Article

Factors Influencing Crowdworkers' Continued Participation Behavior in Crowdsourcing Logistics: A Textual Analysis of Comments from Online Platforms

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Abstract: With the lazy economy's rise in the digital era, the demand for crowdsourcing logistics delivery is increasing. In this process, the continued participation of crowdworkers has been a considerable challenge. In order to further clarify the influencing factors of crowdworkers' continuous participation and better and targeted incentives for their participative behavior, we use ROST-CM 6.0 software to conduct textual analysis on 3000 comments from crowdworkers on China's Meituan and Hummingbird crowdsourcing logistics platforms. The results show that the order dispatch system, reward and punishment system, and platforms' service are the key factors concerned by crowdworkers. The total negative sentiment among crowdworkers regarding crowdsourcing logistics platforms is close to 20%. We also find that crowdsourcing logistics platforms still have room for improvement in the quantity and quality of orders dispatched, the evaluation factors and the appeal system for reward and punishment rules, and the freedom and flexibility of distribution work. Otherwise, this might lead to a trust issue between crowdworkers and the crowdsourcing logistics platform. Based on the research findings, we recommend that the crowdsourcing logistics platforms should enhance service awareness, provide a better work experience for crowdworkers, and optimize platform functions. The government should act as a regulator as well as a service provider. This paper's innovations include methodologically, from the perspective of the crowdworkers, online comment texts are used to mine the behavioral factors that influence the crowdworker's continued participation in crowdsourcing logistics; content-wise, it adds fresh insights to existing research on how the order allocation system and platform reward and punishment mechanisms affect the crowdworkers' continuous participation behavior.

Keywords: urban logistics; crowdworkers; participative behavior; factors; textual analysis

1. Introduction

With the progress of mobile information and communication technology and the popularization of mobile transactions, crowdsourcing logistics has gradually become vital in urban logistics as a more efficient way of organizing production [1,2]. Howe [3] first proposed the concept of crowdsourcing in Wired Magazine. He generalizes crowdsourcing as the outsourcing of work tasks by a firm or institution to voluntary, non-specific personnel through a mass network. He also mentioned that individuals usually undertake crowdsourcing tasks, but if it involves tasks that require multiple people to collaborate, it may also come in the form of individual production relying on open source [3]. Crowdsourcing is a new solution to obtain labor through the Internet, providing additional labor

capabilities to solve issues and seek innovation [4]. The online crowdsourcing logistics platform provides logistical orders that need to be executed by crowdworkers. Crowdworkers are able to choose which delivery orders to complete or execute those allocated to them by the platform. This is comparable to the P2U (platform-to-user) paradigm. However, the user in this context does not refer to the customer but rather to the deliveryman. It is worth mentioning that, regardless of the approach used for receiving orders, the end result is a service that completes order delivery for customers. Therefore, this also explains why consumers can widely promote and love the mode of crowdsourcing logistics. For example, data from Yunkuaimai, an online mobile delivery platform, revealed that the number of employees engaged in food delivery and courier jobs has increased in recent years. "Ele. Me", "Meituan Takeaways" and "Baidu Takeaways" have registered more than four million people [5]. Other crowdsource logistics platforms, such as Dianwoda, Dada, and JD Home, also have more than three million part-time delivery workers, a total of seven million people [5]. Meanwhile, the worldwide crowdsourcing logistics market is valued at around USD 135 billion and is predicted to grow to USD 202.6 billion by 2027 [6]. Due to the significant labor incremental advantage of crowdsourcing logistics in solving the problem of orders' delayed delivery during peak times [2,7], as well as providing solutions for "last-mile delivery" [8,9], consumers show an open and accepting attitude towards this mode of delivery.

In academia, crowdsourcing logistics has also been widely discussed by scholars. For example, the research topics involve the promotion of sustainable development for urban logistics by crowdsourcing logistics (e.g., Rai et al. [10]; Chen et al. [11]), the continuous participation behavior of crowdworkers (e.g., Huang et al. [2]; Liang et al. [12]), the implementation behavior of logistic enterprises (e.g., Bin et al. [6]), and the value creation of crowdsourcing logistics (e.g., Li et al. [13]; Carbone et al. [14]). However, despite the significant market expansion, crowdsourcing logistics platform still confronts several operational challenges, the most prominent of which is how to motivate additional crowdworkers to continue participating in platform recruiting [2]. In comparison to its business significance, the crowdworkers' continuous participation behavior concerns have received insufficient scholarly attention. Obviously, this research gap is worth investigating and bridging. Although some scholars have paid attention to the continuous participation of crowdworkers before this, most of them conducted research through questionnaire survey (e.g., Liang et al. [12]; Bin et al. [15]), case analysis (e.g., Mladenow et al. [1]), and other methods. These studies hope to identify solutions to encourage the continued participation of crowdworkers by analyzing the potential factors that affect their continuous participation behavior. However, it is noticeable that the empirical research method of questionnaire survey may be constrained by the theoretical model and research hypotheses, and the case study approach may confront the issue of further exploring the generalizability of the results.

It is worth mentioning that there are many comments from crowdworkers in the interactive community of crowdsourcing network platforms. These reviews involve crowdworkers' multi-perspective evaluation of crowdsourcing logistics platforms and consumers (e.g., platform compensation, routes, order allocation, consumer attitudes, and requirements). However, few scholars have paid attention to these essential research data. Therefore, this paper attempts to collect the review data of crowdworkers in the crowdsourcing logistics platform and use ROST-CM 6.0 software for data analysis. The advantage of this method is that it can assist us in understanding the factors promoting their continued participation in crowdsourced delivery from the crowdworkers' perspective. We may need to analyze issues based on users' perspective, as Gao et al. [16] and Shan et al. [17] have done. Our key research questions are: (1) What factors affect crowdworkers' continuous participation behavior in crowdsourcing logistics distribution? (2) How to encourage crowdworkers to continue participating in crowdsourcing delivery? In terms of theory, our research expands the research methods of this topic and enriches relevant literature. Our unique contribution is that we offer fresh insight and a new research channel for

investigating crowdworkers' continual participation behavior in crowdsourcing logistics by evaluating their online review texts. In practice, it broadens the identification channels of the factors influencing the continuous participation behavior of crowdworkers. Meanwhile, providing more detailed recommendations for stakeholders, such as crowdsourcing logistics platforms to encourage the continuous participation of crowdworkers, is beneficial.

The rest of this paper is arranged as follows: The second section is a related literature review; the third section is the research method and data analysis; the fourth section discusses the results of data analysis; and the fifth section presents the conclusions, limitations, and prospects.

2. Related Literature

As an emerging "last-mile" distribution method in the era of mobile Internet, crowdsourcing logistics has been deeply studied and discussed by scholars on its business mode (e.g., Vecera and Pribyl [18]), types (e.g., Rai et al. [10]), advantages and challenges (e.g., Mladenow et al. [19]), as well as future development prospects (e.g., Mladenow et al. [1]) since its birth. The research perspective involves crowdsourcers (crowdsourcing platforms and online stores) (e.g., Wang and Xie [20]), crowdworkers (e.g., Liang et al. [12]), and users (e.g., Punel et al. [21]). In recent years, due to the increase in labor costs, the increase in express delivery volume, and the improvement of delivery service quality requirements for crowdworkers, the influencing factors of crowdworkers' continuous participation in delivery have become the focus of platforms and researchers.

The factors affecting crowdworkers' continuous participation can be roughly divided into three categories. The first is the positive motivating factors, the second is the negative hindering factors, and the third is the potential mediating factors (See Table 1).

Table 1. Factors affecting the continuous participation of crowdworkers.

Types of Factors	Examples of Factors	Research Methods	Sources
motivating factors	motivation for participation, subjective norms, perceived behavioral control, embeddedness within the organization, trust, monetary and non-monetary returns	questionnaire survey, case study, and literature analysis methods are the main methods	Liang et al. [12]; Bin et al. [15]; Rai et al. [10]
hindering factors	imperfect laws, delay, unclear assignment of responsibility, work enjoyment from previous work, entry threshold of work, perceived risk		Mladenow et al. [1]; Huang et al. [2]; Guo et al. [22]
Mediating factor	trust, satisfaction, operational cost perception, social value perception, and functional value perception		Huang et al. [2]; Liang et al. [12]; Bin et al. [15]; Upadhyay et al. [23,24]; Xiao and Ke, [25]

In terms of positive motivating factors, for example, Liang et al. [12] found that participation motivation, subjective norms, and perceived behavioral control positively impacted the crowdworkers' continuous participation intention. Bin et al. [15] proposed that embeddedness and trust within an organization positively impact the crowdworkers' continuous participation intention. Rai et al. [10] pointed out more comprehensively that monetary and non-monetary rewards may encourage crowdworkers to continue participating in crowdsourcing delivery.

In terms of negative hindering factors, for example, Mladenow et al. [1] presented that imperfect laws, untimely delivery, and unclear allocation of responsibility are reverse factors for the continuous participation of crowdworkers. In addition, work enjoyment from previous jobs, entry barriers of work [2], and perceived risk [22] were found to have a significant adverse effect on the continued involvement of crowdworkers.

In terms of mediating factors, factors, such as trust [2,15,23,24], satisfaction [12], operational cost perception, social value perception, and functional value perception [25], were found to have potential mediating effects in various empirical studies.

From the above analysis, it can be inferred that the influencing factors of the crowdworkers' continuous participation in crowdsourcing logistics have become an important research topic in urban logistics. Research on this topic has attracted widespread attention from scholars. It should be admitted that the existing relevant literature provides relatively rich materials and in-depth inspiration for the development of this paper. However, we note that the majority of the previous studies were carried out using the methods of questionnaire survey (e.g., Xiao and Ke [25]), case study (e.g., Mladenow et al. [19]), or literature analysis (e.g., Rai et al. [10]). The online review data of crowdworkers were rarely paid attention to (see Zhang and Shi [26] for a notable exception). Therefore, we use the text content mining software ROST-CM for data analysis to better explore the factors affecting crowdworkers' continuous participation in crowdsourcing logistics from the first perspective. This may aid in developing strategies to motivate crowdworkers to continue participating in crowdsourced delivery.

3. Research Method and Data Analysis

This paper aims to discover factors that may influence crowdworkers' continued engagement in crowdsourcing logistics from the crowdworkers' online reviews. Therefore, based on the literature analysis, we organized the research process of this paper, as shown in Figure 1, which consists of four steps.
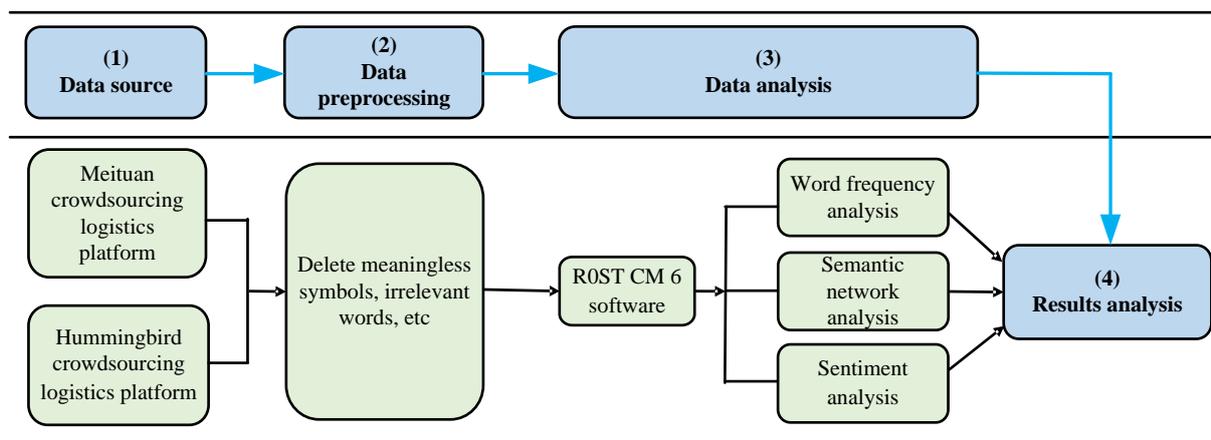
Figure 1. The method framework of crowdworkers' continued participation behavior analysis in crowdsourcing logistics.

3.1. Methods and Processes

Content analysis refers to the classification and quantitative processing of text data and the statistical analysis of words and sentences in text data with the help of specific tools and methods. Its purpose is to find the meaning, emotion, and regularity of text expression [27,28]. The text analysis method based on ROST-CM6.0 has matured and is widely used in social science. For example, this research method is used in personalized tourism preference research [29], "Internet + rural retail" policy comparison [30], and satisfaction investigation [31]. Therefore, this paper uses text content mining software ROST-CM6.0 for text analysis. We mainly conducted word segmentation processing, high-frequency word statistical analysis, social network, and semantic network analysis, and sentiment analysis on the online reviews collected from the crowdworkers.

3.2. Text Source

Online text has the characteristics of authenticity, validity, diversity, and extensiveness, which has incomparable advantages compared with the data collected by questionnaire

surveys [32]. According to the principle of high software popularity, high download times, and strong user interaction, we chose China's Meituan crowdsourcing logistics platform and Hummingbird crowdsourcing logistics platform as the source of review text. Meituan Crowdsourcing is a part-time delivery platform developed by Beijing Sankuai Technology Co., Ltd. (Beijing, China) to make money. This platform sees more than 20 million delivery orders every day. Its coverage density is relatively large, and the number of crowdworkers, merchants (crowdsourcer), and consumers on the platform is in the forefront of the industry [33]. Hummingbird Crowdsourcing is the latest delivery service brand app under Ele. Me, which aims to create an instant delivery logistics form. It is also at the forefront of the country regarding popularity and user numbers [34]. Therefore, we chose the public review texts of these two crowdsourcing logistics platforms as the research data, which is representative. We selected the online public reviews of the crowdworkers from 31 December 2021 to 20 October 2022. Specifically, we randomly selected 500 positive, medium, and poor reviews for single application software. Finally, we obtained 1500 comments for the Meituan crowdsourcing application software and 1500 comments for the Hummingbird crowdsourcing application software, totaling 3000 comments. Among them, the preview text is captured by using the extended screenshot function of mobile phone and then using the text extraction function of Quark browser to extract the text and summarize the research text's data.

3.3. Data Preprocessing

After obtaining the text data, we deleted the non-comment text (e.g., publication time, the anonymous title of the publisher) from the data. In addition, to make the analysis results more accurate and effective, we also removed meaningless symbols, spaces, and comments irrelevant to the research topic in the review text.

3.4. Data Analysis

3.4.1. Word Frequency Analysis

Word frequency analysis counts the occurrence frequency of words in the text. It obtains the high-frequency words in the text material [35]. This paper conducted word frequency analysis on the review texts collected by Meituan crowdsourcing, Hummingbird crowdsourcing, and the two platforms. At the same time, we deleted some meaningless high-frequency words (e.g., every day, otherwise). We incorporated several high-frequency words with the same meaning (e.g., "Danzi" and "Dingdan" in Chinese, which means orders in English; "Qishou" and "Qishi" in Chinese, means the crowdworker in English; "Zhuanqian" and "Zhengqian" in Chinese, means make money in English), and the final word frequency analysis results are shown in Table 2.

In general, the terms mentioned frequently by the crowdworkers in the review text are the ones that they are most concerned about. Therefore, the top 45 high-frequency words from the review texts of the two crowdsourcing logistics platforms are sorted out and analyzed by classification. We found that these words are dominated by nouns (e.g., unit price, orders, subsidy, welfare, penalty), followed by adjectives (e.g., perfect, rubbish, freely), and a minimal number of verbs (e.g., complaint, cheat, appeal, make money). Among them, from the words "unit price", "orders", "subsidy", "welfare", etc., it can be seen that the crowdworkers pay great attention to the monetary return and reward, as well as the orders. Terms such as "kilometer", "hour", "positioning", and "distance" indicate the importance that the crowdworkers attach to factors related to the delivery process. The words that reflect the crowdworkers' positive attitude towards the delivery platform and user experience include "humanized", "perfect", "freely", and "convenient." However, there are also negative words, such as "problem", "rubbish", "cheat", "delay", "appeal", "penalty", and "complaint", which reflect the crowdworkers' experience in using the crowdsourcing logistics software and their negative emotions on the distribution and punishment mechanism of the crowdsourcing logistics platform.

Table 2. Word frequency analysis results.

No.	Review Source					
	Meituan Crowdsourcing		**Hummingbird Crowdsourcing**		**All the Two Platforms**	
	Term	**Frequency**	**Term**	**Frequency**	**Term**	**Frequency**
1	Platform	201	Rider	80	Platform	274
2	Unit price	97	Platform	73	Rider	138
3	Make Money	89	Orders	39	Unit price	129
4	Orders	75	Time	38	Orders	114
5	Rubbish	72	Hummingbird	36	Make Money	99
6	Rider	58	Unit price	32	Time	91
7	Time	53	Problem	26	Rubbish	78
8	Rookie	41	Merchant	26	Problem	66
9	Problem	40	Fail	24	Appeal	54
10	Delay	37	Delivery	23	Delay	54
11	Kilometer	35	One star	21	Delivery	49
12	Complaint	35	Complaint	19	Kilometer	48
13	Acclaim	33	Penalty	19	Rookie	47
14	Hour	33	Delay	17	Merchant	47
15	Freely	32	Match	14	Hummingbird	46
16	Delivery	26	Enroll	14	Hour	43
17	Customer	26	Kilometer	13	Fail	43
18	Experience	25	Dispose	12	Acclaim	36
19	Convenient	24	Pay	12	One star	36
20	Perfect	24	Various	12	Customer	36
21	Served	23	Reason	11	Freely	33
22	Merchant	21	Version	11	Served	33
23	Lot	20	Succeed	11	Experience	32
24	Cancel	20	Cancel	10	Cancel	30
25	Positioning	20	Distance	10	Enroll	30
26	Fail	19	Customer	10	Various	30
27	Distance	18	Ticket	10	Penalty	30
28	Welfare	16	Hour	10	Distance	28
29	Enroll	16	Healthy	10	Cheat	25
30	Subsidy	16	Cheat	10	Perfect	24
31	Limit	16	Served	10	Convenient	24
32	Navigation	16	Complaint	9	Positioning	23
33	Reward	15	All	9	Reason	22
34	Cheat	15	Deposit	8	Welfare	20
35	Humanized	13	Audit	8	Reward	19
36	Place	12	Manage	8	Dispose	19
37	Five stars	12	Verify	8	Humanized	18
38	Penalty	11	Clear	8	Subsidy	18
39	Reason	11	Training	7	Abnormal	17
40	Call	11	Still	7	Navigation	17
41	Abnormal	11	Why	7	Limit	16
42	Hummingbird	10	Experience	7	Complaint	15
43	In advance	10	Rubbish	6	Efforts	15
44	Upgrade	9	Rookie	6	Version	15
45	Map	9	Improvement	6	Succeed	15

Notes: All the words (vocabularies) in the table are translated from Chinese.

The results of our high-frequency word analysis are similar to existing research conclusions. In addition, we obtained some new findings. For example, as in previous studies, monetary and non-monetary rewards (e.g., freedom and convenience) [10,36] are essential for crowdworkers to focus on. In addition to the factors proposed by previous scholars that hinder crowdworkers' continuous participation behavior, such as overtime and fines [1,2], we also found new issues, such as inaccurate software positioning and difficulties for the crowdworkers to appeal.

The above analysis shows little difference in the high-frequency words obtained from the review texts in the two crowdsourcing logistics platforms. In order to further understand the distribution of keywords, this paper refers to the statistical method of Sun and Ni [37]. It performs curve-fitting on the top 45 terms of Meituan crowdsourcing, Hummingbird crowdsourcing, and overall review text, respectively (see Figure 2 for details). The results show that the high-frequency words all conform to the characteristics of exponential power distribution. The coefficient of determination R^2 in the simulation equation is above 0.90, which indicates that the goodness of curve fitting is very high. According to the extended tail theory, high-frequency words such as "unit price", "rider", "platform", "time", and "order" are the key factors that the crowdworkers pay attention to, while the tail words are mostly the specific description, modification, and complementary words of the headwords, which are the crowdworkers' evaluation and perception of the above keywords.

(a)

(b)

(c)
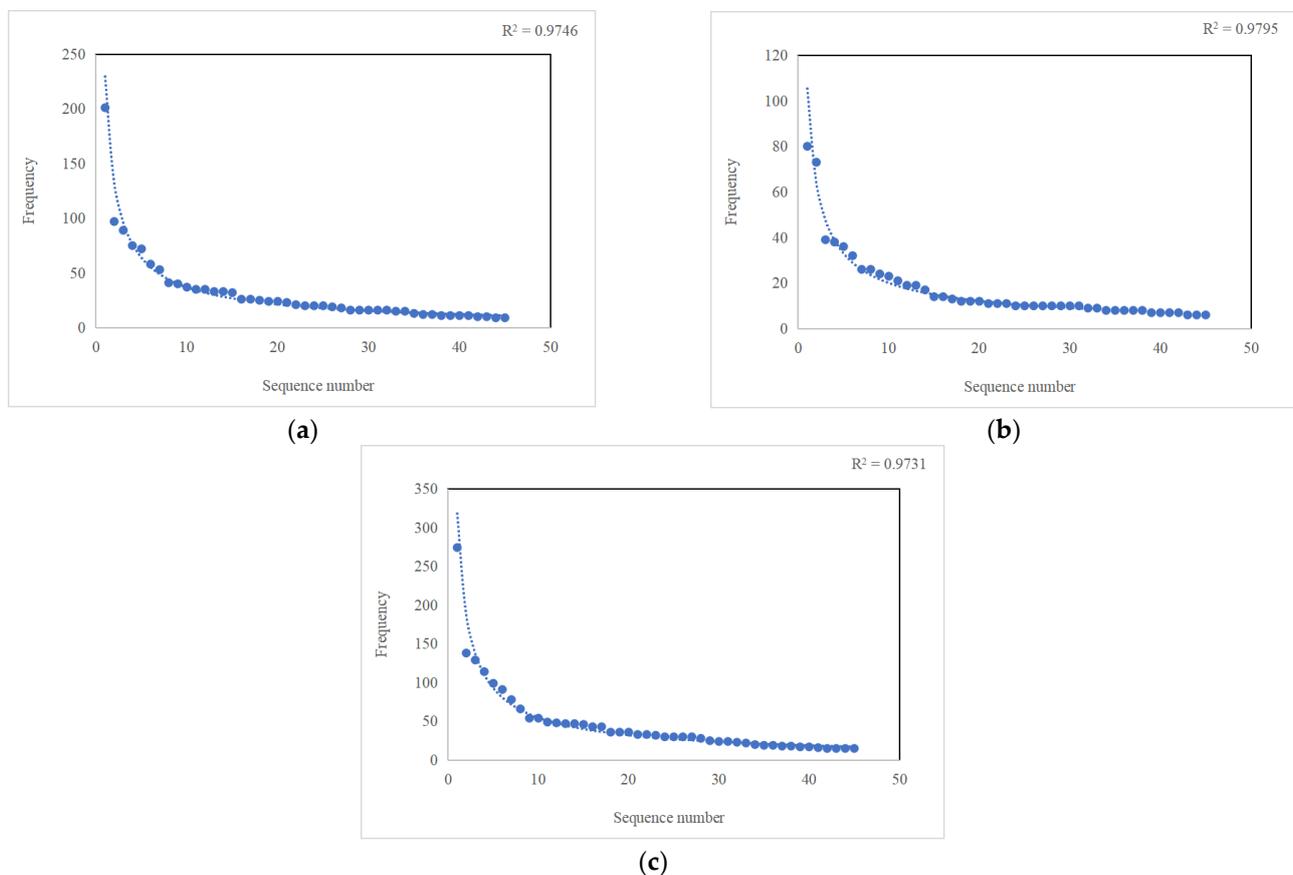
Figure 2. Curve fitting of high-frequency words for crowdworkers' online comments from crowdsourcing logistics platforms. (**a**) Curve fitting for Meituan crowdsourcing's high-frequency words. (**b**) Curve fitting for Hummingbird Crowdsourcing's high-frequency words. (**c**) Curve fitting for all of the two platforms' high-frequency words.

3.4.2. Semantic Network and Social Network Analysis

Semantic and social network analysis is based on the results of word frequency analysis, which focuses on the relationship between words in the review text and may compensate for the word frequency analysis's shortcomings [37]. In the semantic network diagram, the pointing of lines between perceptual objects is related to their co-occurrence frequency. Generally speaking, the higher the intensity of pointing and the higher the co-occurrence frequency are, the stronger the correlation between the two is [38]. We drew the semantic network diagram of the review text collected by Meituan crowdsourcing, Hummingbird crowdsourcing, and the two crowdsourcing logistics platforms, as shown in

Appendix A (it consists of Figures A1–A3). The semantic network graph shows the shape characteristics of multiple high-frequency words as the center and lower-frequency words are scattered around. The words marked in red are the most frequent words, followed by yellow, and blue with the lowest frequency. The arrows connecting the high-frequency words indicate a relationship between them. We undertook an in-depth analysis utilizing the semantic network diagrams of the two platforms (Figure A3). According to the collinear number of high-frequency words, classification and analysis can be carried out: The core words (red color) with the most intensive collinear number are "unit price", "rider" (crowd-worker), "platform", "time", and "orders." Among them, the words collinear with "unit price" include "kilometer", "distance", "time", etc. This shows that from the perspective of crowdworkers, the unit price of delivery is related to the difficulty of completing the order task (represented by the distance length). With the "rider", collinear vocabulary includes "unit price", "merchants", "time", "customer", "delay", "appeal", "fail", and "problem." This shows that the crowdworkers are concerned about the delivery unit price, delivery overtime, appeal, and other issues. The words collinear with "time" are "freely", "match", "delivery", "order", "delay", etc. On the one hand, this reflects the autonomy and flexibility of the crowdworkers' work, and on the other hand, it reflects the time urgency of the crowdsourcing logistics distribution. The words collinear with "platform" include "make money" and "perfect", which reflect the expectations and experiences of crowdworkers on the platform. The words collinear with "order" include "unit price", "time", "delay", "problem", "appeal", etc., which reflects the attention of crowdworkers to order issues.

The core words with the second most intensive collinear number (yellow color) are "customer", "appeal", "problem", "delivery", and "delay." Among them, the words collinear with "customer" include "merchant", "rider", "served (songda in Chinese, it means finished delivery)", "platform", "order", etc. This reflects the possible reasons and aspects for customer complaints against crowdsourcing logistics delivery. Collinear words with "problem" include "platform" and "call." This reflects issues with the governance mechanisms of the platform as well as issues related to privacy. The words collinear with "appeal" include "problem" and "reason", which reflects the appeal process and difficulty of crowdworkers from the side.

3.4.3. Sentiment Analysis

Sentiment analysis can analyze and summarize the subjective words with vibrant colors in the review text and classify them into positive, intermediate, and negative emotions [39,40]. This paper's sentiment analysis can directly reflect crowdworkers' emotions and perceptions of the crowdsourcing logistics platform. We first subjected the processed comment text to general line processing. Only one line was kept for repeated lines. This can avoid the accuracy of data analysis results due to text repetition to a certain extent. Then, we used ROST-CM 6.0 to conduct sentiment analysis on Meituan crowdsourcing, Hummingbird crowdsourcing and the summarized reviews of the two platforms, respectively, and the results are shown in Figure 3. It can be seen from Figure 3 that, in general, crowdworkers' positive emotions on the crowdsourcing logistics platform account for 53.66%, neutral emotions for 27.69%, and negative emotions for 18.65%. The above analysis shows that crowdworkers are not very satisfied with the crowdsourcing logistics platform, which still has much room for improvement. Further checking the review text, it was found that there are three main reasons for such high negative emotions: First, the exemplary mechanism implemented by the platform after the delivery delay or customer complaints makes the crowdworkers dissatisfied; second, crowdworkers believe that the price of delivery orders provided by the platform does not match the delivery difficulty, the number of orders is relatively small in many cases, and the setting of order dispatch mechanism is unreasonable; third, the user experience of platform navigation service and location service in the delivery process is not good.

	Positive emotions	Neutral emotions	Negative emotions
■ All of the two platforms	53.66%	27.69%	18.65%
■ Hummingbird crowdsourcing	40.92%	29.06%	30.02%
■ Meituan crowdsourcing	51.94%	27.05%	21.01%
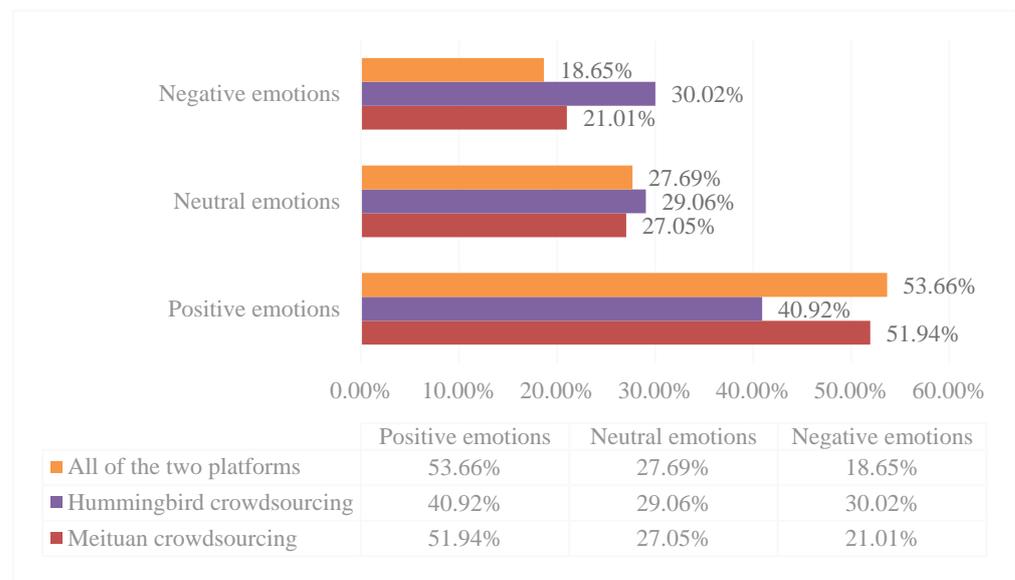
Figure 3. Results of sentiment analysis.

In addition, we noted that there are also significant data differences between the two platforms regarding positive and negative emotions. For example, the crowdworkers have 11.02% higher positive emotions towards the Meituan crowdsourcing logistics platform than Hummingbird. Similarly, negative sentiment was nearly 10 percent lower. Through further confirmation of the review text, we found that the reasons for the above differences may be as follows: First, it is affected by differences in order quantity, unit price, and subsidy policies. For example, most reviews reflect that Hummingbird crowdsourcing has fewer daily orders than Meituan crowdsourcing, a lower unit price, and a worse subsidy policy. Second, there is a gap in positioning, appeal, order dispatch, other functional services, and punishment mechanisms. For example, there were more reviews reflecting problems with the navigation and location services of Hummingbird crowdsourcing.

4. Discussion

We focused on what factors influence crowdworkers' continual participation behavior in crowdsourcing logistics, as well as how to encourage crowdworkers to continue participating in crowdsourcing delivery. By analyzing the online review information of crowdworkers, this paper finds that crowdworkers pay special attention to such factors as delivery location, platform system, appeal system, privacy protection, order quantity, time arrangement, customer relationship, and reward and punishment system. In general, crowdworkers have powerful negative emotions about crowdsourcing logistics platforms and distribution work (accounting for more than 18%), which may hinder their continuous participation behavior. The above findings are consistent with the views of the existing relevant literature, but we also obtained some different findings. Based on these results, we present the theoretical and practical implications.

4.1. Theoretical Implications

This paper uses ROST-CM6.0 software to conduct content analysis, aiming to determine the factors affecting the crowdworkers' continuous participation behavior in crowdsourcing logistics from the first perspective (crowdworkers). The main theoretical contributions of this study are reflected in the following aspects.

First, this study enriches the literature on crowdworkers' continuous participation behavior in crowdsourcing logistics. Currently, crowdsourcing logistics has become a popular occupation and has attracted more researchers' attention. The majority of the existing literature studies the factors affecting the crowdworkers' continuous participation behavior in crowdsourcing logistics utilizing scholars' hypotheses and conjections and then

seeking evidence for verification (e.g., Huang et al. [2]; Bin et al. [15]) or summarizes the influencing factors from cases (e.g., Mladenow et al. [19]) and literature (e.g., Rai et al. [10]). However, we conducted content mining from the first perspective of the crowdworkers' review text and tried to answer the two core questions: What factors affect the crowdworkers' continuous participation behavior, and how to make the crowdworkers continue participating in crowdsourcing distribution? Thus, we provide new data and a logical perspective for the research on this topic and enrich the relevant literature.

Second, we found some essential information that differs from existing studies. For example, our results show that "order delivery time" dramatically impacts the crowdworkers' continuous participation behavior. The crowdworkers often run out of time due to the time set by the system, even when they are working hard. This is not conducive to the crowdworkers' continued participation. However, the relevant research (e.g., Huang et al. [2]; Bin et al. [7]; Liang et al. [12]; Bin et al. [15]; Guo et al. [22]; Zhang et al. [26]) ignores this vital factor.

Finally, we found from the online review text that the negative emotions of the crowdworkers on crowdsourcing logistics platforms account for more than 18%. However, previous empirical studies, case studies, and literature reviews (e.g., Rai et al. [10]; Liang et al. [12]; Mladenow et al. [19]) are challenging to reach this result. Further, through checking the content of the review text, we found that such negative emotions are mainly caused by the unreasonable fines imposed by the platform on the crowdworkers; the price, delivery difficulty, quantity and order delivery mechanism of the orders do not meet expectations; and the poor user experience of the navigation service and location service of the platform. Thus, our findings make up for the limitations of most existing studies. In other words, we quantified the emotions in the crowdworkers' continuous participation behavior and found the reasons for the negative emotions.

4.2. Practical Implications

We focused on approaches to better incentivize crowdworkers to continue participating in crowdsourcing delivery tasks from a practical perspective after determining the factors that impact their continual participation behavior. Our findings indicate that we could assess this issue from the views of both platform companies and governments. In practice, this paper can recommend crowdsourcing logistics platforms to attract better crowdworkers to participate continuously and optimize platform functions. Furthermore, the government has to perform as both a supervisor and a service provider. Specifically, this study has the following four practical implications.

First, the crowdsourcing logistics platform should optimize the order dispatch system. The results show that "order" and "platform" are core words with the highest co-linear frequency in semantic and social network analysis. In the crowdsourcing logistics platform, the number of orders received by newly registered crowdworkers and those who have been registered for a long time are unequal, and the difficulty of order implementation is different. Clearly, negative impacts can be seen on the crowdworkers' continuous engagement behavior, especially regarding the absorption of new crowdworkers. Crowdsourcing logistics platforms should provide new users with more opportunities to receive orders to ensure the experience of receiving orders from old users to attract and retain new users. We suggest, for example, providing more options for new users to receive orders, providing closer locations based on the user's location, and adjusting the probability of receiving orders to be the same for new and old users.

Second, the crowdsourcing logistics platform should optimize the platform reward and punishment system so that the crowdworkers can enjoy crowdsourcing work more. Our results show that "unit price" is also one of the core words of co-line frequency in semantic network and social network analysis. Previous studies have found that external incentives, enjoyment, and fun drive the crowdworkers' continuous participation in crowdsourcing logistics [12,19]. It can be seen from online reviews that increasing the channels of rewards (e.g., increasing the number of orders for the crowdworkers or directly increasing the

reward for completed orders) or lowering the threshold of rewards (e.g., relaxing the requirements for receiving rewards) are the main demands of most crowdworkers. These will primarily affect the crowdworkers' continuous participation behavior. Furthermore, through the analysis of the comments, it can be found that among the most frequent words, "delay", "appeal", "problem", and "fine" account for a considerable proportion of the punishment system of crowdsourcing logistics platforms. It can be seen that there is still a lot of room for improvement in the punishment system of crowdsourcing logistics platforms. In addition, the comments indicate that when penalized, crowdworkers' complaints are not heeded or ignored frequently. Therefore, we propose that the platform develop a more reasonable and fair system in terms of punishment (e.g., strengthen the inspection for poor reviews, increase attention to crowdworkers' appeals, and reinforce communication with crowdworkers and customers).

Third, crowdsourcing logistics platforms should enhance service awareness and provide better work experience for crowdworkers. From the high-frequency words such as "freely" and "convenient" in the semantic network and social network analysis, it can be seen that crowdworkers pay great attention to whether the platform assigns work freely and conveniently. Whether the amount of work is allocated sufficiently, the freedom of order choice, and whether the delivery destination is too far away or inconvenient transportation will affect the crowdworkers' evaluation of the crowdsourcing logistics platform and their continuous participation behavior. It can be found from the comment text that there are still many problems existing in the task allocation of crowdsourcing logistics platforms. Therefore, we suggest that the platform should optimize the service function system from the following aspects: For example, strengthen the association between orders and the location of crowdworkers, optimize positioning and navigation functions, update the order allocation mode, and ensure that the crowdworkers have higher freedom of order selection.

Finally, the government should act as a regulator as well as a service provider. The terms "appeal", "penalty", and "delay" appear often in the analytical findings of high-frequency word analysis, semantic network analysis, and social network analysis. Can the crowdsourcing logistics platform handle the crowdworker's complaints fairly and reasonably? Are the platform's fines levied on crowdworkers reasonable and standardized? For what grounds might crowdworkers be excused from penalties for exceeding delivery deadlines? It appears impossible to overcome the aforementioned challenges only through a game between crowdworkers and the crowdsourcing logistics platform, in which the crowdworkers are at a disadvantage. As a result, competent government surveillance and the provision of adjustment and problem-solving services for the platform and crowdworkers will assist crowdworkers in performing better crowdsourcing delivery services.

5. Conclusions

The rapid development of mobile e-commerce has boosted the large-scale application of crowdsourcing logistics, and the number of crowdsourcing delivery workers has increased significantly. This also gives rise to some practical problems worthy of attention, such as how to encourage the continued participation of crowdworkers and manage the increasing number of crowdworkers better. To address these issues, it is crucial to understand how crowdworkers perceive crowdsourced delivery efforts. Therefore, we used ROST-CM6.0 to conduct word segmentation processing, high-frequency word processing analysis statistics, social network and semantic network analysis, and sentiment analysis on the crowdworkers' reviews in the crowdsourcing logistics part-time job platform. The main objective was to more intuitively show the factors that affect the continuous participation behavior of crowdworkers and provide guidance for their continuous participation in crowdsourcing delivery. The findings show that: The order dispatch system, reward and punishment system, and platforms' service are the key factors concerned by crowdworkers. The total negative sentiment among crowdworkers regarding crowdsourcing logistics plat-

forms is close to 20%. We also found that the crowdsourcing logistics platform still has room for improvement in the quantity and quality of orders dispatched, the evaluation factors and the appeal system for reward and punishment rules, and the freedom and flexibility of distribution work. Otherwise, this might lead to a trust issue between crowdworkers and the crowdsourcing logistics platform. The results of this study can enrich the literature on the research direction of crowdworkers' continuous participation behavior and provide practical enlightenment for better encouraging and guiding crowdworkers' continuous participation in crowdsourcing logistics distribution. Furthermore, this is conducive to promoting the sustainable development of urban logistics. In this regard, our findings reveal that the crowdsourcing logistics platforms should enhance service awareness, provide a better work experience for crowdworkers, and optimize platform functions (e.g., the order dispatch system, the platform reward and punishment system). The government should act as a regulator as well as a service provider.

However, we should also admit that this study still has some limitations. First of all, it is difficult to ensure that the comments used as data in the study do not contain the components of troll, fake, and malicious comments, which have a particular impact on the data analysis results. Second, reviews are only collected from the two leading crowdsourcing logistics platforms (Meituan and Hummingbird) in China, and the total number of review data is only 3000. This challenges the universality of our research conclusions to some extent. Moreover, we have only initially identified some factors that may affect the continuous participation behavior of crowdworkers from online reviews. However, the detailed influencing mechanism behind them may need to be explained and theorized through qualitative methods. Fourth, as an approach of analysis, we only employed text analysis. In the future, it will be essential to compare the outcomes of various models or methodologies. Finally, there are still many directions for the research on crowdworkers of crowdsourcing logistics, such as the optimization of delivery time, delivery route, subsidy policy, and order dispatch system that crowdworkers are concerned with. In addition, investigation and research on the work background of delivery personnel engaged in crowdsourcing part-time may provide insights into developing better incentive policies for continuous participation.

Appendix A

Figure A1. Semantic network analysis for Meituan crowdsourcing's high-frequency words. (Notes: All the words (vocabularies) in the figure are translated from Chinese).
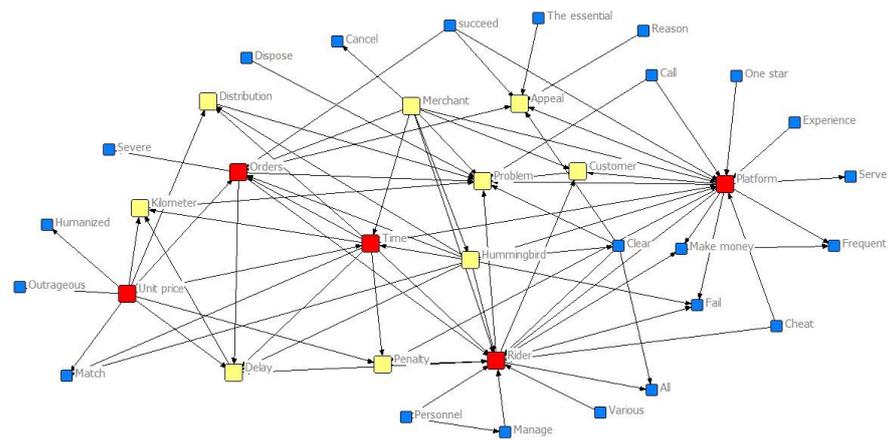
Figure A2. Semantic network analysis for Hummingbird Crowdsourcing's high-frequency words. (Notes: All the words (vocabularies) in the figure are translated from Chinese).
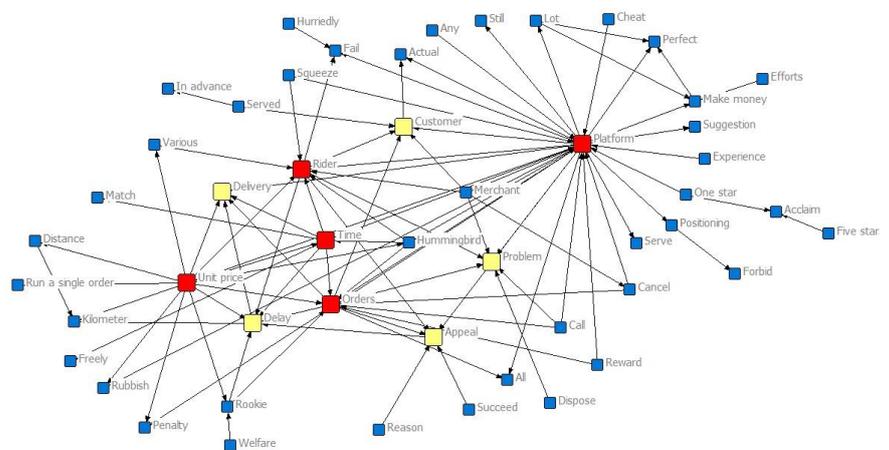
Figure A3. Semantic network analysis for Meituan and Hummingbird Crowdsourcings' high-frequency words. (Notes: All the words (vocabularies) in the figure are translated from Chinese).

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