create more stress for the riders. For example, a rider said,

"The system-allocated time should be slightly extended on rainy days. Why? Some restaurants are less busy on rainy days, so they only start cooking after receiving an order. One dish is OK, if there are multiple dishes, they can't make it in time, and the delivery will be delayed".

Electric motorbikes are more affordable than petrol ones and therefore become the default choice of transport for most riders. The battery on electric motorbikes, however, usually does not last for a whole day. Charging the motorbike is also part of the daily routine of the riders, which can affect their work schedule, route planning, and spatial movement. For example, running frequent short trips depletes the battery very quickly. Riders have to plan their day carefully so that they can charge the battery in the post-lunch-service break time, ready for the evening peak hours. Thefts of the batteries are not uncommon. The purchase and maintenance of motorbikes, delivery boxes, mobile phones, outfits and other job-related equipment, are all part of the hidden costs and invisible labour subsumed in a rider's routine work.

4.3 Spatiotemporality of Riders' Algorithmic Work

There exist different modes of social time across social groups in the food delivery system, which can cause tension and conflict. The platform company predefines a time framework within which a food order must be delivered to the customer; the restaurant has its tempo and routine in preparing food; and the customer has an expectation when to receive the ordered food. All these time modes shape the delivery work's temporal structure, but they are not always in harmony. In this section, we show how the riders' movement across space and time is regulated, monitored and managed digitally, how riders struggles with the sociomaterial challenges in performing the deliveries within the digital parameters, and diverse strategies riders come up with to cope with spatiotemporal conflicts and compete with fellow riders to excel in a gamified sociotechnical process.

4.3.1 Algorithmic Regulation of Spatiotemporal Movements

Once a customer places a food-delivery order from their customer-facing app, the order details are processed in the platform's backend system. The backend system provides both historical and real-time data to aid delivery coordination, including geographical and temporal distribution of orders, individual rider's performance, overall operational performance of a station, and a series of managerial tools to monitor and manage peak-time and unexpected order spikes (e.g., due to bad weather). The backend system is constantly monitored by station managers, each oversees an approximately 3-kilometer radius service area. Once an order is processed, a customer will be able to track the rider's whereabouts on a map and see a time series with key events (Figure 1). The backend system provides even more detailed spatiotemporal information, as riders are required to record each step of the procedure on the app, e.g. arrival at the restaurant, picking up order, delivery of order, and so forth. As a station manager explains:

"A rider has to enable location tracking on their mobile app; the restaurant has a location on the map, so does the customer. It (the platform algorithm) determines the location-based matching. ... Location tracking, delivery delay, time limit – all standardized."

As the rider's app is always synchronized with the backend system, the delivery work is assessed, and rewarded or penalized, by the system in real time. The synchronization of data on space and time across different interfaces creates a sense of transparency (for customers) and temporal uniformity (for all parties). From the customer's point of view, seeing the movement and progress of their food order gives them a sense of assurance. Once a rider picks up an order on the app, a specific amount of time, e.g. 40 minutes, is allocated by the system to complete delivery, which includes the time required for food to be prepared by the restaurant. However, between the time an order is placed by the customer to the time the order is delivered, a number of behind-the-scene activities must take place: the worker moves from their current location to the restaurant; the worker waits for the restaurant to prepare the food; the worker rides their bike and travels from the restaurant to the customer's location.

Figure 1. Order Status Tracking on Customer's App

Each of these events occurs in space and time, and each could go astray in space and time. One of the most complained issues we heard from the riders was restaurants' delay in food cooking:

"The restaurants are hopelessly slow in preparing the food. There is nothing I can do about it. … In many cases, we went over time simply because the restaurants were slow. We actually don't have much time for delivery. … They ignore you, or keep telling you 'almost ready' no matter how long it actually takes!"

Delivery time is also greatly impacted by the geolocations of the rider, the restaurant, and the customer. Once the three locations are known, the platform algorithm automatically plans a route for the rider. However, according to our interviewees, the GPS positioning of these locations is often inaccurate, and the algorithm-generated route misses road barriers, constructions, and last-minute change of address by the customer – all these factors could lead to severe delays:

"I don't look at it [the system-generated route]. I go my own way. It always gives you the shortest path. … Let's say we go from here to [place name] and it would suggest you taking the footbridge. Now you tell me how I can go up to the footbridge on my bike? … The platform's route planning has problems. Not just this one; all platforms are designed the same way."

"Of course I would rush – why wouldn't I? One minute or even one second late, my fee would be deducted. Sometimes we dispute with the platform and won the case, but sometimes we lost. Yesterday I had an unsuccessful dispute: I called the customer service [of the platform] and they said I was 500 meters away from the restaurant. I said, 'are you kidding me?!' I was right outside the restaurant and also responded on the app that I was at the restaurant. … Sometimes the GPS geo-positioning is inaccurate. You arrived at the destination and checked the GPS position on the map – I was there, the place was there, but you just couldn't tap [on the app to report the arrival at the destination]."

Indeed, a station manager confirmed how he relied on geodata and platform algorithms to make his judgement in handling this type of disputes:

"Because a rider's mobile phone must be geolocation-enabled, and the restaurant and the customer also have their geolocations, the system will automatically measure the distances. If the distance is greater than 200 meters, or whatever number [as determined by the algorithm], we then know the rider didn't lie, or the customer didn't lie, or the restaurant didn't lie. Through geodata, we check and then assess whose responsibility it was."

All our interviewees expressed their fear of missing the delivery time set by the system. As one rider put it: "*The biggest challenge [of this job] is … you don't know the route and then you exceed the time limit.*" The penalty is not only financial – a rider would lose at least half of the delivery fee for just one-second overtime – but also affects their rating in the system, which could lead to further financial loss: the lower rating of in-time delivery, the lower are they ranked in the system, and the less opportunities to get "good" delivery orders. In some cases, a rider can be blacklisted and kicked out of the system:
"if the system detects that you have gone over time limit too many times, it will automatically shut your app down. … it forces you to 'rest' for a day to reflect on why you are blacklisted. … Now the requirement is the on-time delivery rate; you won't get away with going overtime too often."

While it seems reasonable for a platform company to incentivise work performance, the algorithmic design behind the time requirements convey a rigid and universal view of spatiotemporality that often collides with the performed, sociomaterial reality. Our observation shows that, when the collision occurs, it is usually the rider who bears the consequences.

4.3.2 Sociomaterial Configuration of Spatiotemporality

Being a gig rider is not exactly a low-skilled job and is actually very competitive if one is to excel and achieve a higher income:

"Many people don't get many orders. Why? First and foremost, your judgement – once an order appears, you must react at the fastest speed. Hand, brain, eyes, all in one! … In the blink of an eye, you must decide if you should snatch this order. One moment of hesitation it will surely disappear. The competition is fierce."

A "blink-of-an-eye" order-snatching decision involves processing a large amount of information concerning the sociomaterial conditioning of their spatial and temporal strategies. For example, the destination of delivery is very important in the decision-making. There are various obstacles that a rider has to overcome as they travel from a restaurant to the customer's place. Apart from the usual traffic conditions, red lights, and road work, they also need to think about possible shortcuts or detours that may affect travel time, and enormous delay when waiting for the lift in a 30-floor high-rise office tower during peak lunch hours. Some hotels and apartment buildings do not allow riders to use the customer lifts so they have to take the slower goods lift. Gated residential estates usually forbid riders from entering with their motorbike, so the rider has to park the bike outside and carry the food boxes and bags with them on foot. It could take an in experienced rider a long while to find a particular apartment unit in a large estate. It is not unusual to see a food-delivery worker running around in these estates with several bags in their hands. The packaging of the food is therefore also crucial, as Chinese meals usually contain dishes with sauce and soup. Leakage and spillage could easily occur if the rider runs on foot or does not ride motorbike steadily. If such incidents do happen, the rider will have to pay compensation to the customer or risk getting a complaint.

Sometimes a delivery address is difficult to find, or simply erroneous. Other times, the rider wastes a lot time waiting at the reception for the customer to come out to accept the order. A rider complains,

"Some office towers don't allow us to go up. We have to call the customer to come down to pick it up. Some people come down in 5 minutes, some don't appear after 15 minutes. We are quite [frustrated] with customers like that. Sometimes we have many orders in our hands, and but have to wait for more than 15 minutes for one person at the risk of delaying all the others. We are the most worried about these situations. It is very difficult…Most people come down quickly, but 2 out of 10 may be late."

The selection of orders is therefore of crucial importance. 'Snatching' the 'best' orders, that is, those that are spatially advantageous is critical in maximising the speed and thus number of orders delivered in a given time. When asked what sort of orders he would like to snatch, a rider answered:

"*Ground-floor business premises, not-too-tall buildings – I don't like tall buildings, nor apartment complexes. They are not easy to get into and get around. … I rarely go there these years.*"
The interviewee then probed: "*Well, if you don't take these orders, would someone else take them?"*
And he replied: "*Yes. I just need to delay a bit, hold on for a little while, then someone else would take it. The newbies. There is always a newbie who takes it. I used to be a newbie; I took these too, but not anymore.*"

Therefore, a rider's movement through space and time is not independent from other agencies in the sociomaterial system. The enactment of algorithmic management in terms of spatiotemporality creates different, yet interconnected, sociomaterial realities for different riders. Furthermore, if a rider reaches a certain ranking in the system, usually after an extended period of high performance, a small number of 'system privileges' are granted by the system to pick and choose orders (e.g. 12 priority selections a day). As a rider explains,

"Privilege means you can go wherever you want to go…I can select where to pick up order and where to deliver to… For example, I can set a radius of 300 meters, both restaurant and destination, I can even just walk… You can also decide which orders to exclude…"

A lower ranking rider, typically newcomers, and those who are less experienced in snatching orders, have weaker knowledge and control over the spatiotemporal parameters of work, which usually means more effort and less income, thereby creating a pecking order of workers. In other words, the presence and practice of one rider in the system shape the spatiotemporal reality of other riders.

4.3.3 Spatiotemporal Strategies of Riders

While Western gig workers on Uber Eats or Deliveroo feel the same type of time pressure imposed by these platforms, it is in Chinese gig riders that we see an extreme manifestation of the temporal aspect of the job. Interestingly, Chinese gig riders constantly worry about going over time not because the platform gives them too little time to deliver a particular order (usually 30-40 minutes); rather, it is because most riders stack multiple orders at any given moment in order to maximize their income. Hence, Chinese riders are subject to even more intense forms of algorithmic management as they are tethered to the multiple spatiotemporalities of different orders. Their work performance is highly dependent on their capability of estimating the time needed for delivering each individual food order. This means the riders must juggle and weave multiple orders as they come in and improvise the delivery sequences ad hoc. Figure 2 and Figure 3 illustrate the comparison between a single-order delivery and a stacked-order delivery.

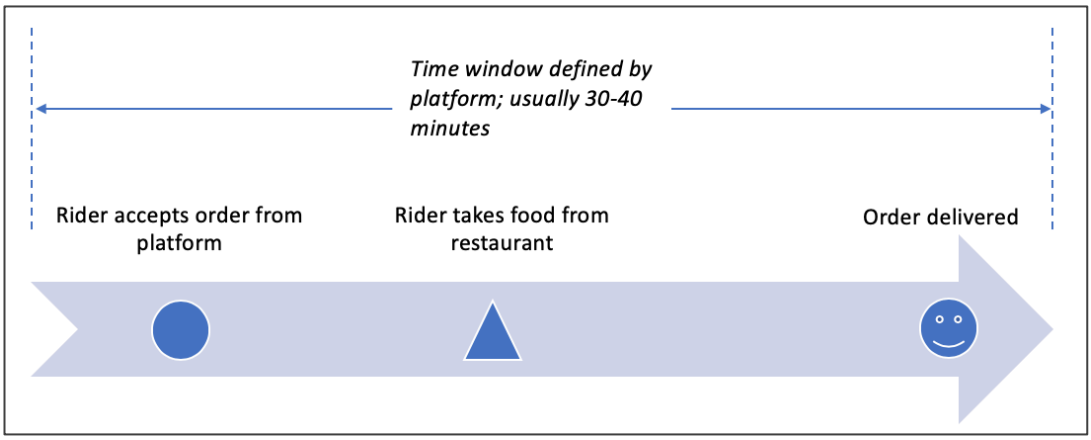

Figure 2. Timeline of a Single Order

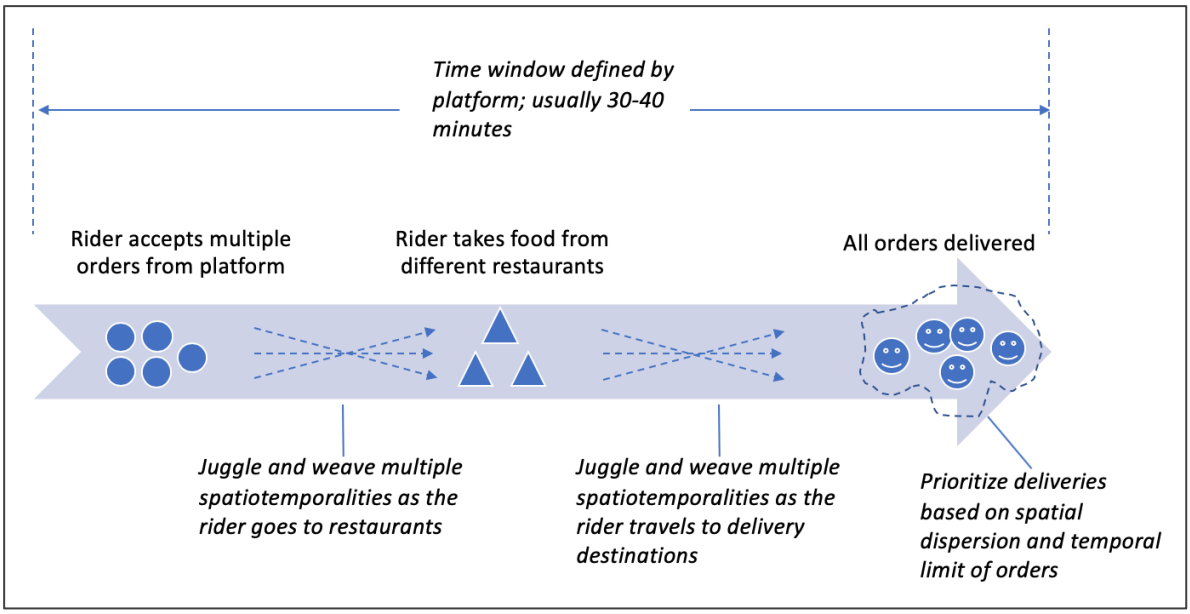

Figure 3. Timeline of Stacked Multiple Orders

When a rider intends to take multiple orders simultaneously, they need to ask themselves a series of questions before setting out:

- How much route overlap between this delivery and the other orders I have taken (or plan to take)?
- Which destination to go first and which the last?
- Approximately how long does it take for these restaurants, separately and combined, to prepare all the food?
- Finally, how many orders can I take at this point without causing delays?

Hence, a seemingly simple delivery job becomes a very complex daily practice that involves bold yet careful estimations, precise calculation of travel time to different places, optimal routing through space, and on-the-fly decision-making based on human, algorithmic, and material agencies. As one seasoned rider put it:

"People say that food delivery job is a simple job; in truth, it's not that easy to do well. … How can I complete many orders, earn more money, stay within time limit, and deliver food to customers as early as possible? You need to turn these things over in your mind!"

Another rider went into further details:

"You need to be able to plan the routes. When you pick up three orders, a route should naturally appear in your head. You have a sense when the restaurants can get the food ready, then you can judge which route to take. If it is in the evening peak time, there will be traffic jam, and you need to know which junction will be congested… We have 48 minutes from the time we take the order, including picking it up from the restaurant. You need to allow extra time, as you may have to wait at the traffic light, get blocked by something else, or if the customer doesn't pick up the phone, etc., random things (may happen), you need to calculate all of these."

An experienced rider described how he often travel in circles when delivering multiple orders:

"Let's say I pick up 5 orders. Before I leave I need to think, which one to deliver first, which one next… if time is too tight, I have to travel in circles. That means I actually deliver the order that's further away, because it is more tight (pressured in time), then return (to deliver the nearer ones)… If you follow direct sequence of order, you will run out of time. Taking circles gives me more time … When you finish all of them you are back here ready for new orders.

While most riders tried to squeeze in as many as orders as possible, a high-performing rider we interviewed adopted a very different strategy:

"Why do you need a strategy in doing the job? Why do some people perform better than you? … For example, when you've accepted three orders, you must get going and not continue to wait for the fourth or fifth. Why? These three orders go in the same direction; it's a small batch so you can deliver quickly and come back quickly. Some people keep waiting … but that's not my strategy. My strategy is "take less and move fast". … My work time is pretty much the same as others. Sometimes you see these people sit and wait there with a couple of orders already in hand. While I have completed my deliveries and come back, they are still waiting!"

These interviewee quotes illustrate that space and time become malleable in riders' day-to-day work in the sense that each rider renders a slightly different spatiotemporal reality depending on their personal capability, their work strategy, and a myriad of social and material factors.

5 Discussion

The empirical case of Chinese food-delivery workers shows how the on-demand platform labour is not only structured and driven by algorithms regulating riders' spatial and temporal movements, but also shaped by the spatiotemporal properties and relationships among multiple agencies in the gig economy, including the platform, restaurants, consumers, riders, and the urban environment as a whole. As revealed from the data, the platform is designed in such a way to structure the delivery work through synchronization and constant monitoring of riders' spatial and temporal activities, creating a datafied, standard spatiotemporality across the entire platform ecosystem. By setting a spatial boundary to the scope of delivery range at each station, measuring riders' movement and performance across a wide range of indicators, and through reward and penalty, the platform attempts to regulate how the food delivery work is performed in time and space. This observation is largely in line with the extant gig work literature where researchers have pointed out gig platform system's omnipresent control over workers through remotely managing spatiotemporal events.

There are however inevitable cracks in the algorithmically regulated spatiotemporality due to technical issues such as imperfect geo-positioning and a myriad of sociomaterial conditions where the algorithm-determined spatiotemporal flow breaks down. Individual skills, creativity and tacit knowledge are therefore required to navigate spatiotemporal contours and ruptures. An assemblage of sociomaterial conditions determines the process of delivery work and riders' decision to take delivery orders: the speed of restaurant's food preparation, the security of food packaging (which affects their speed), the riding route planning and improvisation, the traffic navigation, the accessibility of buildings and neighbourhoods, the (lack of) interaction with customers, and occasional delays and the subsequent penalties and penalty appeals. The riders are striving to configure their own spatiotemporality within the boundaries of the algorithmic system, sometimes pushing these boundaries to their limits. Through (re)configuring and enacting multiple spatiotemporal structures in a material world, these riders perform "strategic manipulation of time" (Bourdieu, 1977, p. 6) and constitute multiple spatiotemporalities in interdependent practices.

An ongoing debate in the sociomateriality literature centres on the concept of agency. For Leonardi (2011), human and technology both have its agency, "but ultimately, people decide how they will respond to a technology" (p. 151). For Orlikowski and Barad, the social and the technology are ontologically inseparable, and there only exist the "mutual constitution of entangled agencies" (Barad 2007, p. 33) rather than independently existing human intentionality or technology autonomy. Both camps seem to agree that human and material agencies must imbricate in practice to constitute reality in space and time. Our observation of platform work seems to contradict Leonardi's claim that "once technology is built its materiality is fixed", and more in line with the co-constitution view. As discussed above, the incoming delivery orders and the route generated by the platform technology are temporally emerging and continuously reconfiguring. The materiality of technology is brought into being only when the technology is in an intra-acting relation with the human agency in space and time. The co-constitution perspective also underlines the "recursive loop between the calculations of the algorithm and the 'calculations' of people" (Gillespie, 2014, p. 183) so that we see platform work as a continuous intra-action unfolding in space and time.

Perhaps we have been overemphasizing algorithmic control, obscuring the fact that gig work – like any other forms of work – is sociomaterial and spatiotemporally embedded. The embeddedness brings into light many "other social processes in a broad variety of domains at different levels" (Jansson 2013, p.281), hence revealing the complexities and micropolitics in the seemingly simple, algorithmically controlled food-delivery work. As Sewell and Taskin (2015) points out, algorithmic control is only achieved through creating "a negotiated social order … under new arrangement of space and time, rather than a wilful attempt by one group to subordinate another" (p.1524). Recognizing the

complex dependencies of multiple spatiotemporalities debunks the "self-as-enterprise" ideology promoted in the gig economy (Moisander et al., 2018) and highlights the inherently collective struggle of workers.

6 Concluding Remarks

This paper shows how Chinese food-delivery riders, mostly rural migrant workers, are tethered to and simultaneously co-construct multiple spatiotemporalities in their work routine to meet the demand of speed and efficiency of the platform algorithms. The paper makes two important contributions to scholarly understanding of platform work. Firstly, we present a rich case of platform work in a Chinese context, juxtaposing it with studies of Western platforms such as Uber and Deliveroo, to provide a fresh reference point for discussing gig work and platform labour. Secondly, our focus on multiple spatiotemporalities of the food-delivery work sheds new light on platform work as a sociomaterial configuration of spatial and temporal orders. When considering the multiplicity of spatiotemporality in platform work, a task or order is no longer just an innocent algorithmic product, but a sociomaterial generation that embodies the imbalance of power in the existing social order. Furthermore, spatiotemporal micropolitics play out among workers themselves, who are all tethered to the platform collectively. Therefore, algorithms are not creating so-called atomized gig workers but interconnected and co-dependent workers in space and time.

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