CONCEPTUALIZING ALGORITHMIC MANAGEMENT CHARACTERISTICS AND EXPLORING THEIR EFFECTS ON GIG WORKERS IN ONLINE LABOR PLATFORMS

JIAHUI HE

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Jiahui He

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CERTIFICATE OF ORIGINALITY

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Jiahui He
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ABSTRACT

The widespread application of digital technologies boosts the rapid growth of the gig economy. In this context, online labor platforms (OLPs), as a new form of organization embodying the duality nature of market and organization, widely adopt algorithmic management to control and coordinate gig workers. However, due to the absence of traditional employment relationships and the transition of management agents from managers to algorithmic technologies, how to effectively manage gig workers has become a severe challenge for OLPs. Existing algorithmic management literature has mainly portrayed algorithmic management as an escalated form of labor control and limited studies have been conducted to comprehensively explore the effects of algorithmic management on gig workers. To address this limitation, this dissertation firstly completes two studies (Studies 1A and 1B) to conceptualize and operationalize the characteristics of algorithmic management respectively. Based on grounded theory, the results of interview data analysis (n = 23) in Study 1A reveal the concept and dimensions of platform workers' perceived characteristics of algorithmic management. In Study 1B, following the six-step procedure, I develop the scale and examine the structure and validation in two different samples of food delivery workers (n=300) and gig drivers (n=300).

Based on the results of Study 1A and Study 1B, I adopt the perspective of job crafting to explore the potential double-edged sword effects of algorithmic management. Specifically, I propose that promotion-focused job crafting will mediate the positive relationships between gig workers' perceived algorithmic management characteristics and their platform commitment. Differently, prevention-focused job

crafting will mediate the positive relationships between gig workers' perceived algorithmic management characteristics and their job insecurity. Moreover, I also investigate the boundary conditions for mitigating the negative effects and amplifying the positive effects of algorithmic management in Study2. Specifically, I propose personal resilience will strengthen the positive relationships between gig workers' perceived algorithmic management characteristics and their promotion-focused job crafting. However, personal resilience will weaken the positive relationships between gig workers' perceived algorithmic management characteristics and their prevention-focused job crafting.

In Study 3A and Study 3B, dialoguing with employment-organization relationship (EOR) literature, I explore how the relationships between gig workers and OLPs construct and evolve, and how different relationship types will influence the effects of algorithmic management characteristics on gig workers. Specifically, in Study 3A, based on a case study, I first develop a process model of EOR evolution in OLPs to illustrate how external environment characteristics determine the switching of OLPs' two functions (i.e., organization and market) and further lead to different types of EOR. Based on Study 3A, Study 3B proposes and examines the moderating role of relationship types on the effects of algorithmic management characteristics on gig workers.

The findings from this dissertation primarily suggest the positive effects of algorithmic management in OLPs on gig workers, which will be moderated by gig workers' personal resilience and their relationship types with OLPs. The implications

of this dissertation for theory and practice are also discussed.

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CHAPTER 1: INTRODUCTION

Research Background

The gig economy has been flourishing worldwide in recent years. McKinsey's report on independent work in 2016 revealed that over one-fifth of U.S. workers worked as gig workers outside of one specific organization. Researchers also indicated that this number might grow to 43% by 2020 (Gillespie, 2017). In China, the growth of this kind of labor force will be more surprising. Statistics released by Alibaba showed that by 2036, there would be over millions of workers getting involved in the gig economy. Actually, the gig economy is not new (Mulcahy, 2017). Thanks to the development of digital technologies such as the Internet, cloud computing, and big data, *Online Labor Platforms* (OLPs, e.g., Didi, Meituan, and Uber), as market intermediary platforms connecting the demand side and the supply side (Thomas et al., 2014), have boosted the gig economy.

As a new form of organization with the dual nature of market and organization (e.g., Möhlmann et al., 2021), on the one hand, OLPs have a profound impact on the whole society due to the considerable network effects. Especially in China, where digital infrastructure is rapidly developing, online labor platforms play an increasingly important role in economic development, poverty alleviation, and digital transformation. For example, Didi, the leading platform company in China with a market value of over 360 billion in 2020, has provided the society with more than 13.6 million job opportunities.

However, due to the characteristics of market intermediary platforms, OLPs,

which embody the dual nature of market and organization, have shocked traditional employee-organization relationship (EOR) and shaped new work contexts. OLPs are market intermediary platforms by nature, which means that they usually provide a digital infrastructure for collecting, processing, and transmitting information on economic activities (Thomas et al., 2014). Moreover, as a type of "meta-organization" (Möhlmann et al., 2021), OLPs are boundaryless and highly decentralized. Therefore, unlike employees in traditional organizational scenarios, gig workers in OLPs usually do not establish a formal labor employment relationship with platforms. Instead, they build loose connections with platforms through User Agreement under a weak contract, which significantly differs from traditional employee-organization relationships.

In this new work context, the top-down job design in traditional organizations may be difficult to apply to these OLPs. Accordingly, gig workers often have to cultivate and define their jobs by themselves (Petriglieri et al., 2019). A full-time worker employed by one specific employer based on a formal contract has been regarded as the norm in the labor market for decades. The contract will specify the work requirement, work conditions, the rules and norms of the organizations, and the employee's remuneration. This type of labor relation reveals that following the top-down job design, employees are under substantial control of their employers since they are required to complete the specific work tasks with the provided resource during the given working hours in the workplace (Williamson & Winter, 1991). However, the gig economy breaks these rules. As independent workers, gig workers

usually have to decide on the content, the organization, and the meaning of their own jobs (Petriglieri et al., 2019).

In this new context, due to the absence of traditional employment relationships and formal hierarchical control (Meijerink & Keegan, 2019; Vallas & Schor, 2020), how to effectively manage these gig workers has become a severe challenge for OLPs. In practice, a new type of organizational management has generally emerged: *Algorithmic Management*. It refers to the new organizational management tactics of platforms using algorithmic technologies to achieve management goals (e.g., Liu et al., 2021; Kellogg et al., 2020; Meijerink & Keegan, 2019; Möhlmann et al., 2021). It includes automatic demand-supply match, work allocation, remote performance monitoring by app, real-time algorithm feedback, etc. These tactics of algorithmic management, to a large extent, have replaced the role of managers in traditional organizations. With the help of algorithmic management, OLPs can organize and manage a large scale of gig workers without standard employment relationships. And this new form of organizational management has gradually played an essential role during platform development.

Research Needs and Objectives

Paralleling the prosperity of the OLP workforce, research on algorithmic management, especially its effects on gig workers, has seen explosive growth over the past few decades. An increasing number of researchers from various disciplines have joined this area. As part of the mechanization of organizational management,

algorithmic management is not entirely new (Danaher et al., 2017). In addition to human resource management and organizational behavior research, concepts such as algorithmic governance and algorithmic regulation have already appeared in the research of decision science, social governance, and organizational design (e.g., Danaher et al., 2017; Schildt, 2017; Yeung, 2018). These constructs mainly refer to collecting and analyzing data to guide, motivate or constrain human behaviors to achieve management goals (Danaher et al., 2017; Yeung, 2018). In the context of OLPs, algorithmic management is regarded as the means of platforms to manage and control platform workers with the help of algorithms (e.g., Meijerink & Keegan, 2019; Möhlmann et al., 2021; Kellogg et al., 2020).

Regarding the effects of algorithmic management on gig workers, the existing research often adopts labor process theory (Edwards, 1979) to explain how platforms exert control over gig workers and workers' resistance to the control. For example, Kellogg et al. (2020) regarded algorithmic control as rational control, whose primary purpose is to covertly obtain more value from workers. It is widely believed that work autonomy in the context of online labor platforms may be illusory. Instead, "digital cage" built by algorithms deprives gig workers of autonomy and gives tight control back to workers (e.g., Rosenblat & Stark, 2016; Vandaele, 2022; Veen et al., 2020). From this perspective, platform workers' responses to algorithmic management are usually resistance at the collective or individual level (Cameron & Rahman, 2022; Kellogg et al., 2020; Vandaele, 2022).

Although this research provides us with insights into the effects of algorithmic

management on gig workers' job crafting, it has the following limitations. First, the extant studies mainly portrayed algorithmic management as an escalated form of labor control that constrains platform workers' autonomy and harms their well-being (Chai & Scully, 2019; Duggan et al., 2020; Veen et al., 2020), missing out on the potential positive sides of algorithmic management. As introduced, OLPs have the dual nature of organization and market, while the existing research mainly focused on the organizational facet of these platforms, which leads to the omission of the exploration of the positive effects of algorithmic management. Due to the nature of market, algorithmic management can also positively influence gig workers in OLPs. For instance, some research revealed that in addition to the dark side, algorithmic management could provide gig workers with benefits such as considerable autonomy and the awareness of self-identity (e.g., Möhlmann et al., 2021).

Although some scholars have begun to explore the enabling effects of algorithmic management in OLPs (Meijerink & Bondarouk, 2022; Möhlmann et al., 2021; Parent-Rocheleau & Parker, 2022), empirical studies are still lacking. Moreover, scholars have gradually noticed that algorithmic management's empowerment and control effects may not exist in isolation (e.g., Ashford et al., 2018; Bellesia et al., 2019). Therefore, this dissertation first aims to explore the potential double-edged sword effects of algorithmic management in OLPs.

Second, with some exceptions (e.g., Pei et al., 2021a), few studies have theoretically and empirically investigated how algorithmic management in OLPs influences gig workers. This calls for more research to open this black box, especially

simultaneously considering both positive and negative effects of algorithmic management in OLPs. In line with this, the second objective of this dissertation is to propose and examine the mechanisms of algorithmic management's double-edged effects on gig workers in OLPs. Moreover, when exploring the effects of algorithmic management on gig workers, previous studies usually assumed that the relationships between gig workers and OLPs were the same. However, in practice, OLPs often establish diverse relationships with gig workers, which will influence how gig workers perceive, evaluate, and behave toward platform management via algorithms. Accordingly, apart from personal traits, this dissertation also aims to explore the moderating role of different types of relationships between gig workers and OLPs.

The last limitation is related to the conceptualization and operationalization of algorithmic management. most of the existing literature usually articulates algorithmic management around its diverse functions (e.g., direction, evaluation, and discipline, Kellogg et al., 2020; Pei et al., 2021). This conceptual way refers to algorithmic management as the specific control or managerial tactics/practices which help platforms or organizations to achieve particular goals. However, since managerial tactics or practices may vary across different platforms, it is difficult to conceptualize and operationalize algorithmic management that is widely applicable. Besides, with the help of algorithms, managerial tactics or practices in OLPs can change rapidly, such as iterated as the APP's update, which will significantly challenge the concepts and measures. Different from the above, a new conceptual way, which depicts the attributes of platform management via algorithms, has

gradually emerged in the literature. For example, Parent-Rocheleau and Parker (2022) regarded algorithmic management as a control system, and they proposed that the characteristics of this system (i.e., transparency and fairness) would greatly influence individuals' reactions to management via algorithms. Moreover, due to the generality and abstraction, the work to conceptualize and operationalize algorithmic management characteristics is urgently needed.

The Present Dissertation

To mitigate the abovementioned limitations, this research aims to concentrate on algorithmic management in OLPs and its effects on gig workers. More particularly, this dissertation will mainly respond to the following research questions.

(1) What are the characteristics of algorithmic management in OLPs?

(2) How will gig workers' perceived algorithmic management characteristics exert their double-edged sword effects on gig workers?

(3) What are the relationships between OLPs and gig workers and how the relationships will influence the effects of algorithmic management characteristics on gig workers?

To answer these research questions, I will conduct three studies within the present dissertation, which constitute the overall conceptual model depicted in Figure 1. In Study 1, I conduct two sub-studies to conceptualize and operationalize the characteristics of algorithmic management, respectively. In Study 1A, I conduct a qualitative study drawing on interviews with 23 food delivery workers mainly from

two leading platforms in mainland China. Based on grounded theory, the results reveal the concept and dimensions of gig workers' perceived characteristics of algorithmic management. In Study 1B, I construct the scale with 18 items following the steps of standard scale development (Hinkin, 1998).

To better understand how algorithmic management in OLPs will influence gig workers' perceptions and behaviors, in Study 2, I investigate the underlying mechanisms of the double-edged sword effects of algorithmic management from the perspective of job crafting. To be specific, I explore how the characteristics of algorithmic management lead to different reactions of gig workers (i.e., platform commitment vs. job insecurity) through their two types of job crafting behaviors (i.e., promotion-focused job crafting vs. prevention-focused job crafting). Moreover, I investigate the moderating role of gig workers' personal resilience in the proposed relationships.

In Study 3, dialoguing with the literature on employee-organization relationship (EOR), I explore how OLPs construct different types of relationships with gig workers and how the relationship types will influence the effects of algorithmic management on gig workers. Specifically, in Study 3A, based on a case study, I first develop a process model of EOR evolution in OLPs to illustrate how external environment characteristics determine the switching of OLPs' two functions (i.e., organization and market) and further lead to different types of EOR. Furthermore, based on the results of Study 3A, Study 3B empirically examine how the relationship types will influence the effects of gig workers' perceived characteristics of

algorithmic management on their job satisfaction.

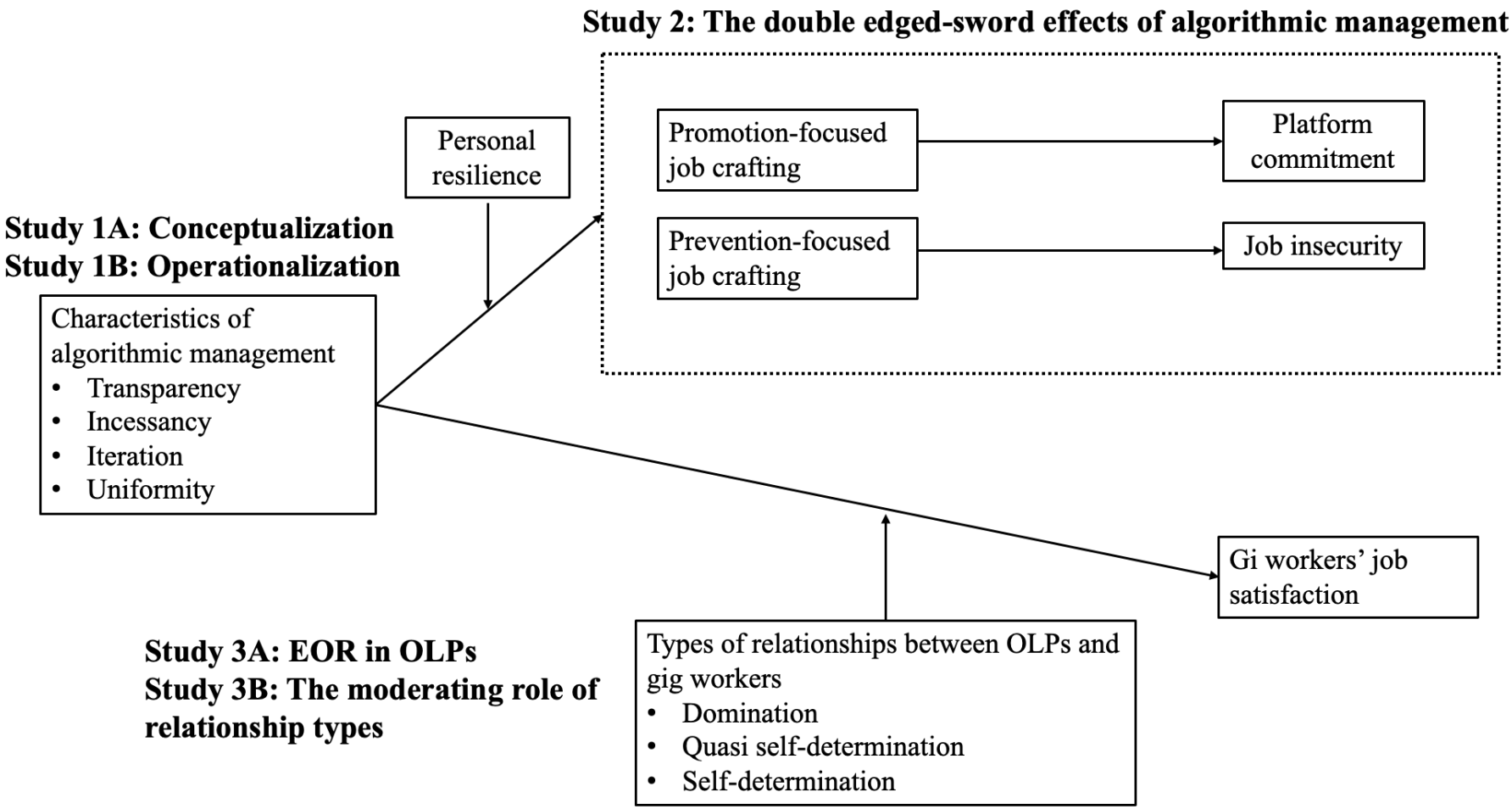

Figure 1. The Overall Conceptual Model of the Dissertation

Research Contribution

This dissertation intends to contribute to the literature in the following ways. First, the dissertation provides a solid foundation for future research on algorithmic management in OLPs by conceptualizing and operationalizing its characteristics. Thanks to the development of digital technologies, algorithmic management emerges in OLPs to help platforms manage gig workers. This calls for more attention to conceptualize this new construct. Responding to this, this dissertation first develops the scale of the characteristics of algorithmic management. Different from previous research that regards algorithmic management as packages of management practice (e.g., Kellogg et al., 2020; Pei et al., 2021), the conceptualization of this dissertation captures the essence of platform management via algorithms. Moreover, the findings can be the foundation for future research and stimulate more empirical explorations to help move the literature forward.

Second, this dissertation contributes to revealing the whole story about the effects of algorithmic management in OLPs. Unlike previous research that often focused on one side of algorithmic management, this dissertation simultaneously considers the bright and dark sides of algorithmic management. OLPs are market intermediary platforms and therefore have the dual nature of organization and market (Möhlmann et al., 2021). This suggests that OLPs via algorithms can empower gig workers through the network effects (e.g., Gawer, 2014; Gawer & Cusumano, 2014). Also, they may exert pervasive control which confines gig workers to an invisible digital cage (Möhlmann et al., 2021; Rahman, 2021). Scholars have gradually noticed that

algorithmic management's empowerment and control effects may not exist in isolation (e.g., Ashford et al., 2018; Bellesia et al., 2019). In line with that, this dissertation theoretically and empirically explores the potential doubled-edged sword effects, which help to depict the overall picture of the impacts of algorithmic management in OLPs.

Third, when investigating the effects of algorithmic management, I adopt the perspective of job crafting to uncover the underlying mechanisms and further explore the boundary condition. OLPs and gig workers are usually loosely connected based on User Agreement. In this context, gig workers have to cultivate and craft their work by themselves (Petriglieri et al., 2019), which suggests that job crafting would be significant for interpreting gig workers' reactions to platform management. Accordingly, this dissertation explores the effects of algorithmic management through the mediating effects of job crafting. This helps to open the black box of algorithmic management and provides empirical evidence on how algorithmic management in OLPs will influence gig workers' outcomes, as well as the relevant boundary condition.

Moreover, focusing on the context of OLPs, this dissertation will contribute not only to algorithmic management research, but also to the literature on EOR in the following ways. First, this dissertation introduces EOR to the new context of OLPs, indicating new directions for this line of research. Unlike previous EOR studies mainly based on formal and stable labor contracts, future research can focus on the uniqueness of market intermediary platforms and investigate the relationships

between gig workers and OLPs that challenge the premise of traditional EOR research. Besides, this dissertation contributes to the EOR research in the emerging OLPs by categorizing the relationships between gig workers and platforms and exploring the moderating role of relationship categories. This provides a basis for follow-up research to explore different perceptions, evaluations, and behaviors of gig workers under different relationship types. Moreover, this dissertation contributes to the EOR literature by depicting the evolving rather than static relationships between gig workers and OLPs, enriching our understanding of the relationship construction and evolution in OLPs.

Lastly, this dissertation may pave the new way for job crafting literature. The existing research on this domain mainly focuses on employees' job crafting behaviors in traditional organizations. This dissertation suggests that OLPs can be a brand-new research context for job crafting research, and future efforts can aim to explore gig workers' job crafting behaviors. Moreover, the literature mainly focuses on the relevant antecedents of job crafting, such as job characteristics, individual differences, and motivational factors (e.g., Zhang & Parker, 2019). This dissertation indicates that management characteristics in the new work context, especially those highly related to traits of advanced technologies, will also greatly determine individuals' job crafting behaviors.

Apart from the theoretical contributions above, more importantly, this dissertation also provides practical implications for platform management in the gig economy. In practice, how to manage gig workers with the help of algorithmic management has

become a severe challenge for OLPs. The findings of this dissertation will help OLPs better understand how gig workers perceive, evaluate, and react to algorithmic management in OLPs. Based on the results, platforms can optimize their algorithms or improve their management to effectively motivate gig workers to be involved in platform work. Moreover, this dissertation also reveals a process model of EOR evolution in OLPs and delineates the characteristics, advantages, and disadvantages of different relationship types between gig workers and platforms. This will provide platforms with guidance for relationship construction and maintenance at different stages.

CHAPTER 2: LITERATURE REVIEW

In this section, I will review the existing literature on the following domains. **First**, considering gig workers is an inclusive concept. Usually, it will be confused with other related constructs (e.g., temporary work, independent contractors, teleworking, and side hustles). Therefore, I will introduce the definition of these constructs and compare them with gig workers. This can help to clarify who the gig workers in this dissertation are. **Second**, to introduce the research context of this dissertation, I will review the research on online labor platforms (OLP), including the definition and the characteristics of this new type of market intermediary platform. **Third**, I will review the research on the core construct of this dissertation: algorithmic management. Specifically, since algorithmic management is newly proposed, I will compare it to another similar construct that is well-established (i.e., organizational control) to indicate the importance and necessity of my further construct development. Based on that, I will review the existing research on algorithmic management's definition and its effects on gig workers from diverse theoretical perspectives. **Fourth**, I will review the literature on employee-organization relationships, especially in the context of the gig economy. **Lastly**, to conclude this Literature Review section, I will illustrate the results of the critical analysis of the literature by indicating the problems to be tackled in the literature.

Definition of Gig Workers

When discussing gig workers, different studies may use diverse constructs. If

we look into their definition, we may find some of them are used interchangeably but some of them may refer to different employment relationships. Therefore, when focusing on the gig economy, we should first clarify the differences and similarities among the constructs.

Temporary work. Temporary work refers to "individuals working through a temporary service agency (TSA) on assignment to client firms that contract with the TSA" (Foote & Folta, 2002). This indicates that temporary workers usually get employed through the TSA and this third party will be no longer involved in the employee-employer transaction once the workers find employment (Aguinis & Lawal, 2013). From this definition, we can see that considering the time span of gig work, it may be temporal. But its ecosystem, including gig workers, requesters, and intermediary platform firms, is different from temporary work. Gig workers, especially gig workers in platforms, often would not contract with the intermediary platforms. Besides, the platforms in the gig economy play a more important role since the entire labor process (Aguinis & Lawal, 2013). Therefore, temporary work is theoretically different from gig work.

Independent contractors/workers. Independent contractors refer to self-employed individuals who contract or sell their services to the clients on a fixed-term or project basis (Gallagher, 2002). According to the definition, we can find this construct shares common ground with gig workers such as work arrangement and employment relationships. In literature, these two terms are often used interchangeably. However, some researchers, especially those interested in the new

gig economy, sometimes may propose that these two terms are not the same considering the role of platforms in the gig economy (Aguinis & Lawal, 2013). Independent contractors or workers only emphasize the relationships between employers and employees. Differently, gig work pays more and more attention to digital platforms since platforms are prevalent from the beginning to the end of the employment process. For example, platforms may provide project information, display recruitment needs, and collect performance feedback. From this perspective, gig workers are not the same as independent contractors or workers.

Teleworking. Teleworking refers to working remotely and communicating via telecommunications or information technology (Bailey & Kurland, 2002). The definition reveals that teleworking and gig work are different terms. The former emphasizes the work location and tools of communications. However, by definition, gig work does not underline these characteristics. Although some types of gig work may rely on teleworking such as crowdwork (Duggan et al., 2020), locations and tools of communications are not the elements of the definition of gig work. For example, some gig work provides the service on-site but should complete the work through apps or other intermediary platforms (Duggan et al., 2020). To sum up, teleworking is different from gig work.

Side-hustles. Side-hustles are defined as "the domain in which full-time employees participate in income-generating work that is separate from their full-time jobs" (Sessions et al., 2020). This type of work arrangement can also refer to multiple jobholding (e.g., Betts, 2006; Caza et al., 2018). Comparing the definitions of side-

hustles and gig work, we can find that side-hustle is a “narrower term” than gig work. Sides-hustles emphasize that individuals usually have their full-time job, and alongside the primary job, individuals engage in other work. However, not all gig work refers to multiple jobholding. For example, some gig workers may work for one specific organization in the given period, or some individuals may be full-time gig workers. Therefore, gig work and side-hustles have some in common, but they are still not the same.

Apart from the abovementioned constructs, in literature, gig workers still have other meanings especially considering the roles of technologies. For example, some researchers conduct their explorations on the gig workers in the **“Old” vs. “New” gig economy.** This classification is mainly based on the usage of the Internet and digitalization. **Old gig economy** only emphasizes the traits of “projects” and “temporary” (e.g., Tepper, 2016), compared with traditional employment forms. This type of gig workers is not new productions. They are freelancers who have specific skills and can independently provide the labor market with their labor force. They usually work and get paid by projects during the given period. Different from the traditional labor force, they will not have the long-term and strong-controlled contracts with one specific organization (Dame, 2016).

Differently, the “**New gig economy”** is the widely discussed new employment relationships. It often relies on the Internet platform and the development of the digital economy and gets used in a wide range of high-tech companies and internet companies (Mulcahy, 2017). As we all know, digital economy includes a series of

effective economic activities that apply the digital knowledge and information as important production factors and rely on the information technologies as carriers (Zheng & Yang, 2019). Therefore, different from the traditional employment form and the old gig economy, the new economy can break various of limits such as working hours, workplace, means of work, and so on (Mulcahy, 2017). Also, it can overcome the shortcomings of the old gig economy: slow information spread and limited coverage, revealing the flexibility and intermediacy of the new gig economy. For example, when one organization requires some temporary or fragmented work demand, it can quickly and effectively spread this demand through the digital platform. Accordingly, independent workers can respond to the demand based on their skills and schedules (Horney, 2016; Lobel, 2017). This new form of employment relationships has become an evolving trend in the worldwide labor market.

Some researchers pay special attention to the "New gig economy" and propose the classification of gig workers **based upon technological features**: app-work, crowdwork, and capital platform work (Duggan et al., 2020). Capital platform refers to the platform where individuals use the digital platform to sell goods peer-to-peer or to lease assets (e.g., Airbnb and Etsy). In this scenario, the role of the platform is to connect customers with a form of capital owned by an individual. Crowdwork refers to "work-mediating digital platforms" (Duggan et al., 2020), such as Amazon Mechanical Turk and Fiverr, through which workers complete their tasks remotely (De Stefano, 2016). In the crowdwork platforms, organizations or individuals post their tasks or project to be completed via the platform. App-work refers to "service-

providing intermediary digital platform organizations (or “apps”) that utilize workers to perform tasks locally (e.g., transport and food-delivery) for customers who pay for these services” (Duggan et al., 2020). In this case, an app is usually designed to perform a specific function directly for the user on mobile devices (Dickinson et al., 2014). Researchers believe that work arrangements, tasks, and conditions are greatly different across these platforms.

Like the “New gig economy” exploration above, some researchers focus on **online gig work** (e.g., Kässi & Lehdonvirta, 2016; Wood et al., 2019) and further investigate the classification of gig workers. These online gig workers are not the same as the gig workers in digital platforms. The former refers to the work remotely transacted and delivered via some ways and the latter one is more related to the mediating tool. Focusing on the online gig workers, researchers try to classify the gig workers based on their occupation class: professional services, clerical and data entry, creative and multimedia, sales and marketing support, and software development and technology (Kässi & Lehdonvirta, 2016).

Apart from the aforementioned typologies, other researchers investigate different typologies. One representative stream of research argues that it is necessary to distinguish between **“serious” vs. “part-time” gig workers** (e.g., Brawley, 2017; Keith et al., 2019). These studies indicate that serious and part-time are helpful categorizations since these two groups of gig workers may have different demographic characteristics, ways of gig platforms usage, motives for engaging in the gig economy, as well as satisfaction level (e.g., Brawley, 2017; Keith et al., 2019;

Kong et al., 2020).

To conclude, this dissertation mainly focuses on gig workers in the "New gig economy". Specifically, we concentrate on gig workers who rely on online labor platforms to meet their requesters.

Review on Online Labor Platforms

Definition of Online Labor Platforms

With the rapid development and application of digital technologies such as the Internet, cloud computing, big data, and machine learning, the platform economy has begun to flourish globally. This change has also attracted widespread attention in the academic community. In the past two decades, scholars from diverse research fields, such as technology management, strategic management, and industrial organization economics, have joined the line of this research (Gawer, 2009; Mcintyre & Srinivasan, 2017). However, there are significant differences in the types of platforms and related research questions concerned by different disciplines.

In general, previous platform research mainly includes four different platform types. **First**, the research on *product family platform* mainly starts from the perspective of technology management and explores how the architectural design of product platform can promote the large-scale production and innovation of enterprises (Gawer, 2014; Mcintyre & Srinivasan, 2017). **Second**, the research on *organizational platform* regards the platform as a new organizational structure with the embodiment

of the dynamic capability of the organization and mainly focuses on how the internal platform of the organization can help enterprises to acquire competitiveness to achieve sustainable development (Thomas et al., 2014). **Thirdly**, research on *platform ecosystems* explores platforms from an ecosystem perspective, focusing on the core technology architecture that enables suppliers to efficiently provide complementary products or services through standardized or open interfaces (Parker et al., 2017; Shipilov & Gawer, 2020). **Fourth**, research on *market intermediary platforms* mainly focuses on the network effects of platform and investigates pricing strategies to better realize network effects (Rochet & Tirole, 2003, 2006). The labor process of platform workers has gradually attracted the attention of the literature (Duggan et al., 2020; Kellogg et al., 2021).

Characteristics of Online Labor Platforms

The online labor platforms concerned in this study are market intermediary platforms connecting demand and supply (Thomas et al., 2014). It provides "a general digital infrastructure for collecting, processing and transmitting information on economic activities such as production, distribution, exchange, and consumption", and provides computing power, data storage, tools, and rules for "digital human production and reproduction activities" (Thomas et al., 2014; Xie et al., 2019). Because it is mainly responsible for connection and market intermediaries, the activities in these platforms revolve around the matching and achievement of transactions, and the content of transactions broadly includes knowledge, information,

resources, and services (Chen et al., 2020). It has the following characteristics regarding organizational attributes, organizational management logic, and organizational management subjects (see Table 1 below).

Table 1. Comparison between Traditional Organizations and OLPs

	Traditional organizations	**Online labor platforms**
Organization features	• With clear boundary • Formal employment relationship, e.g., labor contract • Organization function	• Boundaryless • Non-standard employment relationship, e.g., user agreement • Dual functions of market and organization
Managerial logic	Organizational control	Organizational control & Matching in the market
Managerial agency	Managers	Algorithmic management

(1) Organization features

As market intermediary platforms, OLPs provide a digital infrastructure that connects demand and supply without owning the means of production or selling products directly. Instead, it collects the information of transactions, which is often regarded as the additional value created by platforms due to its market intermediary function (Constantinides et al., 2018; Thomas et al., 2014; Xie et al., 2019). Moreover, these OLPs should coordinate and control gig workers to better achieve

their management goals. Therefore, different from traditional organizations and open markets, OLPs have dual functions of organizations and platforms.

Due to the unique functions, OLPs usually exhibit three structural characteristics: decentralization, boundaryless, and network effects (Gawer, 2014; Xie et al., 2019). First, OLPs have no formal hierarchical structures like traditional organizations. Instead, they guide the retrieval, interaction, and transactions by setting platform rules of engagement (Chen et al., 2020). Second, there is no clear physical boundary for OLPs, and their interfaces are almost open due to their boundarylessness. They are more like an ecosystem compared to the internal platform of the organization (Gawer, 2014). In addition, thanks to boundarylessness, OLPs can continuously involve external participants to realize their network effects and further achieve scaled development (Gawer, 2014; Gawer & Cusumano, 2014; Xie et al., 2019).

(2) Managerial logic

Concerning the dual functions, OLPs creatively combine the market logic and the organizational logic during their management. On the one hand, like traditional organizations, OLPs impose monitoring, evaluation, reward, and punishment on gig workers, which reflects the logic of organizational control. On the other hand, embodying the market logic, platforms follow the free trading rules based on the price mechanism in an open environment (Constantinides et al., 2018; Möhlmann et al., 2021). The empirical research of Meijerink et al. (2021) pointed out a tension between the market logic and the organizational logic of these OLPs. The former advocates

free and autonomous profit-making activities of participants in an open environment, while the latter is committed to controlling workers to achieve profit and growth of OLPs. Therefore, these platforms need to exert their control and, at the same time, maintain the status of gig workers as independent and autonomous market participants, which leads to great institutional complexity and management challenges (Mejerink et al., 2021).

(3) Managerial agency

In OLPs, organizational boundaries are open, the cornerstone of traditional organizational management—formal employment relationship no longer exists, and hierarchical authority becomes invalid (Meijerink & Keegan, 2019; Kuhn & Maleki, 2017; Vallas & Schor, 2020). At this time, algorithmic management based on digital technologies gradually replaces managers in traditional organizations to coordinate and control the large number of gig workers who are geographically dispersed. Synthesizing the viewpoints of recent theoretical research, we define algorithmic management as a new type of organizational management of market intermediary platforms using algorithmic technologies to achieve their management goals (e.g., Liu et al., 2021; Meijerink & Keegan, 2019; Möhlmann et al., 2021; Parent-Rocheleau & Parker, 2022; Wood et al., 2019). These platforms rely on algorithmic management to overcome the constraints of time and space, directly reach tens of thousands of workers, connect demand and supply, and simultaneously supervise and intervene gig workers' work process. Therefore, algorithmic management plays the role of

managers in traditional organizations and becomes a " faceless boss " (Wang, 2020), which leads to gig workers' experience of "working for an algorithm" (Curchod et al., 2020).

Review on Algorithmic Management in OLPs

Organizational Control vs. Algorithmic Management

Given the importance of algorithmic management in OLPs, we should clarify what it is. Since it is a new concept, we can compare it to the other similar construct which is more well-established to indicate the importance and necessity of my further construct development. In this dissertation, we mainly focus on organizational control.

By definition, **organizational control** refers to a variety of mechanisms that direct actors to align their goals, actions, and capabilities with those of the organizations of which they are a part (Cyert & March, 1963; Merchant, 1985). From its definition, we can easily find that it shares great common ground with algorithmic management. Although the labor relations of the gig economy are different from those within traditional organizations, the goals of management are similar. Both of them aim to use various tactics to make employees/gig workers work as their organizations/platforms require to further reach goals of organizations/platforms and maximize their interests. Therefore, to some extent, reviewing the research of organizational controls can inspire us when clarifying algorithmic management.

Organizational control is a fundamental component of modern organizations

(e.g., Dunbar & Statler 2010; Scott, 2003). Previous research has explored a lot mainly on control systems and mechanisms of organizations. It indicates that organizations exert their controls over employees mainly through the following mechanisms: monitoring, coordination, and subordination (e.g., Delbridge, 2010; Lumineau & Malhotra, 2011; Malhotra & Lumineau, 2011). Besides, during the exploration, different scholars usually draw upon various control framework to illustrate the control designs. For example, based on reviewing the existing empirical work on organizational control, Cardinal et al. (2017) summarized seven different control frameworks, such as control system (Ouchi, 1979) and formal control targets (Cardinal, 2001). Under the different use of control framework, the literature indicates that organizational control will greatly influence diverse organizational outcomes, such as adaptability outcomes and human relationships (see review of Cardinal et al., 2017; Sitkin et al., 2020).

Although these studies inspire us to understand the possible control mechanisms, control systems, and outcomes of algorithmic management in OLPs, we should pay attention to their differences. As we all know, organizational control usually involves two entities: organizations and employees. However, in OLPs, there are at least three different entities as shown in Figure 2 and all of them may play important roles in platform management. “The key economic exchange that is taking place in the gig economy is platform-enabled gig work” (Meijerink & Keegan, 2019). This indicates that in the new employment relationships, OLPs function as brokers between gig workers and requesters (Meijerink & Keegan, 2019). Specifically,

platforms provide both employers and employees with opportunities to match the labor demand and labor supply by integrating massive information from two sides.

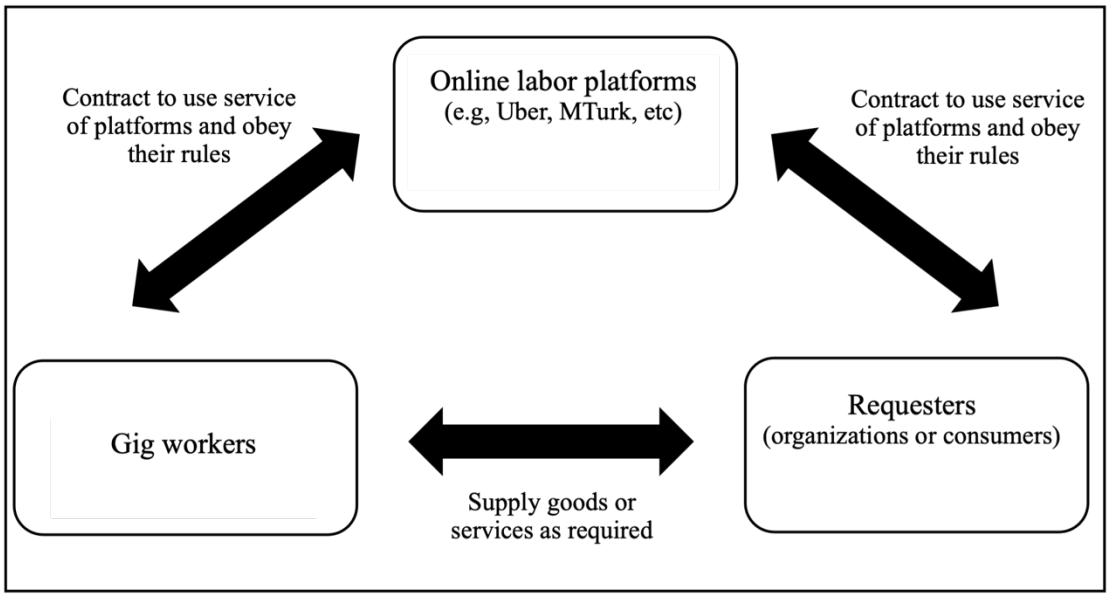

Figure 2. Ecosystem of OLPs

Note. This figure was adapted from Stewart & Stanford (2017)

Definition of Algorithmic Management in OLPs

When reviewing the literature, research on algorithmic management has seen explosive growth over the past few decades as shown in Figure 3.

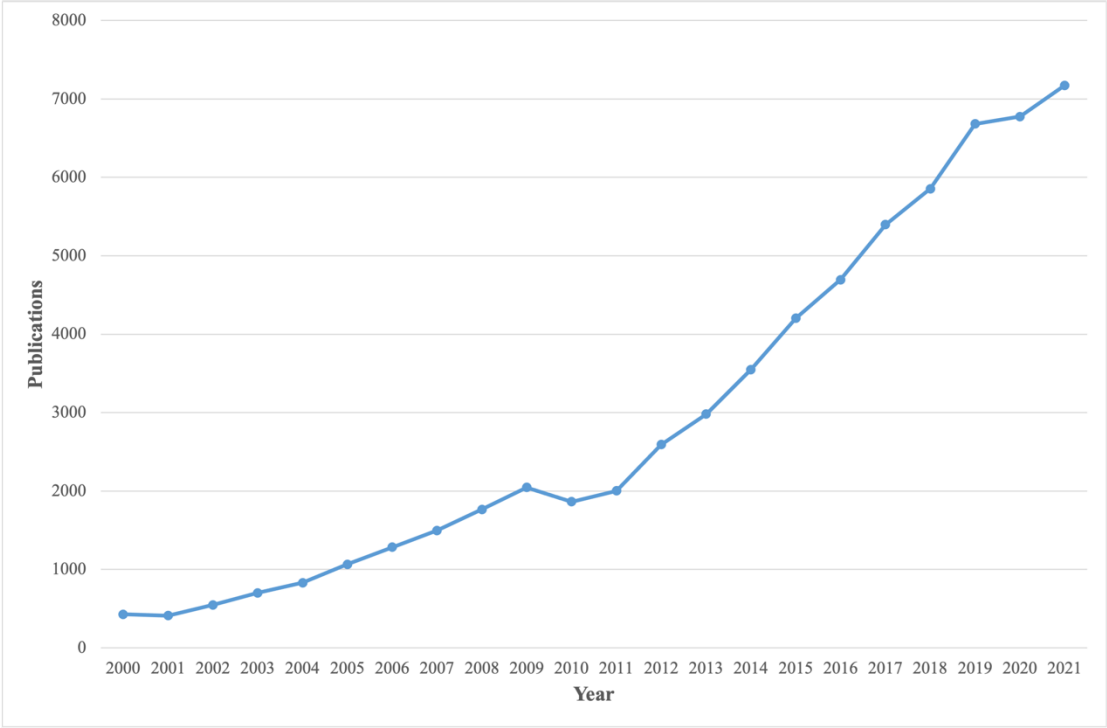

Figure 3. The Trend of Publications on Algorithmic Management

Note. I drew this figure based on the results of data search in the Web of Science core citation database using the terms "algorithm" and "platform" in their topic.

Different scholars may have different definitions of algorithmic management. I summarize the related constructs in Table 2. Based on the previous research, I define algorithmic management as new types of organizational management tactics of OLPs using algorithmic technologies to achieve management goals. In practice, it usually includes tactics of human resource management and organizational control, such as task pricing, scoring mechanisms, real-time feedback, and APP-based remote monitoring (e.g., Liu et al., 2021; Kuhn & Maleki, 2017; Meijerink & Keegan, 2019; Möhlmann et al., 2021). With the help of algorithmic management, OLPs can directly reach tens of thousands of workers who are geographically dispersed and simultaneously supervise and intervene in their work processes. Concentrating on this

construct, scholars from different disciplines have joined this line of research and provided us with diverse understandings of the effects of algorithmic management on gig workers. In the literature, the existing explorations are mostly theoretical investigations from the perspectives of economics and sociology. The former starts from the platform side and is committed to exploring how the platforms can better realize their network effect, empower, and connect the majority of participants. The latter starts from the labor process of gig workers and focuses on depicting the platforms' strong control and "new type of exploitation" of workers. The existing research progress is introduced in the next section.

Table 2. Definition of Algorithmic of Management

Construct	Research	Definition
Algorithmic management	Liu et al.，2021	The platform control system designed based on computer algorithm technology is a set of rules and procedures developed by coding and programming the operating instructions of platform management, which replaces manual intervention and controls workers in real time to ensure work performance.
Algorithmic management	Bucher et al., 2021 Duggan et al., 2020 Parent-Rocheleau & Parker, 2022	A control system that automates decision-making and control through advanced computer technologies such as monitoring, data processing, and machine learning to limit human participation and supervision in the labor process.
Algorithmic management	Möhlmann et al., 2021	Ensure platform workers are aligned with platform goals by collecting and using data at scale on the platform and developing and improving learning algorithms to take on the coordination and control functions of traditional managers.
Algorithmic control	Kellogg et al., 2020	It is a new form of organizational control that uses algorithm technology to guide, evaluate and discipline workers.
Algorithmic control	Wood et al., 2019	The practical activities of management control based on digital technology mainly rely on the evaluation and digital reputation system to restrict the behavior of platform workers in the way of "soft control”.
HRM through algorithm	Meijerink & Keegan, 2019 Meijerink et al., 2021	Algorithmic or digital technology to automate human resource management activities and related decisions

Research on the Effects of Algorithmic Management in OLPs

(1) Explorations on the positive effects of algorithmic management

This line of research focuses on the market intermediary role of OLPs in transactions between different stakeholders, exploring how to achieve the network effects from the perspective of economics (Gawer, 2014; Gawer & Cusumano, 2014). Researchers believe that the essential mechanism for platforms to achieve this goal is the pricing strategy (Gawer, 2014). By exploring pricing models of completed transactions, these studies investigate how to set a reasonable price to attract participants, facilitate the matching between demand and supply, and maintain them in platforms (Facin et al., 2016; Gawer, 2020). For example, the research on network effects pays particular attention to the "chicken and egg problem". In order to attract more demanders, the platforms need to have more suppliers. However, before attracting more suppliers, the platforms should have enough demanders (Caillaud & Jullien, 2003; Gawer, 2020). Therefore, how to set registration and transaction fees to better realize network effects is an important research topic in this field (Caillaud & Jullien, 2003).

In general, this research more positively describes platform management via algorithms. According to this research, OLPs establish "a self-reinforcement feedback loop that magnifies incumbents' early advantages" by continuously involving new participants (Gawer, 2014, p.1241). This perspective emphasizes the enabling effects of algorithmic management in OLPs. However, there are some limitations in this research domain. First, this line of research treats the demand and the supply sides as

the same, neglecting the differences and complexities of two sides (Gawer, 2014). Besides, the studies based on pricing mechanisms usually assume that participants in OLPs are only economically driven, ignoring motivational aspects such as their personal needs. Therefore, they mainly emphasize the empowering role of algorithmic management and focus more on the economic attributes of gig workers, ignoring individuals' social attributes and the characterization of their behaviors.

(2) Explorations on the negative effects of algorithmic management

Unlike above studies, this line of research usually focuses on gig workers and explores the impact of platform management via algorithms on their labor process. This stream of research regards gig workers as "independent contractors" who fail to be protected by labor laws. At the same time, OLPs enabled by algorithms have tremendous power to control gig workers (Wang, 2020). This indicates the unbalanced relationships between the two sides. For example, in the process of App work, platforms often use the advantages of information asymmetry and the opacity of performance evaluation systems to strengthen control over gig workers (Veen et al., 2020). Digital technologies make gig workers lose their rights to decide on issues such as work assignments and performance evaluation (Duggan et al., 2020).

Labor process theory states that managers often control employees' work process to capture their residual value, obscuring the means and processes by which they achieve this goal simultaneously (Chai & Scully, 2019; Donnelly & Johns, 2020; Kellogg et al., 2020). The opacity and real-time nature of algorithmic management in

OLPs help to fully control the working process of gig workers, and the attributes algorithms also make this exploitative relationship more hidden, making gig workers not know whom to fight against (Lee et al., 2015; Veen et al., 2020; Wang, 2020). In addition, the task-based work model also induces job instability and the degradation of workers' skills (Xie et al., 2019). Taking the food delivery workers as an example, the discontinuity of delivery orders makes the workers often in a highly embedded standby mode for a long time every day. Therefore, their work becomes fragmented and individualized, which increases their dependence on OLPs. In general, the research of this domain pays more attention to the labor process of gig workers in OLPs and regards platform management via algorithms as the exploitation of labor by capital (Xie et al., 2019). However, this dark portrait of algorithmic management in OLPs ignores the positive aspects of gig work, such as low barriers to entry and free exit mechanisms (Vallas & Schor, 2020).

Review on Employee-organization Relationship (EOR) in Online Labor Platforms

EOR Research in Traditional Organizations

Employee-organization relationship (EOR) depicts the formal or informal, economic, social, or psychological connection between employees and their organizations (Tsui & Wang, 2002). It reflects the connections between employees and organizations and influences organizational development and employees'

interests. Research on this topic can be traced back to Barnard (1938), who defined EOR as an exchange between organizations and employees. Specifically, organizations provide inducements, such as compensation, benefits, and social support. And employees have to contribute to organizations accordingly (Barnard, 1938). Then, based on this research, different scholars explored EOR from diverse theoretical perspectives and proposed various ways to classify this relationship. Specifically, in order to better understand the important factors that affect organizations' choice of relationship type, scholars have completed a series of studies on the antecedents of EOR.

Existing research on the antecedents of EOR mainly focuses on the influence of factors at different levels on the choice of EOR category. First, at the organizational level, some studies have found that factors, such as enterprise ownership structure (Zhang, 2004), internal communication and hierarchical structure characteristics (Kim, 2007), capabilities of human resource management (Zhao et al., 2016), characteristics of human capital (Lepark & Snell, 1999), enterprise development stage and enterprise category (Ni, 2007), as well as internal factors such as the company's strategic model, organizational culture, and job characteristics (Pearce et al., 1995), all profoundly affect organizations' choices of relationships with their employees. These studies are mainly based on diverse theories and perspectives, such as the incentive-contribution model (Tsui et al., 1997), the resource-based view (e.g., Barney, 1991), organizational justice (Colquitt & Greenberg, 2003), to differentially explore how the attributes at the organization level affect the final choice of the relationship between

organizations and employees.

At the individual level, researchers mostly conduct research on the antecedents of EOR from the perspective of agents. When exploring EOR, it is necessary to first clarify who are the two main subjects in the relationship. In other words, we should specify the connotations of employee and organization. Specifically, the primary question for research on this topic is to answer whether the relationship between employees and organizations refers to the direct connection between employees and their organizations or the relationship between employees and a specific agent in the organization, such as employees' direct leaders (Kang & Shi, 2011). Since organizations are too abstract for employees, organizations are often portrayed as leaders who actually connect and interact with employees (Othman et al., 2005). Thus, when exploring the individual-level antecedents that influence organizations' selection of EOR category, researchers often focus on the impact of leadership as organizational agents on EOR construction within organizations. In addition, employees' characteristics, such as whether they are core members (Ni, 2017), also affect the EOR construction.

The above studies have explored factors within organizations that may affect EOR construction and selection. In addition, a small number of studies have focused on external factors such as the characteristics of labor market (Ni, 2007; Pearce et al., 1995), policy environment (Pearce et al., 1995), and other macro features. In response to this line of research, more and more scholars have gradually realized the importance of the external environment for the construction and selection of EOR

(Coyle-Shapiro &Shore, 2007; Shore et al., 2004). However, the number of such studies is still very limited, and there is a lack of empirical exploration.

EOR Research in the New Context

With the development of the economy and technologies, the forms of organizations and their employment relationships have changed drastically around the world, which poses new challenges to EOR research (Shore et al., 2004). For example, the emergence of platform organizations and new forms of employment, such as labor dispatch and temporary employment, have all impacted the employment relationships in traditional organizations. As a result, research on new types of EOR in new scenarios began to emerge. This line of research mainly focuses on how and what kind of relationships organizations will construct with workers in the new context.

For example, focusing on the sharing economy, Pei et al. (2021b) constructed different organization environments of atypical employment and explored four new types of employment strategies (i.e., crowdsourced distributed employment, online matching employment, autonomous competitive employment, and outsourcing intensive employment). In particular, as a special organizational category, this study also discusses the online labor platforms that this dissertation focuses on. For the employee-organization relationship in this scenario, Pei et al. (2021b) described it as a control system that platforms designed based on machine learning to replace traditional management with real-time labor control through algorithms.

Also, in the context of online labor platforms, Duggan et al. (2020) similarly noticed that the relationship between platforms and gig workers is significantly different from that between traditional organizations and their employees. Specifically, through APPs, platforms construct a new type of relationship with gig workers, where platforms unilaterally make rules to shape or limit the rights of gig workers while increasing workers' dependence on them. In this circumstance, gig workers only enjoy autonomy to a limited extent, and more often, they face extremely high power asymmetry with platforms (Duggan et al., 2020).

This imbalanced relationship between platforms and gig workers was also depicted by the work of Long et al. (2021). Focusing on the online labor platforms, they found that the relationship between platforms and gig workers was different in different stages of gig worker management. For example, in the selection stage, gig workers were highly autonomous since they were free to enter the platforms. However, during platform work and human resource development, gig workers were under tight control and lacked investment from platforms. This indicated that the relationships between gig workers and platforms were based on economic rather than social emotional exchange (Long et al., 2021).

It can be seen from the above research that more and more scholars have gradually paid attention to the uniqueness of EOR in new scenarios, such as online labor platforms, which are different from EOR in traditional organizations. To a certain extent, these explorations have important implications for our understanding of gig worker-OLP relationships. However, based on the previous review of the

research on the antecedents of EOR, we found that the current progress is still insufficient to fully understand the construction, characteristics, and evolution of EOR in online labor platforms. To conclude, EOR research has the following limitations.

First, the existing EOR research fails to pay sufficient attention to the context, which limits the explanatory power of previous EOR studies. On the one hand, in addition to some exceptions I introduced above, in the literature, few studies have explored EOR in the new scenario, such as market intermediary platforms. In the new context, the findings or theories (e.g., the incentive-contribution model, Tsui et al., 1997) may fail to depict the full picture of gig work-OLP relationships. Traditional employee-organization relationships are mostly based on labor contracts (e.g., Ehrenberg & Smith, 1994; Hart, 1983), which indicates a formal and relatively stable employment relationship. However, in online labor platforms, the employee-organization relationship is wholly subverted. In practice, gig workers often do not establish long-term and formal labor relationships with platforms. They typically establish instant and loose connections based on the User Agreement. In this circumstance, platforms seldom invest in gig workers, such as training and personnel development. Accordingly, gig workers do not need to make a corresponding return on investment in platforms. Therefore, under this topic, it is urgent to analyze the characteristics of the relationships between gig workers and platforms, as well as the antecedents, mechanisms, and evolutionary processes of relationship construction. On the other hand, when exploring the antecedents of EOR, the existing research focuses more on the internal factors and ignores the influence of external factors of the

organization, such as political, environmental, social, and technological factors. Therefore, more research is needed to explore the influence of external factors on EOR formation, especially in the new context of online labor platforms.

Second, the EOR research in the emerging platform scenario depicts the relationships between gig workers and platforms in a homogeneous way and mainly investigates the relationships from the control perspective. This line of research focuses on the organization function of online labor platforms and homogeneously depicts the relationships between gig workers and platforms, which fails to fully capture the diversity of EOR in this new context. For example, the studies of Pei et al. (2021b), Long et al. (2021), and Duggan et al. (2020) have all noticed the characteristics of online labor platforms that are different from traditional organizations. They have regarded the relationships between gig workers and platforms as unbalanced connections, where platforms exert tight control over gig workers. However, considering the diverse employment practices in online labor platforms and their role as market intermediaries, exploring different types of gig worker-OLP relationships are of great significance.

Third, the existing research on EOR is characterized relatively statically, failing to capture its dynamic evolution process. In practice, the relationships between employees and organizations are usually not static, and they often undergo dynamic adjustments and changes under the influence of internal and external factors, especially in the gig economy. As early as 2004, Shore et al. proposed that the connection between employees and organizations was not fixed and static and this

dynamic attribute had not been fully investigated in the EOR literature. They called for more research to capture the evolution of employee-organization relationships in the future (Shore et al., 2004). However, despite the development of research in the field of EOR, the above dynamic relationship is still lacking. The few studies that focus on relationship dynamism were mostly based on the employee perspective, which regarded EOR as employees' personal perceptions, and then explored the factors that affected individuals' interpretation of their relationships with organizations (e.g., Eldor & Vigoda-Gadot, 2007; Schalk & Roe, 2007).

Conclusions of Literature Review

According to the literature review above, research on algorithmic management in online labor platforms is still in its early stages and several lines of inquiry merit further exploration. First, regarding the conceptualization and operationalization of algorithmic management, the literature usually articulates algorithmic management around its diverse functions (e.g., direction, evaluation, and discipline, Kellogg et al., 2020; Pei et al., 2021). This line of research refers to algorithmic management as the specific control or managerial tactics of platforms to achieve their goals. However, since managerial tactics/practices may change with the development of platforms, it is difficult to conceptualize and operationalize algorithmic management that can be widely applicable. Moreover, due to the development of algorithms, managerial tactics or practices in OLPs can also change rapidly, such as iterated as the APP's

update. These traits of platforms and technologies will significantly challenge the concepts and measures of algorithmic management based on the functions. To address these limitations, a new way to effectively conceptualize and operationalize algorithmic management, especially in the context of online labor platforms is urgently needed.

Second, as introduced, online labor platforms have the dual nature of organization and market. However, the existing research mainly focused on the organizational facet of these platforms, which leads to the omission of the exploration on the positive effects of algorithmic management. Due to the nature of market, gig workers in OLPs can work as independent workers. In this case, apart from control, algorithmic management can also positively influence gig workers, indicating the potential bright side of algorithmic management in OLPs. For instance, some research revealed that in addition to the negative effects, algorithmic management in OLPs could provide platform workers with benefits such as considerable autonomy and the awareness of self-identity (e.g., Möhlmann et al., 2021). To comprehensively depict the nature of algorithmic management in OLPs, more research is in need to reveal its double-edge sword effects. Furthermore, in order to mitigate the negative effects and amplify the positive effects, future research can explore the boundary conditions to provide both theoretical and practical implications.

Besides, based on the accumulated conceptual research, researchers have gradually started to empirically explore how algorithmic management will influence platform workers (e.g., Pei et al., 2021a). When conceptualizing algorithmic

management, the existing research preferred to regard it as management practice and then construct it with several packages of practice, such as algorithmic direction, evaluation, discipline (e.g., Kellogg et al., 2020; Pei et al., 2021a). However, considering that practices of algorithmic management may vary across different platforms, it is difficult to conceptualize and operationalize algorithmic management that widely applicable. Therefore, future research could attempt to conceptualize algorithmic management in a more abstract way.

Moreover, regarding the relationships between gig workers and online labor platforms, the existing research suffers from the following limitations. Previous studies fail to pay sufficient attention to the new scenario, which weakens the explanatory power of the existing theories and findings in the context of online labor platforms. In this kind of market intermediary platforms, different from traditional organizations that often have relatively stable and long-term formal labor contracts with employees, online labor platforms are often loosely connected to gig workers based on weak contracts such as User Agreements. Therefore, the explanatory power of the classic theories, such as the investment-contribution model (Tsui et al., 1997), may be relatively limited in the new context.

Although a small number of studies have focused on EOR in new scenarios, most of them apply a relatively homogeneous perspective to look at the relationships between platforms and gig workers, ignoring the diverse employment practices in the online labor platforms scenario. Moreover, most of the existing research adopts a relatively static perspective to depict employment-organization relationship, failing to

capture the process of EOR construction and evolution. More research is urgently needed to explore the diverse relationships in OLPs and illustrate how gig worker-platform relationships construct and evolve.

CHAPTER 3: STUDY 1

As a new form of organization with the duality nature of market and organization, online labor platforms face the severe challenge of how to effectively manage the massive platform workers without formal contracts. In practice, platforms turn to algorithmic management, which is defined as new organizational management tactics of platforms using algorithmic technologies to achieve management goals (e.g., Liu et al., 2021; Meijerink & Keegan, 2019; Möhlmann et al., 2020).

In order to better understand algorithmic management on online labor platforms, in Study 1, I tend to conduct two sub-studies. In Study 1A, I will conduct qualitative research in the context of food delivery platforms in mainland China to figure out what algorithmic management is. Based on grounded theory, the results will help to reveal the concept and dimensions of platform workers' perceived characteristics of algorithmic management. Furthermore, following the steps of standard scale development (Hinkin, 1998), in Study 1B, I will construct the scale to lay a solid foundation for future empirical research.

Study 1A: Conceptualization

Research Context and Methodology

(1) Online food delivery platforms in China

When studying online labor platforms, especially in mainland China, online food delivery platforms can be suitable and valuable research context. Since 2008, with the emergence of online labor platforms, the labor relations in China have undergone

significant changes. The "China Sharing Economy Development Report" pointed out that in 2020, the number of participants in the sharing economy would be about 830 million, including about 84 million service providers and about 6.31 million employees of platform companies. During the development of the platform economy, the food delivery industry has continued to maintain rapid growth. As of 2020, the size of food delivery market in China had reached 664.62 billion yuan, a year-on-year increase of 2965.60%.

As the market intermediaries, these online food delivery platforms integrate massive amounts of take-out information, connecting the supply and demand sides to facilitate the online transactions and the completion of online distribution for merchants. On these online food delivery platforms, delivery workers receive and inspect orders to earn money. At the same time, they are managed by the market intermediary platforms they are working on such as obeying the order requirements, following the intelligent planning route of the platform, and delivering the food to the designated place within a certain period of time.

(2) Grounded theory

Grounded theory was first proposed by Glaser and Strauss (1967) in their classic book titled The Discovery of Grounded Theory. As a new research paradigm, grounded theory emphasizes that in qualitative research, researchers should not be constrained to the analysis of the narrative and discourse of the research object. Instead, researchers should break away from the simple description of the phenomenon and propose new theories using use the empirical data. Correspondingly,

the two proponents of grounded theory, Glaser and Strauss (1967), clearly pointed out that the main purpose of the theory was to fill in the gap between theoretical research and empirical research.

The uniqueness of the grounded theory mainly comes from the diverse education backgrounds of the two proponents (i.e., Glaser and Strauss). On the one hand, the quantitative research training received by Glaser made him believe that qualitative research should follow scientific principles and minimize the impact of the researchers' subjective consciousness on the process of theory construction. On the other hand, the training on the traditional sociological research paradigm that Strauss received made him advocate that in qualitative research, researchers should give full play to their subjective initiative and construct theories through data collection and data mining.

After incorporating the above-mentioned characteristics and advantages of the two research streams, grounded theory can integrate the research paradigms of positivism and interpretivism. On the basis of scientific principles, grounded theory can provide rich theories for the construction of new theories by restoring social reality. Therefore, grounded theory is widely used in research of diverse disciplines such as sociology and management. In this study, I adopted grounded theory to conceptualize gig workers' perceived characteristics of algorithmic management in online labor platforms. The detailed procedures and results were introduced below.

(2) Research procedure and data sources

Sampling. To collect data, I firstly distributed the invitation letter for interview

offline to the platform workers. The letter explained the research purpose, research method, the remuneration and my contact information (i.e., my WeChat QR code). If they would like to participate to my research, they added me as a friend by scanning a QR code in the letter. After that, they were firstly required to provide the proof of their identity as food delivery workers (i.e., a screenshot of their profile on the APP). Then I made an appointment with them and interviewed them online.

The sample comprised 23 food delivery workers and most of them work on the two largest instant delivery platforms on mainland China. Among 23 food delivery workers, 22 are male and 1 is female. Their average age was 31.80 years (standard deviation = 4.74), and their average tenure was 3.52 years (standard deviation = 1.96), which indicated that they knew this context very well.

Interviews. Interviews lasted between 47 and 90 minutes (the average duration was 65.60 minutes), which amounted to nearly 26 hours in total. I stopped data collection when no new information emerged from the interviews. To be specific, I followed a semi-structured interview protocol that concentrated on the interviewees' work experiences on online labor platforms.

(3) Data analysis

Data analysis followed three steps. I started with the first-order open coding of interviews with gig workers (Strauss & Corbin, 1998). At very beginning, I was not clear about what data would prove to be the most salient ones. After I repeatedly read and coded the interview materials, I got the first-order categories. During the second stage, I tried to collate the first-order categories into second-order themes (Strauss &

Corbin, 1998; Charmaz, 2014). The final stage was to assemble the second-order themes into aggregate dimensions, which depicted the characteristics of algorithmic management (Gioia et al., 2013). To extract these dimensions, I identified relations among them and considered the final coding structure of this qualitative study shown in Figure 4. To illustrate, statements that revealed platform workers' experiences of algorithmic management were gathered in four first-order categories, such as "It depends on luck to receive orders" and "It is not easy to understand how the systems distribute orders". These first-order categories were further grouped into two second-order themes, which were then ordered in one aggregate dimension: transparency.

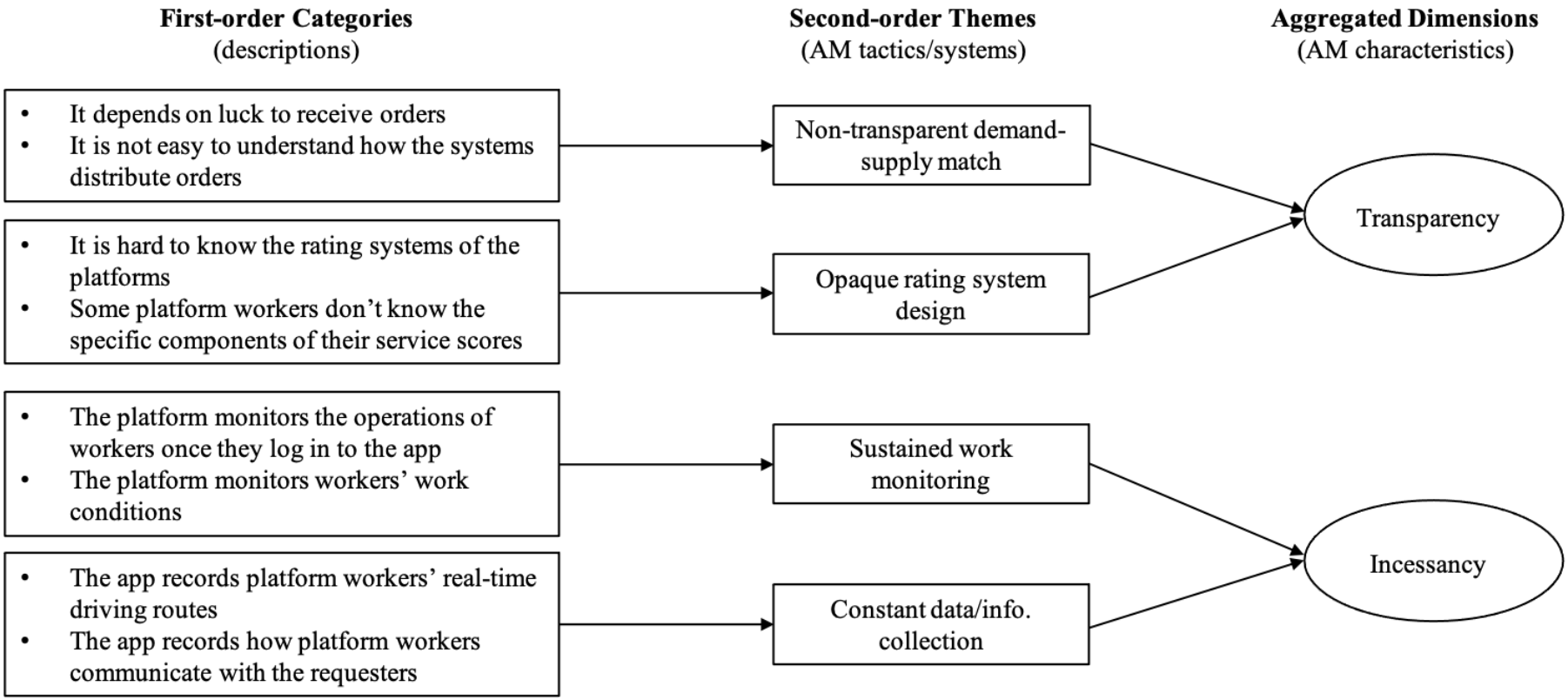

Figure 4. Coding results of Study 1A

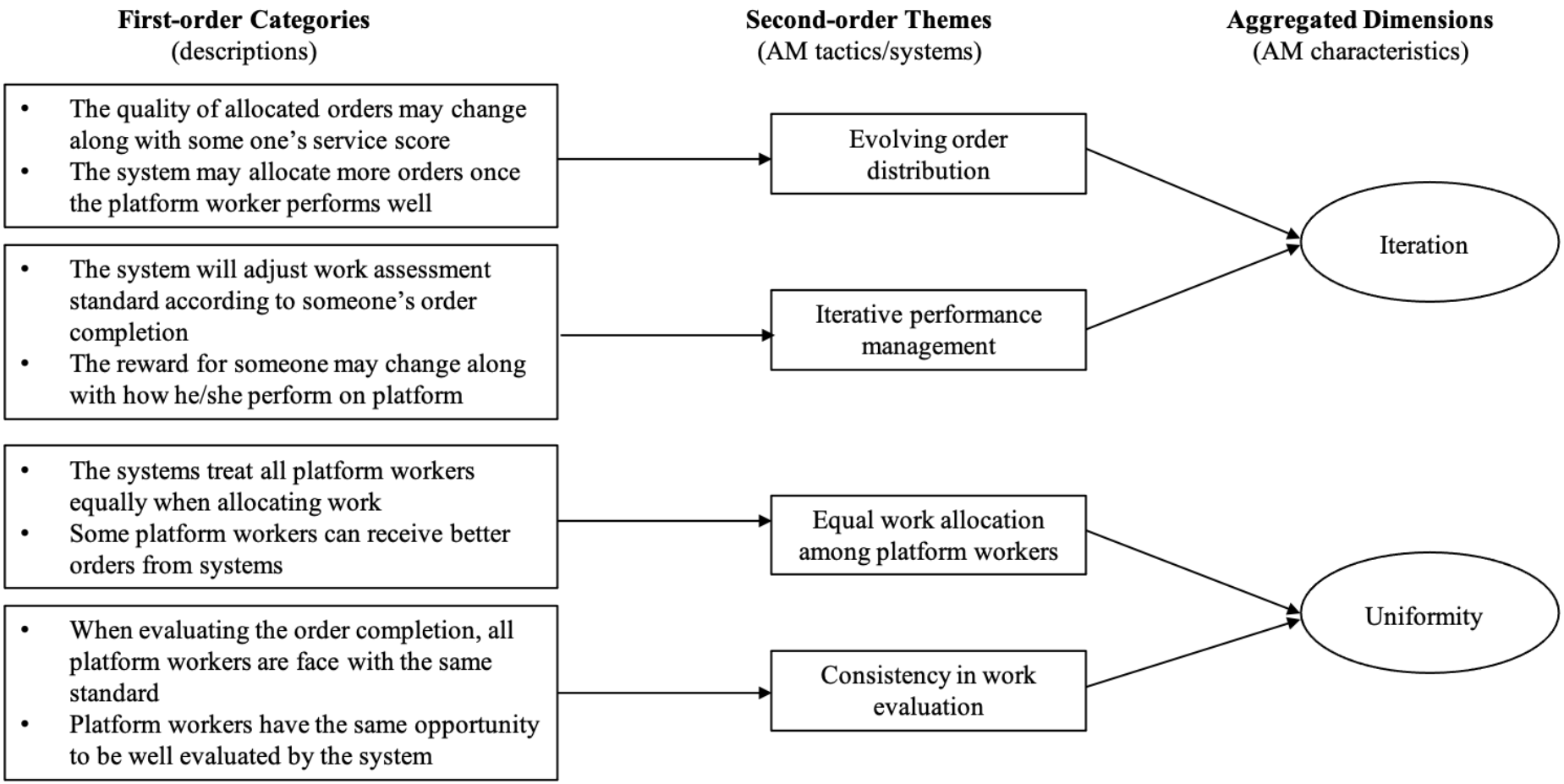

Figure 5. Coding results of Study 1 (continued)

Results

According to the results of the data analysis in Figure 4, I finally extract four different characteristics of algorithmic management in this research context. We illustrate the definition and the connotation of the four dimensions as followed.

(1) Transparency

The first characteristic of algorithmic management in OLPs is transparency. I define transparency as **the extent to which gig workers could fully understand the procedures or mechanisms of algorithmic management**. In general, gig workers' understanding of algorithmic management was usually manifested as a non-transparent demand-supply match and an opaque rating system design. The gig workers complained that they failed to figure out how the work was allocated. They knew that all of the orders that they received were automatically allocated. However, they said they knew nothing about the "rules" of work allocation. One gig worker explained this confusion as follows:

> *I just have to accept the orders and seldom refuse them, because rejection could decrease the number and quality of my subsequent orders. I don't know why I receive these orders. I have worked on this platform for four years and I still cannot explain it. [GW#4]*

The gig workers' confusion extended beyond work allocation. They were also confused about how to increase the number of their allocated orders, as described by another gig worker:

> *I tried to improve my ability to receive more orders, for example, by completing*

more orders during the rush hours. But my efforts seem useless. I don't know how to get more orders. [GW#3]

Many gig workers complained that there were no rules associated with receiving orders and that their workloads were completely dependent on personal luck. They could not solve this "mystery." A gig worker commented on this issue as follows:

It is totally like the lottery. I don't know how the platform allocates the orders. When I am lucky, I receive good orders or more orders. But if I fall on hard times, I am allocated very few orders. It is a "mystery!" [GW#7]

A similar mystery was perceived to surround the performance evaluation process. Some of the most experienced gig workers—those who had worked on the platforms for several years and completed more than 10,000 orders—complained about this issue. One such complaint is set forth below.

I cannot understand the rating system of this platform. Although I know that the number of completed orders and high customer ratings in recent days influence my follow-up service score, certainly there are unknown factors that also play a role! [GW#9]

Similarly, the gig workers failed to find effective ways to improve their service scores. Proactively changing their scores was a difficult challenge, which one gig worker described as follows.

It is too hard! I tried many methods to improve my service score, such as going to remote areas to complete orders. Useless! I have given up on figuring out this problem. [GW#4]

These opaque performance evaluations were also reflected during the gig workers' experience learning. Some gig workers complained that it was too difficult to figure out the rating system. Even when they learned from the successful deliveries, their service scores remained unchanged, as illustrated below.

It is weird! I don't know the principles of our rating system. I once collected information about many successful deliveries by other gig workers on the platform from their posts on social media. However, when I did what they had done, my service score remained the same. [GW#10]

Taken together, these accounts suggest that the first characteristic of algorithmic management is transparency, which depicts the extent to which work allocation and performance evaluation procedures are transparent to gig workers. The higher the level of algorithmic management transparency, the higher the likelihood that gig workers can understand how to obtain more work and improve their performance evaluations.

(2) Incessancy

Another characteristic that emerged during the coding process was incessancy, which we define as **the extent to which platforms continue to monitor or record data on their gig workers with the help of algorithms**. Many gig workers said that they often worked under continual monitoring by the platform. They claimed that the platform monitored everything they did, with one worker stating as below.

Once I log on to the app, I am monitored. The app, the recorder, and the camera

in my car monitor me. It only stops when I log off. [GW#6]

The gig workers also reported that this monitoring was very strict. Once a gig worker does anything improper, the platform immediately contacts them, a practice recounted by one gig worker as follows.

If I receive an order but nearly fail to complete it within the given time, the app sends a reminder message or even calls me to find out what happened. The platform knows everything I do. [GW#20]

The platform continuously records everything that gig workers do using advanced technologies. The platform workers mentioned that the app recorded all of their activities, with one worker indicating as below.

You can see that the app is recording my real-time driving routes. Even when I am not completing an order, it records where I go and how I drive. [GW#6]

Moreover, the app records not only gig workers' behaviors but also their interactions with customers, with one gig worker stating, "*When we complete an order, all of our conversations with the customer are recorded by the app*" *[GW#1]*.

All of these accounts indicate that the second characteristic of algorithmic management is incessancy, which depicts the extent to which OLPs monitor or record the work data and relevant behaviors of gig workers with the help of algorithms. The higher the level of algorithmic management incessancy, the higher the likelihood that gig workers feel that the platforms track them and record all of their behaviors and operations.

(3) Iteration

The third dimension of OLPs' algorithmic management is iteration, which I define as **the extent to which platform algorithms adjust their management of gig workers in response to those workers' input**. Iteration is a unique dimension, especially compared with management in traditional organizations. Typically, organizational management is relatively stable because it functions through formal rules, norms, or policies. It is uncommon for these rules or norms to change in traditional organizations, indicating that organizational management may seldom evolve. However, during the interviews, I found that algorithmic management in OLPs was more dynamically changing and continuously evolving than traditional organizational management. According to the interviewees, given updated versions of the app and the historical data of gig workers, OLPs continuously revised their work requirements and standards. Below, I set forth one gig worker's comment on the evolution of order distribution:

> *The platform changes the work rules and requirements. For example, once my service score increased, it (i.e., the platform) allocated better orders to me. If I fail to log on for a long time, I receive few orders once I log on again. [GW#1]*

The interviewees also indicated that platform management often changed because of the iterative performance management in OLPs. One gig worker illustrated these changes as follows.

> *The system keeps updating … I feel that the reward system often changes. Monthly, our scores are reset to zero and I have to start from scratch. [GW#9]*

Taken together, these accounts reveal the third characteristic of algorithmic management: iteration, which depicts the dynamic facet of OLPs' algorithmic management. The higher the level of iteration of algorithmic management, the more frequently OLPs adjust their management of gig workers in response to workers' input.

(4) Uniformity

The final dimension that emerged during my coding process was uniformity, which I define as **the extent to which platforms' algorithmic management is consistent for each gig worker**. During the interviews, some gig workers mentioned uniformity issues between them and their peers. Some complained about unequal work allocation among different gig workers in the same platform. One illustration of this issue is as follows.

I don't know why. Some gig workers receive many more good orders than I do. To some extent, I feel that this is unfair. [GW#10]

That said, some of the interviewed gig workers reported completely different experiences. They said that the platforms treated all gig workers equally when allocating orders. One example of this view is as follows.

I do not feel any unfairness when receiving orders from the platform. The system treats all of the gig workers the same. [GW#8]

Nevertheless, when discussing their work experiences, the gig workers mentioned the variability of the work evaluations among their colleagues. Some gig workers felt

that all of the gig workers were subject to the same rules and standards, whereas others complained that gig workers received inconsistent evaluations. Two examples are set forth below.

> *To be honest, I feel that the platform treats us the same. Regarding the differences in our performance evaluations, some gig workers may blame the system for giving inconsistent evaluations. However, I think that view is due to their unbalanced mentalities. [GW#12]*
>
> *I can't understand why some riders have higher service scores than me. I work long hours every day and complete many orders. Why is my score lower than those of others? It is not fair. [GW#19]*

Taken together, these accounts suggest the fourth dimension of the characteristics of algorithmic management: uniformity, which depicts the extent to which gig workers perceive that they are treated the same by algorithmic management. The higher the level of uniformity in OLPs' algorithmic management, the more likely gig workers were to perceive algorithmic management as consistent among all platform workers.

Conclusion of Study 1A

In Study 1A, I conducted qualitative research in the context of food delivery platforms in mainland China to conceptualize what algorithmic management was. Based on grounded theory, the results reveal four different dimensions (i.e., transparency, incessancy, iteration, and uniformity), which constituted the

characteristics of algorithmic management on online labor platforms.

Study 1B: Scale Development

Based on the results of Study 1A, I followed the steps of standard measure development (Hinkin, 1998) to construct the scale of characteristics of algorithmic management in Study 1B. I briefly summarized the steps and procedures in Table 3.

Table 3. Summary of Scale Development in Study 1B

Steps	Procedures	Results
Step 1: Initial item generation	Based on interviews in Study 1A	4 dimensions, 57 items
Step 2: Qualitative content validity assessment	Several rounds revision based on the advice of 12 OB researchers and Ph.D. students	4 dimensions, 40 items
Step 3: Quantitative content validity assessment: item sorting	11 Ph.D. students sorted the 40 items into the four dimensions independently	correct assignment reached nearly 100%
Step 4: EFA, internal consistency assessment (Sample 1)	Online survey, 300 food delivery workers in China	4 dimensions, 18 items, see Table 5 below
Step 5: CAF, validation (Sample 2)	Online survey, 300 gig drivers in China	See Table 6, Table 7, and Table 8 below
Step 6: Test-retest reliability (Sample 3)	Two-wave online survey, 155 food delivery workers in China	See Table 9 below

Step 1: Initial Item Generation

I generated the initial items for characteristics of algorithmic management in OLPs using the inductive approach. To be specific, referring to the same interview data of Study 1A, as well as the relevant literature concerning the characteristics of algorithmic technologies and platform work, we got the initial 57 items.

Step 2: Qualitative Content Validity Assessment

To ensure content validity of my measurements, I shared the initial version with a group of 5 researchers of organizational behaviors and a group of 7 Ph.D. candidates. I asked advice from them to determine whether some items should be deleted and other items should be added. Also, they independently evaluated the wording of measurements following the criteria:

(1) statements are simple

(2) items are consistent in wording

(3) each item only addresses one issue

(4) no leading questions.

Based on their advice, I revised the measures and returned them to the two groups. They re-evaluated the measures and forwarded items to me with their further advice. After several rounds, we agreed on a final version of 40 items for characteristics of algorithmic management on platforms as shown in Table 4. Among 40 items, 14 items pertained to transparency: 8 items pertained to incessancy; 8 items pertained to iteration; and 10 pertained to uniformity.

Table 4. Items after Qualitative Content Validity Assessment

Factors	**Items**
Transparency	Trans_1 There's a pattern of how to get more orders on the platform. Trans_2 There's a pattern of how to get better orders on the platform. Trans_3 The pattern can be learnt of how to get more orders. Trans_4 The pattern can be learnt of how to get better orders. Trans_5 The pattern can be learnt of how to elevate the level or the service score. Trans_6 The platform system provides me with a way to get more orders. Trans_7 The platform system provides me with a way to get better orders. Trans_8 The platform provides me with the dispatching pattern. Trans_9 The platform provides me with indicators used to dispatch orders. Trans_10 The platform provides me with indicators used to evaluate me. Trans_11 The platform provides me with rules used to manage me. Trans_12 It's just a matter of luck in receiving orders on the platform. (R) Trans_13 It's difficult to learn the dispatching pattern of the platform system. (R) Trans_14 It's difficult to understand the platform system's evaluation indicators. (R)
Incessancy	incess_1 In the process of completing orders, the platform system continues to record my driving route. incess_2In the process of completing orders, the platform system continues to record my real-time geographic location. incess_3In the process of completing orders, the platform system continues to record my communication with clients. incess_4In the process of completing orders, the platform system continues to record everything about me. incess_5In the process of completing orders, once I behave abnormally (e.g., temporary roadside parking, delivery timeout, etc.), the platform system will immediately remind or contact me. incess_6During my platform work, the platform system continues to record my order receiving throughout the day. incess_7During my platform work, the platform system continues to record my order completion process. incess_8During my platform work, the platform system continues

	to record all customers' evaluations of me.
Iteration	iterat_1 The platform system adjusts the number of orders sent to me according to my order completion. iterat_2 The platform system adjusts the quality of orders sent to me according to my order completion. iterat_3 The platform system adjusts the difficulty of orders sent to me according to my order completion. iterat_4 The platform system adjusts my priority of receiving orders according to my order completion. iterat_5 The platform system adjusts my work requirements according to my order completion. iterat_6 The platform system adjusts my work evaluation criteria according to my order completion. iterat_7 The platform system adjusts my work assessment criteria according to my order completion. iterat_8 The platform system adjusts my reward criteria according to my order completion.
Uniformity	uniform_1 The platform system uses the same rule to manage all platform workers including me. uniform_2 The platform system uses the same criteria to dispatch orders to all platform workers including me. uniform_3 The platform system uses the same evaluation criteria for all platform workers including me. uniform_4 The platform system treats every platform worker fairly. uniform_5 The platform system manages every platform worker equally. uniform_6 The platform system gives equal opportunity to every platform worker when dispatching orders. uniform_7 The platform system applies the same standard when evaluating platform workers. uniform_8 The platform system never treats platform workers differently in management. uniform_9 The platform system never treats platform workers differently when dispatching orders. uniform_10 The platform system never treats platform workers differently in evaluation.

Step 3: Quantitative Content Validity Assessment

To further ensure the content validity of the final version, I shared the measures

with a group of 11 Ph.D. students. They sorted the 40 items into the four dimensions of characteristics of algorithmic management independently, and the percentage of correct assignment for each item reached nearly 100%.

Step 4: EFA (Sample 1)

(1) Samples and procedures

Samples. The participants were recruited online through the Data Market application on a professional data collection platform named Credamo (https://www.credamo.com/), which is similar to MTurk and has been widely used in China (e.g., Fu et al., 2022; Huang et al., 2022; Zhang et al., 2022). Among 300 participants, about 90.67% were male, 46.33% had a bachelor's degree, their average age was 32.05 years (standard deviation = 7.33), and their average tenure was 2.59 years (standard deviation = 1.61).

Procedures. Referring to the recommended procedures by Hinkin (1998, pp. 112), I firstly completed the initial item reduction following three rules: (1) eigenvalue was greater than 1; (2) factor loading was greater than 0.4; and (3) the loading on the specific factor was equal or greater than two times the loading on other factors. Therefore, I draw the flow chart (see Figure 5) to show how I completed the initial item reduction.

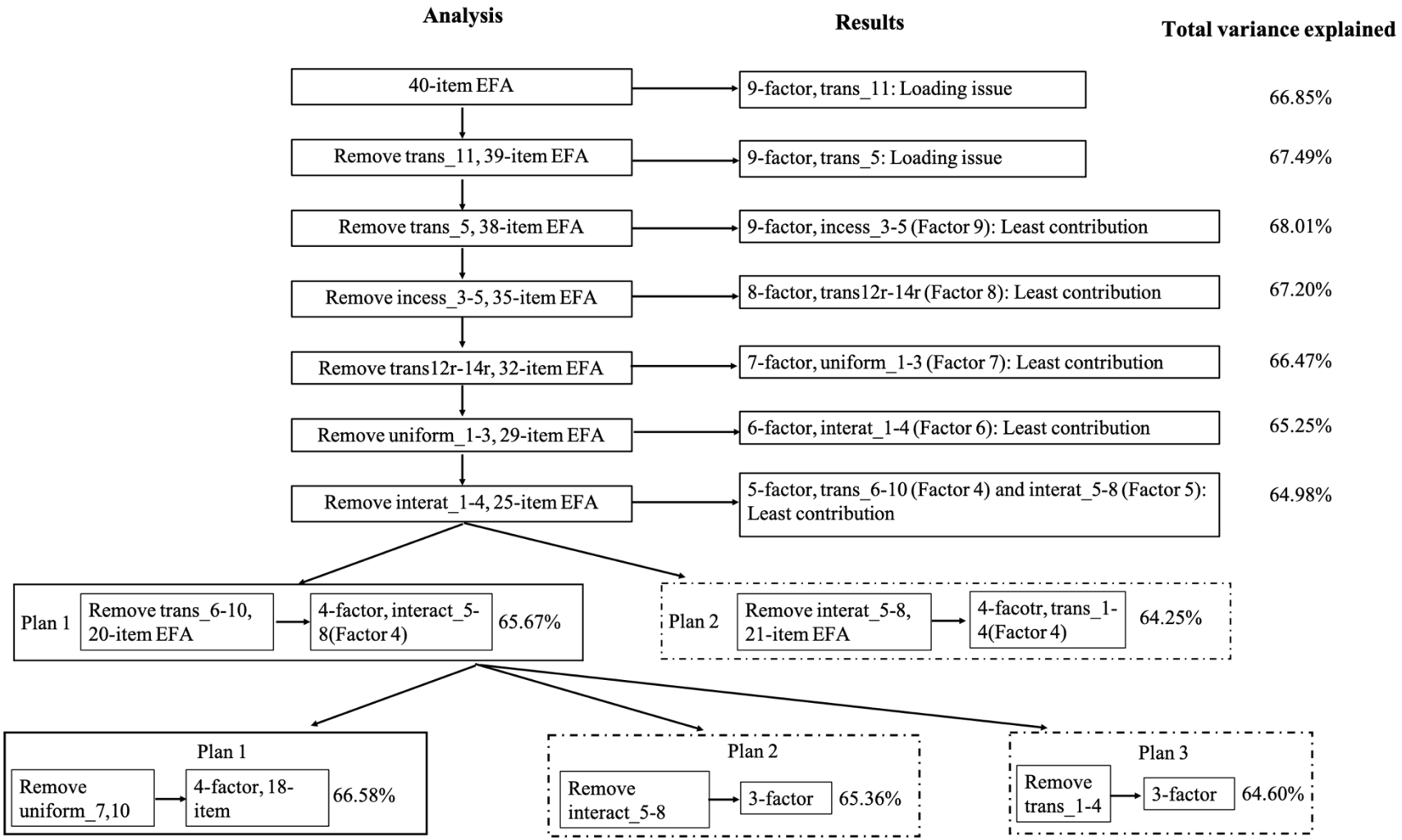

Figure 6. Flow Chart of the Item Reduction

At the beginning, all 40 of the items were entered into the analysis, and nine factors were extracted, which gave us more than the four dimensions revealed by Study 1A. However, when I evaluated the factor loading, the results showed that although the number of extracted factors exceeded the originally proposed four dimensions, there was no cross-loading. These results indicated a good distinction between different dimensions and subdimensions within a single dimension. For example, three factors were extracted from the 14 items of transparency, and two factors were extracted from each of the other three dimensions (i.e., iteration, incessancy, and uniformity). Therefore, based on this analysis, the initial items needed further reduction.

Before removing the factor with the lowest contribution, according to Hinkin (1998), the loading of an item on a certain factor should be greater than or equal to twice its loading on other factors; thus, I deleted two items. Then, based on the results of our analysis, the items corresponding to the factor that contributed the least I gradually eliminated until I obtained an analytical result that contained five factors. At that time, the factors with the bottom two rankings were removed respectively, and thus I obtained two different four-factor analysis results. After we compared these results with total variance explained, I kept the better results and removed five transparency items. Considering the balance of the number of items among the different dimensions, I attempted to remove the bottom two uniformity items in the four-dimensional factor loading ranking, which increased the total variance explained.

(2) Results.

The final analytical results were obtained, as shown in Table 5. The EFA of the developed scale returned four factors that accounted for 66.48% of the total variance. The eigenvalues for the four factors were 5.24, 2.87, 2.43, and 1.43.

Table 5. Results of EFA (Step 4, Sample 1)

Factors and items	EFA Loading			
Dimension 4: Uniformity				
The platform system never treats gig workers differently in management.	**.86**	.10	.00	.08
The platform system manages every gig worker equally.	**.85**	.17	.05	.08
The platform system gives equal opportunity to all gig workers when dispatching orders.	**.83**	.08	.06	.09
The platform system never treats gig workers differently when dispatching orders.	**.82**	.02	.09	.13
The platform system treats every gig worker fairly.	**.81**	.21	.07	.07
Dimension 2: Incessancy				
In the process of completing orders, the platform system continues to record my order receiving throughout the day.	.15	**.79**	.00	.08
In the process of completing orders, the platform system continues to record my real-time geographic location.	.06	**.78**	.12	.10
In the process of completing orders, the platform system continues to record all customers' evaluations of me.	.16	**.73**	.10	.09
In the process of completing orders, the platform system continues to record my driving route.	-.05	**.71**	.28	.03
In the process of completing orders, the platform system continues to record my order completion process.	.23	.67	.02	.05
Dimension 1: Transparency				
There's a pattern of how to get better orders on the platform.	.07	.00	**.84**	.12

The pattern can be learnt of how to get better orders.	.09	.08	**.82**	.09
The pattern can be learnt of how to get more orders.	.06	.11	**.79**	.10
There's a pattern of how to get more orders on the platform.	.02	.25	**.78**	.02
Dimension 3: Iteration				
The platform system adjusts my work evaluation criteria according to my order completion.	.12	.06	.06	.87
The platform system adjusts work assessment criteria according to my order completion.	.08	-.04	.09	.85
The platform system adjusts my work requirements according to my order completion.	.12	.08	.14	.79
The platform system adjusts my reward criteria according to my order completion.	.07	.24	.04	.65
Reliability	**0.90**	**0.81**	**0.84**	**0.84**

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

Step 5: CFA (Sample 2)

(1) Samples and procedures

Samples. The participants were also recruited online through the Data Market application on a professional data collection platform named Credamo. Different from Sample 1 of EFA, when conducting CFA, I recruited 300 gig drivers in China. Among 300 participants, about 77.70% were male, 60.70% had a bachelor's degree, their average age was 32.67 years (SD = 6.19), and their average tenure was 2.59 years (SD = 1.67).

Procedures. To examine the factor structure, I first compared the fit of three factor structures. The first structure was one-factor model in which all 18 items indicated one factor; the second structure was a first-order, four-factor model in which items were allowed to load onto their respective factors; the third was a second-order factor model in which items were loaded onto their respective factors and the four factors were loaded onto a second-order, latent algorithmic management factor. I further compared the second-order factor model with alternative first-order, three-factor and first-order, two-factor models.

(2) Results

The results of the CFA, as shown in Table 6, indicated that the first-order, four-factor model and the second-order factor model were better fits than the one-factor model. However, the second-order model was not significantly better than the first-order model ($\Delta\chi^2[2] = 1.32$, $p > .05$). Indeed, the two models were mathematically equivalent. The relatively good fit of the first-order model may derive from the four-

dimensional measures, which conceptually capture different facets of algorithmic management of OLPs and have significant but relatively low relationships. Nevertheless, the four dimensions shared a variance, as reflected in the latent higher-order factor: the characteristics of OLPs' algorithmic management. Thus, I preferred the second-order model because it allowed covariation among the first-order factors by accounting for corrected errors, a common occurrence in first-order CFA (Gerbing & Anderson, 1984).

Table 6. Results of CFA (Step 5, Sample 2)

Models	**$\chi 2$**	**df**	**$\chi 2$/df**	**$\Delta\chi^2$**	**CFI**	**TLI**	**SRMR**	**RMSEA**
Second-order factor model:	320.37	131	2.45	-	0.93	0.92	0.05	0.07
First-order, four-factor model:	319.05	129	2.47	-1.32(2)	0.93	0.92	0.05	0.07
One-factor model:	1476.08	135	10.93	1155.71(4)	0.51	0.44	0.17	0.18
First-order, three-factor model:								
TP+IC, IT, UF	684.11	132	5.18	363.74(1)	0.80	0.77	0.11	0.12
TP, IC+IT, UF	568.07	132	4.30	247.70(1)	0.84	0.82	0.09	0.11
TP, IC, IT+UF	605.73	132	4.59	285.36(1)	0.83	0.80	0.11	0.11
TP+UF, IC, IT	879.12	132	6.66	558.75(1)	0.73	0.68	0.13	0.14
TP+IT, IC, UF	563.16	132	4.27	242.79(1)	0.84	0.82	0.10	0.10
TP, IC+UF, IT	688.16	132	5.21	367.79(1)	0.80	0.76	0.12	0.12
TP+IC, IT+UF	955.68	134	7.13	635.31(3)	0.70	0.66	0.14	0.14
TP+IT, IC+UF	916.91	134	6.84	596.54(3)	0.71	0.67	0.14	0.14
TP+UF, IC+IT	1110.09	134	8.28	789.72(3)	0.64	0.59	0.15	0.16

Note.: Dimensions of characteristics of algorithmic management: transparency (TP), incessancy (IC), iteration (IT), uniformity (UF)

To further validate the scale, in Sample 2, I also measured organizational transparency (Pirson & Malhotra, 2011), organizational justice (Colquitt, 2001), algorithmic control (Pei et al., 2021), and perceived managerial control (Long et al., 2011) to evaluate its discriminant validity. Specifically, I tested the discriminant validity using organizational transparency (i.e., how it differs from the transparency dimension), organizational justice (i.e., how it and its dimensions differ from the uniformity dimension), and the evaluation dimension of algorithmic control (i.e., how it differs from incessancy dimension) in CFA. I also differentiated algorithmic management we proposed from algorithmic control and perceived managerial control to validate the overall construct. The results are shown in Table 7. All the two-factor models were significantly better than one-factor model, which indicates that the scale I developed has good discriminant validity.

Besides, I also demonstrated predictive validity in correlations between algorithmic management characteristics and the criterion variables including work autonomy (Morgeson & Humphrey, 2006), platform identification (items adapted from Smidts et al., 2001), and job satisfaction (Hackman et al., 1980). Referring to the existing literature on algorithmic management, I predicted algorithmic management characteristics and their dimensions I proposed to be positively associated with the criterion variables (e.g., Parent-Rocheleau & Parker, 2022). Results in Table 8 overall supported my hypotheses. Therefore, I finally developed the four-dimensional scale of characteristics of algorithmic management with 18 items.

Table 7. CFA Results for Scale Validation of Algorithmic Management Characteristics

Models	x2	df	x^2/df	△ x^2	CFI	TLI	SRMR	RMSEA
Models used to validate dimensions of algorithmic management characteristics								
1 Two-factor model: TS and org. transparency (Pirson & Malhotra, 2011)	107.09	19	5.64		0.91	0.87	0.06	0.12
2 One-factor mode: two factors merged	418.61	20	20.93	311.52	0.60	0.44	0.17	0.26
3 Two-factor model: UF and org. justice (Colquitt, 2001)	325.19	118	2.76		0.93	0.92	0.05	0.08
4 One-factor mode: two factors merged	801.47	119	6.74	476.28	0.76	0.73	0.09	0.14
5 Two-factor model: UF and procedural justice (Colquitt, 2001)	103.04	19	5.42		0.95	0.92	0.04	0.12
6 One-factor mode: two factors merged	150.52	20	7.53	47.48	0.92	0.88	0.06	0.15
7 Two-factor model: UF and distributive justice (Colquitt, 2001)	90.99	19	4.79		0.95	0.93	0.04	0.11
8 One-factor mode: two factors merged	165.18	20	8.26	74.19	0.90	0.86	0.07	0.16
9 Two-factor model: IC and evaluation of algo. control (Pei et al., 2021)	40.03	26	1.54		0.97	0.96	0.04	0.04
10 One-factor mode: two factors merged	48.41	27	1.79	8.38	0.96	0.94	0.04	0.05
Models used to discriminate algorithmic management characteristics from alternative measures								
11 Two-factor model: AM and perceived managerial control (Long et al., 2011)	2236.23	323	6.92		0.49	0.44	0.16	0.14
12 One-factor mode: two factors merged	2481.92	324	7.66	245.69	0.42	0.34	0.16	0.15
13 Two-factor model: AM and algorithmic control (Pei et al., 2021)	2005.01	376	5.33		0.53	0.50	0.14	0.12
14 One-factor mode: two factors merged	2225.91	377	5.90	220.90	0.47	0.43	0.14	0.13

Note. AM (i.e., algorithmic management), TP (i.e., transparency), IC (i.e., incessancy), IT (i.e., iteration), UF (i.e., uniformity).

Table 8. Means, Standard Deviations, and Intercorrelations of Variables (Sample 2)

Variables	Mean	SD	1	2	3	4	5	6	7	8
1. Transparency	5.08	1.07	(.86)							
2. Incessancy	6.14	.62	.11	(.77)						
3. Iteration	5.59	.82	.37**	.32**	(.77)					
4. Uniformity	5.25	1.25	.20**	.12*	.33**	(.93)				
5. Algorithmic management characteristics	5.52	.63	.68**	.46**	.73**	.72**	(.85)			
6. Work autonomy	3.93	.79	.23**	.07	.18**	.25**	.30**	(.92)		
7. Platform identification	3.99	.76	.30**	.17**	.36**	.60**	.59**	.39**	(.86)	
8. Job satisfaction	4.09	.62	.25**	.13*	.30**	.51**	.49**	.33**	.69**	(.74)

*Note. N = 300. * $p < 0.05$; ** $p < 0.01$. The figures on the diagonal in parentheses are the alpha coefficients.*

Step 6: Test-retest reliability (Sample 3)

(1) Samples and procedures

To ensure the test-retest reliability of the developed scale, I measured the algorithmic management characteristics twice among the recruited food delivery workers who work on two leading platforms in mainland China. To be specific, firstly, I went to the gathering places of food delivery workers during their rest time and distributed the invitation letter for research to them. The letter provided the information on the purpose, method, the remuneration of the research, as well as my WeChat QR code. If the workers were willing to participate to the research, they added me as a friend by scanning a QR code in the letter. After that, they were firstly required to provide the proof of their identity as food delivery workers (i.e., a screenshot of their profile on the APP). Then, I sent the link of the first-round online questionnaire to the qualified food delivery workers through WeChat. In order to prevent unqualified people from filling out the questionnaires to get paid, I set the link to not be shared personally. In other words, only those food delivery workers that were my WeChat friends and simultaneously passed the identity verification can fill out the online questionnaires.

During data collection, I sent the online surveys at two time points separated by approximately one week. At Time 1, 206 food delivery workers participated in the research. Approximately one week later (Time 2), I sent the new link of questionnaire to each workers who completed the first-round survey. Among 206 food delivery workers, 155 completed the second-wave questionnaire, with a response rate nearly of

75.24%. As a result, the final sample consisted of 155 platform workers. In the final sample, 94.80% were male, the mean age was 46.02 years (standard deviation = 5.59), and the majority had a high school degree (49%).

(2) Results

The results of test-retest reliability were shown in Table 9. As the table indicated, the correlations between the Time 1 and Time 2 gig workers' perceived characteristics of algorithmic management measurements were between .54 and .76, demonstrating high test-retest reliability.

Table 9. Means, Standard Deviations, and Intercorrelations of Variables (Sample 3)

Variables	Mean	SD	1	2	3	4	5	6	7	8	9	10
1. Transparency (T1)	4.24	1.28	-									
2. Incessancy (T1)	6.04	.89	.24**	-								
3. Iteration (T1)	4.86	1.32	.35**	.35**	-							
4. Uniformity (T1)	4.17	1.71	.30**	.01	.11	-						
5. Algorithmic management characteristics (T1)	4.86	.84	.70**	.50**	.63**	.70**	-					
6. Transparency (T2)	4.14	1.41	.63**	.17*	.25**	.31**	.52**	-				
7. Incessancy (T2)	5.85	1.15	.26**	.58**	.29**	.10	.42**	.25**	-			
8. Iteration (T2)	4.78	1.36	.29**	.14	.54**	.16	.42**	.33**	.31**	-		
9. Uniformity (T2)	4.28	1.64	.25**	.11	.22**	.76**	.62**	.27**	.24**	.22**	-	
10. Algorithmic management characteristics (T2)	4.79	.94	.52**	.36**	.47**	.56**	.76**	.65**	.64**	.64**	.73**	-

*Note. N = 155. * $p < 0.05$; ** $p < 0.01$. The figures on the diagonal in parentheses are the alpha coefficients.*

Conclusion of Study 1B

Based on the results of Study 1A, following the steps recommended by Hinkin (1998), I further conducted the scale development study. To be specific, I firstly extracted initial items based on the qualitative interview (n = 23). Then, I conducted the qualitative content validity assessment with the help of OB researchers and Ph.D. students (n = 12). Furthermore, I invited Ph.D. students to complete quantitative content validity assessment (n = 11). To further ensure the reliability and validity of the measures, I conducted exploratory factor analysis (n = 300), and confirmatory factor analysis (n = 300) in two different groups of platform workers (i.e., online food delivery workers and gig drivers in China, respectively). Moreover, I measured gig workers' perceived characteristics of algorithmic management twice for test-retest reliability using a new dataset (n = 155). After these procedures, I developed the four-dimensional scale of characteristics of algorithmic management with 18 items.

Discussion

To better understand algorithmic management on online labor platforms, in Study 1, I have completed two sub-studies. In Study 1A, I conceptualized algorithmic management through a qualitative study in the context of food delivery platforms in mainland China. Based on grounded theory, the results uncovered the concept and dimensions of platform workers' perceived characteristics of algorithmic management of online labor platforms. Furthermore, following the steps of standard scale development (Hinkin, 1998), in Study 1B, I constructed the scale with 18 items. The findings of Study 1 contribute to uncovering the dimensions and connotation of

algorithmic management characteristics in online labor platforms and laying the solid foundation for future empirical research.

CHAPTER 4: STUDY 2

The results of Study 1 help us to conceptualize and operationalize the characteristics of algorithmic management in OLPs, which providing the follow-up empirical studies with a solid foundation. Therefore, based on the findings of Study 1, I tend to further explore the effects of gig workers' perceived characteristics of algorithmic management in OLPs. In practice, we may find platform management results in different reactions from gig workers. For example, some may actively engage more in platform work and have high commitment to the platforms they work on, while some may avoid engaging more during platform work and have negative evaluations of their job.

To better understand how algorithmic management in OLPs will influence gig workers' perceptions and behaviors, in Study 2, I plan to investigate the underlying mechanisms of the double-edged sword effects of algorithmic management from the perspective of job crafting. To be specific, I aim to explore how the characteristics of algorithmic management lead to different outcomes of gig workers (i.e., platform commitment vs. job insecurity) through their two types of job crafting behaviors (i.e., promotion-focused job crafting vs. prevention-focused job crafting). Moreover, I will further investigate the moderating role of gig workers' personal resilience in the proposed relationships. The overall research model of Study 2 is graphically depicted in Figure 6 below.

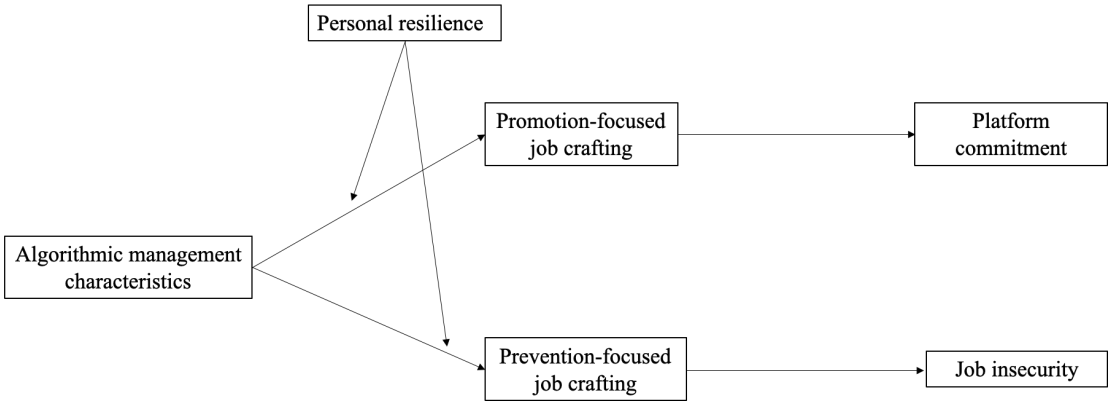

Figure 7. The Conceptual Model of Study 2

Theory and Hypotheses

Algorithmic Management Characteristics and Gig Workers' Outcomes: The Mediating Role of Job Crafting

First of all, when exploring the effects and mechanisms of platform management on gig workers' perceptions and behaviors, the perspective of job crafting may provide us with valuable insights, especially considering the uniqueness of OLPs. OLPs platforms are market intermediary platforms by nature, which means that they usually provide a digital infrastructure for collecting, processing, and transmitting information on economic activities. Therefore, unlike employees in traditional organizational scenarios, gig workers usually do not establish a formal labor employment relationship with the platform party. Instead, they usually build loose connections with platforms through User Agreement under a weak contract. In this type of new work context, the top-down job design in traditional organizations no longer applies on these OLPs. Indicated by the existing research, gig workers, as independent contractors, usually often have to cultivate and define their jobs by themselves (Petriglieri et al., 2019). From this view, we can know that the perspective

of job crafting, which emphasizes the bottom-up job design and meaning construction of workers (Wrzesniewski & Dutton, 2001), is of great significance for understanding the effects of algorithmic management in the market intermediary platform scenario.

The job design perspective has historically dominated our understanding of how individuals experience their jobs (Wrzesniewski & Dutton, 2001). The basic assumption of this literature is that employees are just passive recipients of their jobs designed by managers in a "top-down fashion" (Wrzesniewski, LoBuglio, Dutton, & Berg, 2013). However, when looking into the practice, we can easily find that employees often proactively make changes to craft their own jobs in workplace. This greatly challenges the premise of job design literature and casts the employees, "job crafters", in a much more active light.

Based on this, Wrzesniewski and Dutton (2001) proposed the concept of job crafting, which refers to "the physical and cognitive changes individuals make in the task or relational boundaries of their work". Given its inspiration for research on employees' job experiences, ever since the concept of job crafting was introduced, numerous scholars have joined this research stream. According to the work of Wrzesniewski and Dutton (2001), crafting behaviors often involve "a series of creative acts in which employees push, shrink, or transform task and relational boundaries" (p. 195). Considering the complexity of job crafting, the recent research has tried to conceptualize it with two different types: promotion-focused vs. prevention-focused job crafting (e.g., Bindl et al., 2019; Lichtenthaler & Fischbach, 2016; Lichtenthaler & Fischbach, 2019).

By definition, *promotion-focused job crafting* refers to individuals' work behaviors of trying to increase their structural and social job resources, as well as increasing their challenging job demands (Brenninkmeijer & Hekkert-Koning, 2015; Lichtenthaler & Fischbach, 2016; Petrou & Demerouti, 2015). For example, it comprises work behaviors such as volunteering for challenging work and seeking for more work opportunities. Differently, *prevention-focused job crafting* refers to employees' work behaviors of trying to decrease their hindering job demands such as reducing reaching out demanding customers (Brenninkmeijer & Hekkert-Koning, 2015; Lichtenthaler & Fischbach, 2016; Petrou & Demerouti, 2015).

Drawing on the perspective of job crafting, especially referring to these two types of bottom-up job design behaviors, we can better understand how algorithmic management in OLPs influences gig workers. First, I propose that gig workers' perceived algorithmic management will lead to their promotion-focused job crafting behaviors, which will further induce their increased commitment to the platforms they work on. Indicated by the existing literature, the characteristics or the nature of the job itself will determine individuals' job crafting behaviors (e.g., Zhang & Parker, 2018). For example, the job which provides individuals with job autonomy, empowerment, and feedbacks can result in individuals' more promotion-focused job crafting behaviors (e.g., Gordon et al., 2015; Kim et al., 2018; Meijerink et al., 2018; Rudolph et al., 2017). Accordingly, perceived algorithm management in OLPs may be positively related to gig workers' promotion-focused job crafting.

As introduced in Study 1, the characteristics of algorithmic management in OLPs

include four dimensions: transparency, incessancy, iteration, and uniformity. These characteristics could motive gig workers to engage more in promotion-focused job crafting behaviors. For example, under the highly transparent algorithmic management, gig workers can more clearly understand the rules of platform management, the details of the evaluation system, as well as the reward systems (e.g., Kim & Moon, 2021; Schnackenberg et al., 2021). In this case, gig workers are more likely to have a sense of control over their platform work since they are aware of how they are managed by the platforms. Therefore, they may be more motivated or feel more empowered to increase their job resources, or to increase their challenging job demands.

Besides, thanks to the incessancy of algorithmic management, gig workers can be aware of their work progress in real time, or continuously obtain work feedback from the platforms they work on (e.g., Kellogg et al., 2020). These kind of sustaining feedbacks and information can lead to gig workers' more promotion-focused job crafting behaviors (e.g., Gordon et al., 2015). Differently, the iteration of algorithmic management is usually reflected in the gamification of platforms, which makes platform work more challenging and competitive (e.g., Cardador et al., 2017; Silic et al., 2020). In this circumstance, gig workers may feel the opportunities for rewards and higher attainment, which will further lead to their promotion-focused job crafting behaviors (e.g., Cullinane et al., 2017; Nipper et al., 2018).

Further, triggered promotion-focused job crafting of gig workers will increase their commitment to the platform. According to the literature, individuals' promotion-

focused job crafting is positively related to their organizational commitment (e.g., Cheng et al., 2016; Rofcanin et al., 2016; Wang et al., 2018). Promotion-focused job crafting such as increasing job resources and challenging job demands, can enhance individuals' perceived meaning of work, their positive work identity, as well as their value in organizations (Wrzesniewski & Dutton, 2001). Consequently, individuals will find their importance and value to their organizations, which in turn make them more committed to the organizations (Meyer & Allen, 1991). Therefore, taken together, I propose the following hypothesis.

Hypothesis 1: Promotion-focused job crafting will mediate the relationships between gig workers' perceived algorithmic management characteristics and their platform commitment.

Different from the proposed relationships, considering the mediating role of prevention-focused job crafting, perceived algorithmic management in OLPs may also lead to negative outcomes of gig workers (i.e., job insecurity). First, the characteristics of algorithmic management may make gig workers feel constrains from platform management via algorithms, which lead to their prevention-focused job crafting. For example, the continuous and real-time algorithmic management of platforms may limit the perceived work autonomy of gig workers since this kind of sustaining supervision and control of platforms would place gig worker in the digital cage of algorithmic management (Chai & Scully, 2019; Duggan et al., 2020; Vallas & Schor, 2020; Veen et al., 2020). The above-mentioned characteristics of platform management greatly constrain gig workers and deprive of their job autonomy, which

will further decrease individuals' motivation to engage in platform work and lead to their prevention-focused job crafting such as decreasing job demands (Bakker & Demerouti, 2007; Rudolph et al., 2017).

Similarly, the perceived iteration of algorithmic management will also lead to prevention-focused job crafting of gig workers. As introduced before, the iteration is often embodied in the gamification of platforms (e.g., Cardador et al., 2017; Silic et al., 2020). The fierce competition makes gig workers trapped in platform work which is lacking autonomy, predictability, and stability. In this circumstance, gig workers are more likely to try to craft their work in the prevention-focused way (Bakker & Demerouti, 2007; Rudolph et al., 2017).

Further, prevention-focused job crafting of platform workers will lead to their perceived job insecurity. According to the literature, individuals' prevention-focused job crafting is negatively related to their perceived personal employability (e.g., Brenninkmeijer & Hekkert-Koning, 2015; Zhang & Parker, 2018) and competence (Akkermans & Tims, 2017). Different from promotion-focused job crafting which can increase individuals' perceived work meaningfulness and their value on platforms, prevention-focused job crafting such as decreasing job demands, would pose a threat to gig worker' perceived security of their job since they may feel that they lack competitiveness compared to other gig workers. Therefore, taken together, I propose the following hypothesis.

Hypothesis 2: Prevention-focused job crafting will mediate the relationships between gig workers' perceived algorithmic management characteristics and their job

insecurity.

The Moderating Role of Gig Workers' Personal Resilience

To effectively mitigate the negative effects of algorithmic management in OLPs, as well as amplifying the positive effects, it is meaningful to explore the boundary conditions of the relationships proposed above. In this study, I mainly focus on the moderating effects of gig workers' personal resilience. By definition, *personal resilience* refers to positive adaptation in the face of stress or challenges (Block & Kremen, 1996; Luthar et al., 2000). This means that individuals with higher level of personal resilience can better deal with the stress they face and withstand or rebound from difficult conditions they experience (Glantz & Johnson, 2002). Nowadays, individuals' ability to maintain their functioning when facing stress has become more important than previously thought (Bonanno, 2004). Especially in the new context of OLPs, gig workers' personal resilience may play a vital role since gig work on platforms is full of instability, uncertainty, and social isolation (Ashford et al., 2018). Therefore, studying personal resilience is important for achieving a comprehensive understanding of the effects of platform management through algorithms on platform workers.

First, personal resilience may positively moderate the relationships between gig workers' perceived algorithmic management and their promotion-focused job crafting behaviors. For gig workers who have the higher level of resilience, they are more likely to see the beneficial aspects of platform management via algorithms (e.g.,

Block & Kremen, 1996; Kobasa & Puccetti, 1983). It is for gig workers with high rather than low personal resilience tend to appraise algorithmic management of platforms as challenging instead of threatening (Tugade & Fredrickson, 2004). In another word, for these gig workers with high personal resilience, the transparency, the incessancy, the iteration, and the uniformity of algorithmic management will not be the constrains which will lead to negative experience and behavioral reactions. Instead, these management via algorithms may be a kind of affordance and help them to better perform in OLPs. For example, for individuals with high personal resilience, the sustaining feedbacks on work process or on work performance are more likely to be regarded as empowerment from platforms which help them better determine how to work and when to work by themselves proactively. Differently, for individuals with low resilience, algorithmic management of OLPs may be regarded as the constrains which will lead to negative experience and behavioral reactions. For example, these gig workers may feel that sustaining feedbacks from platforms via algorithms keep consuming them, which makes them less willing to craft platform work promotively.

Moreover, personal resilience is supposed to negatively moderate the relationships between gig workers' perceived algorithmic management and their prevention-focused job crafting behaviors. Previous research has shown that individuals' personal resilience plays a critical role by mitigating their negative reactions to stressors (Ong, Bergeman, Bisconti, & Wallace, 2006). This is because individuals with high personal resilient are able to find resources to deal with stressful situations (e.g., Kobasa & Puccetti, 1983). And their resilience can also provide them

with energy to get through the difficulties since it ensures cognitive pervasiveness, emotional stability, and physiological endurance (Waugh et al., 2008). Therefore, the effects of algorithmic management on gig workers' prevention-focused job crafting may be mitigated by individuals' high personal resilience which provides them with resources and energy to deal with platform management. Differently, individuals with low personal resilient may fail to find enough resources to deal with stress induced by algorithmic management (e.g., Kobasa & Puccetti, 1983). In this case, the effects of algorithmic management on gig workers' prevention-focused job crafting may be amplified by individuals' low resilience.

Taken together, I propose the following hypotheses.

Hypothesis 3: Personal resilience will positively moderate the relationships between gig workers' perceived algorithmic management characteristics and their promotion-focused job crafting behaviors.

Hypothesis 4: Personal resilience will negatively moderate the relationships between gig workers' perceived algorithmic management characteristics and their prevention-focused job crafting behaviors.

Method

Sample and Procedure

I invited food delivery workers who working on two leading platforms in mainland China to participate in my study. As of the second quarter of 2020, the two platforms accounted for 68.2% and 25.4% of the market share, basically covering the

domestic and foreign delivery markets of mainland China. As the market intermediary platforms, they integrate massive amounts of take-out information, connecting the supply and demand sides to facilitate the online transactions and the completion of online distribution for merchants. On these platforms, food delivery workers receive and inspect orders to earn money. At the same time, they are managed by the market intermediary platforms they are working on such as obeying the order requirements, following the intelligent planning route of the platform, and delivering the food to the designated place within a certain period of time.

To collect the data, at the very beginning, I surveyed the places in the city where food delivery workers congregate most often as well as their working hours. Then, I went to the gathering places during their rest time and distributed the invitation letter for research to them. The letter explained the research purpose, research method, the remuneration and my contact information (i.e., my WeChat QR code). If they would like to participate to my research, they added me as a friend by scanning a QR code in the letter. After that, they were firstly required to provide the proof of their identity as food delivery workers (i.e., a screenshot of their profile on the APP). Then, I sent the link of my online questionnaires to the qualified food delivery workers through WeChat. In order to prevent unrelated and unqualified people from filling out the questionnaires to get paid, I set the link to not be shared personally. In other words, only those food delivery workers that were my WeChat friends and simultaneously passed the identity verification can fill out the online questionnaires.

During data collection, I sent the online surveys at two time points separated by

approximately one month. At Time 1, 334 food delivery workers participated in the research and answered questions regarding their personal experiences working on the market intermediary platforms and the demographic information. Approximately one month later (Time 2), I sent the new link of questionnaire to each platform workers who participated in the first-round survey. Among 334 food delivery workers, 280 completed the second-wave questionnaire, with a response rate nearly of 83.83%. As a result, the final sample consisted of 280 platform workers. In the final sample, 96.80% were male, the mean age was 29.11 years (standard deviation = 8.73), and the majority had a high school degree (45%).

Measures

Except algorithmic management characteristics that I develop the measures in Study 1, I adopted well-established scales to measure the constructs in the hypothetical model. Given that the original measurements were developed in English while the survey was administered in Chinese, I followed Brislin's (1980) translation-back-translation procedure to set up the questionnaire. Specifically, I translated the English scales into Chinese first. Then, two doctoral students in management with bilingual expertise reviewed the questionnaire items to ensure semantic clarity. Unless otherwise stated, the participants responded to the measurement items on 7-point Likert scales ranging from 1 (totally disagree/never) to 7 (totally agree/always).

Algorithmic management characteristics (Time 1). On a 7-point Likert scale, I measure gig workers' perceived algorithmic management characteristics in OLPs they

were working on using the 18-item scale that I developed in Study 1B. It includes four dimensions: transparency, incessancy, iteration, and uniformity. The sample items were “There’s a pattern of how to get better orders on the platform”, “In the process of completing orders, the platform system continues to record my driving route”, “The platform system adjusts my work requirements according to my order completion”, and “The platform system gives equal opportunity to every gig worker when dispatching orders”. The Cronbach’s alpha for this scale was 0.92.

Personal resilience (Time 1). I adapted the five-item scale originally developed by Campbell-Sills and Stein (2007) to measure gig workers’ personal resilience. On a 7-point Likert scale, the gig workers were required to evaluate to what extent they were resilient. The sample items were “I am able to adapt to change”, “I can deal with whatever comes”, and “I try to see humorous side of problems”. The Cronbach’s alpha for this scale was 0.90.

Promotion-focused job crafting (Time 1). I adapted the nine-item scale originally developed by Tims et al., 2012 (e.g., Fong et al., 2021; Lichtenthaler & Fischbach, 2018; Lichtenthaler & Fischbach, 2019) to measure the gig workers’ promotion-focused job crafting. On a 5-point Likert scale, the gig workers were required to evaluate how frequently they had promotion-focused job crafting behaviors. The sample items were “I try to develop my capabilities”, “I make sure that I use my capacities to the fullest”, and “If there are new developments, I am one of the first to learn about them and try them out”. The Cronbach’s alpha for this scale was 0.88.

Prevention-focused job crafting (Time 1). I adapted the six-item scale originally developed by Tims et al., 2012 (e.g., Fong et al., 2021; Lichtenthaler & Fischbach, 2018; Lichtenthaler & Fischbach, 2019) to measure the gig workers' prevention-focused job crafting. On a 5-point Likert scale, the gig workers were required to evaluate how frequently they had prevention-focused job crafting behaviors. The sample items were "I make sure that my work is mentally less intense", "I try to ensure that my work is emotionally less intense", and "I manage my work so that I try to minimize contact with people whose problems affect me emotionally". The Cronbach's alpha for this scale was 0.89.

Platform commitment (Time 2). I adapted the nine-item scale originally developed by Meyer et al. (1993) to measure the gig workers' platform commitment. On a 7-point Likert scale, the gig workers were required to evaluate the extent to which they felt committed to the platform they were working on. The sample items were "I feel a strong sense of belonging to the platform that I work on", "Right now, staying with the platform is a matter of necessity as much as desire", and "I feel the obligation to remain with the platform that I am currently working on". The Cronbach's alpha for this scale was 0.88.

Job insecurity (Time 2). I adapted the three-item scale originally developed by Mauno et al. (2001) to measure job insecurity. On a 7-point Likert scale, the gig workers were required to evaluate the extent to which they felt that their job as a gig worker on the platform that they were working on was not guaranteed. The sample items were "My job is not guaranteed", "I may change jobs in the future", and "My

job is not a long-term job". The Cronbach's alpha for this scale was 0.80.

Controls. I controlled age, education, and tenure of gig workers during data analyses. How gig workers respond to algorithmic management in OLPs is largely influenced by factors such as their age, educational background, and work experience on the platform. Working on such market intermediary platforms usually requires the use of an APP; and algorithmic management is often manifested as gamified management. Therefore, age and education affect the use process and behavioral response of gig workers to the above-mentioned trendy apps. In addition, the past years of working on the platform may have a profound impact on gig workers' understanding and response to platform management. In summary, I controlled age, education, and tenure of platform workers in this study. The gig workers were required to report their age, education background, and tenure in Time 1.

Analytic Strategy

In Study 2, I conducted the analyses in three steps: descriptive analysis, CFAs, and hypotheses testing. To further confirm the hypotheses regarding the moderated mediation effects, I also adopted the parameter-based bootstrapping approach to estimate the 95% confidence intervals of the effects (Preacher & Selig, 2012). The CFAs and hypotheses testing were performed with Mplus 8.0 (Muthén & Muthén, 2017).

Results

Descriptive Statistics and Confirmatory Factor Analyses

Before hypotheses testing, I conducted descriptive analyses. I present the means, standard deviations, and correlations of the variables in Table 10.

I conducted CFAs on the six variables rated by gig workers (i.e., algorithmic management characteristics, personal resilience, promotion-focused job crafting, prevention-focused job crafting, platform commitment, and job insecurity). The six-factor model had an acceptable fit ($\chi 2/df$ = 1.98, $p < .01$, *RMSEA* = .06, *CFI* = .95, *TLI* = .94, *SRMR* = .05). This model fit the data better than alternative models when the following variables were combined: (1) promotion-focused job crafting and prevention-focused job crafting ($\Delta\chi 2/\Delta df$ = 150.99, $p < 0.01$); (2) platform commitment and job insecurity ($\Delta\chi 2/\Delta df$ = 51.13, $p < 0.01$); (3) the aforementioned two pairs of constructs, respectively ($\Delta\chi 2/\Delta df$ = 111.85, $p < 0.01$); (4) the variables measured at Time 1 and the variables measured at Time 2 ($\Delta\chi 2/\Delta df$ = 127.36, $p < 0.01$); and (5) all of the variables ($\Delta\chi 2/\Delta df$ = 167.58, $p < 0.01$). These results show that the measures captured distinct constructs. The results are shown in Table 11.

I also conducted Harman's one-factor test for common method bias considering the data of this study were all provided by gig workers themselves. According to Podsakoff et al. (2003), based on the principal component analysis on all measured items, if the extracted first factor explains less than 40% of the variation, it can be inferred that there is no serious problem on common method bias. Therefore, I performed exploratory factor analysis on a total of 50 self-reported items, and the first

extracted factor had an eigenvalue of 12.15, explaining 24.29% of the variance, which is less than 40%. At this time, the KMO of the model is .88, which is greater than .60, and the chi-square value of the model is 10,574.18, $p < .001$. Therefore, there is no serious problem of common method bias in this model.

Table 10. Means, Standard Deviation and Correlates among Variables of Study 2

Variables	Mean	SD	1	2	3	4	5	6	7	8	9
1. Age	29.11	8.73	—								
2. Education	2.82	.83	-.01	—							
3. Tenure	2.57	1.94	-.03	.01	—						
4. Algorithmic management characteristics	5.05	1.06	-.04	-.03	.08	(.92)					
5. Personal resilience	5.49	1.13	-.00	.00	-.02	.58**	(.90)				
6. Promotion-focused job crafting	3.46	0.81	-.04	-.04	-.01	.47**	.52**	(.88)			
7. Prevention-focused job crafting	3.25	0.90	-.06	-.04	.01	.10	.14*	.24**	(.89)		
8. Platform commitment	3.34	1.24	.10	-.13*	.03	.18**	.11	.22**	-.01	(.88)	
9. Job insecurity	4.75	1.47	.05	.04	-.06	-.25**	-.18**	-.26**	.06	-.38**	(.80)

*Note. N = 280. * $p < 0.05$; ** $p < 0.01$. The figures on the diagonal in parentheses are the alpha coefficients.*

Table 9. Results of CFA (Study 2)

Model	x^2	df	x^2/df	△ x^2	RMSEA	CFI	TLI	SRMR
Model 1	425.32	215	1.98	—	0.06	0.95	0.94	0.05
Model 2	1180.29	220	5.36	754.97	0.13	0.78	0.74	0.12
Model 3	680.97	220	3.10	255.65	0.09	0.89	0.88	0.08
Model 4	1431.98	224	6.39	1006.66	0.14	0.72	0.68	0.13
Model 5	2208.31	229	9.64	1782.10	0.18	0.54	0.49	0.16
Model 6	2939.10	230	12.78	2513.77	0.21	0.37	0.31	0.18

Note. **Model 1**: Six-factor model (i.e., algorithmic management characteristics, personal resilience, promotion-focused job crafting, prevention-focused job crafting, platform commitment, and job insecurity); **Model 2**: Five-factor model (i.e., algorithmic management characteristics, personal resilience, promotion-focused job crafting + prevention-focused job crafting, platform commitment, and job insecurity); **Model 3**: Five-factor model (i.e., algorithmic management characteristics, personal resilience, promotion-focused job crafting, prevention-focused job crafting, platform commitment + job insecurity); **Model 4**: Four-factor model (i.e., algorithmic management characteristics, personal resilience, promotion-focused job crafting + prevention-focused job crafting, platform commitment + job insecurity); **Model 5**: Two-factor model (i.e., algorithmic management characteristics + personal resilience + promotion-focused job crafting + prevention-focused job crafting, platform commitment + job insecurity); **Model 6**: One-factor model (i.e., algorithmic management characteristics + personal resilience + promotion-focused job crafting + prevention-focused job crafting + platform commitment + job insecurity).

Hypotheses Testing

Both Hypothesis 1 and Hypothesis 2 were about mediation effects. Regarding Hypothesis 1, it predicted that promotion-focused job crafting will mediate the relationships between gig workers' perceived algorithmic management characteristics and their platform commitment. The results in Figure 7 show that the direct effect of gig workers' perceived algorithmic management on promotion-focused job crafting behaviors was significant and positive ($b = .36$, $p < .001$), and the direct effect of promotion-focused job crafting behaviors on platform commitment was significant and positive ($b = .29$, $p < .01$). Further, the indirect effect of algorithmic management characteristics on platform commitment, through promotion-focused job crafting, was significant ($b = .11$, $p < .05$, 95% CI = [.02, .19]), supporting Hypothesis 1.

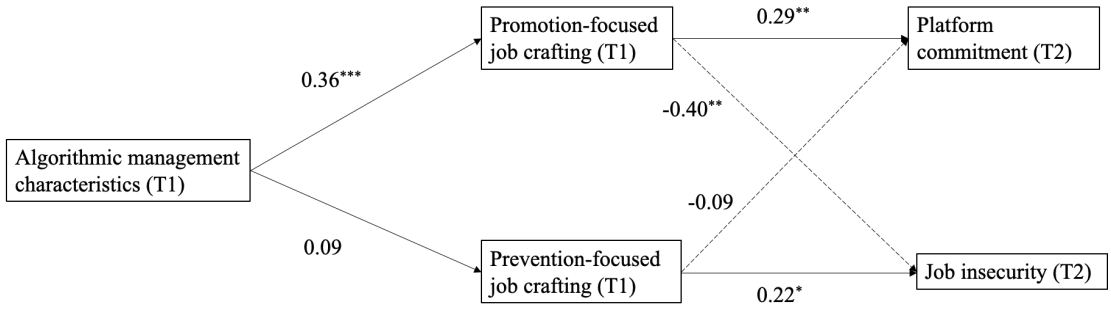

Figure 8. Results of Mediation Effects

Regarding Hypothesis 2, it predicted that prevention-focused job crafting will mediate the relationships between gig workers' perceived algorithmic management characteristics and their job insecurity. As shown in Figure 7, the results indicate that

the direct effect of gig workers' perceived algorithmic management characteristics on prevention-focused job crafting behaviors was positive but not significant (b = .09, p = .13), and the direct effect of prevention-focused job crafting behaviors on job insecurity was significant and positive (b = .22, p < .05). Further, the indirect effect of algorithmic management characteristics on job insecurity, through prevention-focused job crafting, was not significant (b = .02, p = .24, 95% CI = [-.01, .05]). Therefore, Hypothesis 2 was not supported.

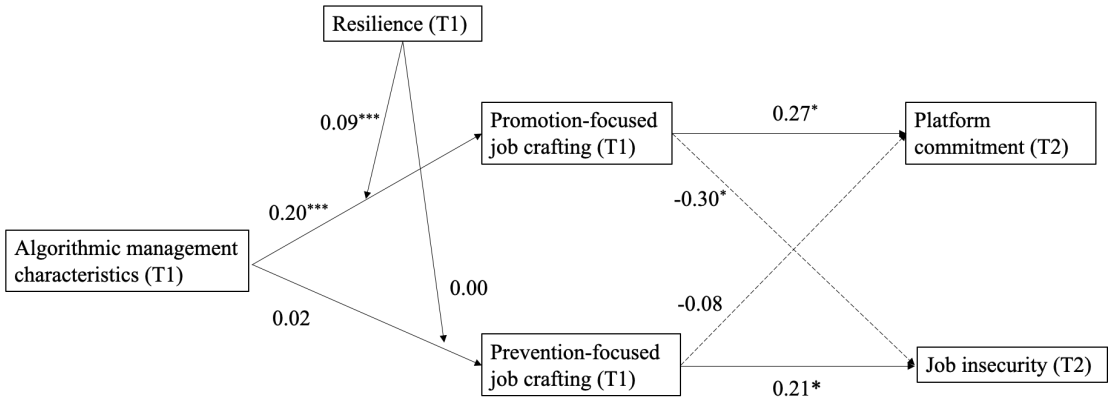

Figure 9. Results of Overall Model

Both Hypothesis 3 and Hypothesis 4 were about moderated mediation effects. About Hypothesis 3, it predicted that the positive indirect effect of gig workers' perceived algorithmic management characteristics on their platform commitment through promotion-focused job crafting behaviors is stronger when individuals' personal resilience is higher rather than lower. The results show the perceived algorithmic management characteristics * personal resilience interaction term was significant on promotion-focused job crafting behaviors (b = .09, p < .001). Figure

10 shows that the direct effect of perceived algorithmic management characteristics on promotion-focused job crafting behaviors was stronger when resilience was higher (b = .31, p ＜ .001) rather than lower (b = .10, p= .09). As predicted, the indirect effect of perceived algorithmic management characteristics on platform commitment was stronger when platform workers' personal resilience was higher (b = .08, p < .05, 95% CI = [.01, .17]) rather than lower (b = .03, p = *.20*, 95% CI = [–.01, .07]). The difference in strength between these two effects was significant (△ b = .06, p = .07, 95% CI = [.01, .13]). Therefore, Hypothesis 3 was supported. I plotted the moderating effects in Figure 9.

About Hypothesis 4, it predicted that the positive indirect effect of gig workers' perceived algorithmic management characteristics on their job insecurity through prevention-focused job crafting behaviors is weaker when individuals' personal resilience is higher rather than lower. The results show the perceived algorithmic management characteristics * resilience interaction term was not significant on prevention-focused job crafting behaviors (b = .00, p = *.99*). Therefore, Hypothesis 4 was not supported.

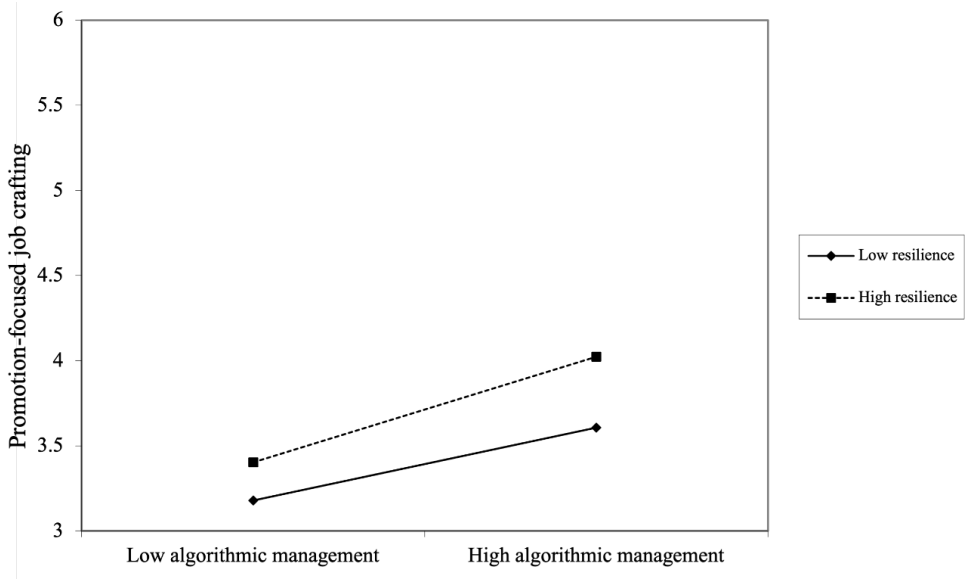

Figure 10. Results of Moderating Effects

Discussion

Based on the results of Study 1, I investigated the underlying mechanisms of the double-edged sword effects of algorithmic management from the perspective of job crafting in Study2. To be specific, I explored how gig workers' perceived algorithmic management characteristics in OLPs lead to their different outcomes (i.e., platform commitment vs. job insecurity) through gig workers' two types of job crafting behaviors (i.e., promotion-focused job crafting vs. prevention-focused job crafting). Moreover, I explored how personal resilience would moderate the abovementioned relationships. The results indicated that promotion-focused job crafting would mediate the relationships between gig workers' perceived algorithmic management characteristics and their platform commitment. And this relationship would be positively moderated by gig workers' personal resilience. To be specific, the positive indirect effect of gig workers' perceived algorithmic management characteristics on

their platform commitment through promotion-focused job crafting would be stronger when individuals' personal resilience was higher rather than lower. However, the proposed positive relationships between algorithmic management characteristics in OLPs and gig workers' job insecurity through their prevention-focused job crafting behaviors were not supported by the empirical results. And the moderating role of gig workers' personal resilience on this dark side of algorithmic management characteristics also failed to be supported.

The findings of this study can advance the literature on algorithmic management and job crafting as below. First, by simultaneously considering the bright and the dark sides of algorithmic management in OLPs other than focusing only on one side of algorithmic management, Study 2 can help to comprehensively reveal the effects of algorithmic management in OLPs on gig workers. Although the results fail to support the dark side of gig workers' perceived algorithmic management in online labor platforms, Study 2 still indicates the potential the double-edged sword of OLPs' algorithmic management.

Second, Study 2 helps to open the "black box" of algorithmic management and provide empirical evidence on how algorithmic management in OLPs influences gig workers' perceptions and behaviors. In this study, I adopted the perspective of job crafting to uncover the underlying mechanisms and further explore the boundary conditions of algorithmic management's effects. Considering the unique relationships between gig workers and OLPs, which are usually depicted as loose connections or weak contract, Study 2 reveals how gig workers' perceived characteristics of

algorithmic management in OLPs induce their diverse outcomes through the mediating effects of their job crafting behaviors. Specifically, algorithmic management in OLPs would lead to gig workers' more promotion-oriented job crafting behaviors, and further increase their commitment toward platforms. And the above-mentioned effects would be much stronger for gig workers with high personal resilience. The uncovered mechanisms of the effects theoretically and empirically enrich our understanding on algorithmic management in OLPs and provide more opportunities for the future research in this field.

Moreover, Study 2 also start a new thread of the job crafting literature. Research on this topic usually focus on the context of traditional organizations. Study 2 suggests that OLPs could provide a new research context for job crafting research, and future studies could explore gig workers' job crafting behaviors, which may play a vital role in the gig economy since gig workers often have to define and cultivate their work.

Last but not least, this study still has several limitations. First, in Study 1, I proposed four types of characteristics of algorithmic management in OLPs. However, Study 2 fails to examine the diverse effects of the different characteristics. Future research can separately explore and empirically examine the effects of different characteristics of algorithmic management in OLPs. Second, the dark side of algorithmic management in OLPs fails to be confirmed in this study, which goes against the existing literature, especially the research adopting labor process theory. The related hypotheses that fail to be supported may be due to the lack of

psychological safety of the participants in this study. These gig workers often feel that they are under great control and monitoring of platforms. Therefore, they are likely to be afraid to negatively evaluate the platforms in their mobile phone which may be under the control of the OLPs' APP. Future research on the double-edged sword of OLPs' algorithmic management can try to allay the concerns of the participants. Besides, I only collected the data from the gig workers in mainland China. However, different countries or regions may have their unique laws or regulations on OLPs, which would greatly influence the interaction between gig workers and algorithmic management of OLPs. Therefore, future research can conduct the study in a different context to examine the generalizability of my Study 2.

CHAPTER 5: STUDY 3

In Study 1, I conceptualized and operationalized the concept of algorithmic management in OLPs. Based on the results of Study 1, I further explored how algorithmic management will influence gig workers' perceptions and behaviors. The findings supported the hypotheses of the enabling effects of platform management via algorithm. To some extent, this research depicted the interaction between OLPs and gig workers in the gig economy.

Study 3 was designed to extend Study 2 in the following ways. Unlike Study 2, which assumes that the relationships between OLPs and gig workers are homogeneous and static, I first conduct a qualitative study (i.e., Study 3A) to explore how the relationships formed and evolved. When exploring the effects of algorithmic management in OLPs, most researchers assumed that the relationships between gig workers and OLPs were the same. However, in practice, OLPs often establish different types of relationships with gig workers to reach their management goals. Moreover, under different types of relationships with OLPs, gig workers may differently perceive, evaluate, and behave toward platform management. Accordingly, dialoguing with the literature on EOR, Study 3A fundamentally captures the essential attributes of relationships between gig workers and OLPs and refines the theoretical classification framework of OLPs-gig worker relationships accordingly.

Based on the results of Study 3A, I further conduct a quantitative study (i.e., Study 3B) to empirically examine how the types of relationships will influence the effects of algorithmic management on gig workers. Particularly, unlike Study 2, Study

3B proposes and examines the effects of different characteristic dimensions of algorithmic management in OLPs. Together with Study 3A, this research has significant theoretical and practical implications.

Study 3A: EOR in OLPs

To depict the evolving relationships between OLPs and gig workers, I conduct a case study in Study 3A. Focusing on the two leading food delivery platforms (i.e., Meituan and Ele.me), I construct a process model of EOR evolution in OLPs and propose a framework to differentiate diverse types of relationships between gig workers and OLPs.

Method

(1) Method and sample selections

Method selection. This study used the longitudinal case study to capture the evolution of the relationships between OLPs and gig workers, as well as the mechanisms of the evolving relationships. Since this research is the exploration of the processes and mechanisms, the method of case study is suitable for my research need (Yin, 2014). Besides, longitudinal case studies can identify the triggers of critical events based on the overall timeline and key time points, which further helps to clarify the dynamic process and internal mechanisms of EOR evolution in the new context of market intermediary platforms.

Sample selection. Regarding sample selection in case studies, previous research has shown that such cases need to be both representative and inspiring, in line with the requirements of "theoretical sampling" (Eisenhardt & Graebner, 2007). Therefore,

in Study 3A, I selected two leading platforms of online food delivery industry in China (i.e., Meituan and Ele.me) as the research objects, which meet the above sample selection requirements.

Online food delivery platforms, especially the two giants in China (i.e., Meituan and Ele.me), are typical for studying OLPs and their relationships with gig workers. Since the establishment of Ele.me in 2008, with the popularization and development of mobile Internet around 2013, online food delivery platforms have continued to grow rapidly. According to data from iiMedia Research[1], in 2020, the scale of mainland China's online food delivery market reached 664.62 billion yuan, and the number of users in the same year reached 456 million. During the past years, many leading Internet companies, including Tencent, Alibaba, and Baidu, have joined the competition, which boosts the rapid development of these platforms. Until 2017, the duopoly of Meituan and Ele.me ended the multi-head competition of food delivery platforms.

As of the second quarter of 2020, these two platforms accounted for 68.2% and 25.4% of the market share, nearly covering the whole domestic market[2]. Based on the above information, it can be seen that the food delivery platforms have developed well in the past years, which represents the prosperity of OLPs in China. At the same time, as the representative and benchmarking companies of food delivery platforms, Meituan and Ele.me are typical cases of this industry. Studying them can help us deeply understand the evolution of such platforms, especially the formation and

[1] https://data.iimedia.cn/13000316/detail/30411291.html
[2] http://www.199it.com/archives/1106731.html

evolution of their relationships with gig workers.

(2) Data collection

I collected data through multiple ways such as interviews, annual reports, official websites of two companies, government policy documents, materials from social media, and my observation of the daily work of food delivery workers. These diverse materials help to improve the richness of my case study and reach the "triangulation" of the data (Glaser & Strauss, 1967), ensuring this study's reliability and validity. The above data collection is detailed in Table 12 below. Although the interview data used in Study 3A were also used in Study 1A of this dissertation, the interview questions and coding materials of these two studies do not overlap at all.

Table 10. Data collection of Study 3A

Data source	**Data**		
	Interviewees	**Total interview duration**	**Word count of text transcription**
First-hand interview data	7 food delivery workers of Meituan	About 8 hours	135,000
	14 food delivery workers of Ele.me	About 15 hours	225,000
Second-hand data	Meituan and Ele.me's official websites and annual reports; research papers; reports of research institutes; government policy documents; materials from social media, etc.		

Data of observation	Observing the daily work of online food delivery workers.

(3) Analytic Strategy

I analyzed the data of Study 3A following the four-step procedure. The first step was to sort out the development history of online food delivery industry and two leading platforms based on the data above. The second step was to identify the key stages and events in the development process of the industry and enterprises. Meanwhile, I summarized five types of relationships between platforms and gig workers across different developmental stages in practice. Dialoging with the literature on EOR, the third step was to extract a classification framework of OLPs-gig worker relationships and reveal three categories of relationships, as well as their relevant features. Lastly, I summarized and constructed a process model of EOR evolution in OLPs to illustrate how external environment characteristics determine the switching of two functions of OLPs (i.e., organization and market) and further lead to different types of EOR in this context.

Results

In this section, in order to better understand the formation and evolution of the relationships between gig workers and OLPs, I first sort out the development history of the online food delivery industry and the two platforms (i.e., Meituan and Ele.me). The results are shown in Figure 10. Referring to the key time points and critical events in the figure, the development of the entire industry can be roughly divided

into three stages: (1) market expansion, (2) monopoly formation, and (3) transformation. Further, I introduced different characteristics of three stages. Accordingly, the two functions of OLPs (i.e., organization and market) switched with the development of the industry and platforms, which would profoundly affect the evolution of the relationships between gig workers and OLPs.

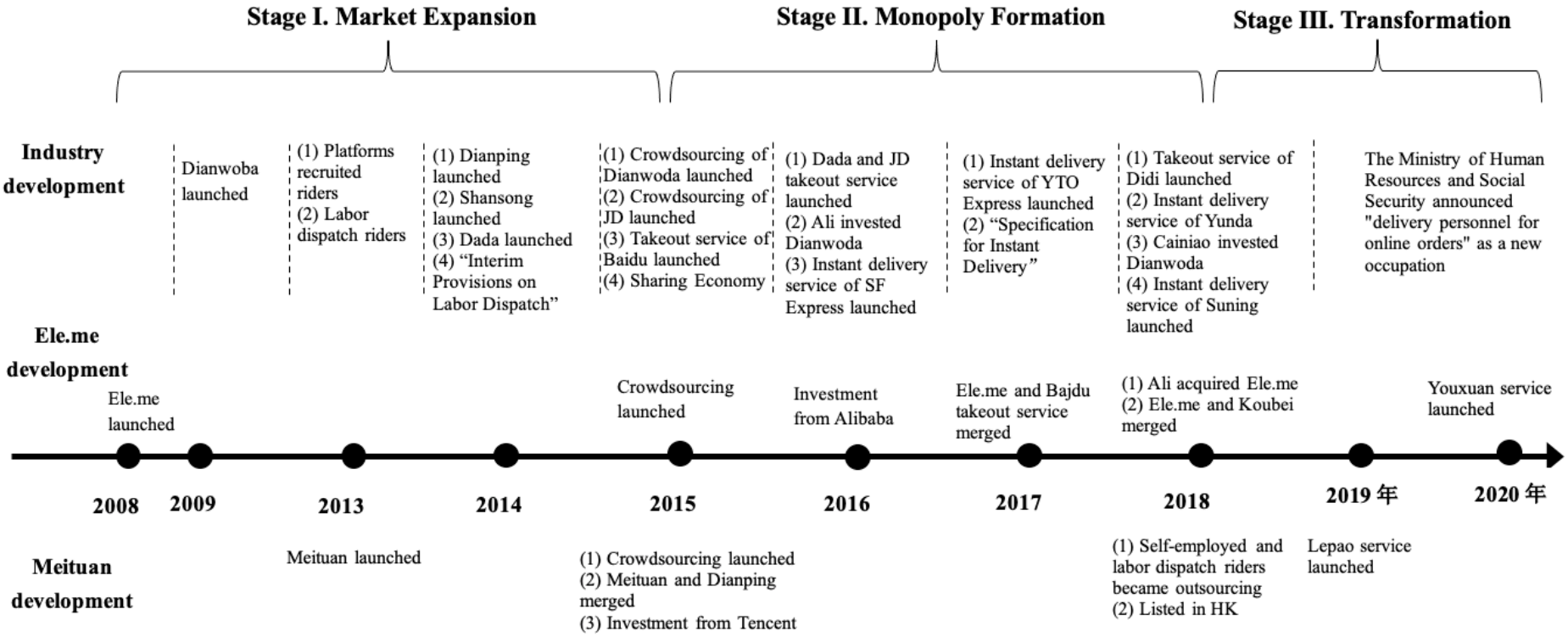

Figure 11. Development History of the Online Food Delivery Industry

Stage I: Loose Connections under the Market Function

(1) Characteristics of this stage

Before the emergence of online delivery platforms, takeaways were delivered by merchants themselves, or by employed personnel. Thanks to the development of digital technologies and applications, online food delivery platforms were established. These market intermediary platforms integrated massive food delivery information and connected both supply and demand sides, facilitating a large number of transactions. This efficient online delivery greatly enhanced the market demand in the industry. At this stage, the entire online food delivery industry was in its early stage of development, and industrial laws and policies were still in the blank. In order to seize more market shares, many Internet giants rushed to join this new market, and various online delivery platforms were established. As shown in Figure 10, since Ele.me was first launched in 2008, other platforms such as Meituan, Dada(达达), and Dianwoda(点我达) established, which made the competition in the industry increasingly fierce. Therefore, how to rapidly realize the scale development to achieve the network effects became the primary goal of the survival and development of these platforms at this stage.

Meanwhile, comparing the status of different stakeholders in the platform ecosystem, OLPs were in a weak position at this stage. In the early development stage of the online food delivery industry, as a brand-new business model, these platforms had to change the user habits of merchants and customers, attracting them to OLPs and completing transactions through the platforms. Another great challenge for these

platforms was that they lacked the sufficient capacity to meet the huge delivery demand after merchants and customers enter the platforms. As a new type of occupation, the supply of labor for online food delivery workers needed to be developed. According to a survey by the International Labour Organization in 2021, in the early stage of online delivery platforms such as Meituan, the platforms often attracted more labor by providing favorable working conditions since the entire industry was short of labor. In other words, these platforms played the role of market intermediary at this stage, relying on gig workers to achieve their scale development and business goals. Correspondingly, OLPs and gig workers were in a state of power asymmetry. Platforms had relatively limited direct management or control over platform workers since they were the weaker party.

(2) Function of platforms: Prominent function of the market

As mentioned above, at this stage, the external environment of online food delivery platforms was (1) industrial laws and policies were in blank, (2) market demand needed to be explored, (3) labor supply had to be developed, and (4) new technologies emerged. In this situation, the market function (i.e., matching) of these market intermediary platforms was prominent. In other words, compared with their organization function (i.e., control), such platforms played the role of facilitators of exchanges between diverse consumers and effectively matched supply and demand to promote transactions (Gawer, 2014). Considering the importance of the network effects in these two-sided markets, the primary goal of online food delivery platforms at this stage was to attract more consumers. For example, at the early stage of

development, Meituan and Ele.me provided a large number of subsidies for consumers, such as increasing the remuneration of delivery workers, reducing the service fee to merchants, and increasing the subsidies for customers, etc. In doing so, as the two-sided market, these platforms did not directly occupy production materials or sell products and made profits by providing digital infrastructures and charging commissions on transactions on platforms (Constantinides et al., 2018; Thomas et al., 2014; Xie et al., 2019).

(3) Relationships between platforms and gig workers: Loose connection

As introduced above, platforms had to attract more labor to complete orders at this stage. Therefore, there were three types of relationships between platforms and delivery workers. In particular, two of them only existed very briefly. At the early stage of development, to seize the market more quickly and effectively, the platforms attracted laborers to this new industry by formally hiring delivery workers or using dispatch delivery workers. These two types of relationships were depicted in Figure 11 and Figure 12, respectively. However, on the one hand, these relationships greatly burdened the platforms' labor costs. At the same time, since the market intermediary platforms did not directly own production materials for profit, the above two types of atypical relationships were abandoned quickly.

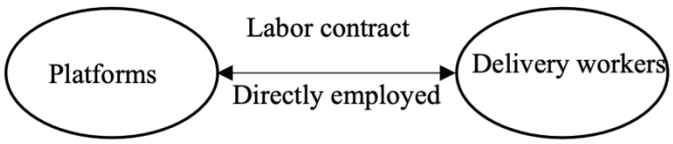

Figure 12. Delivery Worker-OLP Relationship: Mode I

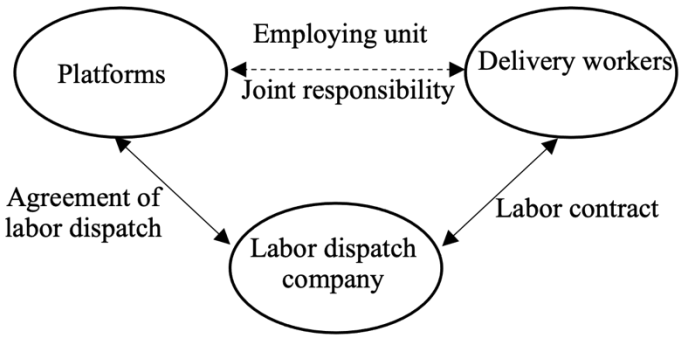

Figure 13. Delivery Worker-OLP Relationship: Mode II

At this stage, the more prevalent relationship was crowdsourcing, as shown in Figure 13. Crowdsourcing riders are those gig workers that platforms or labor service companies outsource to, and these independent workers freely register the APP and complete orders in OLPs. Under this type of relationship, for workers, they are loosely connected to platforms without formal labor contracts and usually enjoy a high level of work autonomy. Specifically, Meituan and Ele.me do not have any requirements for their work time and workload. Such workers can flexibly arrange their work. Moreover, they can freely enter or exit such platforms. For example, gig workers mentioned in the interviews:

We have great automy, which means that we are not managed by anyone. For example, you can work if you want, and you can take a rest as you like. [GW#6]

If you are crowdsourcing riders, you can reject the orders distributed by platforms once you are not satisfied. [GW#14]

For OLPs, they do not have to bear many labor costs like traditional employers, which relieves the pressure under the two atypical models above. In addition, the prominent market function at this stage requires platforms to match supply and demand effectively. Given this, due to the loose connections to platforms and flexible work characteristics, crowdsourcing riders under this relationship type can quickly respond to immediate distribution needs, which helps platforms play the role of market intermediaries. Because of these benefits, this relationship still contributes to online food delivery platforms nowadays.

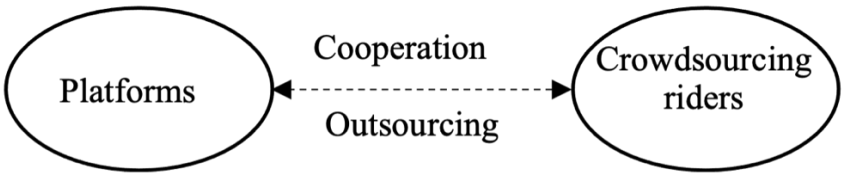

Figure 14. Delivery Worker-OLP Relationship: Mode III

However, the autonomy mentioned above enjoyed by crowdsourcing riders not only improves the flexibility of platform employment but also brings serious challenges to the stability and predictability of platform operation. The use of crowdsourcing riders was initially intended to supplement the previous two relationships, flexibly making up for the lack of delivery capacity and reducing labor costs. However, such flexibility may also be disruptive when platforms face an urgent need for delivery capacity. For example, when the weather is terrible, the orders may surge, and the previous two relationships fail to meet the demand for riders. At this time, as an extra capacity, crowdsourcing riders should fulfill the flexible demands to

alleviate the plight of platforms. However, because of the autonomy mentioned above, crowdsourcing riders often stop accepting or rejecting orders from the platform system in bad weather, failing to supplement the rider demand in this situation effectively. To solve this problem, new types of relationships emerged at Stage II.

Stage II: Tight control under the Organizational Function

(1) Characteristics of this stage

With the development of the online food delivery industry, the market structure gradually took shape, and the monopoly replaced the initial situation of numerous platforms' competition. As shown in Figure 10, while different delivery platforms continued to be launched, the monopoly was gradually formed. Specifically, Meituan accepted Tencent's injections and then merged with Dianping. Ele.me accepted Alibaba's acquisition, subsequently acquired the delivery service of Baidu, and incorporated Koubei. Under the series of mergers and acquisitions, the giant platforms (i.e., Meituan and Ele.me) began to promote monopoly formation. As of 2018, Meituan and Ele.me had a market share of 60.10% and 29.30%, respectively, and the duopoly pattern of the online food delivery industry was finally established[3].

With the formation of a monopoly, the market demand was fully developed, and labor supply was sufficient at this stage. Unlike Stage I, in which platforms had to educate consumers, in Stage II, both the demand and supply sides greatly depended on these market intermediary platforms. According to the report of Meituan Research

[3] http://www.199it.com/archives/789872.html

Institute, more than 2.7 million riders were engaged in delivery work on Meituan in 2018, and the platform work became the only source of income for nearly 65% of riders[4]. In particular, with the further development of algorithms, the platform systems were continuously optimized, thus providing strong support for OLPs to effectively coordinate and control delivery workers. Further, at this stage, attracting more consumers was no longer the primary goal of platforms. Instead, improving effective control over delivery workers and reducing labor costs became salient.

(2) Function of platforms: Prominent function of the organization

Due to the above characteristics, the weak position of platforms in the first stage changed, and the organization functions of OLPs began to be salient. The organization functions of market intermediary platforms usually emphasize that platforms use traditional organizational control methods such as monitoring, evaluation, rewards, and punishments to control platform workers (Constantinides et al., 2018; Möhlmann et al., 2020). The monopoly formation brought possibility and necessity to the organization function of platforms at this stage.

First, the monopoly formation reversed the asymmetric dependence between platforms and delivery workers. Unlike the asymmetric dependence of platforms on delivery workers due to the insufficient supply in the first stage, at Stage II, a large number of riders entered the food delivery market and regarded platform work as the only source of income. Therefore, platforms could use traditional organizational control methods combined with digital technologies such as algorithms to effectively

[4] http://www.199it.com/archives/823693.html

control delivery workers at this stage.

In addition, the development goals of these platforms at this stage also determined the prominence of their organization functions. In the first stage, platforms prioritized expanding the platform workforce and achieving rapid supply and demand matching to seize market shares. However, in the stage of monopoly formation, the market shares of platforms were nearly established. The development goals of platforms were to exert control over delivery workers to improve their operating efficiency and reduce costs. As a result, replacing the market function, the organization function of platforms became increasingly prominent, which promoted the evolution of a new type of delivery worker-OLP relationship at this stage.

(3) Relationships between platform and gig workers: Tight control

During this stage, in the face of the instability and unpredictability risks of crowdsourcing riders, platforms began to update their relationships with delivery workers based on their organization functions. As a result, "Zhuansong" rider (专送骑手), which is shown in Figure 15, came out. Under this relationship, platforms exerted tight control over delivery workers, who provided relatively standardized delivery services in OLPs. Figure 14 shows that such delivery workers usually sign contracts with franchisees or outsourcing companies, and then the latter established cooperative relationships with platforms. During platform work, these workers were similar to employees in traditional organizations embedded in strict hierarchical structures. For example, the delivery workers mentioned in the interviews as below:

We (i.e., "Zhuansong" riders) are under the strict management. We have several

leaders in the hierarchical structure. They are responsible for the whole process of our work. [GW#5]

We (i.e., "Zhuansong" riders) must be online during the peak hours and complete at least 8-hour work every day. We also need to be on duty and attend the morning assembly. [GW#17]

In addition, the platforms put forward more standardized requirements for these workers regarding their dress and language when communicating with customers. More strictly, in terms of the exit, these delivery workers could not exit the platforms freely. Instead, they had to apply in advance, and they could leave only after obtaining approval from their leaders. Besides, they were likely to face restrictions similar to "competition restrictions" after leaving. They could not work on the same platform for a certain period of time.

From the above introduction, we can see that a new type of relationship emerged due to the organization functions at this stage. Therefore, the platforms could use the control methods in traditional organizations to effectively control delivery workers and realize their development goals. This new relationship under the organization function ensures the stability and predictivity of delivery work, which guarantees operational efficiency in OLPs. At the same time, regarding costs and risks, under this new relationship, the platforms cooperate with outsourcing companies or franchisees who are responsible for the recruitment and management of delivery workers as required by the platforms. Therefore, OLPs no longer need to directly manage tens of millions of delivery workers and transfer the related risks and pressures to the

outsourcing companies and franchisees, which further boosts the scale development and advantage acquisition of these platforms in the stage of monopoly formation.

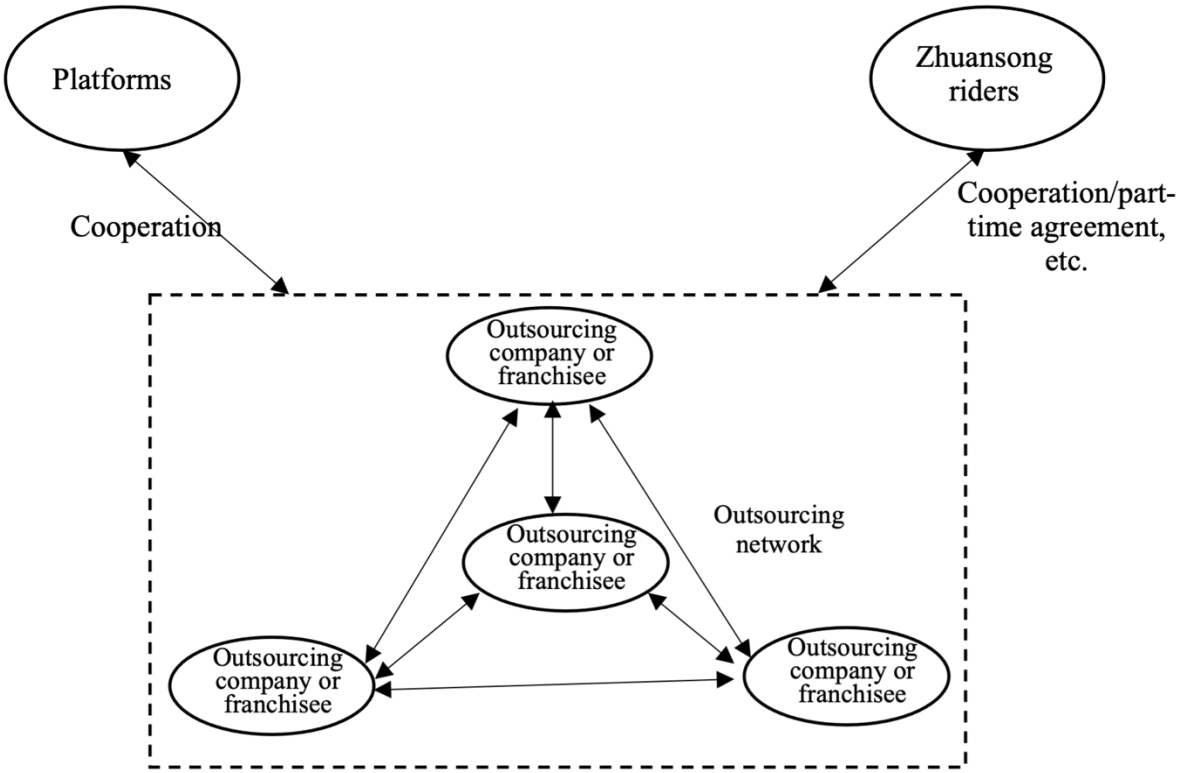

Figure 15. Delivery Worker-OLP Relationship: Mode IV

Stage III: A New Type of Connection under the Balance between Two Functions

(1) Characteristics of this stage

As the industry matures, online food delivery platforms have entered the stage of transformation. For example, "The Research Report of Food Delivery Industry in China (the first three quarters of 2019)," led by the Meituan Research Institute, shows that the competition of food delivery platforms has begun to gradually transform into a stage of the value competition. At the same time, with the development of this industry, platforms like Meituan and Ele.me carry tens of millions of jobs and have

become an essential driving force for social development and transformation. Therefore, the nation has paid attention to the problems and deficiencies during the platform development. The industrial laws and regulations such as "Anti-Monopoly Guidelines in the Platform Economy" have been gradually released.

At the same time, public opinion has also begun to pay more attention to the confrontational relationships between the platforms and delivery workers. For example, in September 2020, a WeChat tweet of "Delivery Workers Who Get Trapped in the Platform Systems" detonated social networks[5], and gig workers in this industry thus gained the support of public opinion in the whole society. The development of the external environment, such as the above-mentioned market development, national policies, and public opinion, has pointed out that these platforms urgently need to enter a new stage of transformation.

(2) Function of platforms: Balance between two functions

Due to the above stage characteristics, the platforms have begun to explore the balance between their dual functions of market and organization to ensure delivery workers as free market participants while achieving their development goals. Reflecting on the previous two stages, merely emphasizing a particular function has certain limitations for all the stakeholders in this ecosystem. For example, when the organization function dominates, such platforms continue to strengthen the control over delivery workers. At this time, these workers under non-standard employment relationships fail to enjoy legitimate rights and interests like traditional laborers.

[5] https://zhuanlan.zhihu.com/p/225120404

Instead, they are faced with continuous and tightening control from OLPs, which is regarded as “a new type of exploitation” in the gig economy (Xie et al., 2019). This type of relationship may pose a significant threat to social stability and sustainable development.

Differently, when the market function dominates, these OLPs may only serve as intermediary markets, matching supply and demand to gain profits. At this time, on the one hand, due to the lack of control over delivery workers, the stability of the platform development may be significantly challenged. At the same time, delivery workers may always work as independent contractors under the piece-rate mode. This fragmented work in a social vacuum may threaten delivery workers' well-being and development (e.g., Anwar & Graham, 2020; Bajwa et al., 2018; Gross et al., 2018). As a result, in the stage of transformation, platforms such as Meituan and Ele.me have begun to explore the balance between their dual functions, which further triggers the new type of delivery worker-OLP relationship.

(3) Relationships between platform and gig workers: A new exploration

In this stage, Meituan and Ele.me, the two giants of food delivery platforms, launched a new type of relationship to achieve the balance between their two functions (i.e., “Lepao” (乐跑骑手) in Meituan and “Youxuan” (优选骑手) in Ele.me) as shown in Figure 15. The relationship between these delivery workers and the platforms is similar to that of crowdsourcing. They do not sign a formal labor contract with the platforms and complete orders as independent workers. However, unlike the crowdsourcing delivery workers, they face some control since they enjoy a

certain priority in dispatching orders and their average income is much higher. Specifically, such delivery workers usually belong to a specific team, and there is a team leader who is responsible for the daily management of them. In addition, platforms have requirements for their daily workload and the number of orders they can reject.

Figure 16. Delivery Worker-OLP Relationship: Mode V

However, compared to the relationship, which is under strict hierarchical control at Stage II, this new type retains a certain degree of autonomy under the platform's market function, such as the delivery workers with the new connections to platforms can enter or exit more freely. It can be seen that this new type of relationship has the characteristics of both crowdsourcing riders and "Zhuansong" riders to a certain extent. This new exploration indicates the balance between the dual functions of OLPs and helps platforms to adapt to the development requirements of the new stage. Therefore, although this type of relationship appeared relatively late, it has been widely used in the industry. Referring to the Research Report of Sinolink Securities, only in Meituan, the proportion of delivery workers with this relationship has reached 20% of the total number of riders.

Discussion

Based on the above case analysis results, dialoguing with EOR literature, I first developed the classification framework of gig worker-platform relationships and discussed the attributes of each relationship type. Furthermore, I propose a process model of EOR evolution in OLPs to illustrate how external environment characteristics determine the switching of two functions of OLPs (i.e., organization and market) and further lead to different types of EOR.

(1) Classification of EOR in OLPs

Referring to the work of Romme (1999), I summarized the diverse relationships in above Results into three types, which is shown in Table 13. This classification will enrich our understanding of EOR in the new context of OLPs.

Table 11. Classification of EOR in OLPs

	Type I. Self-determination	**Type II. Quasi self-determination**	**Type III. Domination**
Examples	Outsourcing riders	Lepao/Youxuan riders	Zhuansong riders
Definition	The capacity to act autonomously.	Autonomy under control	The capacity to carry their will despite the resistance of other parties.
Contractual notion	Partnership	Short-term cooperation agreement	Long-term work agreement/contract
Authority	Authority is defined by workers	Limited authority and part of that is defined by platforms	Authority is clearly defined by platforms or outsourcing firms
Organizational	Heterarchy	Hierarchy: nearly flat	Hierarchy: vertical

structure			sequence of layers of accountability
Control	Self-regulation	Platform control via leaders; self-regulation	Top-down control; platform control
Context	Open-ended and dynamic context	Open-ended context	Predictable and stable context
Advantages	Flexibility and autonomy	Stability with somewhat autonomy	Stability with guarantee
Disadvantages	External risks without guarantee	Under control without corresponding guarantee	Tight control with risks of legal isolation

Type I. Gig workers under the self-determination relationship can be regarded as partners of platforms. Therefore, the platforms do not sign formal labor contracts or employment agreements with such workers. Delivery workers can work as independent workers in OLPs. Under this relationship, they enjoy a high degree of autonomy without hierarchical management from platforms or any third party. Instead, they are more self-disciplined. However, in practice, such gig workers often face the risks of the dynamic and highly uncertain market environment since they work under the piece-rate payment. Due to the unpredictability of dispatching orders in OLPs, their incomes face high uncertainty.

Type III. The second relationship type is quasi self-determination. Under this relationship, there is usually a short-term cooperation agreement between gig workers and platforms. During the cooperation period, the platform may promise workers certain orders or incomes. Correspondingly, gig workers have to cede certain autonomy and face the management from platforms, such as daily workload and work

methods. However, they cannot enjoy the income return and labor assurance corresponding to the management and control they follow since they do not have any labor contracts with platforms or third parties. This poses a great challenge to the protection of their rights and interests.

Type III. The third relationship type is domination, under which platforms usually form a relatively long-term and stable relationship with gig workers by involving a third party. Such gig workers face management and control from the platforms and third parties simultaneously, and their work autonomy is extremely limited. Instead, they are usually embedded in a multi-layer vertical hierarchical structure and work under tight control. However, compared with gig workers under other types of relationships, these workers can complete orders in a more stable work context with guaranteed incomes.

(2) A process model of EOR evolution in OLPs

Compared to the existing EOR research, which usually statically depicts the relationships, I construct a process model of EOR evolution in OLPs. As shown in Figure 16, this process model helps to illustrate how external environment characteristics determine the switching of two functions of OLPs (i.e., organization and market) and further lead to different types of EOR.

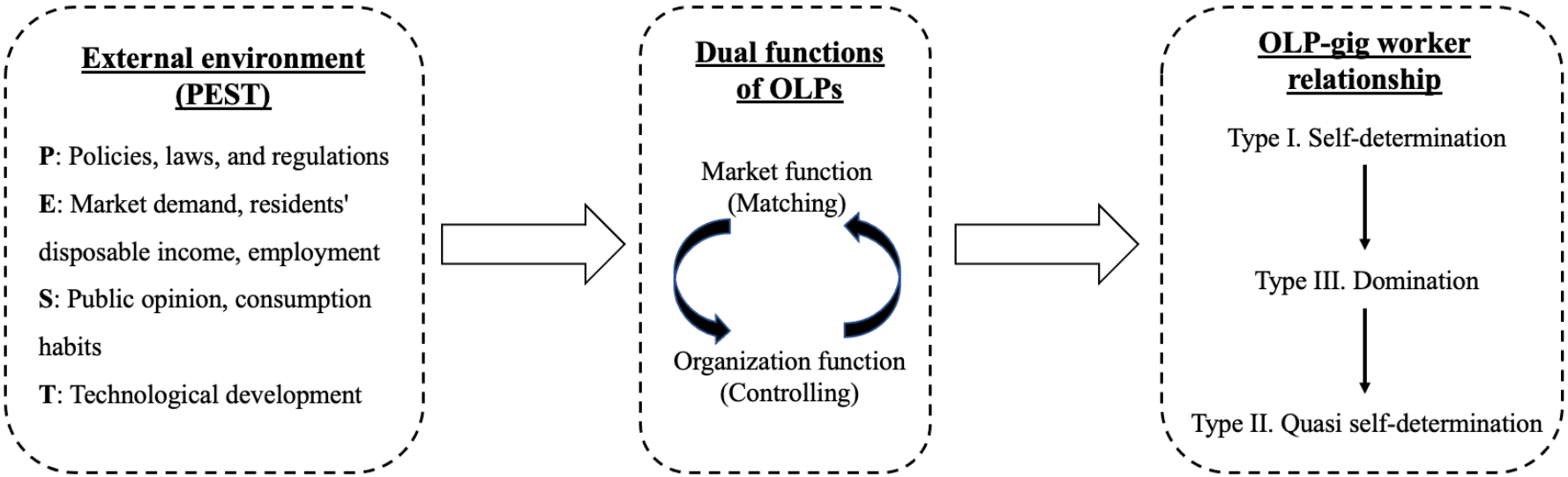

Figure 17. The Process Model of EOR Evolution in OLPs

Elements of the external environment

Based on the case analysis, it can be found that multiple external factors are of great significance to the construction and evolution of EOR in OLPs. In this regard, I adopt the PEST model to sort out the external environmental factors that influence the above relationships.

Political factors. These factors are mainly related to how the government intervenes in economic activities. Referring to the above case, it can be found that for the relationships between OLPs and gig workers, the most important political factors are national policies, relevant laws, and regulations for the industry. For example, Interim Regulations on Labor Dispatching was officially implemented in 2014. The Promotion of the Healthy Development of the Platform Economy was issued in the 14th Five-Year Plan and 2035 Proposals. Moreover, the Anti-Monopoly Committee of the State Council released The Anti-monopoly Guidelines in the Platform Economy in 2021. All of these significantly influence the development of platforms and their relationships with gig workers.

Economic factors. These factors mainly include the critical components of the economic environment. The results of the case analysis suggest that in the process of EOR evolution in OLPs, market demand, residents' disposable income, and employment status all play essential roles. Specifically, the cultivation and expansion of the online food delivery market, the improvement of residents' living standards, and the growing number of flexible employment have all promoted the formation of dynamic and diverse relationships between platforms and gig workers.

Social factors. The case analysis results indicate that factors, such as public opinion, and people's consumption habits, may play an important role in the formation and evolution of EOR in OLPs. The most typical example is that the article "Food Delivery Workers Who are Trapped in the Platform Systems" in 2020 once aroused the attention of the whole society to the online delivery workers and urged the platforms to further adjust their relationships with gig workers.

Technological factors. These factors mainly include technological inventions, as well as the emergence and application of new technologies, processes, and materials closely related to the development of enterprises. Through case analysis, it can be found that for market intermediary platforms, technical factors play a vital role in the construction and evolution of EOR in OLPs. In this case, advances such as digital and network technologies are of great significance when exploring how to effectively gather, manage, and coordinate geographically distributed gig workers.

The process of EOR evolution through dual functions of OLPs

When analyzing how external environmental factors affect the formation and evolution of EOR in OLPs, we should notice the characteristics of these market intermediary platforms, especially compared to traditional organizations. As a type of “meta organizations”, OLPs have two different functions: organization and market (Möhlmann et al., 2021), which helps to explain the EOR construction and evolution in these platforms. Regarding the dual functions, some scholars have made preliminary explorations. For example, Gol et al. (2019) proposed that when

exploring the governance of OLPs, there are two different mechanisms: control mechanism and coordination mechanism. Under the control mechanism, the platforms play more organizational management functions, such as monitoring and guiding gig workers' work process and performance through formal or informal control. The primary purpose of this mechanism is to ensure that the behaviors of gig workers are consistent with the platforms' goals and interests. Differently, under the coordination mechanism, the platforms play more of an intermediary market role, such as matching supply and demand and making pricing strategies. The primary purpose of this mechanism is to increase gig workers' dependence on the platforms, thereby ensuring their status as market intermediaries (Gol et al., 2019).

Similarly, Möhlmann et al. (2021) also differentiated the dual functions of market (i.e., matching) and organization (i.e., controlling) when analyzing the management of OLPs. Comparing these two functions, there are not only differences in objectives and means but also differences in the power and status between platforms and gig workers. Under the organization function, the power is asymmetric between platforms and gig workers, and platforms exert more control and supervision of workers (Duggan et al., 2020; Long et al., 2021; Pei et al., 2021a). However, under the market function, platforms, as the market intermediaries, depend more on gig workers and other stakeholders to realize their scale development and network effects (Constantinides et al., 2018; Thomas et al., 2014; Xie et al., 2019). The analysis results indicate that the platforms in my case study have the above two different functions, which play a significant role in the formation and evolution of EOR in

OLPs.

First, the two functions will switch due to the effects of different external environmental factors. For example, when the industry is not mature, the market demand needs to be developed, and the relevant policies are absent. In this case, the primary goal of OLPs is to effectively achieve scale development and network effects by playing the role of market intermediaries. At the same time, the platforms are often in a weak position in the ecosystem and rely more on other stakeholders, such as gig workers, to ensure their market function. Therefore, compared to the organization function, the market function of OLPs is more prominent under such external factors, which leads to their loose connections to gig workers (i.e., Type I).

However, with the changes in the external environment, such as the industry's maturity, the development of market demand, the increasing supply of labor, and the advances in digital technologies, the platforms gradually eliminate their dependence on gig workers. On the contrary, the dependence of gig workers on OLPs will increase significantly. Therefore, in this stage, the market function of platforms begins to decline, and the organization function gradually becomes prominent. That is, the primary goal of platforms is to strengthen the control of gig workers to improve management efficiency and reduce costs. In this circumstance, platforms may dominate their relationships with gig workers (Type III).

Furthermore, with the release of the relevant policies, laws, and regulations and the supervision of public opinions, the above organization function of OLPs will be constrained. Under the influence of such external factors, emphasizing the specific

function cannot promote the sustainable development of OLPs. Therefore, exploring the balance between the two functions has become the primary goal of this stage. Therefore, platforms will turn to the new type of EOR, which can provide gig workers with autonomy as independent workers and simultaneously ensure their control of platform work (i.e., Type II).

Conclusion of Study 3A

In Study 3A, focusing on the context of online food delivery platforms in China, I conducted a case study to explore the relationships between gig workers and OLPs. The results revealed that EOR in OLPs was not homogeneous and static like the findings of the previous studies. Instead, due to the dynamic external environment, the two functions of OLPs (i.e., organization and market) would switch, which further led to diverse types of relationships between gig workers and OLPs. This study developed a classification framework of gig worker-platform relationships and constructed a process model of EOR evolution in OLPs.

Study 3B: The Moderating Role of Relationship Types

The results of Study 3A, which clarify three types of relationships between OLPs and gig workers, provide a theoretical basis for follow-up research to explore different motivation, cognitive and emotional experiences, as well as corresponding behavioral responses of gig workers under different relationship types. Therefore, based on Study 3A, I further conduct a quantitative study (i.e., Study 3B) to empirically examine how the types of relationships would influence the effects of gig workers' perceived algorithmic management on their job satisfaction. Besides, compared to Study 2, Study 3B explored the influence of different dimensions of algorithmic management instead of focusing on the overall construct. The research model of Study 3B is graphically depicted in Figure 17 below.

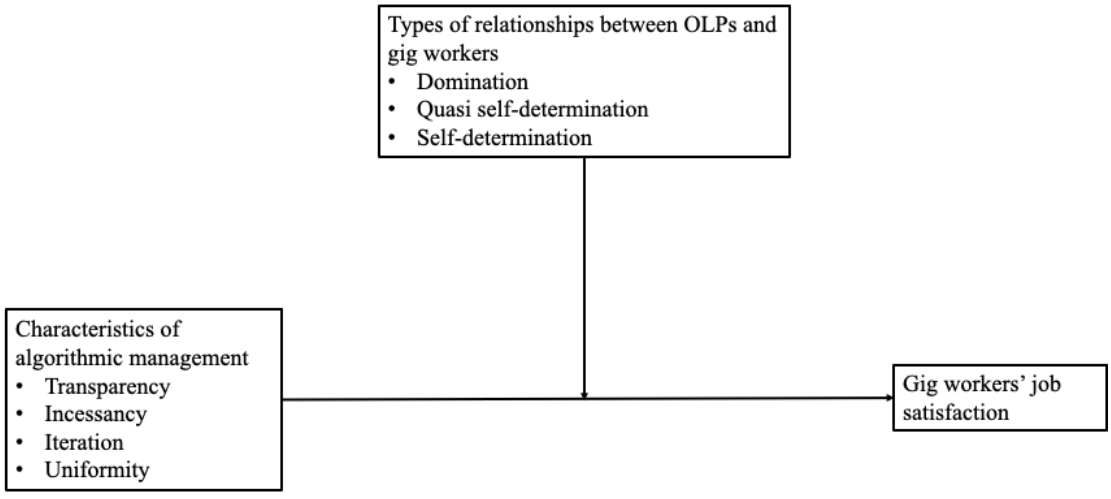

Figure 18. The Conceptual Model of Study 3B

Theory and Hypotheses

The relationships between dimensions of algorithmic management and gig workers' job satisfaction

Before exploring the moderating role of relationship types, I first propose the main effects of four dimensions of algorithmic management (i.e., transparency, incessancy, iteration, and uniformity) on gig workers' job satisfaction. Overall, I predict that the four dimensions will be positively related to gig workers' job satisfaction.

Transparency refers to the extent to which the procedures or mechanisms of algorithmic management can be fully understood by gig workers. The highly transparent algorithmic management can enable gig workers better understand the platform management rules related to their work content, work process, task evaluation, and final compensation (e.g., Kim & Moon, 2021; Schnackenberg et al., 2021). This means that transparency can help gig workers better grasp platform management and improve their sense of control over their work, which can further increase their job satisfaction. Therefore, I propose the following hypothesis:

Hypothesis 5: Transparency of algorithmic management in OLPs is positively related to gig workers' job satisfaction.

Incessancy refers to the extent to which platforms keep monitoring or recording the data of gig workers with the help of algorithms. Although some scholars describe this kind of attribute as the reflection of a "digital cage" (e.g., Vallas & Schor. 2020),

incessancy may play an enabling role for gig workers, especially considering the characteristics of this new work context. Different from employees in traditional organizations, gig workers usually work in a social vacuum (e.g., Ashford et al., 2018; Petriglieri et al., 2019). This means they may fail to get feedback or information about their real-time work. From this perspective, incessancy of algorithmic management will provide gig workers with timely and continuous work feedback, action guidance, and other relevant information during their platform work (Kellogg et al., 2020). And this will further increase their satisfaction with their job. To conclude, I propose the following hypothesis:

Hypothesis 6: Incessancy of algorithmic management in OLPs is positively related to gig workers' job satisfaction.

Iteration refers to the extent to which platform algorithms can adjust their management of gig workers in response to workers' input. This attribute will greatly help gig workers' job satisfaction, especially considering their platform work is usually boring, fragmented, and repetitive (e.g., Xie et al., 2019; Veen et al., 2020). In this case, iteration of algorithmic management, which is usually embodied in the gamification of platform management, makes platform work more challenging and competitive (e.g., Cardador et al., 2017; Silic et al., 2020). Therefore, gig workers may feel that they can utilize or develop their skills (e.g., Cullinane et al., 2017; Nipper et al., 2018), and this can further increase their job satisfaction. To conclude, I propose the following hypothesis:

Hypothesis 7: Iteration of algorithmic management in OLPs is positively related to gig workers' job satisfaction.

Uniformity refers to the extent to which algorithmic management of platforms could be consistent among gig workers. High uniformity of platform management via algorithms will make gig workers perceive that platforms equally treat them as other gig workers. This kind of perception will greatly influence gig workers' justice perceptions, which can further affect their job satisfaction (e.g., Bakhshi et al., 2009; Loi et al., 2009). To conclude, I propose the following hypothesis:

Hypothesis 8: Uniformity of algorithmic management on online labor platform is positively related to platform workers' job satisfaction.

The moderating role of relationship types

Based on the above hypotheses, I first argue that the relationship types will moderate the effects of uniformity on gig workers' job satisfaction. To be specific, I predict that the positive relationship between uniformity and job satisfaction will be stronger for gig workers who have quasi self-determination relationships with platforms than workers with other types of relationships (i.e., self-determination and domination). By definition, we can see that uniformity often involves interpersonal comparisons. Therefore, when it exerts its effects, gig workers need to be able to find comparative objects. And then, during interpersonal comparisons, platform uniformity is more likely to positively influence gig workers' job satisfaction. Considering the

characteristics of different types of relationships between gig workers and OLPs, we can infer the moderating role of relationship types.

Based on the findings of Study 3A, gig workers who have self-determination relationships with platforms can be seen as independent workers. These individuals often have a high level of job autonomy in OLPs without any constraints (Ashford et al., 2018). However, these individuals are also in a social vacuum and work alone, which means they have few connections with other peers (Ashford et al., 2018; Petriglieri et al., 2019). Therefore, it is difficult for them to find available comparative objects when perceiving and evaluating uniformity of algorithmic management on platforms.

For gig workers who have domination relationships with platforms, they are often nested in a hierarchical structure, and their work process, evaluation, and assessment criteria are often standardized. This means that although gig workers with this relationship type can easily find their comparative objects who are in the same structure, the positive effects of uniformity of algorithmic management may be limited due to their consistent work conditions during their standard work.

Different from gig workers with the above two relationship types, individuals who have quasi self-determination relationships with platforms are most likely to maximize the positive effect of uniformity. This is because with this relationship type, gig workers have a certain degree of work autonomy on the one hand. On the other hand, since they usually work in teams, they can interact with their team leaders and other team members during their platform work. Therefore, it is easier for them to

find comparative objects. In this case, uniformity of algorithmic management is more likely to further have positive effects on gig workers' job satisfaction by improving their justice perception. In summary, I propose the following hypothesis:

Hypothesis 9: The positive relationship between uniformity of algorithmic management and job satisfaction will be stronger for gig workers who have quasi self-determination relationships with platforms than gig workers with other types of relationships (i.e., self-determination and domination).

Second, I propose that the relationship type will moderate the effects of transparency on gig workers' job satisfaction. To be specific, I predict that the positive relationship between transparency of algorithmic management and job satisfaction will be less strong for gig workers who have self-determination relationships with platforms than workers with other types of relationships (i.e., quasi self-determination and domination).

By definition, we can see that high transparency often involves complex rules and procedures of algorithmic management. This may help gig workers to better understand how platforms manage them via algorithms, which enables them to leverage algorithms and perform better in platforms. However, the underlying algorithmic logic is usually a combination of multiple complex rules, which may greatly consume gig workers' cognitive resources and distract their attention (Session et al., 2020). From this perspective, compared to independent workers, gig workers who have quasi self-determination and domination relationships with platforms are

more likely to figure out the rules of algorithmic management. This is because they can cooperate with or learn from other colleagues or their leaders, which will make the positive effects of transparency on job satisfaction possible. To conclude, I propose the following hypothesis:

Hypothesis 10: The positive relationship between transparency of algorithmic management and job satisfaction will be less strong for gig workers who have self-determination relationships with platforms than workers with other types of relationships (i.e., quasi self-determination and domination).

Third, I propose that the relationship type will moderate the effects of iteration on gig workers' job satisfaction. To be specific, I predict that the positive relationship between iteration of algorithmic management and job satisfaction will be less strong for gig workers who have self-determination relationships with platforms than workers with other types of relationships (i.e., quasi self-determination and domination).

By definition, iteration indicates that platform algorithms can adjust their management over gig workers in response to workers' input. This means that platform management will be dynamic and evolving to make gig workers better engaged. However, similarly to the dimension of transparency I discussed above, the positive effects of this attribute on gig workers' job satisfaction may be also influenced by relationship types. This is because once platform management gets updated, gig workers need to renew their understanding of platform rules. In this case, compared to

individuals under self -determination relationships, gig workers who have quasi self-determination and domination relationships with platforms can better adapt to the iterative platform management since they can get help from colleagues or leaders in the same team or site. To conclude, I propose the following hypothesis:

Hypothesis 11: The positive relationship between iteration of algorithmic management and job satisfaction will be less strong for gig workers who have self-determination relationships with platforms than workers with other types of relationships (i.e., quasi self-determination and domination).

Lastly, I propose that the relationship type will moderate the effects of incessancy on gig workers' job satisfaction. To be specific, I predict that the positive relationship between incessancy of algorithmic management and job satisfaction will be stronger for gig workers who have self-determination relationships with platforms than workers with other types of relationships (i.e., quasi self-determination and domination).

By definition, incessancy indicates that platforms will keep monitoring or recording the data of gig workers with the help of algorithms. This can also provide gig workers with much information about their work process and outcomes (Kellogg et al., 2020), which will further increase their sense of control over their work and lead to job satisfaction. However, the above positive effects of incessancy may be influenced by relationship types. Compared to gig workers who have quasi self-determination and domination relationships with platforms, independent workers (i.e.,

self-determination relationships) usually work in the context lacking organizational environment and interpersonal connections. In this circumstance, incessancy of algorithmic management will provide these workers with timely and continuous feedback, action guidance, rewards, and remuneration (Kellogg et al., 2020). This will enhance individuals' vitality and passion for work (Shraga & Shirom, 2009) and further increase their job satisfaction. To conclude, I propose the following hypothesis:

Hypothesis 12: The positive relationship between incessancy of algorithmic management and job satisfaction will be stronger for gig workers who have self-determination relationships with platforms than workers with other types of relationships (i.e., quasi self-determination and domination).

Method

(1) Sample and Procedure

The participants of Study 3B were recruited online through the Data Market application on a professional data collection platform named Credamo (https://www.credamo.com/), which is similar to MTurk and has been widely used in China (e.g., Fu et al., 2022; Zhang et al., 2022). Considering that the typology results of Study 3A were extracted from the sample of online food delivery workers in mainland China, in Study 3B, I also recruited participants having the same profession. Moreover, apart from the attention check which is common to use, to further ensure the data quality and reliability of this study, before sending out the questionnaire, all

the participants were required to provide relevant information to prove they were working as food delivery workers in OLPs. At the same time point, all participants should provide their personal information. The final sample size was 267. Among 267 participants, about 76.40% were male, 34.10% had a bachelor's degree, their average age was 31.50 years (standard deviation = 5.89), and their average tenure was 2.56 years (standard deviation = 1.41). About the platforms and the category of the delivery workers, the specific information is shown in Table 14.

Table 12. Samples of Study 3B

Platform work	**Sample size**
1. Meituan: Crowdsourcing riders (美团众包)	144
2. Meituan: Lepao riders (美团乐跑)	32
3. Meituan: Outsourcing riders (美团站点)	36
4. Ele.me: Crowdsourcing riders (饿了么众包)	32
5. Ele.me: Youxuan riders (饿了么优选)	13
6. Ele.me: Outsourcing riders (饿了么站点)	10
Total	267

(2) Measures

Except for algorithmic management I developed in Study 1, I adopted well-established scales to measure the constructs in the hypothetical model. Given that the original measurements were developed in English while the survey was administered

in Chinese, I followed Brislin's (1980) translation-back-translation procedure to set up the questionnaire. Specifically, I translated the English scales into Chinese first. Then, two doctoral students in management with bilingual expertise reviewed the questionnaire items to ensure semantic clarity. Unless otherwise stated, the gig workers responded to the measurement items on seven-point Likert scales ranging from 1 (totally disagree/never) to 7 (totally agree/always).

Algorithmic management. On a seven-point Likert scale, I measure the gig workers' perceived algorithmic management in OLPs using the 18-item scale that I developed in Study 1B. It includes four dimensions: transparency, incessancy, iteration, and uniformity. The sample items were "There's a pattern of how to get better orders on the platform", "In the process of completing orders, the platform system continues to record my driving route", "The platform system adjusts my work requirements according to my order completion", and "The platform system gives equal opportunity to every gig worker when dispatching orders". The Cronbach's alpha for this scale was 0.86.

Job satisfaction. I adapted the three-item scale originally developed by Hackman and his colleagues (1980) to measure the gig workers' job satisfaction. On a five-point Likert scale, the gig workers were required to evaluate to what extent they were satisfied with their work in OLPs. The sample items were "Overall, I am satisfied with my work", "I am generally satisfied with the sense of accomplishment I get from this job", and "I am generally satisfied with the job I have done on the platform". The Cronbach's alpha for this scale was 0.73.

Types of the relationships. I identified the types of relationships between participants in this study and the platforms they were working on based on the typologies of their platform work (see Table 13). Therefore, similarly to Study 3A, I got three types of relationships: (1) Self-determination (i.e., including participants of crowdsourcing riders in Meituan and Ele.me, sample size = 176), (2) Quasi self-determination (including participants of Lepao riders in Meituan and Youxuan riders in Ele.me, sample size = 45), and (3) Domination (including participants of outsourcing riders in Meituan and Ele.me, sample size = 46).

Controls. I controlled age, gender, and tenure during data analyses. As introduced in Study 2, how gig workers feel about and react to algorithmic management in OLPs may be greatly influenced by some personal attributes such as their age, gender, and work experience in platforms since these factors would have an impact on their interactions with algorithms, as well as their satisfaction with platform work. Therefore, I controlled age, gender, and tenure of platform workers in this study.

(3) Analytic Strategy

In Study 3B, I conducted the analyses in three steps: descriptive analysis, CFAs, and hypotheses testing. To further confirm the hypotheses, I also adopted the parameter-based bootstrapping approach to estimate the 95% confidence intervals of the effects (Preacher & Selig, 2012). The CFAs and hypotheses testing were performed with Mplus 8.0 (Muthén & Muthén, 2017).

Results

(1) Descriptive Statistics and Confirmatory Factor Analyses

Before hypotheses testing, I conducted descriptive analyses. I present the means, standard deviations, and correlations of the variables in Table 15.

I conducted CFAs on the five variables rated by platform workers (i.e., transparency, incessancy, iteration, uniformity, and job satisfaction). The five-factor model had an acceptable fit ($\chi 2/df$ = 2.00, $p < .01$, *RMSEA* = .06, *CFI* = .93, *TLI* = .92, *SRMR* = .05). This model fit the data better than alternative models when the following variables were combined: (1) four dimensions of algorithmic management: transparency, incessancy, iteration, and uniformity ($\Delta\chi 2/\Delta df$ = 132.71, $p < 0.01$); and (2) all of the variables ($\Delta\chi 2/\Delta df$ =129.80, $p < 0.01$). These results show that the measures captured distinct constructs. The results are shown in Table 16.

Similar to Study 2, the data of Study 3B were also provided by gig workers. To examine the common method bias, I conducted Harman's one-factor test. Specifically, I performed exploratory factor analysis on a total of 21 self-reported items, and the first extracted factor had an eigenvalue of 6.00, explaining 28.59% of the variance, which is less than 40%. At this time, the KMO of the model is .84, which is greater than .60, and the chi-square value of the model is 2676.70, p < .001. Therefore, there is no serious problem of common method bias in this model.

Table 13. Means, Standard Deviation and Correlates among Variables

Variables	Mean	SD	1	2	3	4	5	6	7	8	9
1. Age	31.50	5.89	—								
2. Gender	0.24	.43	-.06	—							
3. Tenure	2.56	1.41	-.21	-.11	—						
4. Transparency	5.11	1.00	-.18**	-.01	-.06	(.86)					
5. Incessancy	6.12	.64	.03	-.01	.00	.21**	(.78)				
6. Iteration	5.46	.92	-.10	.02	-.03	.46**	.29**	(.82)			
7. Uniformity	5.36	1.03	-.09	-.07	-.03	.19**	.16*	.25**	(.91)		
8. Job satisfaction	4.16	.53	-.10	-.06	.05	.32**	.33**	.38**	.40**	(.73)	

*Note. N = 267. * $p < 0.05$; ** $p < 0.01$. The figures on the diagonal in parentheses are the alpha coefficients.*

Table 14. Results of CFA

Model	x^2	df	x^2/df	△ x^2	RMSEA	CFI	TLI	SRMR
Model 1	357.61	179	2.00	—	0.06	0.93	0.92	0.05
Model 2	1551.97	188	8.26	1194.36	0.17	0.47	0.40	0.17
Model 3	1655.65	189	8.76	1298.04	0.17	0.43	0.36	0.16

Note. **Model 1**: Five-factor model (i.e., transparency, incessancy, iteration, uniformity, and job satisfaction); **Model 2**: Two-factor model (i.e., transparency + incessancy + iteration + uniformity, and job satisfaction); **Model 3**: One-factor model (i.e., transparency + incessancy + iteration + uniformity + job satisfaction).

(2) Hypotheses Testing

Main effects

Hypotheses 5, 6, 7, and 8 were about the main effects. First, regarding Hypothesis 5, it predicted that transparency of algorithmic management in OLPs is positively related to gig workers' job satisfaction. The results in Table 16 show that transparency of algorithmic management is significantly and positively related to gig workers' job satisfaction ($b = .07, p < .05$). Regarding Hypothesis 6, it predicted that incessancy of algorithmic management in OLPs is positively related to gig workers' job satisfaction. The results in Table 17 show that incessancy of algorithmic management is significantly and positively related to job satisfaction ($b = .17, p < .001$). Regarding Hypothesis 7, it predicted that iteration of algorithmic management in OLPs is positively related to gig workers' job satisfaction. The results in Table 16 show that the iteration is significantly and positively related to job satisfaction ($b = .11, p < .05$). Finally, regarding Hypothesis 8, it predicted that uniformity of algorithmic management in OLPs is positively related to gig workers' job satisfaction. The results in Table 16 show that uniformity is significantly and positively related to gig workers' job satisfaction ($b = .15, p < .001$). Taken together, Hypotheses 5-8 were all supported.

Table 15. Results of Main Effects Analysis

Variables	Gig worker's job satisfaction	
	Model 1	**Model 2**
Control variables		
Gender	-.06	-.04
Age	-.01	-.00
Tenure	.03	.03
Main effects		
Transparency		.07 *
Incessancy		.17**
Iteration		.11 *
Uniformity		.15**
R^2	.02	.30
ΔR^2		.28**

Note. $N = 267$. * $p < 0.05$; ** $p < 0.01$.

Moderating effects

Hypotheses 9, 10, 11, and 12 were about the moderating effects. Regarding Hypothesis 9, it predicted that the positive relationship between uniformity of algorithmic management and job satisfaction will be stronger for gig workers who have quasi self-determination relationships with platforms than workers with other types of relationships (i.e., self-determination and domination). To test this hypothesis, I chose the type of self-determination relationship as reference group and further created two dummy variables: Dummy1 and Dummy2. In this case, I transfered the three types of relationships (i.e., quasi self-determination, domination, and self-determination) into two dummy variables respectively.

The results show that uniformity * Dummy1 interaction term was significant on job satisfaction ($b = .25$, $p < .05$). The effect of uniformity on job satisfaction was stronger for gig workers under quasi self-determination relationships ($b = .42$, $p < .001$) than those under self-determination relationships ($b = .16$, $p < .001$). However, uniformity * Dummy2 interaction term was negative but not significant on job satisfaction ($b = -.04$, $p = .61$). The moderating role of these relationship types was also depicted in Figure 18. Taken together, we can conclude that the positive relationship between uniformity of algorithmic management and job satisfaction will be stronger for gig workers who have quasi self-determination relationships with platforms than workers with other types of relationships. Therefore, Hypothesis 9 was supported.

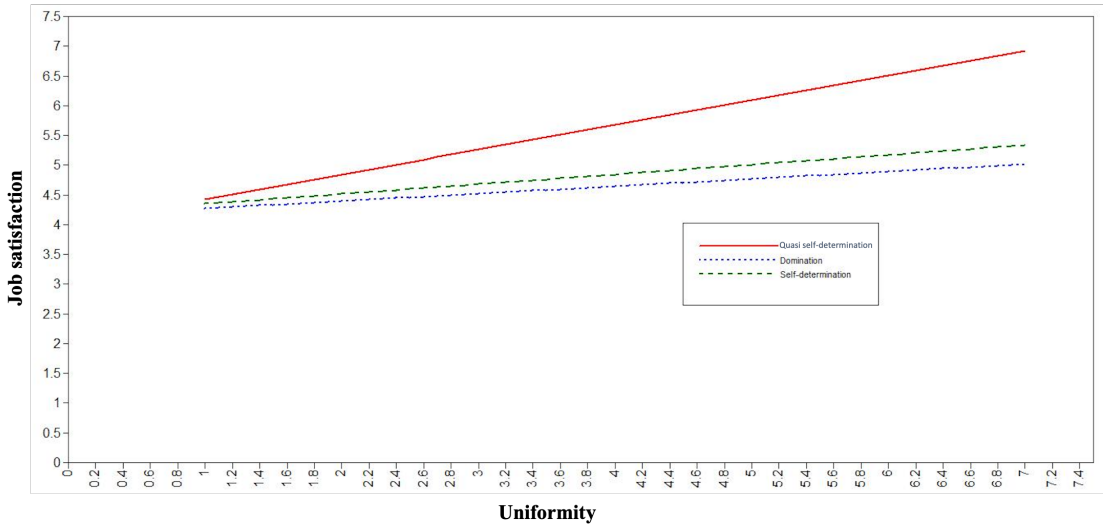

Figure 19. Results of Moderating Effects (H9)

Using the same way to create the dummy variables, I further tested Hypothesis 10, which predicted that the positive relationship between transparency of algorithmic management and job satisfaction will be less strong for gig workers who have self-determination relationships with platforms than workers with other types of relationships (i.e., quasi self-determination and domination).

The results show that transparency * Dummy1 interaction term was of marginal significance on job satisfaction (b = .16, p = .07). The effect of transparency on job satisfaction was stronger for gig workers under quasi self-determination relationships (b = .27, p ＜ .05) than those under self-determination relationships (b = .11, p ＜ .05). Besides, transparency * Dummy2 interaction term was positive but not significant on job satisfaction (b = .15, p = .23). The moderating role of the relationship types was depicted in Figure 19. Therefore, based on the results, we can only infer that the positive relationship between transparency of algorithmic management and job satisfaction will be less strong for gig workers who have self-

determination relationships with platforms than workers with quasi self-determination relationships. To conclude, Hypothesis 10 was partly supported.

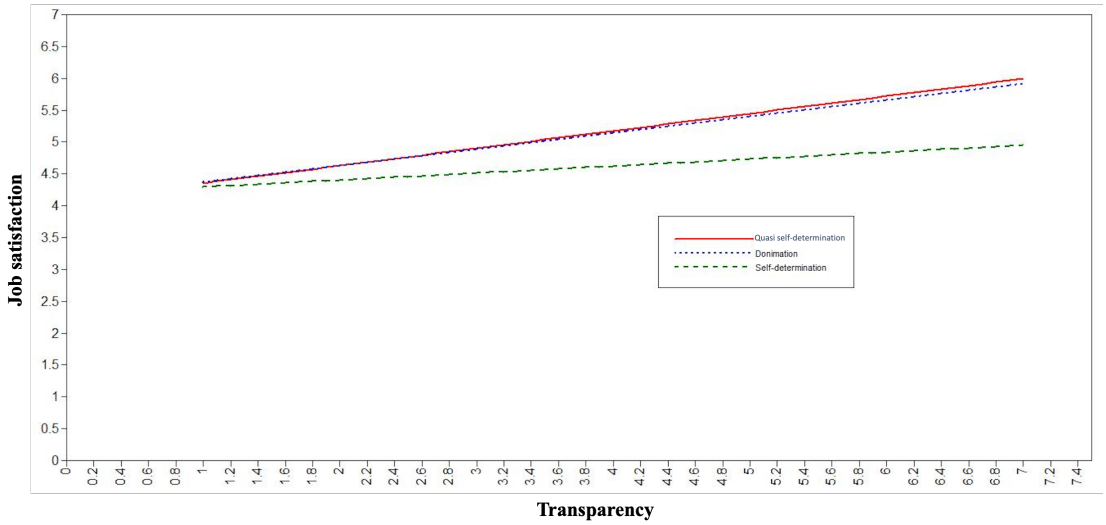

Figure 20. Results of Moderating Effects (H10)

Using the same way to create the dummy variables, I further tested Hypothesis 11, which predicted that the positive relationship between iteration of algorithmic management and job satisfaction will be less strong for gig workers who have self-determination relationships with platforms than workers with other types of relationships (i.e., quasi self-determination and domination). However, the results failed to support my hypothesis since both iteration * Dummy1 and iteration * Dummy2 interaction terms were not significant ($b = .17$, $p = .27$, and $b = .12$, $p = .37$, respectively).

I finally tested Hypothesis 12 which predicted that the positive relationship between incessancy of algorithmic management and job satisfaction will be stronger for gig workers who have self-determination relationships with platforms than

workers with other types of relationships (i.e., quasi self-determination and domination). The same as the results of Hypothesis 11 testing, both incessancy * Dummy1 and incessancy * Dummy2 interaction terms were not significant ($b = .10$, $p = .71$, and $b = .07$, $p = .73$ respectively). Therefore, Hypothesis 12 was not supported.

Conclusion of Study 3B

Based on the results of Study 3A which indicates the diverse types of relationships between gig workers and OLPs through the qualitative exploration, I further conducted a quantitative study (Study 3B) to empirically examine how the types of relationships would influence the effects of the characteristics of algorithmic management on gig workers' job satisfaction. The results first showed that four dimensions of algorithmic management (i.e., transparency, iteration, incessancy, and uniformity) are positively related to gig workers' job satisfaction. Besides, about the moderating role of the relationship types, the results indicated that the positive relationship between uniformity of algorithmic management and job satisfaction will be stronger for gig workers who have quasi self-determination relationships with platforms than workers with other types of relationships (i.e., self-determination and domination). Besides, the positive relationship between transparency of algorithmic management and job satisfaction will be less strong for gig workers who have self-determination relationships with platforms than workers with quasi self-determination relationships. Other hypotheses on the moderating effects failed to be supported in

Study 3B.

Discussion

Different from the existing research which often assume that online labor platforms have the homogeneous relationships with gig workers, Study 3 mainly explored what the relationships between OLPs and gig workers, as well as how the types of relationships would influence the effects of algorithmic management on gig workers' job satisfaction. Specifically, in Study 3A, I qualitatively explored how the relationships formed and evolved based on the cases of two leading online food delivery platforms in mainland China. The results revealed that external environment characteristics would determine the switching of two functions of OLPs (i.e., organization and market) and further lead to different types of EOR.

The findings of Study 3A provided a theoretical basis for follow-up research to further explore different work characteristics, work motivation, cognitive and emotional experiences, and corresponding behavioral responses of gig workers under different relationship types. Therefore, based on Study 3A, I further conducted a quantitative study (i.e., Study 3B) to empirically examine how the types of relationships would influence the effects of the characteristics of algorithmic management on gig workers' job satisfaction. The results indicated that all the dimensions of algorithmic management (i.e., transparency, iteration, incessancy, and uniformity) were positively related to gig workers' job satisfaction. Among them, the positive effects of uniformity and transparency on job satisfaction would be

moderated by relationship types which proposed in Study 3A.

The findings of Study 3 can help to move the literature forward in the following ways. First, this study clarifies the EOR in the new context of the gig economy. As we all know, EOR research usually focuses on the formal labor contracts in organizations. However, with the development of the gig economy, organizations face the challenge of managing their unstandardized relationships with independent workers. And due to the uniqueness of OLPs, the traditional EOR may subvert, which calls for the exploration on EOR in the new era. Study 3 responds to this research need to vividly show the new types of relationships between gig workers and OLPs, as well as the effects of EOR on the two parties' interaction. This exploration contributes to both the literature of EOR and algorithmic management in the gig economy. To be specific, the EOR researchers can pay more attention to the new context of OLPs and discover more research opportunities by examining whether the existing theories and findings can be applied in the gig economy. Moreover, different from the previous research on algorithmic management in OLPs which usually assumes that all gig workers are connected to platforms in the same way, Study 3 indicates that the relationships between gig workers and OLPs may vary a lot and the diverse relationships will further influence how gig workers perceive and behave. This paves new ways for the literature of algorithmic management.

Study 3 still has its limitations. First, supplemented to Study 2, Study 3 separately explores the effects of four types of characteristics of algorithmic management in OLPs. However, it fails to provide a comprehensive framework to organize the

proposed relationships between diverse characteristics of algorithmic management and gig workers' outcomes. Therefore, future research can try to explore the appropriate theories or perspectives to systematically explain the proposed relationships in Study 3. Besides, among the proposed hypotheses, only some of them are supported. If we look into the results, it may be due to the different effects of diverse characteristics of algorithmic management. In other words, the relationships between gig workers and OLPs can only influence the effects of some specific characteristics of algorithmic management (i.e., transparency and uniformity). Regarding the effects of incessancy and iteration, especially considering their differences compared to transparency and uniformity, future research can explore other possible boundary conditions to further increase the positive sides of these characteristics.

CHAPTER 6: GENERAL DISCUSSION AND CONCLUSION

The development of digital technologies has boosted the rapid growth of the gig economy and OLPs. As a type of "meta-organization" (Möhlmann et al., 2021), OLPs are boundaryless, highly decentralized, and use algorithms to control and coordinate a large scale of platform workers, which is also referred as algorithmic management (Mohlmann et al., 2021; Vallas & Schor, 2020). It is worth noting that such "disruptive forms of technological change" in management (Parent-Rocheleau & Parker, 2022) has induced considerable controversies. Though algorithmic management enables efficient matching of demand and supply as well as work flexibility of gig workers, it inevitably exerts pervasive control which confines gig workers to an invisible digital cage (Mohlmann et al., 2021; Rahman, 2021).

Paralleling the prosperity of the OLP workforce, research on the effects of OLPs' algorithmic management has seen explosive growth over the past few decades. In the literature, algorithmic management in OLPs is predominantly portrayed as an escalated form of labor control that constrains gig workers' autonomy and harms their well-being (Chai & Scully, 2019; Duggan et al., 2020; Veen et al., 2020). Differently, recent research has revealed its potential enabling effects (Meijerink & Bondarouk, 2022; Mohlmann et al., 2021; Parent-Rocheleau & Parker, 2022). However, few studies explored the double-edged sword effects of algorithmic management on these platforms. Moreover, when exploring the effects of algorithmic management, existing research mainly assume the relationships between all gig workers and OLPs are the same, ignoring that the relationships may be diverse and influence gig workers'

reactions to algorithmic management. Besides, when conceptualizing algorithmic management, the existing research preferred to regard it as management practice and then construct it with several packages of practice (e.g., Kellogg et al., 2020; Pei et al., 2021). However, considering that practices of algorithmic management may vary across different platforms, the existing conceptualization and operationalization of algorithmic management may fail to be widely applied. Therefore, in this dissertation, I aimed to concentrate on the context of online labor platforms and mainly respond to the following three research questions.

(1) What are the characteristics of algorithmic management in OLPs?

(2) How will gig workers' perceived characteristics of algorithmic management influence their outcomes?

(3) What are the relationships between platforms and gig workers? And how will the relationships influence the effects of algorithmic management on gig workers?

To answer these research questions, I conducted three empirical studies. In the preceding three chapters, I have described the details of each study. In this chapter, I will summarize the key findings from all the studies as well as discuss the key implications for both theory and practice. I then reflect upon the limitations of three studies in my dissertation. I also propose some recommendations for future research and end with an overall conclusion of this dissertation.

Summary of Key Findings

Given that I have reported the details of the findings from the three studies in the

preceding chapters, here I simply summarize the results of each hypothesis testing in order to avoid redundancy. To facilitate interpretation, I have provided a summary of the results of the hypotheses testing along with the overall conceptual model that I presented in Chapter 1. From Table 18, we can see that most hypotheses were supported by the findings from the empirical studies. The exceptions were H2, H4, H11, and H12 which were not supported by any studies. Overall, the findings from the three studies provided insights for the proposed model.

Table 16. Summary of Three Studies

	Results	**Findings**
Study 1A	Conceptualization of algorithmic management characteristics	Four dimensions
Study 1B	Operationalization of algorithmic management characteristics	The scale of characteristics of algorithmic management with 18 items
Study 2	H1 and H3 were supported. H2 and H4 were not supported.	Promotion-focused job crafting will mediate the positive relationships between gig workers' perceived algorithmic management characteristics and their platform commitment. And the relationships will be positively moderated by gig workers' personal resilience.

Study 3A	Construct a process model of EOR evolution in OLPs. Propose a typology of the relationships between OLPs and gig workers	External environment characteristics will determine the switching of two functions of OLPs (i.e., organization and market) and further lead to different types of EOR. Three types of relationships between OLPs and gig workers: self-determination, quasi self-determination, and domination.
Study 3B	H5, H6, H7, H8, and H9 were supported H10 was partly supported. H11 and H12 were not supported	Four dimensions of algorithmic management characteristics will be positively related to gig workers' job satisfaction. The types of relationships will moderate the effects of two dimensions (i.e., uniformity and transparency) of algorithmic management characteristics on gig workers' job satisfaction.

Theoretical Implications

This dissertation intends to contribute to the literature in the following ways. First, this research provides a solid foundation for future research on algorithmic management in OLPs by conceptualizing and operationalizing its characteristics. Different from traditional organizations, online labor platforms are loosely connected

to platform workers and this new context poses a threat to the traditional management tactics which are usually based on formal contracts. More specifically, different from traditional organizations, OLPs as market intermediary platforms are boundaryless and decentralization (Thomas et al., 2014). In this scenario, the cornerstone of human resource management and organizational control in traditional organizations—formal employment relationship—is gradually invalid. Thanks to the development of digital technologies, algorithmic management emerges in OLPs to help platforms manage gig workers. This calls for more attention to conceptualize this new construct. Responding to this, Study 1A and Study 1B of this dissertation first develop the scale of the characteristics of algorithmic management. Different from previous research that articulated algorithmic management around its functions (e.g., Kellogg et al., 2020; Pei et al., 2021), our conceptualization captures the essence of platform management via algorithms. Moreover, the findings can be the foundation for future research and stimulate more empirical explorations to help move the literature forward.

Second, this dissertation contributes to revealing the whole story about the effects of algorithmic management in OLPs. OLPs are market intermediary platforms and therefore have the dual nature of organization and market (Möhlmann et al., 2021). This suggests that OLPs via algorithms can empower gig workers through the network effects (e.g., Gawer, 2014; Gawer & Cusumano, 2014). Also, they may exert pervasive control which confines gig workers to an invisible digital cage (Möhlmann et al., 2021; Rahman, 2021). Scholars have gradually noticed that algorithmic

management's empowerment and control effects may not exist in isolation (e.g., Ashford et al., 2018; Bellesia et al., 2019). In line with that, unlike previous research that often narrowly focused on only one side of algorithmic management, Study 2 of this dissertation focuses on OLPs' dual nature of organizations and markets and aims to theoretically and empirically uncover the potential doubled-edged swords effects of algorithmic management in OLPs. Although the results only suggest the bright side of algorithmic management, this study can inspire future research on this topic to simultaneously investigate the bright and dark sides of algorithmic management to depict the overall picture of the impacts of algorithmic management in OLPs.

Third, when investigating the effects of algorithmic management, I adopt the perspective of job crafting to uncover the underlying mechanisms and the relevant boundary condition. OLPs and gig workers are usually loosely connected based on User Agreement. In this context, gig workers have to cultivate and craft their work by themselves (Petriglieri et al., 2019), which suggests that job crafting would be significant for interpreting gig workers' reactions to platform management. Accordingly, Study 2 explores the effects of algorithmic management on gig workers' different outcomes through the mediating role of job crafting. This helps to open the black box of algorithmic management and provides empirical evidence on how algorithmic management in OLPs will influence gig workers' outcomes, as well as the relevant boundary condition.

Focusing on the context of OLPs in the gig economy, this dissertation will contribute not only to the research on algorithmic management, but also to the

literature on employee-organization relationship (EOR) in the following ways. First, this dissertation helps to clarify the EOR in the new context of OLPs, indicating new directions for this line of research. The literature often focuses on relationships based on formal and stable labor contracts (e.g., Ehrenberg and Smith, 1994; Hart, 1983). However, in boundaryless and decentralized OLPs, the traditional EOR subverts. Instead, gig workers establish an instant and loose connections based on user agreement. In this circumstance, OLPs do not need to invest in gig workers. And accordingly, gig workers are not required to make corresponding investment returns. This challenges the premise of traditional research on EOR. Based on the analyses of the uniqueness of the new scenario, Study 3A reveals the characteristics of EOR in OLPs, which shows the great potential for EOR research in gig economy.

Second, this dissertation contributes to the EOR research in the emerging OLPs by categorizing the relationships between gig workers and platforms and exploring the moderating role of relationship categories. Unlike the literature which usually depicts the above relationships in a homogeneous way, OLPs usually establish diverse connections to gig workers in practice. In line with this, Study 3A and Study 3B of this dissertation suggest different types of relationships between gig workers and OLPs. Moreover, the diverse relationships will further influence how gig workers perceive, evaluate, and react to platform management, which helps to enrich our understanding of EOR in OLPs. In particular, this dissertation refers to the essential attributes of connections and accordingly refines the theoretical classification framework of gig worker-platform relationships. This provides a theoretical basis for

follow-up research to further explore different motivations, cognitive and emotional experiences, and corresponding behavioral responses of gig workers under different relationship categories.

Third, this dissertation contributes to EOR research by depicting the evolving rather than static relationships between gig workers and OLPs. With the changes in internal and external environments, the relationships between organizations and employees are no longer static (Shore et al. 2004). Especially in OLPs, platforms dynamically adjust their connections with gig workers according to their development goals. This calls for more research to capture the dynamics of EOR (Shore et al., 2004). Answering the call, Study 3A of this dissertation constructs the process model of EOR evolution in OLPs. The model illustrates how external environment characteristics determine the switching of two functions of OLPs (i.e., organization and market) and further lead to different types of EOR. The findings help to reveal the dynamics of EOR construction and evolution and provide insights for the follow-up research to explore the determining factors of EOR evolution in OLPs.

Lastly, in addition to the contributions to the literature on algorithmic management and EOR in OLPs, this dissertation also has implications for the perspective of job crafting that I adopt by paving the new ways for this line of research. The existing research on this domain mainly focuses on employees' job crafting behaviors in traditional organizations. This dissertation suggests that OLPs can be a brand-new research context for job crafting research, and future efforts can aim to explore gig workers' job crafting behaviors. As mentioned before, compared to

traditional organizations, OLPs are loosely connected to gig workers. This means that top-down job design in organizations may be difficult to apply in this new context. Instead, gig workers' self-initialed crafting behaviors are more salient in OLPs (Petriglieri et al., 2019), which provides the literature on job crafting with many research opportunities in this new context. Moreover, this literature mainly focuses on the relevant antecedents of job crafting, such as job characteristics, individual differences, and motivational factors revealed by previous studies (e.g., Zhang & Parker, 2019). This dissertation indicates that management characteristics in the new work context, especially those highly related to traits of advanced technologies, will also greatly determine individuals' job crafting behaviors.

Practical Implications

Apart from the theoretical contributions, more importantly, this dissertation attempts to provide practical implications for platform management in the gig economy. According to the "China Sharing Economy Development Report (2021)" issued by the Ministry of Information Industry in 2021, OLPs have become an important force in ensuring employment and people's livelihood, and improving the resilience of economic development. However, this emerging economy also faces the management challenge of how to effectively manage and control gig workers while respecting their independent status. Based on this, this dissertation is rooted in this burgeoning new problem situation and is devoted to complementing the organizational management theories applicable to these OLPs. Based on the

conceptualization and operationalization of the characteristics of algorithmic management in OLPs, this dissertation comprehensively interprets the double-edged sword effects of algorithmic management through job crafting behaviors of gig workers, and further investigates the moderating roles of gig workers' personal resilience and their diverse relationship with platforms.

The findings of this dissertation will first help to understand how decentralized and boundaryless OLPs can use algorithmic management to effectively manage and coordinate the large scale of gig workers without formal labor contracts. Practically, how to manage gig workers with the help of algorithmic management has become a severe challenge for OLPs. For example, to get rid of platform management, gig workers' responses to algorithmic management are usually resistance at the collective or individual level (Cameron & Rahman, 2022; Kellogg et al., 2020; Vandaele, 2022). Therefore, it is necessary to help these platforms understand how gig workers perceive, evaluate, and react to algorithmic management in OLPs. This dissertation can provide theoretical and empirical evidence of gig workers' perceptions, motivations, and behaviors when interacting with algorithmic management in OLPs. Based on these findings, platforms can effectively motivate gig workers to be more involved in platform work and increase their satisfaction with OLPs. Moreover, platforms can turn to the results of this dissertation and optimize their algorithms to induce gig workers' more proactive behaviors. This may help to increase the efficiency of platform management as well as improve the quality of relationships between OLPs and gig workers. The latter is of great significance to the healthy

development of the gig economy.

Second, this dissertation can provide guidance and suggestions for the practice of EOR management in OLPs. As an essential participant in OLPs, gig workers affect supply-demand matching and transaction completion. Furthermore, gig workers will influence the ultimate network effects and benefits of these market intermediary platforms. Therefore, establishing and maintaining good relationships with gig workers have become the determining factor for the survival and development of OLPs. In particular, such platforms usually have to adjust their relationships with gig workers to diverse challenges such as industry maturity, market competition, regulations and policies, and the platforms' own development stage. In this circumstance, what kind of relationship they should build with gig workers has become an important problem for OLPs nowadays. Study 3 of this dissertation can help these platforms understand the dynamic process and the underlying mechanisms of EOR evolution. Moreover, the findings help to grasp the characteristics, advantages, and disadvantages of different relationship categories. This will provide platforms with guidance for relationship construction and maintenance at different stages.

Third, apart from OLPs, this dissertation also provides theoretical guidance for human resource management in traditional organizations transforming into platform organizations or boundaryless organizations. In practice, in addition to the emergence of many OLPs, more and more traditional organizations have gradually opened up the originally closed organizational boundaries. In this case, organizations may have to

manage different types of workers, especially those under non-traditional employment relationships such as gig workers, outsourced employees, etc. Therefore, apart from the scenario of market intermediary platforms, this dissertation can also provide valuable guidance for EOR management of organizations in transformation.

Lastly, the findings of this dissertation may provide insights into the formulation of laws and regulations in the context of OLPs. With the rapid development of the gig economy, traditional labor relations have been shocked, which puts forward new requirements and challenges to the relevant laws and regulations. In practice, many countries and regions have reflected on the development of the gig economy and updated their laws and regulations to protect the rights of gig workers. This dissertation may help in the above process. Looking into online food delivery platforms, this dissertation illustrates the development process of OLPs, the evolving relationships between gig workers and platforms, and the problems of different relationship types. These findings can be valuable references for formulating laws and regulations for the gig economy and help develop policies according to the needs and characteristics of different types of gig workers.

Limitations and Future Directions

This dissertation has not been without its limitations. First, except for one sample of Study 1B which is gig divers on online labor platforms, most of samples in this dissertation are gig workers on online food delivery platforms. However, in practice, market intermediary platforms of different industries may have their uniqueness when

managing their gig workers. As such, we should be cautious about whether the findings from this dissertation can be generalized to other online labor platforms. Future research on algorithmic management of market intermediary platforms could further examine the hypotheses of this dissertation in other types of platforms.

Second, also related to the samples of this dissertation, all the samples of three studies are from mainland China. However, when exploring the relationships between online labor platforms and gig workers, previous studies have shown that different countries may have diverse policies in this new labor context which will influence how platforms exert controls over gig workers and how workers react to the management tactics from these online labor platforms (Tu, 2021). Therefore, we should be cautious about whether the findings from this dissertation can be generalized to the online labor platforms in other countries. Accordingly, researchers who are interested in the same topic could conduct the explorations in the same types of platforms outside of mainland China such as Ubereats, Deliveroo, Take Eat Easy, etc.

Third, in Study 2, I theoretically proposed the double-edged sword effects of algorithmic management on online labor platforms and the empirical results only supported the bright sides of the platform management based on algorithms. However, referring to hypotheses testing, the results indicated the possibility of the dark side in of algorithmic management. And the unsupported hypotheses may be due to evaluation concerns of subjects since they may be afraid of negatively evaluate the platforms they are working on. Therefore, the follow-up research could try to further

explore whether algorithmic management of online labor platforms has double-edged sword effects on platform workers especially after reducing their evaluation concerns.

Fourth, based on the result of Study 3A, in Study 3B, I empirically examined whether the type of relationships between online labor platforms and platform workers would influence the effects of algorithmic management on platform workers' job satisfaction. However, Study 3B was a cross-sectional design which only collected one-wave data and failed to explore the causal relationships and mechanisms. Therefore, to help to better illustrate how and why different platform workers having diverse relationships with platforms will perceive, evaluate, and react to algorithmic management of online labor platforms, future research could further extend the existing Study 3B based on the better research design.

Concluding Remarks

I began this dissertation with my great interests in the gig economy, especially the online labor platforms in this new context. Different from organizational management based on labor contracts in traditional organizations, algorithmic management of these market intermediary platforms has its uniqueness. Therefore, in my dissertation, I first conceptualized and operationalized the characteristics of algorithmic management, which has four dimensions with the 18-item scale. Based on the findings, I further explore their double-edged sword effects through the mediating role of platform workers' job crafting behaviors and the boundary conditions. The results indicated that promotion-focused job crafting would mediate the relationships between platform

workers' perceived algorithmic management characteristics and their platform commitment. And platform workers' resilience would positively moderate the abovementioned relationships.

Moreover, I proposed the typology of the relationships between online labor platforms and platform workers through a qualitative case study. Further, I examined how the types of relationships would influence the effects of dimensions of algorithmic management. The results revealed the diverse and evolving relationships between platforms and platform workers. And under different types of relationships, platform workers would differently perceive and react to the algorithmic management of online labor platforms.

Taken together, these findings contribute to a better understanding of how online labor platforms interact and manage the massive platform workers without traditional labor contracts. I hope to contribute to the literature with insights into algorithmic management in this new context. Moreover, I also hope to have provided platforms with some practical implications with which they can better manage platform workers and finally reach a win-win situation in this growing gig economy. If this dissertation is regarded as a good starting point for studies on algorithmic management of online labor platforms and further stimulates future research and practice, then all the effort involved in its production will have been worth it.

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APPENDICES

Appendix 1: Interview outline of Study 1A (Chinese version)

1、基本情况

（1）麻烦先简单介绍一下自己，例如年龄，籍贯，做了多久的骑手了？现在在哪个平台做骑手？是不是全职当骑手（现在是不是就做骑手的工作）？

（2）在当骑手之前还做过什么工作？为什么后来选择当骑手？

（3）自从开始当骑手，是不是一直都在现在这个平台？有没有在别的外卖平台当过骑手？为什么后来选择现在这个平台？

（4）骑手好像有众包、分包这些类别，不知道你现在是哪一类骑手？不同类别间有什么区别？

（5）现在有和骑手公司或者外卖平台签劳动合同或者用工协议之类的吗？包含哪些内容（比如保险、工作要求、奖惩要求、工作规范等）？签署时间有多久？自己或者听说过送餐过程有没有发生过意外？

2、骑手工作日常

（6）能不能以平时工作中的“送一单外卖”为样例，介绍一下在外卖 APP 上接单、送餐的一整个工作流程和你的工作感受？

- 工作流程例如：

1）派单：订单获取过程（是否清楚系统怎么派单？依据什么来派单？）

2）送餐时间（系统送餐规定的时间怎么制定？）

3）送餐路线（系统导航？合不合理？）

4）送餐规范与要求（有没有送餐过程比如说什么话、穿什么衣服等这些要求）

——有没有相关培训？

5）送餐过程中的 APP 平台系统提示/监控（送餐的时候外卖 APP 是不是会一直持续记录你们的行车路线、地理位置等？推送其他信息？）

6）送达及后续工作评价与奖励（是不是有排名、评分系统或者什么考核指标？是否清楚具体参照哪些数据来评价考核骑手？这些评价指标或评分系统是否会改变？怎么变？）——这些排名或者评分，对你们日常工作有什么影响（如有些骑手朋友圈晒每日单量）？压力？激励？

王者骑手、青铜骑手、挑战值——游戏化

7）收入：每单的收入在骑手、平台、商家之间怎么分配？这个分配方案是不是会变动？怎么变动？每天日均收入多少（有无基本收入保障）？单量多少（至少多少单的要求或保障）？工作时长（基本工作时长要求）？每单的报酬是不是可以当天提现？

8）与顾客纠纷处理（如果发生和客户的纠纷一般会怎么处理？外卖平台怎么解决）等

（7）能不能介绍下你印象最深刻（最不满意、最满意）的送的一单外卖（事件过程及为什么满意或不满意）？

（8）外卖平台是否有提供一些骑手间交流的渠道呢？比如线上社区？平时会和其他骑手交流沟通吗？聊得多吗？主要聊一些什么？骑手间会有一定的竞争吗？或者互相帮助？

（9）一天当中工作休息时间是怎么安排的？除了高峰期，是什么工作节奏（随时待命接单？）和休息状况？每天/每周平均工作多少小时？

（10）平台在对待商家、顾客、骑手三方时的一般态度？你对此的看法？有无相

关经历？总体来看，你觉得骑手和平台的关系怎么样？

（11）平台对骑手的一些规则（如奖励机制、每单的收入、超时的惩罚等）是否会变动？变动的频次或契机是什么？

（12）骑手如果对平台或者配送过程有相关的意见与建议，有什么方式可以反馈给平台吗？平台面对这些建议会怎么处理/是否会考虑采纳？是否有相关的经历或者见闻？

（13）骑手工作稳定吗？

（14）是否会在工作中感到孤独？

3、工作经历与感受

（15）结合日常工作经历与体验，你觉得外卖 APP 在你的日常工作中发挥着什么样的作用（对你的日常工作有什么样的影响）？

（16）就你的个人使用感受来说，你如何评价外卖 APP/平台？为什么？

（17）就你的个人使用感受来说，你觉得外卖 APP 最需要改善的是什么？

（18）在你日常工作观察与听闻中，其他骑手有没有在工作过程中存在一些“取巧”的，或者不太符合工作规范与要求的工作行为？在你的理解中，他们为什么会做出这样的行为？你觉得怎么样才能减少或者杜绝这种行为？

（19）对于一直坚持在同一个外卖 APP 或站点做骑手，你觉得最重要的决定性因素是什么？

（20）怎么看待平台基于大数据或算法等技术管理？相关体验？什么特点？——借助大数据、系统算法的平台管理 VS 一般公司的管理，有何特征？有何差异？

Appendix 2: Scales used in Study 1B, Sample 1 (Chinese version)

Initial scale of algorithmic management characteristics

(1) Transparency

在平台上如何接到更多的订单是有规律可循的。

在平台上如何接到更好的订单是有规律可循的。

在平台上如何接到更多订单的规律能够被掌握。

在平台上如何接到更好订单的规律能够被掌握。

在平台上如何提高等级或服务分的规律能够被掌握。

平台系统会让我知道接更多订单的方法。

平台系统会让我知道接更好订单的方法。

平台会让我知道系统派单的规律。

平台会让我知道系统是依据哪些指标进行派单。

平台会让我知道系统是依据哪些指标在评价我。

平台会让我知道系统是依据哪些规则在管理我。

平台上的接单完全是看运气。（R）

平台系统的派单规律难以掌握。（R）

平台系统对我的评价指标难以理解。（R）

(2) Incessancy

在完成订单的过程中，平台系统会持续记录我的行车路线。

在完成订单的过程中，平台系统会持续记录我的实时地理位置。

在完成订单的过程中，平台系统会对我与顾客间的沟通进行全程录音。

在完成订单的过程中，我的一举一动都会被平台系统记录下来。

在完成订单的过程中，一旦我有任何异常行为（如路边临时停车、配送超时等），平台系统会立即提醒或联系我。

在平台工作过程中，平台系统会持续记录我全天的接单情况。

在平台工作过程中，平台系统会全程记录我的订单完成情况。

在平台工作过程中，平台系统会持续记录所有顾客对我的评价结果。

(3) Iteration

平台系统会依据我的订单完成情况，调整给我派单的数量。

平台系统会依据我的订单完成情况，调整给我派单的质量。

平台系统会依据我的订单完成情况，调整给我派单的难易程度。

平台系统会依据我的订单完成情况，调整对我的派单优先级。

平台系统会依据我的订单完成情况，调整对我的基本工作要求。

平台系统会依据我的订单完成情况，调整对我的工作评价标准。

平台系统会依据我的订单完成情况，调整对我的工作考核标准。

平台系统会依据我的订单完成情况，调整对我的奖励标准。

(4) Uniformity

平台系统会用同样的规则管理我和其他平台工作者。

平台系统会用同样的标准给我和其他平台工作者派单。

平台系统会用同样的标准评价我和其他平台工作者。

平台系统公平地对待所有平台工作者。

平台系统在管理所有平台工作者时一视同仁。

平台系统在派单时所有平台工作者机会均等。

平台系统在评价所有平台工作者时标准一致。

平台系统在管理所有平台工作者时不会差别对待。

平台系统在给所有平台工作者派单时没有差别对待。

平台系统在评价所有平台工作者时标准不会因人而异。

Appendix 3: Scales used in Study 1B, Sample 2 (Chinese version)

Algorithmic management characteristics

(1) Transparency

在平台上如何接到更多的订单是有规律可循的。

在平台上如何接到更好的订单是有规律可循的。

在平台上如何接到更多订单的规律能够被掌握。

在平台上如何接到更好订单的规律能够被掌握。

(2) Incessancy

在完成订单的过程中，平台系统会持续记录我的行车路线。

在完成订单的过程中，平台系统会持续记录我的实时地理位置。

在平台工作过程中，平台系统会持续记录我全天的接单情况。

在平台工作过程中，平台系统会全程记录我的订单完成情况。

在平台工作过程中，平台系统会持续记录所有顾客对我的评价结果。

(3) Iteration

平台系统会依据我的订单完成情况，调整对我的基本工作要求。

平台系统会依据我的订单完成情况，调整对我的工作评价标准。

平台系统会依据我的订单完成情况，调整对我的工作考核标准。

平台系统会依据我的订单完成情况，调整对我的奖励标准。

(4) Uniformity

平台系统公平地对待所有平台工作者。

平台系统在管理所有平台工作者时一视同仁。

平台系统在派单时所有平台工作者机会均等。

平台系统在管理所有平台工作者时不会差别对待。

平台系统在给所有平台工作者派单时没有差别对待。

Organizational transparency

平台会向平台工作者解释其管理决策。

平台会告知工作者平台上发生的问。

平台是透明的。

平台会公开分享所有相关的信息。

Organizational justice

(1) Procedural justice

平台做出的决策对于所有平台工作者都是一致适用的。

平台做出管理决策时会听取平台工作者的意见和看法。

平台工作者能够对平台做出的决策提出质疑与申诉。

(2) Distributive justice

我在平台上的收入反映了我工作中的努力程度。

我在平台上的收入反映了我对平台做出的贡献。

我在平台上的收入能够反映我的工作表现。

(3) Interpersonal justice

平台会维护我的尊严。

平台尊重我。

平台没有对我做出不恰当的评价。

(4) Information justice

平台会就与我有关的决策向我提供细致说明。

平台会就与我有关的决策向我进行合理的解释。

平台会适时地向我提供管理决策的细节。

Algorithmic control

(1) Direction

算法智能地分配我的工作任务。

算法按照平台标准对我的工作做出了规范指示。

算法向我提供大量与完成工作任务相关的信息支持。

算法向我实时动态地反馈与工作绩效相关的信息。

(2) Evaluation

算法实时追踪定位我的地理位置。

算法持续地跟进我的工作进度。

算法实时地监控我的工作态度。

算法自动地评估我的工作完成质量。

(3) Discipline

算法根据我的工作表现划分等级并在平台内进行排名。

算法在特定时段或时期提供现金奖励激励我努力工作。

当我工作未能满足平台要求时，算法会对我进行罚款。

Perceived managerial control

平台主要监督我的工作表现。

平台强调平台工作者需要实现高水平的个人绩效。

我在平台上能否取得成功，很大程度上取决于我个人的工作绩效水平。

平台主要监督我在平台工作过程中如何执行标准化的规则和流程。

平台强调工作者在平台工作过程中必须遵守规则和流程。

我在平台上能否取得成功，很大程度上取决于我如何执行正式的规则和流程。

平台主要监督我与其他平台工作者的相处情况。

平台强调工作者之间需要和睦相处。

我在平台上能否取得成功，很大程度上取决于我与其他平台工作者相处得如何。

Appendix 4: Scales used in Study 1B, Sample 3 (Chinese version)

Algorithmic management characteristics

(1) Transparency

在平台上如何接到更多的订单是有规律可循的。

在平台上如何接到更好的订单是有规律可循的。

在平台上如何接到更多订单的规律能够被掌握。

在平台上如何接到更好订单的规律能够被掌握。

(2) Incessancy

在完成订单的过程中，平台系统会持续记录我的行车路线。

在完成订单的过程中，平台系统会持续记录我的实时地理位置。

在平台工作过程中，平台系统会持续记录我全天的接单情况。

在平台工作过程中，平台系统会全程记录我的订单完成情况。

在平台工作过程中，平台系统会持续记录所有顾客对我的评价结果。

(3) Iteration

平台系统会依据我的订单完成情况，调整对我的基本工作要求。

平台系统会依据我的订单完成情况，调整对我的工作评价标准。

平台系统会依据我的订单完成情况，调整对我的工作考核标准。

平台系统会依据我的订单完成情况，调整对我的奖励标准。

(4) Uniformity

平台系统公平地对待所有平台工作者。

平台系统在管理所有平台工作者时一视同仁。

平台系统在派单时所有平台工作者机会均等。

平台系统在管理所有平台工作者时不会差别对待。

平台系统在给所有平台工作者派单时没有差别对待。

Appendix 5: Scales used in Study 2 (Chinese version)

Algorithmic management characteristics

(1) Transparency

在平台上如何接到更多的订单是有规律可循的。

在平台上如何接到更好的订单是有规律可循的。

在平台上如何接到更多订单的规律能够被掌握。

在平台上如何接到更好订单的规律能够被掌握。

(2) Incessancy

在完成订单的过程中，平台系统会持续记录我的行车路线。

在完成订单的过程中，平台系统会持续记录我的实时地理位置。

在平台工作过程中，平台系统会持续记录我全天的接单情况。

在平台工作过程中，平台系统会全程记录我的订单完成情况。

在平台工作过程中，平台系统会持续记录所有顾客对我的评价结果。

(3) Iteration

平台系统会依据我的订单完成情况，调整对我的基本工作要求。

平台系统会依据我的订单完成情况，调整对我的工作评价标准。

平台系统会依据我的订单完成情况，调整对我的工作考核标准。

平台系统会依据我的订单完成情况，调整对我的奖励标准。

(4) Uniformity

平台系统公平地对待所有平台工作者。

平台系统在管理所有平台工作者时一视同仁。

平台系统在派单时所有平台工作者机会均等。

平台系统在管理所有平台工作者时不会差别对待。

平台系统在给所有平台工作者派单时没有差别对待。

Promotion-focused job crafting

我努力在工作中发展自己的能力。

我尝试在工作中学习新事物。

我会确保在工作中最大限度地发挥了我的能力。

我主动搜寻平台向工作者提供的相关培训与指导。

我向其他人寻求对我工作表现的反馈意见。

我向其他平台工作者寻求工作建议。

当平台推出一个新的活动时，我会主动参加。

每当平台有新的举措，我通常是第一批了解并尝试的人。

我会做一些超出工作要求的任务，如主动向客户提供额外服务，即便我没有因此获得奖励。

Prevention-focused job crafting

我会确保我的工作不会让自己的精神过于紧张。

我会确保我的工作不会让自己的情绪过于紧张。

我会安排我的工作以便减少我和其他人的接触。

我会安排我的工作以避免我被其他人影响。

我会确保自己不用在工作中做出很多艰难的决定。

我会安排好自己的工作以确保我不用长时间持续集中精力。

Resilience

应对压力能够让我更强大。

在遇到困难后我能快速恢复。

面对压力我能保持专注。

我不会因为失败而轻易感到气馁。

我认为我自己是一个坚强的人。

Platform commitment

我对我所工作的平台有很强的归属感。

在平台上，我觉得自己是“大家庭”的一份子。

我所工作的这个平台对我个人具有重要意义。

除了在这个平台上工作之外，我没有太多其他的选择。

如果我现在决定离开这个平台，我的生活将会受到很大影响。

即便我想离开这个平台，一时之间我也很难真的做到。

如果我现在离开这个平台我会有负罪感。

我没有离开现在工作的这个平台是因为我认为自己有责任留下来。

我觉得我有义务留在现在工作的这个平台上。

Job insecurity

我的工作没有保障

未来我可能会换工作

我的工作不是一份能干得长久的工作

Appendix 6: Scales used in Study 3B (Chinese version)

Algorithmic management characteristics

(1) Transparency

在平台上如何接到更多的订单是有规律可循的。

在平台上如何接到更好的订单是有规律可循的。

在平台上如何接到更多订单的规律能够被掌握。

在平台上如何接到更好订单的规律能够被掌握。

(2) Incessancy

在完成订单的过程中，平台系统会持续记录我的行车路线。

在完成订单的过程中，平台系统会持续记录我的实时地理位置。

在平台工作过程中，平台系统会持续记录我全天的接单情况。

在平台工作过程中，平台系统会全程记录我的订单完成情况。

在平台工作过程中，平台系统会持续记录所有顾客对我的评价结果。

(3) Iteration

平台系统会依据我的订单完成情况，调整对我的基本工作要求。

平台系统会依据我的订单完成情况，调整对我的工作评价标准。

平台系统会依据我的订单完成情况，调整对我的工作考核标准。

平台系统会依据我的订单完成情况，调整对我的奖励标准。

(4) Uniformity

平台系统公平地对待所有平台工作者。

平台系统在管理所有平台工作者时一视同仁。

平台系统在派单时所有平台工作者机会均等。

平台系统在管理所有平台工作者时不会差别对待。

平台系统在给所有平台工作者派单时没有差别对待。

Job satisfaction

总体而言，我对自己的工作感到满意。

对于从这份工作中获得的成就感，我大体感到满意。

对于在平台上从事的这份工作，我大体感到满意。