Factors Influencing the Participation of Crowdsourcing Solvers: Benefit or Cost

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Factors Influencing the Participation of Crowdsourcing Solvers:

Benefit or Cost

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Abstract: Crowdsourcing has become a new channel for companies and organizations to collect the wisdom of crowds and reach business objectives. How to effectively motivate user participation and improve the quality of solutions has become an important issue that needs to be addressed in crowdsourcing research. While the influence of benefit factors on user participation has been widely tested, understanding of cost factors is still insufficient in extant literature. Based on social exchange theory, this paper proposed a research model to explain the impacts of benefit and cost factors on solver participation behavior as well as the moderating role of task complexity in crowdsourcing. The model will be tested using data from an online translation crowdsourcing task where solvers were invited to participate in the translation and fill out the questionnaire. This paper explores the differences in the factors which affect solvers participation intention and the quality of solutions. In addition, the role of task complexity can be found out by designing translation tasks of different task complexity and randomly assigning solvers to different tasks.

Keywords: crowdsourcing, social exchange, task complexity, participation intention, completion quality

1. INTRODUCTION

Crowdsourcing was initially introduced by Howe in 2006, which was defined as the act of recruiting a large group of undefined individuals, i.e., solvers, to undertake organizational tasks through Internet-based platforms[1]. Crowdsourcing can help companies and organizations effectively make use of external knowledge, skills and resources, so as to reduce cost and increase revenues[1].

With the development of crowdsourcing, third-party crowdsourcing platforms have emerged. Firms or individuals can publish their task requirements on the platform, and solvers choose to participate and complete the task according to their ability and interest. The best solution will be selected based on its quality and the solver will be rewarded. However, due to the low cost of crowdsourcing and the increasing number of platforms which support crowdsourcing, more and more companies adopt this kind of channel, making it competitive for firms to attract solvers to participate[2]. In this case, many crowdsourcing projects ended in failure because of lack of users' attention and participation[2]. The participation of users and the quality of solutions are crucial to the success of the project. Therefore, how to motivate more users to participate in the crowdsourcing project, and further improve the quality of their solutions has become a common concern of scholars.

To date, a few studies have proposed factors from the perspective of external and internal motivations which are positively related to participation intention based on theories such as the motivation theory. When users participate in the task, they need to spend time and effort to understand the requirement of the task and provide corresponding solutions. These costs may weaken the user's willingness to participate, so users will consider probable gains as well as the cost they should pay when they decide whether to complete the task. Social exchange theory explains human behavior in social exchanges from a cost-benefit perspective[3]. It posits that individuals behave in ways that maximize benefits obtained and minimize costs from an exchange. Social exchange theory is often used to explore factors that promote and hinder users from taking certain actions, but few scholars consider the cost factors that hinder users from participating in tasks in crowdsourcing. In addition, only a few scholars

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have examined the actual participation behavior, and they mainly took participation intention as a mediator of antecedents and actual participation. Given that the quality of completion and participation intention are not completely consistent[4], it is necessary to analyze the completion quality and compare the differences in the factors which effect users' intention to participate and completion quality.

On the crowdsourcing platform, the participation of users differs since the type of tasks is different. Among them, simple tasks can often attract users' attention and engage users in a short period of time. Complex tasks appear to users by high reward and interesting forms, but only a few solvers are really involved. Thus, in addition to exploring the direct influence of psychological factors on participation intention and behavior, some scholars found that task complexity also has an important influence on users' participation. However, the mechanism of how task complexity moderate the relationship between cost-benefit factors and participation has not been explained quite clear and needs to be further examined.

Motivated by these knowledge gaps, this study develops a model based on social exchange theory and aims to answer the research questions: (1) How do cost and benefit factors affect solvers' participation intention and quality in crowdsourcing? (2) How do task complexity moderate the relationship between cost-benefit factors and participation? (3)Whether the impacts of cost-benefit factors on participation intention and quality are different?

2. LITERATURE REVIEW

2.1 Theoretical basis

In extant literature, the most used theory is motivation theory and other sub-theories derived from it, including the self-determination theory. The motivation theory explains the factors that drive people to take certain actions[5], so it is often applied to explain individual knowledge sharing behaviors. Based on the motivation theory, the self-determination theory divides motivations into two categories: external motivation and internal motivation. Extrinsic motivation can be defined as performing a certain activity in order to achieve an outcome stemming from external sources while intrinsic motivation refers to situations where an activity is likely to be performed for its own sake[6].

On the basis of motivation theory, Kaufman et al.[5]proposed enjoyment based, community based motivation and immediate payoffs, delayed payoffs and social motivation have an effect on the participation of Mechanical Turk users. Based on the theory of extrinsic and intrinsic motivation as well as the theory of job design, Zheng et al. [7] developed a research model to explain participation in crowdsourcing contests, as well as the effects of task attributes on intrinsic motivation.

It is not difficult to find that motivation theory and self-determination theory explore the incentives for people to take action, and do not involve the inhibitors that hinder people's actions. Since participating in crowdsourcing tasks requires time and effort, these factors also have an impact on user participation, it is necessary to discuss the role of cost factors in the intention and actual participation behavior of solvers.

The social exchange theory is less used in the literature on the participation of crowdsourcing users. The main idea of the theory is that people will participate in and maintain the exchange relationship with others under the expectation of receiving returns. Social exchange theory explains human behavior in social exchanges from a cost-benefit perspective[8]. In crowdsourcing, solvers contribute their knowledge and expect to receive reward from assigners. The publish of the task and the participation of solvers constitute the transaction process, and solvers and assigners form an exchange relationship, which is compatible with social exchange theory. Few literature have studied user participation in crowdsourcing based on this theory. Therefore, this paper takes social exchange theory as the theoretical basis, and proposes variables from both benefit and cost to explore the influencing factors of crowdsourcing user participation intention and completion quality.

2.2 Benefit factors affecting the participation of solvers

With the development of crowdsourcing platforms, on the basis of the model proposed by qualitative analysis, scholars gradually turned to the quantitative analysis of the influencing factors of users' participation. After conducting a survey with workers on the crowdsourcing platform Amazon Mechanical Turk, Kaufmann et al. [5] found that intrinsic motivation factors seem to dominate the extrinsic ones. With the deepening of research, some scholars have refined external and internal motivations. Zheng et al. [7] proposed earning money and gaining recognition from the perspective of external incentives and the empirical results showed that recognition and internal incentives have a significant positive effect on user participation intention.

From extant literature, scholars have proposed factors that have a positive effect on user participation in crowdsourcing from the perspectives of external and internal motivations, including monetary reward, reputation, recognition, enjoyment, self-development, altruism and so on. However, in different situations, the conclusions of whether these factors affect participation intention and completion quality and whether the impact is significant have not been consistent.

2.3 Cost factors affecting the participation of solvers

Some of the literatures, based on other theories, introduce factors that have a negative effect on user participation. Drawing upon the goal attainment theory, Sun et al.[9] examine the effects of two types of benefits and two types of costs on knowledge contributors' satisfaction, and highlight the mediating role of perceived net goal attainment(PNGA). A field survey indicate that opportunity cost negatively influenced PNGA while actual cost had no significant effect. Based on social exchange theory, Ye and Kankanhalli[10] develop a model to explain the impacts of benefit and cost factors(cognitive effort and loss of knowledge power) on solver participation behavior in crowdsourcing. From the perspective of cost, though cognitive effort was negatively related to the dependent variable, loss of knowledge power was not related to solvers' participation in crowdsourcing. Through the research of user participation in crowdsourcing, cost factors are less considered compared with benefit factors and the analysis of the impact of cost factors on user participation intention and completion quality is still insufficient.

2.4 Task complexity

Wood has suggested that a task is made up of three basic elements: products, required acts and information cues[11]. Specifically, task complexity refers to the sum of actions required to be performed and information cues associated with the task that need to be processed.

Some scholars believe that the improvement of task complexity has a negative impact on the completion of tasks. In contrast, simple tasks make it easier to achieve a specific outcome, thereby reducing the risk of failure The higher task complexity means that the task performer needs to take more actions and process more information, and needs to invest more resources to complete the task[12]. When the task complexity increases, the individual's attention to the task will decrease, and it is easy to be bored with the task. However, complicated tasks provide task performers with more challenging and meaningful experiences that are more likely to enhance the incentives they feel, thereby motivating performers to complete tasks more efficiently[13]. It can be seen that the moderate effect of task complexity on user participation in crowdsourcing does not form a consistent conclusion.

## 3.   RESEARCH MODEL AND HYPOTHESES

Social exchange theory explains human behavior in social exchanges from a cost-benefit perspective. In such exchanges, people do others a favor with an expectation of some future return but no clear expectation of what that return will be. This belief of future returns is central to a social exchange, because the lack of explicit rules means

that people rely on this belief to justify their expected benefits from the exchange. Therefore, social exchange assumes the existence of relatively long-term relationships of interest rather than one-off exchanges[14]. These principles of social exchange, i.e., a cost-benefit analysis of exchange, have been used to understand knowledge sharing behavior in online communities and organizations.

In the context of crowdsourcing, solvers submit solutions to crowdsourced projects, which is a type of knowledge contribution, though the specific costs and benefits of such contribution may depend on the context. Solvers may consider whether their solutions will win rewards and if the value of their proposals will be acknowledged when choosing to participate or not. Since crowdsourcing users decide whether to participate in tasks and how much effort they should pay into the tasks based on the cost-benefit analysis of exchanges, social exchange theory can effectively explain the characteristics of users' participation intention and completion quality.

In addition to cost and benefit factors which have a direct effect on user participation, task complexity plays a more complex role of moderating. Sun et al. propose task complexity and self-efficacy to moderate the relationship between motivations and sustained participation[15]. According to findings, negative interaction effect between extrinsic motivation and task complexity, as well as positive interaction effect between intrinsic motivation and self-efficacy are observed. Based on the expectancy theory, Sun et al.[16] develop a research model to study the factors influencing effort in the crowdsourcing context and propose a non-linear relationship between self-efficacy and effort and the moderating role of task complexity. The results show that when task complexity is high (low), there will be a convex (concave) relationship between self-efficacy and effort.

Therefore, based on social exchange theory and combined with task complexity, this paper develops the research model shown in Figure 1. From the perspective of benefit, this paper chose monetary reward (external motivation) and enjoyment (internal motivation) based on motivation theory. And the representative cost factors are cognitive effort and opportunity cost. This paper proposes that monetary reward and enjoyment have a positive impact on participation intention and completion quality, while cognitive effort and opportunity cost have a negative effect on both. Meanwhile, task complexity moderates the relationship between cost-benefit factors and participation quality.
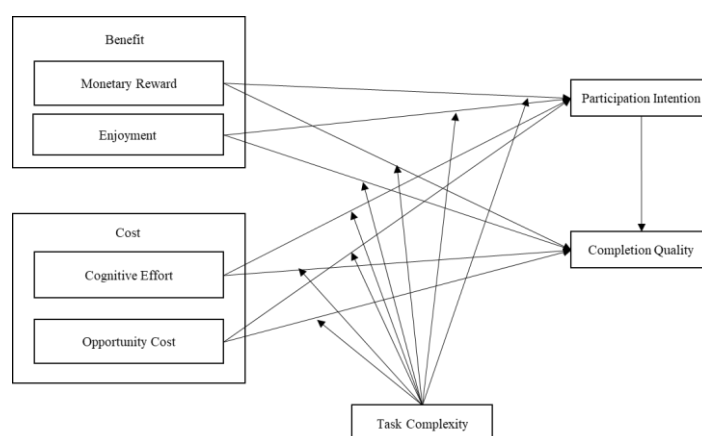
Figure 1. Research model

3.1 Monetary reward

Companies or organizations will provide monetary reward for solvers whose solution is selected. Money reward can be seen as an motivation for users and many papers have empirically tested that external motivations like monetary reward have a positive effect on user participation.. In order to receive rewards, users tend to submit solutions of high quality. Thus, we propose that

H1a: Monetary reward is positively related to solvers' participation intention in crowdsourcing.

H1b: Monetary reward is positively related to solvers' completion quality in crowdsourcing.

3.2 Enjoyment

In general, users are more willing to participate in the task when the enjoy solving the problem[17]. Solvers may be motivated by new tasks or interesting tasks and choose to complete the mission. Crowdsourcing tasks can stimulate users' interest and curiosity. The more fun users experience from the task, the more they are willing to accept and complete the task with high quality. After analyzing content contribution and community contribution of Wikipedia users, Xu and Li[18] found that enjoyment has a positive impact on both behaviors of users, and the effect on content contribution is greater than the other. Thus, we propose that

H2a: Enjoyment is positively related to solvers' participation intention in crowdsourcing.

H2b: Enjoyment is positively related to solvers' completion quality in crowdsourcing.

3.3 Cognitive effort

Cognitive effort refers to the effort required to complete a task on a crowdsourcing platform. Psychologists have suggested that humans have only limited cognitive resources. Users need to make a cognitive effort in understanding the task requirements, thinking about new ideas, and proposing solutions when taking part in a task. And according to social exchange theory, people tend to reserve their efforts[14]. So when people expect to spend a lot of time and effort to complete a task, they are less willing to participate in it. In addition, when users need to spend a lot of effort to solve the task, they often pay the minimum value of the required effort to complete the task, which will affect the quality of the completion. Thus, we propose that

H3a: Cognitive effort is negatively related to solvers' participation intention in crowdsourcing.

H3b: Cognitive effort is negatively related to solvers' completion quality in crowdsourcing.

3.4 Opportunity cost

Opportunity cost reflects the hidden costs of resource scarcity and exclusivity[8]. When participating in a task, solvers lose the opportunity to complete another task, lose the time to rest, and lose time spent with family and friends, which are all part of opportunity cost. Similar to cognitive effort, opportunity cost can measure the loss of users in the process of participating in a task. Therefore, when the opportunity cost of completing a task is high, users are less willing to participate, which will also reduce the quality of task completion. Thus, we propose that

H4a: Opportunity cost is negatively related to solvers' participation intention in crowdsourcing.

H4b: Opportunity cost is negatively related to solvers' completion quality in crowdsourcing.

3.5 Task complexity

Task complexity refers to the sum of actions required to be performed and information cues associated with the task that need to be processed. Jiang and Benbasat[19] believe that as task complexity increases, task performers need to invest more resources to complete the task. And when the time and effort that the participants need to invest increase to some extent, the participants will think that the reward they receive from the task is not worth their own investment and commitment. If the complexity of a task makes users think that they are not qualified for the task, the user will not participate for motivation to improve the ability. Therefore, as the complexity of the task increases, the positive effect of monetary reward and enjoyment on participation intention will be weakened. Meanwhile, compared with simple tasks, complex tasks will reduce the incentives from monetary rewards and enjoyment, thus affecting the quality of solutions submitted by users.

Higher task complexity means that the task performer needs to take more actions and process more information, which means that the task performer needs to invest more resources to complete the task. When task

complexity is low, the negative effect of cognitive effort and opportunity cost on participation intention and quality is weak. With the increase of task complexity, required effort and opportunity cost will be more and users participation intention will be weaken. What's worse, the limited nature of resources restricts the quality of users' completion. In other words, the increase in task complexity will enhance the negative impact of cost factors on participation intention and completion quality. Thus, we propose that

H5a: Task complexity negatively moderates the relationship between benefit factors and participation intention.

H5b: Task complexity negatively moderates the relationship between benefit factors and completion quality.

H5c: Task complexity positively moderates the relationship between cost factors and participation intention.

H5d: Task complexity positively moderates the relationship between cost factors and completion quality.

3.6 Participation intention and completion quality

According to the theory of reasoned action, an intention to perform a certain behavior links the actual behavior to upstream antecedents. The stronger the willingness of users to participate in the project, the more effort they may put into finish the solutions, which can help improve the completion quality. So we propose that

H6: Participation intention is positively related to completion quality.

4.   RESEARCH MOTHODOLOGY

4.1 Experimental design

This paper collects data to verify the model and hypotheses using experimental research methods, which is helpful to data collection and further analysis. According to the model, this paper designed two translation tasks with different complexity, and participants were randomly assigned to one of the tasks. Based on the examples provided that are consistent with the complexity of the translation tasks, participants should choose their participation intention first based on their feelings. Even if the participants choose low intention, they have to finish the task, so that this paper can get complete data. After completing the translation task, the participants need to fill in the questionnaire so that we can obtain the data of independent variables. Finally, according to the scoring standard of translation in national college English Test-6, the submitted translations will be evaluated so as to get the user's completion quality.

4.2 Instrument development

Instruments for most of constructs were adapted from prior relevant studies (as shown in Table 1). Slight wording modifications were applied to fit the research context, and all measures used seven-point Likert scale. Among them, monetary reward and opportunity cost were measured using items adapted from Sun et al. [9]. Enjoyment was measured using three items derived from Xu and Li [18], and cognitive effort was measured with four items from Ye and Kankanhalli [20]. As to the dependent variable participation intention, items were adapted from Zheng et al. [7].

Table 1. Items of constructs in the proposed model

Constructs	Items	Source
Monetary Reward	MR1: I will receive monetary rewards in return for participating in online tasks.	[9]
	MR2: Participating in online tasks can help me earn money.	
	MR3: Seekers provide monetary rewards to task solvers.	
Enjoyment	EN1: I find participation in crowdsourcing to be enjoyable.	[18]
	EN2: I have fun being a member of crowdsourcing.	

Constructs	Items	Source
Cognitive Effort	EN3: Participation in crowdsourcing provides me with much enjoyment.	[10]
	CE1: I try very hard to understand task requirements in the platform.	
	CE2: I need to put in effort into understanding firms' task requirements.	
	CE3: I need to input much time and effort to solve tasks in the platform.	
	CE4: I need to put in time into solving firms' problems.	
Opportunity Cost	OC1: When participating in the tasks on Taskcn.com, I will lose the opportunity for good rest.	[9]
	OC2: When participating in the tasks on Taskcn.com, I will lose the opportunity to enjoy time with friends and family.	
	OC3: When participating in the tasks on Taskcn.com, I will lose the opportunity to earn more money by doing other things.	
Participation Intention	PI1: I intend to participate in this crowdsourcing contest.	[7]
	PI2: I will try to participate in this crowdsourcing contest.	
	PI3: I am determined to participate in this crowdsourcing contest.	

4.3 Data analysis

In this paper, structural equation modeling (SEM) will be used for data analysis for two reasons. First, one of the dependent variable - completion quality - is measured by objective data, which may not conform to the proportionality constraints and uncorrelated measurement errors of co-variance based SEM[21]. Second, since the model includes the formative factor of opportunity cost, PLS is more applicable [21].

The data analysis found that (1) Monetary reward and enjoyment have positive effects on participation intention. Enjoyment can significantly improve the quality of the user's completion, and cognitive effort can reduce the quality of completion. (2) Task complexity negatively moderates the positive relationship between enjoyment and participation intention, quality of completion, while strengthens the negative effect of cognitive effort on participation intention and quality of completion. (3) The positive effect of monetary reward on participation intention are greater than the impact on quality of completion, while cognitive effort have greater effects on completion quality than on the participation intention of users.

5. RESEARCH INNOVATIONS

Compared with extant research, the innovations of this paper are as follows:

First, based on social exchange theory, this paper proposed factors that affect the participation intention and completion quality of crowdsourcing users from the perspectives of benefit and cost, expanding the perspective of existing literature which mainly focus on benefit factors.

Second, in addition to exploring the determinants of solvers' participation intention, this paper also introduces the objective data of completion quality, which can explain to some extent why there are many solutions of low quality. On the one hand, most of the research on crowdsourcing user participation focuses on the user's willingness to participate, lacking rational use of objective data. On the other hand, some of the literatures have included actual participation in the model, but tend to use participation intention as a mediator of antecedents and actual participation. Motivated by these knowledge gaps, this study separately examines the factors affecting the user's willingness to participate and the quality of completion, and further analyzes the differences in the effects of these factors on the intention and quality.

Third, this paper focuses on the role of task complexity, one of the task characteristics, in moderating the relationship between benefit cost factors and participation intention and quality of completion. The introduction of task complexity can provide more suggestions for designers of crowdsourcing projects to attract more users to participate in the project, and to improve the quality of completion to a certain extent.

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