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Investigating the Influence of Task Complexity and Outcome Variety on User Performance in Crowdsourcing Projects

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Abstract: Nowadays many companies leverage crowdsourcing to solve problems in order to reduce cost. The quality of the solution submitted by the participant is especially important for the company, so how to improve participation performance has become an essential research topic. From the perspective of task design, this paper proposes a theoretical model based on the job characteristics model to explore how task complexity and outcome variety affect participation performance through influencing self-efficacy and task meaningfulness. We will collect data through an online experiment to validate our proposed research model in the context of a crowdsourced translation task. Participation performance will be measured with subjective questionnaire and objective translation grades. Findings of this research will have theoretical implications and provide practical guidelines for crowdsourcing projects.

Keywords: crowdsourcing, task characteristics, job characteristics model, participation performance

1. INTRODUCTION

In recent years, with the advancement of modern information technology, a mode of leveraging crowd to solve problems - crowdsourcing has gradually emerged. Crowdsourcing is a service that company or organization can outsource a task performed by employees in the past to a non-specific (and usually large) mass group of Internet users in a free and voluntary or monetary manner. There are three main roles in the crowdsourcing, that is the crowdsourcing participant, the company, and the crowdsourcing platform. After the company publishes a task in the crowdsourcing platform, the participant submits a solution based on his expertise and the solution will be evaluated later by the company. With the development of crowdsourcing, lots of companies prefer to use the crowdsourcing platform to publish tasks and seek to use the knowledge and skills which is outside the company to solve problems in order to reduce costs. However, the quality of solutions received are usually poor. Therefore, how to improve the participation performance and quality of participants in crowdsourcing has gradually evolved into a research theme. Some scholars discussed the influence of task characteristics on intrinsic motivation and willingness to participate from the perspective of task design. Some scholars also discussed the impact of task complexity on participation performance by affecting the intrinsic motivation. Although many prior researches studied the impact of different task characteristics on participants' motivation, participation performance, and participation quality, there is a lack of research on the difference analysis in intrinsic incentives of different task characteristics, and in participation performance of task characteristics.

Crowdsourcing is a new model that opens the way for a collaborative process^[1]. Based on the development of Web2.0, companies can solve problems by the cooperation of Internet users, so crowdsourcing has also developed rapidly. In short, crowdsourcing can be seen as an online, distributed problem-solving model that leverages the capabilities and knowledge of a large number of participants to solve rather than leveraging traditional employees or suppliers^[2-6].

Although companies can receive mass of solutions, the performance and quality cannot be guaranteed.

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Some scholars have suggested how to attract a large number of people to participate in the crowdsourcing task and how to improve the quality of the solution, that is, to improve the participation quality in the crowdsourcing field is crucial^[7]. Nowadays, to pursue lower costs, more and more companies are leveraging crowdsourcing mode to solve problems^[8]. Therefore, how to improve the participation performance is the focus of research in the field of crowdsourcing.

In our study, based on the job characteristics model, in the context of crowdsourcing translation, we explore how different task characteristics (task complexity and outcome variety) affect the participants' participation performance by influencing the intrinsic motivation (self-efficacy and task meaningfulness) of participants. Specifically, we focus on task characteristics and its relationship to the intrinsic motivation, perceived efforts and perceived and actual performance of the participants. In order to achieve the purpose of this study, we first review the related research. Next, from the perspective of task design, a research model that affects the participants' participation performance is constructed, and research hypotheses are proposed according to the model. According to the proposed model, we describe our research methods including experiment design, construct measure, and data analysis. Finally, we propose several expected contributions.

2. LITERATURE REVIEW

2.1 Task characteristics

The design of the task can affect the user's intrinsic motivation, and then affect the performance. As Zhang's research shown, the design of the task could influence different mental states and intrinsic motivation of the participants, and a reasonable design had an impact on the participants' self-efficacy, task meaningfulness, and playfulness^[9]. Moreover, Schulze discussed in the crowdsourcing field how task characteristics affected participants' willingness to participate by studying the payment fit, enjoyment fit, and time fit of the task^[10]. Zheng explored how task characteristics (the autonomy of the task and skill variety) influenced the intrinsic motivation of participants and affected user's willingness to participate, and ultimately affected the actual participation^[7]. Kaufmann divided the user's motivation into two parts, intrinsic motivation and extrinsic motivation. In the intrinsic motivation, he mainly studied the influence of the autonomy of tasks and skill variety on intrinsic motivation^[11]. Unlike the above scholars, Moussawi transformed the research object. He explored the impact of the autonomy of task, skill variety, and task meaningfulness on participation effort and participation performance^[12]. Similar to Moussawi, Piccolo studied five core job characteristics in the context of organizational citizenship behavior: skill variety, task identity, task significance, autonomy, and feedback. He also studied the impact of intrinsic motivation on participation performance^[8]. From this point of view, prior studies have shown that designing tasks according to the task characteristics can effectively influence the intrinsic motivation and participation performance and quality. Therefore, how different task characteristics affect the intrinsic motivation and participation performance is the concern of the company.

Moreover, prior research studied the task categorization. Ye classified tasks from two dimensions of tasks: task complexity and outcome variety^[13]. Task complexity represents the amount of time and expertise required for a crowdsourcing task. For difficult tasks, the skills and time required are relatively high. Outcome variety represents the diversity of the results of a solution received by a crowdsourcing task. For solutions that are not diverse, such as audio transcription, they are consistent. While tasks like logo design, solutions are often diverse due to the different design concept of each participant. Therefore, we can define tasks from the above two characteristics' dimensions and study the impact of different tasks with different levels of complexity and outcome variety on participation performance of participants.

2.2 Job characteristics model

How a rational design of task improves the performance, the job characteristics model is one of the theories to explain this mechanism. In 1976, Hackman and Oldham proposed a job characteristics model that outlined the conditions under which employees could spontaneously perform more effectively at work ^[14]. The model focuses on the interaction of three types of variables: the psychological state of the employee, job characteristics, and personal and work outcome. The model believes that the job itself has an intrinsic incentive on employees, so employees who are internally motivated will have excellent work performance. In turn, it has a good psychological state, and this good mental state will enable employees to maintain an excellent performance level and form a benign cycle. The most important part of job characteristics model is to strengthen the core job characteristics to improve the intrinsic motivation of employees. Hackman described the job characteristics from five dimensions, namely skill variety, task identity, task significance, autonomy, and feedback. These five core job characteristics mainly affect the three psychological states of employees: experienced meaningfulness of the work, experienced responsibility for work outcomes, and knowledge of results. The skill variety represents the degree to which a job requires a variety of different skills. And task complexity represents the required professional skills. Outcome variety represents the innovation ability of the participants. Thus, the definition of task complexity and outcome variety match with the definition of skill variety. Therefore, our study mainly focus on the skill variety and expand it to task complexity and outcome variety, and discuss how these two task characteristics influence the participants' intrinsic motivation and participation performance.

Based on job characteristics model, some prior studies payed attention to the impact of task characteristics on task performance, satisfaction, and participation. Judge made assumptions that task characteristics had an impact on job satisfaction, and also discussed the relationship between self-evaluation variables such as self-efficacy and task characteristics ^[15]. It can be concluded that self-efficacy is more critical in the intrinsic motivation. Schulze focused on the impact of different task characteristics on participants' willingness to participate in the context of crowdsourcing, and gave a systematic overview of how participants could choose their own tasks based on task characteristics ^[10]. Kaufmann also established a model in the crowdsourcing field that influenced the participants' willingness to participate. He divided the participants' motivation into intrinsic motivation and extrinsic motivation. The factors affecting intrinsic motivation included four task characteristics: autonomy, skill variety, task identity, and feedback. He found that the skill variety and autonomy of task had significant influence on the intrinsic motivation of participants ^[11]. Piccolo explored how core job characteristics affected job performance in the context of organizational citizenship behavior. Empirical studies found that core job characteristics could affect employee performance by enhancing employees' intrinsic motivation ^[8]. Moussawi also proposed a model on how to design a task. He studied relationship between perceived task characteristics and perceived performance, perceived effort. He focused on autonomy, skill variety, and task meaningfulness. According to the questionnaire, he came up with the conclusion that autonomy and task meaningfulness could improve the performance of participants ^[12]. Generally speaking, although many scholars have studied the impact of task characteristics on participation performance, willingness to participate, there are little research on the differences in intrinsic incentives of different task characteristics, and the differences in participation performance of task characteristics.

Therefore, based on the job characteristics model, in the context of crowdsourcing translation, we mainly study how different task characteristics (task complexity, outcome variety) affect perceived efforts and performance by improving the intrinsic motivation (self-efficacy, task meaningfulness). We also objectively measure the participation performance through online experiments by grading the translation, and analyze the impact of the task characteristics on the actual participation performance.

3. RESEARCH MODEL

Drawing on the job characteristics model, we mainly investigate how task complexity and outcome variety affect self-efficacy and task meaningfulness, which in turn influence perceived effort, perceived performance and actual participation performance. The research model is shown in Figure 1.

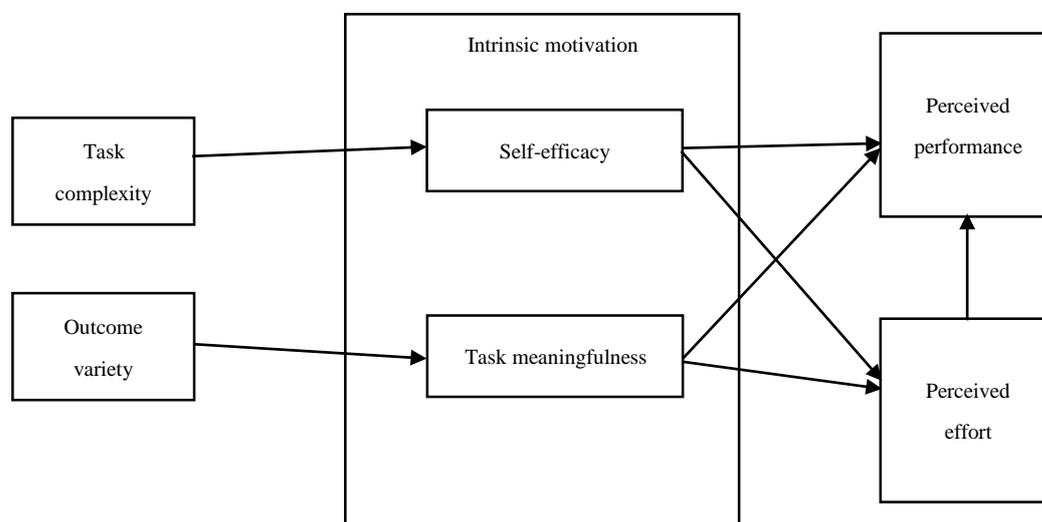


Figure 1. Research model.

Task complexity refers to the amount of professional skills required by the task, while self-efficacy refers to the participant's confidence of completing the task. The lower the difficulty of a task, the less professional skills required, and the greater participant believes that they can complete the task, and the higher self-efficacy they will gain^[16]. Hence, we hypothesize:

H1: Compared to tasks with high complexity, tasks with low complexity can enhance participants' self-efficacy to a greater extent.

Outcome variety refers to whether the solution received is diverse, and it can be further regarded as a symbol of the innovative thinking skills of participants^[13]. Task meaningfulness refers to that participants consider the task is meaningful and worthwhile to do. The task with high outcome variety requires an innovative thinking of participants, while the solution with low outcome variety is similar and monotonous, which cannot trigger the enjoyment and involvement of participants, which cannot meet the needs of self-actualization for participants, and thus cannot make them feel valuable to the task. Therefore, when the task requires participants to give their own innovative thinking and propose a different solution, participants will consider the task to be more valuable and worthwhile to complete. Hence, we hypothesize:

H2: Compared to tasks with low outcome variety, tasks with high outcome variety can make participants feel more meaningful to the task.

Self-efficacy is a measure of self-evaluation that affects the actions, effort, and persistence of participant. According to social cognition theory, if someone thinks he or she has enough ability to successfully accomplish something, he or she expects more results^[17]. Therefore, people with stronger self-efficacy will be more convinced of their ability to complete tasks than those with low self-efficacy, so they will work harder to complete the task. Hence, we hypothesize:

H3: There is a positive connection between self-efficacy and perceived effort.

Task meaningfulness refers to a sense of value and meaning in the task, which satisfies the demand of the

participants for self-actualization. Prior research has shown in the Amazon Mechanical Turk that meaningful competitions are more attractive to participants when other conditions remain unchanged^[18]. So meaningful tasks can increase the involvement of people, and then people will spend more time and effort to complete the task. Hence, we hypothesize:

H4: There is a positive connection between task meaningfulness and perceived effort.

There are two main parts of the expectation theory, the effort-performance probability, which is the expectation that more effort would lead to better performance, and the performance-reward probability, which is the expectation that better performance will lead to higher rewards (intrinsic or extrinsic)^[12]. People always hope to achieve the desired goal through certain efforts. If the individual subjectively believes that the probability of reaching the goal is high, they will have confidence and stimulate a strong work force, that is, more efforts can bring better performance. So, when the participant thinks that he works harder, he will think that his performance will be higher. Hence, we hypothesize:

H5: There is a positive connection between perceived effort and perceived performance.

When giving incentives to the participants, such as sense of accomplishment, competence, satisfaction, etc., they will increase the participation behavior to a greater extent, and further bring better participation performance^[16]. When participants are confident in completing the task, which is a strong self-efficacy, they will gain an intrinsic incentive to subjectively evaluate his ability highly, so that they will perceive they have sufficient ability to perform the task, that is, they will think the performance of the task is matched with their ability, and the performance will be considered well. Hence, we hypothesize:

H6: There is a positive connection between self-efficacy and perceived performance.

When the participants feel meaningful to a task, the task meets their needs for self-actualization. The atmosphere created by this demand will increase the intrinsic incentives of participants, resulting in their performance more efficiently in the task^[12]. Task meaningfulness gives the participants a sense of self-actualization and motivate them to perform effectively^[14]. Thus, when the participants think a task is meaningful to them, it will bring positive intrinsic incentives to them, so that they will think their participation performance will be better. Hence, we hypothesize:

H7: There is a positive connection between task meaningfulness and perceived performance.

According to the above assumptions, the task with low complexity will enhance self-efficacy of participants. When participants gain more confidence in completing the task, they believe that the performance of the task is better. Also, the task with high outcome variety will make participants feel more meaningful to the task, thus satisfying their pursuit of self-actualization, and generating positive internal incentive effects, and then they will gain a better performance. Hence, we hypothesize:

H8: Compared to other tasks, tasks with low complexity and high outcome variety can enhance participants' perceived participation performance to a greater extent.

H9: Compared to other tasks, tasks with low complexity and high outcome variety can enhance the actual translation quality of task to a greater extent.

4. RESEARCH METHODOLOGY

4.1 Experiment design

Recent research has found that crowdsourcing is rapidly gaining popularity, especially in the language processing community^[19]. Crowdsourcing translation is the task that companies post one or more sentences containing the source language and require translation into the target language. To complete translation tasks by crowdsourcing, companies can get multi-language support, quick-respond solutions, and low cost. Since crowdsourcing translation is solved by human translating, a variety of required language translations are

available according to the needs of the company. Leveraging the power of the crowd, the translation task can be done very quickly. Compared with hiring professional translators, the cost of publishing translation tasks on the crowdsourcing platform is much lower. And through the crowdsourcing platform community, crowdsourcing solver and company can better communicate, which is also the needs of the company.

Therefore, in the context of crowdsourcing translation, we will conduct an online experiment including a translation task and questionnaire. For this article mainly discusses two characteristics of the task, the translation task can be divided into four kinds of tasks according to the level of complexity and outcome variety. Participants will be allocated to one of the experimental conditions randomly. After completing the translation part, participants will finish the questionnaire based on their experiences with translation tasks. Finally, the translation submitted by participants will be graded in order to give an objective measure of their participation performance

For the measurement of the translation task complexity, the Flesch Reading Ease indicator is used, which is calculated according to the statistical method of Dr. Rudolf Flesch of the United States. The calculation is based on the number of words in the sentence and the number of syllables contained in the sentence. The value is between 0 and 100. The larger the number, the easier it is to read. For the measurement of translation task outcome variety, we use two types of translated articles to distinguish, the instruction type represents the task with low outcome variety, and the poetry type represents the task with high outcome variety. After the participants complete the translation task, they will continue to answer questionnaires about other variables in the model. For the grading of the translation quality of participants, the grading standard for CET-6 paragraph translation is used. This grading standard has been adopted by CET-6 and is relatively universal.

4.2 Construct Measures

In order to enhance the validity of the survey scales, our scales used in the questionnaire referred to the prior relevant research (as presented in table 1). In order to comply with the context of the research, we did some word modifications. All measurements were measured using 5 Level Likert scale. The scale for self-efficacy were adapted from Sun et al ^[16]. The scale for task meaningfulness were adapted from Spreitzer et al ^[20]. The scale for perceived effort and perceived performance were adapted from Moussawi ^[12].

4.3 Data analysis

We will use AMOS to analyze survey data, and independent-samples T test and one-way analysis of variance to explore difference analysis on the impact of different task characteristics.

Table 1. Items of constructs

Constructs	Items	Source
Self-efficacy	SEL1: I am competent at completing the task.	[16]
	SEL2: I have the expertise needed to complete the task.	
	SEL3: I have confidence in my ability to complete the task.	
Meaningfulness	MEA1: The task I did is very import to me.	[20]
	MEA2: The task is personally meaningful to me.	
	MEA3: The task I completed is valuable to me.	
Perceived effort	EFF1: I worked at my full capacity to finish the task.	[12]
	EFF2: I tried hard to finish the task.	
	EFF3: I put a lot of effort into completing the task.	
Perceived performance	PER1: I expect that I did well enough on the task I just completed.	[12]
	PER2: I believe I did well on the task I just completed.	
	PER3: I believe that I answered correctly a good number of task related questions.	

5. EXPECTED CONTRIBUTION

This paper explores the influence of task complexity and outcome variety on intrinsic motivation (self-efficacy and task meaningfulness), perceived effort and perceived performance, and finally analyzes the impact of task characteristics on actual participation performance. We construct a research model based on the job characteristics model and will conduct a two-way factorial online experiment. Our research will make several contributions to extant literature.

First, our study develops a theory-driven research model to explore the relationship between task characteristics and participants' participation performance. We explore how task complexity and outcome variety affect participation performance through influencing intrinsic motivation and extend the application of job characteristics model to explain user performance in the context of crowdsourcing. This will pave a way for future study on the impacts of task characteristics for participation performance in crowdsourcing and enrich the existing literature in the context of studying crowdsourcing task characteristics.

Secondly, this paper will investigate to what extent task design can motivate participants and finally enhance their performance. As one of the contribution to the IS literature, this paper points out that well-designed tasks will enhance the crowdsourcing performance of participants. According to our hypotheses, a task with low complexity and high outcome variety will enhance self-efficacy and a sense of meaningfulness of participant, which will result in boosting participation performance. For example, when the task is allocated to participants with different capabilities, the task can be divided into several sub-tasks, which can reduce the complexity of the task, so that participants will believe in its ability when facing the sub-task and submit higher quality solutions. Also, company can prompt participants that the various outcome of their solutions will contribute to the company's projects, and each individual's solution is critical to completing the whole projects, which will create a meaningful feeling to participants and motivate them to perform better. Therefore, our study will enrich the literature by convincingly suggesting how task can be designed to intrinsically motivate user performance in the context of crowdsourcing.

Finally, we will measure participants' subjective perceptions of their performance and then grade their contributed translations to ensure a more objective evaluation of their performance, which can make up for the shortcoming of relying only on subjective measurements. Our findings are expected to fill in gaps discussed above and provide guidelines for companies to make a better-informed decision regarding task design.

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