Task Design, Motivation, and Participation in Crowdsourcing Contests

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ABSTRACT: Firms can seek innovative external ideas and solutions to business tasks by sponsoring co-creation activities such as crowdsourcing. To get optimal solutions from crowdsourcing contest participants, firms need to improve task design and motivate contest solvers' participation in the co-creation process. Based on the theory of extrinsic and intrinsic motivation as well as the theory of job design, we developed a research model to explain participation in crowdsourcing contests, as well as the effects of task attributes on intrinsic motivation. Subjective and objective data were collected from 283 contest solvers at two different time points. We found that intrinsic motivation was more important than extrinsic motivation in inducing participation. Contest autonomy, variety, and analyzability were positively associated with intrinsic motivation, whereas contest tacitness was negatively associated with intrinsic motivation. The findings suggest a balanced view of extrinsic and intrinsic motivation in order to encourage participation in crowdsourcing. We also suggest that crowdsourcing contest tasks should preferably be highly autonomous, explicitly specified, and less complex, as well as require a variety of skills.

KEY WORDS AND PHRASES: Analyzability, autonomy, co-creation, crowdsourcing, extrinsic motivation, intrinsic motivation, tacitness, task design, variability.

Many firms currently sponsor a variety of co-creation activities to involve consumers and unidentified individuals on the Internet in the process of product development and value creation [14, 15, 35, 37, 70, 78]. One type of co-creation is crowdsourcing, in which the firm outsources its internal business tasks to a group or crowd on the Internet [35]. Co-creation through crowdsourcing in particular is gaining attention as the newest wave of electronic commerce (EC) practice enabled by the Internet and Web 2.0 sites [35, 49, 64, 76, 78].

A firm can implement co-creation and crowdsourcing through either its own firm-hosted communities or third-party providers who work with the firm to set up and administer portals to conduct crowdsourcing contests. For example, InnoCentive was the first online marketplace to host open innovation or crowdsourcing contests. Many corporations, such as Procter & Gamble, Solve, and Avery Dennison, utilize InnoCentive to seek innovative solutions to their business problems and challenges. Approximately 200,000 engineers, scientists, inventors, businesspeople, and research organizations from more than 200 countries are registered with InnoCentive. Disciplines that sponsor contests on InnoCentive include business, chemistry, computer science, engineering, design, mathematics, and statistics. As of March 1, 2010, 1,008 contests or challenge projects were posted on InnoCentive, and rewards totaled $5.3 million.

How to design an effective crowdsourcing contest to encourage problem solvers' participation is a high priority for EC researchers and practitioners [26,

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35, 44, 49, 64, 78]. Theoretically, user participation has long been an important topic in information systems (IS) research [42, 67, 78]. Recently, several studies have investigated participation in various online communities such as open source software (OSS) communities [33, 36, 40]. Practically, attracting problem solvers to join a crowdsourcing contest is an effective way to improve the contest outcome because more solvers can increase the quantity and diversity of solutions [65]. Also, diverse solutions can add significant contributions to the generation of exceptional innovations and solutions [64].

Several studies have investigated crowdsourcing contests as well as innovation contests (e.g., [9, 44, 49, 65, 74, 75, 76]). However, there exist some gaps. First, studies of contestants' motivation are focused on extrinsic motivation such as winning monetary awards. To our best knowledge, no empirical study has systematically examined the role of intrinsic motivation in participation. Understanding the motivation beyond extrinsic motivation is important [78] because not all contests are aimed at winning money [35, 64]. Second, there is a lack of research on how to better design crowdsourcing contests. An exception is found in Leimeister et al. [44], who investigated how to design a system to promote an idea competition. Third, most studies were based on secondary data collected from crowdsourcing platforms (e.g., [65, 74, 75, 76]), which were unable to fully reveal the contestants' motivations. Among the limited number of studies that collected firsthand data directly from the contestants (e.g., [9, 38, 44]), the sample sizes were small [9, 44]. Therefore, the generalizability of the findings may be questioned.

To fill these gaps, we develop a research model based on extrinsic motivation and intrinsic motivation theory [21]. We also integrate job design theory [32, 50] to reveal the relationship between task attributes and intrinsic motivation. To the best of our knowledge, in the literature of co-creation and crowdsourcing, no studies have examined the relationship between contest task design and participation motivation. In the broader scope of IS literature, we find only one study revealing such a relationship in the context of the workplace [66].

The remainder of this paper is organized as follows. We first review the literature about open innovation and crowdsourcing. We then describe a research model and develop the research hypotheses. Next, we report an empirical study conducted in China and the results of the empirical tests. Finally, we discuss the findings and draw some implications for research and practice.

Literature Review

Because of the limited crowdsourcing research, in this section we review the open innovation literature in order to describe the background of crowdsourcing and to better understand crowdsourcing contests.

Open Innovation and Crowdsourcing

Open innovation means that firms use external ideas and resources to advance their technology, innovation, and capabilities [14]. It complements closed in-

novation because collaborating with external resources can increase a firm's internal R&D capability [14, 46]. About 60 percent of companies apply the hybrid innovation strategy [7].

In the past, open innovation was conducted through interorganizational linkages and communities where firms collaborate with one another [71, 72]. In recent years, individuals have started to participate in open innovation by means of innovation contests [64, 65] or crowdsourcing [35], both of which mean that individuals or teams compete to win a contest designed by a firm or sponsor. In a crowdsourcing contest, the sponsor first posts a task and describes the task requirements, the duration of the contest, and the reward price. Next, contestants or problem solvers submit proposals, plans, or prototypes as solutions to problems or tasks initiated by the sponsor. After getting solutions submitted by solvers, the sponsor gives feedback to the solutions, if necessary, and decides whether or not to extend the contest if the ideal solution is not submitted at the end of the contest. Finally, the sponsor evaluates the solutions and then chooses and rewards the winners who provide the best solutions.

Crowdsourcing contests can be conducted online by either sponsors themselves [37, 44] or third-party online platform providers. Several actors exist in an online crowdsourcing contest [38, 43, 65]. In some cases, such as with InnoCentive and Taskcn, the actors include the sponsor, problem solvers, and InnoCentive or Taskcn, which provides the contest platform. In other cases, such as SAP's ideas competition, there is no third-party platform provider. Instead, SAP, the sponsor, provides the platform [23, 44].

Innovation and Crowdsourcing Contest Research

Economics Perspective

Economics research of innovation and crowdsourcing contests focuses on two major issues—the reward mechanism and the number of solvers in the contests [6, 22, 27, 28, 58, 63]. Generally, the higher the reward, the higher the number of solutions [5, 22, 65]. Archak and Sundararajan [6] found that a reward was a significant determinant of a solver's performance. Fullerton et al. [28] suggested that using an auction to reward the contest winner was more cost-efficient for the sponsor. Terwiesch and Xu [65] proposed that rewarding the best solver with a fixed-priced reward was optimal when the quality of the solution was affected by many random factors. Taylor [63] indicated that the number of solvers was inversely related to the probability of winning and the amount of effort invested. Fullerton and McAfee [27] posited that an entry fee mechanism lowered the cost of evaluating solutions. Terwiesch and Xu [65] found that the sponsor's expected profit always increased with the number of solvers. In this case, the sponsor benefited from better knowledge diversity in the pool of solvers [35, 64]. Yang et al. [76] proposed that the higher the number of solvers, the better the solution to the problem. Hautz et al. [34] also suggested that the more solutions generated, the more likely the sponsor is to get an ideal solution.

Behavioral Perspective

Leimeister et al. [44] investigated solvers' motivation to participate in an idea competition to optimize the design of enterprise resource planning (ERP) software and found four salient motivations in the idea competition contest. These motivations were learning, direct compensation, self-marketing, and social motives. Based on 17 interviews conducted through instant messaging, Brabham found similar motives for participation in crowdsourcing [9]. These motives included the opportunity to make money, the opportunity to develop one's creative skills, the potential to find additional work and job opportunities, and the positive attitudes toward the community involved. Lakhani et al. [43] revealed that being a winning solver was significantly correlated with the desire to earn money and the intrinsic motivation to participate. Lakhani et al. also found that the intrinsic motivation was significant even though there was a substantial award.

Findings of research into co-creation and OSS communities also provide clues to further investigate the solver's motivation in a crowdsourcing contest. Zwass [78] recommended a diverse list of motivations for future studies to investigate. Füller [26] found that co-creation community members were driven by direct compensation, personal need, curiosity, or intrinsic interest. Hars and Ou [33] suggested that OSS community members' motivations could be internal, such as intrinsic motivation and altruism, and external, such as expected future returns. Participants' extrinsic motivation and intrinsic motivation had different effects on effort intensity and goal commitment, which were positively correlated with performance in OSS projects [40].

In addition, some studies have revealed the overall behavior pattern of solvers' participation in crowdsourcing contests. Solvers with a high level of expertise faced tougher competition from opponents. To reduce competition, expert solvers moved first to join the contest in order to deter entry of additional opponents in the same contest [5]. Yang et al. [75] found that most solvers became inactive after submitting solutions to a few contests. Over time, some solvers tended to join contests with fewer participants, and some solvers tended to select only those contests with high rewards. Therefore, solvers' participation was unevenly distributed; a few contests attracted most of the solvers, and in those few contests only a handful of solvers could win the awards [74]. In addition, Yang et al. [74] found that monetary award was not a significant incentive, which was contradictory to Yang et al. [76] but in agreement with Chen et al. [13]. Yang et al. [74] also found that the level of expertise required by the contest problem was negatively correlated with the number of solvers entering the contest.

Research Model and Hypotheses

The research model *(Figure 1)* is based on motivation theory [20, 21] and the theory of job design [32]. Motivation theory suggests that an individual's behavior can be predicted by his or her extrinsic motivation and intrinsic motivation [21]. This theory has been widely tested in different academic disciplines [4]. Empirically, several studies have consistently found the importance

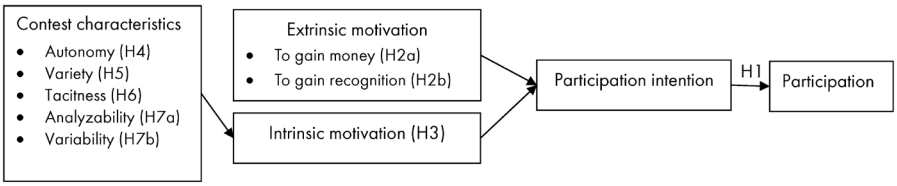

Figure 1. Research Model

of contest solvers' motivation for participation in crowdsourcing contests [9, 26, 43, 44]. Howe stated that "successful crowdsourcing involves satisfying the uppermost tier on Maslow's hierarchy of needs. People are drawn to participate because some psychological, social or emotional need is being met. And when the need isn't met, they don't participate" [35, p. 288].

Participation Intention and Actual Participation

The theory of planned behavior [1] posits that an individual actual behavior can be predicated by the intention to perform the behavior. This theory has been widely applied to EC research and has gained consistent support for the strong correlation of participation intention and actual participation (e.g., [41]). Therefore, we hypothesize

> ***Hypothesis 1:*** *Participation intention is positively associated with actual participation.*

Extrinsic Motivation and Intrinsic Motivation

Extrinsic motivation is the motivation to work for something apart from and external to the work itself, such as reward or recognition from other people [20, 21]. Intrinsic motivation is defined as the motivation to engage in work for its own sake because the work itself is interesting or satisfying [20, 21]. Studies from different disciplines have found that both extrinsic motivation and intrinsic motivation significantly influence people's behavior.

Extrinsic motivation drives participation in OSS development [33, 40]. Crowdsourcing studies have found different types of extrinsic motivation to explain a contest solver's participation in a crowdsourcing contest [9, 26, 43, 44]. In this study, we focus on two types of extrinsic motivation—motivation to gain monetary reward and motivation to gain reputation or recognition. Because the contest seeker often evaluates different solutions from the solvers and communicates with these solvers, participating in a contest is an opportunity to draw the attention of the contest seeker. Furthermore, the sponsor of the contest platform develops an online reputation system to keep a record of each contest solver and to allow problem solvers and seekers to rate each other's reputation. Therefore, getting involved in a contest and solving the contest problem may satisfy a solver's desire for winning monetary rewards, gaining reputation in an online community, or being recognized by the sponsor

of the contest [9, 26, 40, 44, 55]. Incentives and recognition may deserve a higher priority when firms plan to implement a powerful and effective innovation contest [35, 49, 64]. Therefore, we hypothesize

> ***Hypothesis 2a:*** *Extrinsic motivation to gain monetary reward is positively associated with participation intention.*

> ***Hypothesis 2b:*** *Extrinsic motivation to gain recognition is positively associated with participation intention.*

In addition to external rewards, intrinsic motivation is a driver of participation in OSS [33, 40, 42]. This may be also true for participating in crowdsourcing contests because the contestants enjoy the process of solving the task and are willing to experience the challenges in the problem. People may work for their own purposes without considering external rewards [21]. In crowdsourcing, "People typically contribute to crowdsourcing projects for little or no money, laboring tirelessly despite the absence of financial reward" [35, p. 15]. Intrinsic motivation is therefore an important factor in a contest solver's participation [26, 43], and we hypothesize

> ***Hypothesis 3:*** *Intrinsic motivation is positively associated with participation intention.*

Contest Task Attributes

Next, we examine contest task attributes that may affect the contest solver's participation motivation. Previous studies have suggested that the features of contest tasks have important implications for contest solvers' participation [26, 35, 78]. For the most part, the theoretical foundation for this section is the theory of job design [32].

Autonomy

Autonomy is an important job design feature in the job characteristics model [31, 32]. Job autonomy means "the degree to which the job provides substantial freedom, independence, and discretion to the individual in scheduling the work and in determining the procedures to be used in carrying it out" [32, p. 79]. In this study, we define contest autonomy as the extent to which the contest provides a problem solver freedom and control over how the contest task is to be solved.

Jobs of higher autonomy are seen as more meaningful by workers and induce greater feelings of responsibility [31]. Higher job autonomy also provides employees clear knowledge of the results expected from the work [31, 32]. Furthermore, job autonomy works as an antecedent of intrinsic motivation, which is the individual's desire for autonomy [20]. Previous research has found

a positive relationship between job/task autonomy and intrinsic motivation in the workplace [25, 32, 50].

In the context of crowdsourcing, if a contest task is not specifically dependent on the sponsor's other jobs and/or business processes, the contest itself has a higher level of autonomy. This will provide the solver some degree of independence from the sponsor. The solver therefore may have some increased level of control over his or her actions in the contest process. If an individual has a higher level of control over his or her behavior, a higher level of intrinsic motivation might emerge [47]. Therefore, a higher level of contest autonomy may increase the solver's intrinsic motivation.

Using the terms of components and modularity to address the issue of autonomy, Howe stated that "when it comes to crowdsourcing, any task worth doing is worth dividing up into its smallest possible components" [35, p. 285]. Rosen indicated that "dividing up the work into tasks people can and will do is among the trickiest decisions the project [manager] will have" [57]. A high level of task autonomy will keep contest solvers from interacting with one another, which will introduce a diverse range of solutions. On the other hand, solvers with too many interactions may employ similar problem-solving approaches and achieve similar solutions. Therefore, the force of collective intelligence may diminish [35].

Hypothesis 4: *Autonomy is positively associated with intrinsic motivation.*

Variety

Following the previous definition [32, 50], we define contest variety as the degree to which the contest requires the contest solver to apply a wide range of skills and perform a variety of activities in the competition process. In the workplace, if a job requires an individual to apply a variety of different skills to complete the job, the use of these different skills may be challenging and therefore engage the employee [32, 50]. In the same way, if a job includes a number of different work activities and procedures, the job is likely to be more enjoyable and interesting to the employee [60].

Crowdsourcing is built on the wide reach of the Internet, which connects a diverse group of individuals who have many kinds of expertise, abilities, and problem-solving skills [35, 64]. If a crowdsourcing contest is designed in such a manner that a contest solver needs to perform repetitive actions and fewer skills can be applied, the contest solver may feel bored and consider the contest less meaningful. This will negatively affect intrinsic motivation. On the other hand, a higher level of contest variety may encourage contest solvers to develop solutions from different perspectives because the contest design requires a diversity of skills and knowledge [35]. If the contest requires the solver to try a variety of skills, the solver may feel more challenged in applying his or her abilities and skills. The solver may also experience increased enjoyment in the process of developing a solution to the contest.

Hypothesis 5: *Variety is positively associated with intrinsic motivation.*

Tacitness

The knowledge management literature suggests that tacit knowledge is difficult to codify by means of manuals, procedures, rules, or other written and oral formats [51]. Because tacit knowledge cannot be explained in an explicit form, it is therefore difficult to transfer tacit knowledge from one individual to another in an organization [39, 51]. In the current study, we define tacitness as the degree of the difficulty of transferring the knowledge required to solve the contest task between the contest sponsor and the contest solver.

To our best knowledge, there is no clear theory that describes the relationship between knowledge tacitness and intrinsic motivation. In this study, we develop some arguments for such a relationship. Apparently, tacitness may increase intrinsic motivation because tasks that require a higher level of tacit knowledge may be more challenging. In the same way, employees need to use their own tacit knowledge to complete jobs of higher tacitness [19]. Therefore, the need for feeling competent can be satisfied [4], which may lead to intrinsic motivation according to self-determination theory [20].

However, knowledge transfer cost increases with knowledge tacitness because of the difficulty of articulating tacit knowledge when transferring this type of knowledge [52]. Because of contest tacitness, the designer of a contest may have difficulty clearly describing the purpose and requirements of an ill-structured contest. If the contest cannot be described accurately in an objective manner, the contest solver may reflect the vagueness and lack of clarity in the contest description, and therefore some misunderstandings and obstacles may emerge. This may negatively affect a contest solver's intrinsic motivation to participate. In explaining this kind of difficulty in crowdsourcing, Howe states that "the topic was simply too meta, too nebulous, too new, to gain the kind of immediate traction we needed" [35, p. 214]. Rosen [57] also indicated that "expectations have to be extremely clear or a crowd will generate a limitless number of honest misunderstandings." Although social interactions and shared experience among members should be encouraged in order to transfer tacit knowledge in the organizational context [51], most participants in crowdsourcing contests have a very limited amount of time to engage in social interactions with sponsors [35].

Furthermore, a high level of tacitness described in a contest may indicate that the sponsor does not have a clearly defined and standard set of criteria, format, and template for evaluating different solutions [64]. The objectiveness of the evaluation process may be questioned. It may be difficult for the solver to perceive the legitimacy of the evaluation because the sponsor may favor explicit knowledge and judge explicit knowledge instead of tacit knowledge in the evaluation process [2]. This will increase the contest solver's risk perception of the contest. Put another way, a higher level of tacitness increases the threat of not winning the contest. When subjects are threatened with punishment, their intrinsic motivation decreases [20]. Sponsors of innovation tournaments are requested to provide sufficient transparency in the rules of the evaluation process and decision making [64] so that participants can understand the logic and fairness of the contest. Based on these findings, we hypothesize

Hypothesis 6: *Tacitness is negatively associated with intrinsic motivation.*

Analyzability and Variability

Task or job complexity is another important factor in the job design literature [10, 11, 73]. In this study, we define contest complexity as the degree of difficulty of performing the necessary tasks inherent in a solution to the contest [50]. Complexity can be defined in terms of two dimensions: analyzability and variability [12, 53, 54]. Analyzability refers to the availability of concrete knowledge about task activities and the degree of complexity of the search process in performing the task [12, 30]. Variability can be defined as the frequency of unexpected and novel events and contingencies that may occur when an individual engages in a task [54]. Generally speaking, the more complex the task, the greater the amount of information search required and the greater the number of exceptions encountered.

The literature suggests a curvilinear relationship between complexity and intrinsic motivation [73]. Initially, complexity may have a positive impact on intrinsic motivation because an increasing level of complexity leads to increasing levels of challenge and activation. This may require an individual to apply a variety of sophisticated skills. Therefore, job complexity may have positive impacts on motivation [50].

However, later on in the problem-solving process, a higher level of complexity places higher cognitive demands. An overload may exceed the cognitive capacity of the individual. Therefore, the individual may lose interest and enjoyment in performing the task. At this stage, a certain level of uncertainty emerges [29], which can be described as the difference between the information required to perform a specific task and the amount of information possessed by the individual. When this discrepancy occurs, it suggests that the task requires a higher level of attention, information processing, and cognitive demands [50]. Given a higher level of uncertainty, the individual may not be motivated to do the task. Innovation diffusion literature suggests that complex innovation is more difficult to diffuse than simple innovation [56]. By the same token, it may be difficult for a complex contest to spread among the community of innovation solvers.

Therefore, in the context of crowdsourcing, we posit that contest complexity has negative impacts on intrinsic motivation. Complex tasks with lower analyzability require more information processing than simple and routine tasks [61]. Broad-scope information is also required to deal with and prepare for various unexpected events when the task variability is high. In crowdsourcing contests, complex contests require solvers to possess much more information and to process more information to perform tasks of low analyzability and high variability. Howe pointed out that "it's also important to keep the nature of the tasks simple. Again, this isn't because the crowd is dense, it's because it's diverse. . . . By bringing clarity and simplicity to your appeal . . . you greatly increase the odds that someone will want to participate" [35, p. 286]. Based on this, we hypothesize as follows:

> ***Hypothesis 7a:*** *Analyzability is positively associated with intrinsic motivation.*

> ***Hypothesis 7b:*** *Variability is negatively associated with intrinsic motivation.*

In addition, we investigate several control variables. Being a hobbyist may influence participation intention [37] because innovation participants are more likely to be hobbyists who contribute to innovation activities on a voluntary basis without monetary rewards. Furthermore, whether an online service provider can be trusted is a critical factor in EC research (e.g., [48, 62]). Contest service providers need to develop trust-building strategies in order to develop the community of contest sponsors and solvers [35, 64]. Therefore, we expect that trust in the contest sponsor has a significant impact on participation intention. We also include several demographic factors about the contest solver, such as gender, age, education, income, and Internet experience.

Research Method

Data Collection

We designed a study that consisted of two waves of data collection. A survey was first conducted to collect subjective data about participation intention, motivations, and task design attributes. Objective data about actual participation were collected from the crowdsourcing contest platform six months later.

The study was conducted with contest solvers who registered with Taskcn (www.tasckcn.com). Taskcn is a crowdsourcing contest platform in China that was founded in 2006. By April 26, 2010, there were 270,000 registered contest solvers and 17,026 contests provided on Taskcn. To understand the types of contests on Taskcn, we collected a sample of 7,162 contests published from August 2008 to October 2009. The top three types of contests were graphic design (logo design: 2,777; advertisement design: 767), name and slogan design (676), and Web site design (502). These three types of contests accounted for 66 percent of the total contests. Although the types of contests examined in the current study may be less sophisticated than those reported in other studies based on InnoCentive, these contests represent the typical categories of tasks in crowdsourcing [35].

To conduct the survey in the first round of data collection, we published a contest on Taskcn. In the description of the contest, we indicated that the nature of the contest was a research project that aimed to understand why contest solvers participated in Taskcn contests. Participants in the contest would have the opportunity to get awards from a lottery draw after the survey, which included 2 first-place prizes (200 renminbi [RMB]), 5 second-place prizes (RMB100), and 35 third-place prizes (RMB20). We thus provided RMB1,600 as the total amount of awards for the contest.

Before the survey, we followed two approaches in developing a pool of Taskcn members as potential respondents to the survey. First, we made the above-mentioned contest public so that individual members were able to voluntarily join the contest. We included in the pool only those members who had participated in other contests before and excluded those members who according to Taskcn's records had no prior experience with any contest. Second, we randomly selected from the top three Taskcn contest categories some contests that had ended in the previous two months. In each contest, we then

Table 1. Description of Contests.

Characteristics	Mean	Standard Deviation
Number of participants	51.25	55.93
Number of solutions Submitted	33.27	46.82
Amount of award (RMB)	454.98	540.22
Contest type	**Frequency**	**Percentage**
Graph design	70	57
Name/slogan	25	20
Web design	28	23

selected all the participants in the contest and added these participants to the pool. A total of 4,814 Taskcn solvers were included in the final pool.

Because of our research budget limit, we randomly selected 2,198 individual members from the list and sent invitations to participate in the survey through Taskcn's e-mail system. The e-mail was written in Chinese, included the research purpose, and repeated the award amount in the beginning of the e-mail. To increase the variance of contest attributes, we randomly chose a total of 123 contests that were open during the period of our survey. Table 1 shows the features of these contests. We customized the invitation e-mail by means of adding a hyperlink to one of these 123 open contests. We asked the respondents to review the specified contest through the hyperlink before answering the survey questions, which were available through another hyperlink in the invitation e-mail.

The questionnaire was written in Chinese, and the scales used to measure the research constructs were translated from English. We asked the respondent to answer questions about the contest that the respondent had just browsed. The hyperlink to the contest was repeated several times in the survey so that the respondent was able to review the contest in a convenient manner. At the end of the questionnaire, questions about respondent demographics were asked.

After a respondent completed the survey, we collected descriptive data about the respondent and the contest, both of which were available from Taskcn. To enhance the response rate, a follow-up invitation e-mail was sent to solvers who did not answer the first invitation before the deadline.

By the time the survey was closed, we had received a total of 327 responses. The response rate was 14.9 percent. Although the response rate seemed lower than rates in conventional survey research, it was compatible with those in recent studies of open source communities [40, 59]. We eliminated incomplete and inappropriate responses, and those from respondents who answered the survey more than once. A total of 283 usable responses were included in the sample. Sample statistics are shown in Table 2.

We followed the conventional procedure to evaluate the issue of nonresponse bias. We compared the early responses and late responses regarding research variables and demographic variables. No significant differences

Table 2. Sample Statistics.

Characteristics	Frequency	Percentage
Age		
≤ 18	7	2
19-25	140	49
26-30	89	32
31-35	20	7
36-40	14	5
> 40	11	4
Missing	2	1
Gender		
Male	173	61
Female	99	35
Missing	11	4
Education		
Middle school	6	2
High school	35	12
2-3 years of college	100	35
4 years of college	132	47
Graduate school	8	3
Missing	2	1
Income (RMB)		
≤ 1,000	56	20
1,001-2,000	101	36
2,001-3,000	61	21
3,001-4,000	36	13
4,001-5,000	16	6
> 5,000	12	4
Missing	1	0
Internet usage frequency		
Few times/week	29	10
Few times/day	80	28
Many times/day	171	61
Missing	3	1

were found between the early and the late respondents. This suggested that nonresponse bias was not present in our study.

The second round of data collection was conducted six months later. We collected actual participation data of these 283 responses, based on the user name and the identification number of the contest. We searched Taskcn's archive to determine whether the respondents participated in the specified contest that we asked them to evaluate in the first round.

Measures

Actual participation was coded based on the objective data we collected from Taskcn's archive. If a solver participated in the contest that we asked the solver to evaluate, participation was coded as 1; otherwise, we coded participation as 0. Unfortunately, we were unable to collect data such as participation duration, a participant's number of submissions and resubmissions, and level of interac-

tions with the sponsor because Taskcn did not make these data available. All other research constructs were measured using multiple-item scales validated in the previous literature. Seven-point Likert scales were used for all measures. To measure solver's participation intention, we adapted a scale that was used to measure an individual's participation in leisure activities [3]. The scale included three questions: "I intend to participate in this innovation contest," "I will try to participate in this innovation contest," and "I am determined to participate in this innovation contest." The scales to measure the two types of extrinsic motivation were adapted from those by Amabile et al. [4]. Three items were used to measure the motivation to gain monetary rewards and the motivation to gain recognition, respectively. To measure intrinsic motivation, we adapted the scale from Amabile et al.

Contest autonomy and contest variety were measured using scales from the job design literature. Contest autonomy was measured using the scale from Sims et al. [60], and the scale for contest variety was adapted from Coelho and Augusto [17]. To measure contest tacitness, we used the scale from Kankanhalli et al. [39], which measured the degree of codifiability and transferability of knowledge. The two dimensions of contest complexity—analyzability and variability—were measured using scales from Chang et al. [12] and Van de Ven and Ferry [69], respectively.

As for control variables, we measured trust with three items adapted from Kim et al. [41]. To measure hobbyist participation, we used the same scale used by Jeppesen and Frederiksen [37]. The list of measures is shown in the Appendix.

Preliminary Investigation

Three rounds of preliminary investigation were conducted before the large-scale survey was implemented. The first round checked the face validity of the translated scales, which were adapted from prior validated instruments. The researchers first translated the scales from English to Chinese independently. The researchers then discussed and resolved inconsistencies and ambiguities in the translation. In the second round, open-ended discussions about the translated items and the questionnaire were conducted with a small number of students and professors. Suggestions from the discussion were incorporated into the revised scales and questionnaire. In the third round, we published a survey contest with semistructured questions on Taskcn to detect misunderstandings of the items. Thirty Taskcn members responded to this preliminary survey. We contacted these members through Taskcn's e-mail system to elicit suggestions about the scales and questionnaire format. We made minor changes in the questionnaire accordingly.

Data Analysis and Results

Scale Validation: The Measure Model

We used PLS-Graph 3.00 with bootstrapping to assess the significance of factor loadings of reflective scales. To achieve satisfactory scale assessment, several

items were dropped from further analysis (as shown in the Appendix). Reliability was assessed by means of composite reliability [24]. As shown in Table 3, all composite reliabilities were higher than 0.7, which was the cutoff value.

Convergent validity was assessed by examining factor loading and average variance extracted (AVE). Convergent validity requires a factor loading greater than 0.7 and an AVE of at least 0.5 [24]. In our study, except for one item in the scale of autonomy, all the other factor loadings ranged close to or above 0.7. Moreover, all AVEs were higher than 0.50. Therefore, sufficient convergent validity was met in the study. Table 4 shows the cross-factor loadings and demonstrates the convergent validity. Table 4 also suggests that we had satisfactory convergent validity in the study.

For a construct to achieve discriminant validity, the AVE of the construct should be higher than the variance shared between the construct and other variables in the model [24]. Table 5 indicates that all the square roots of AVEs were greater than the correlations of research constructs. Therefore, we had satisfactory discriminant validity.

To minimize the effect of common method bias in the study, we collected both subjective and objective data. In addition, we followed the approach in the existing literature [40] for examining common method bias in the subjective data. We found that the average of variances explained by the research constructs under study was 0.682 and that the average of variances explained by the common method factor was 0.013. The ratio of substantive variance to method variance was about 53:1. This suggests that method variance exerted little influence and that common method bias was not a serious concern for this study.

Hypothesis Testing: The Structural Model

We ran both PLS and logistic regression to test path coefficients of the structural model. The results of hypotheses testing are shown in Figure 2 and Table 6. First, we ran a separate logistic regression to test H1 because actual participation was measured using a dichotomous scale. Using PLS would underestimate the magnitude of the effect of participation intention on actual participation [16]. The results of the logistic regression showed that the likelihood ratio was significant ($\chi^2 = 13.99$, $p < 0.001$). However, the Homer-Lemeshow test suggested a good model fit with the data ($\chi^2 = 12.65$, $p = 0.08$). The Wald statistic indicated that participation intention had a significant effect on actual participation (coefficient = 0.34, Wald = 11.36, $p < 0.001$). Therefore, H1 was supported. However, the prediction power of participation intention for actual participation was relatively low (McFadden's R^2 = 5 percent, Cox and Snell's R^2 = 5 percent, Nagelkerke's R^2 = 8 percent).

All the other hypotheses were tested in PLS. As shown in Figure 2, the research model explained 35 percent of the variance in participation intention. Motivation to gain monetary reward had no significant effect on participation intention (coefficient = 0.08, $p > 0.1$). Therefore, H2a was not supported. On the other hand, motivation to gain recognition was significantly associated with participation intention (coefficient = 0.16, $p < 0.05$), supporting H2b. Fur-

Table 3. Measures.

Construct/ item	Loading	Standard error	*t*-Statistic	Composite reliability	AVE
Participation intention (PI)				0.92	0.80
Inten_1	0.93	0.01	106.42		
Inten_2	0.85	0.03	31.31		
Inten_3	0.89	0.02	46.23		
Extrinsic motivation to gain money (MGM)				0.83	0.62
ExMotM_1	0.69	0.28	2.49		
ExMotM_2	0.96	0.31	3.06		
ExMotM_3	0.68	0.20	3.36		
Extrinsic motivation to gain recognition (MGR)				0.85	0.65
ExMotR_1	0.88	0.02	39.91		
ExMotR_2	0.64	0.07	9.45		
ExMotR_3	0.88	0.03	28.71		
Intrinsic motivation (IM)				0.85	0.66
InMoti_2	0.71	0.05	13.63		
InMoti_4	0.87	0.02	43.90		
InMoti_5	0.85	0.03	30.47		
Autonomy (Auto)				0.78	0.56
Auto_1	0.43	0.15	2.92		
Auto_2	0.84	0.07	11.60		
Auto_3	0.88	0.05	17.40		

(continues)

Table 3. Continued

Construct/ item	Loading	Standard error	*t*-statistic	Composite reliability	AVE
Variety				0.91	0.83
Variet_1	0.95	0.02	41.88		
Variet_2	0.87	0.08	10.52		
Tacitness				0.81	0.59
Tacit_1	0.88	0.15	5.90		
Tacit_2	0.68	0.23	3.00		
Tacit_3	0.74	0.18	4.10		
Analyzability				0.92	0.79
Analyze_1	0.89	0.04	23.59		
Analyze_2	0.90	0.03	33.09		
Analyze_3	0.87	0.04	22.05		
Variability					
Variabi_3	NA	NA	NA	NA	NA
Trust				0.92	0.79
Trust_1	0.87	0.02	40.45		
Trust_2	0.92	0.02	54.01		
Trust_3	0.88	0.02	56.66		

NA = not applicable.

Table 4. Factor Loadings and Cross-Loadings.

	PI	MGM	MGR	IM	Auto	Variety	Tacitness	Analyz-ability	Trust
Inten_1	**0.94**	0.11	0.36	0.45	0.25	0.20	0.04	0.30	0.44
Inten_2	**0.85**	0.14	0.31	0.42	0.20	0.18	-0.01	0.18	0.34
Inten_3	**0.90**	0.08	0.35	0.45	0.29	0.27	0.02	0.35	0.43
ExMotM_1	-0.03	**0.69**	0.31	0.04	0.07	0.05	0.00	0.02	0.04
ExMotM_2	0.14	**0.96**	-0.11	0.20	0.08	-0.04	0.06	0.01	0.12
ExMotM_3	-0.04	**0.69**	0.23	-0.10	0.01	0.15	0.08	-0.01	-0.07
ExMotR_1	0.36	-0.10	**0.88**	0.49	0.23	0.17	-0.02	0.21	0.34
ExMotR_2	0.17	-0.25	**0.64**	0.34	0.12	0.18	0.07	0.10	0.01
ExMotR_3	0.34	-0.17	**0.88**	0.47	0.13	0.17	0.07	0.24	0.21
InMoti_2	0.37	0.32	0.34	**0.71**	0.22	0.07	-0.11	0.11	0.27
InMoti_4	0.44	0.06	0.48	**0.89**	0.23	0.25	-0.09	0.23	0.31
InMoti_5	0.39	0.06	0.49	**0.85**	0.24	0.14	-0.12	0.23	0.27
Auto_1	0.06	0.02	0.10	0.14	**0.43**	0.07	0.08	0.21	0.13
Auto_2	0.20	0.07	0.17	0.21	**0.84**	0.15	-0.07	0.28	0.17
Auto_3	0.30	0.01	0.17	0.25	**0.88**	0.30	-0.04	0.32	0.20
Variet_1	0.24	-0.07	0.24	0.21	0.24	**0.95**	0.14	0.16	0.14
Variet_2	0.20	-0.05	0.11	0.14	0.21	**0.88**	0.24	0.11	0.13
Tacit_1	0.03	0.01	0.03	-0.13	-0.02	0.23	**0.87**	-0.09	0.07
Tacit_2	0.04	0.06	-0.02	-0.05	-0.03	0.18	**0.68**	-0.21	0.05
Tacit_3	-0.02	0.01	0.06	-0.10	-0.03	0.05	**0.76**	0.06	-0.11
Analyze_1	0.30	0.07	0.17	0.19	0.34	0.16	-0.02	**0.89**	0.09
Analyze_2	0.29	-0.01	0.22	0.20	0.30	0.13	-0.08	**0.90**	0.08
Analyze_3	0.24	-0.05	0.24	0.23	0.33	0.12	-0.09	**0.87**	0.11
Trust_1	0.42	0.09	0.31	0.34	0.24	0.17	-0.07	0.10	**0.88**
Trust_2	0.38	0.08	0.26	0.32	0.19	0.10	-0.01	0.12	**0.92**
Trust_3	0.41	0.10	0.17	0.26	0.17	0.14	0.09	0.06	**0.89**

Notes: PI = participation intention; MGM = extrinsic motivation to gain money; MGR = extrinsic motivation to gain recognition; IM = intrinsic motivation; Auto = autonomy. Variability is not included because only one item was kept for further analysis. Boldface figures are factor loadings.

Table 5. Interconstruct Correlations.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Intention (1)	0.89															
MGM (2)	0.12	0.79														
MGR (3)	0.38	-0.19	0.81													
IM (4)	0.54	0.16	0.54	0.81												
Autonomy (5)	0.28	0.05	0.20	0.28	0.75											
Variety (6)	0.24	-0.07	0.21	0.19	0.26	0.91										
Tacitness (7)	0.02	0.02	0.04	-0.13	-0.03	0.20	0.77									
Analyzability (8)	0.31	0.00	0.24	0.24	0.36	0.15	-0.07	0.89								
Variability (9)	-0.05	-0.03	-0.01	-0.09	-0.06	-0.08	0.09	-0.04	n.a.							
Trust (10)	0.45	0.10	0.28	0.35	0.22	0.15	0.01	0.11	-0.14	0.89						
Gender (11)	0.07	-0.01	0.09	0.06	-0.01	-0.02	0.01	-0.07	-0.04	0.03	n.a.					
Age (12)	0.03	-0.04	0.02	-0.02	0.02	-0.03	0.07	0.02	0.10	0.02	-0.09	n.a.				
Income (13)	-0.08	-0.16	0.06	-0.03	0.02	0.12	0.05	0.12	0.09	-0.16	-0.04	0.29	n.a.			
Education (14)	-0.02	-0.07	0.04	0.03	0.14	0.10	0.12	0.04	0.01	-0.09	0.00	0.04	0.20	n.a.		
Internet (15)	-0.11	-0.12	0.05	-0.10	-0.01	0.10	0.12	0.16	-0.06	-0.03	0.02	-0.04	0.27	0.08	n.a.	
Hobbyist (16)	0.01	-0.14	0.02	-0.04	0.06	0.07	0.07	0.17	0.05	0.02	0.00	-0.18	0.07	-0.03	0.15	n.a.

Notes: Square root of AVE of reflective scale is shown on the diagonal of the matrix. MGM = extrinsic motivation to gain money; MGR = extrinsic motivation to gain recognition; IM = intrinsic motivation; n.a. = single-item scale.

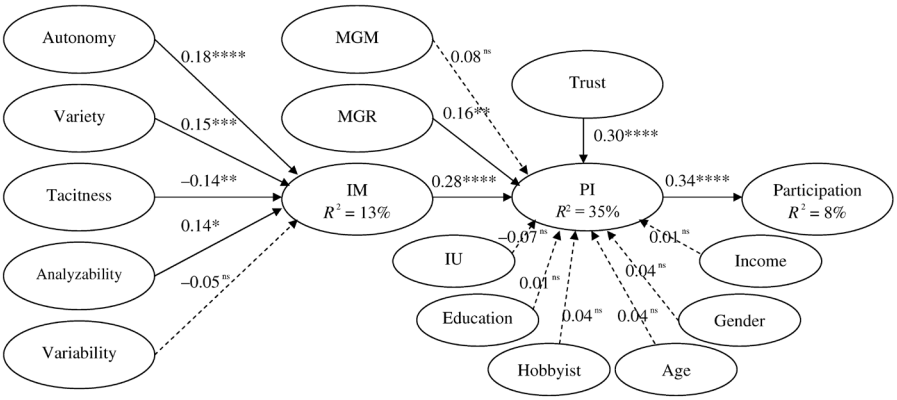

Figure 2. Results of Hypotheses Testing

Notes: PI = participation intention, MGM = extrinsic motivation to gain money, MGR = extrinsic motivation to gain recognition, IM = intrinsic motivation, IU = Internet usage. ns = nonsignificant; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; **** $p < 0.001$.

Table 6. Hypotheses Testing.

Hypothesis	Coefficient	Significance level
H1: Participation intention > participation	0.34	$p < 0.001$
H2a: MGM > participation intention	0.08	not significant
H2b: MGR > participation intention	0.16	$p < 0.05$
H3: Intrinsic motivation > participation intention	0.28	$p < 0.001$
H4: Autonomy > intrinsic motivation	0.18	$p < 0.001$
H5: Variety > intrinsic motivation	0.15	$p < 0.01$
H6: Tacitness > intrinsic motivation	-0.14	$p < 0.05$
H7a: Analyzability > intrinsic motivation	0.14	$p < 0.1$
H7b: Variability > intrinsic motivation	-0.05	not significant

thermore, we found that intrinsic motivation had a strong positive effect on participation intention (coefficient = 0.28, $p < 0.001$), so H3 was supported.

The antecedent factors explained 13 percent of the variance in intrinsic motivation. Autonomy had a significant effect on intrinsic motivation (coefficient = 0.18, $p < 0.001$). Therefore, H4 was supported. Variety was also significantly associated with intrinsic motivation (coefficient = 0.15, $p < 0.01$), indicating that H5 was supported. The effect of tacitness was significant (coefficient = –0.14, $p < 0.05$), supporting H6. Analyzability had a marginal positive effect on intrinsic motivation (coefficient = 0.14, $p < 0.1$). Therefore, H7a was supported. Variability had no significant effect (coefficient = –0.05, $p > 0.1$). Therefore, H7b was not supported.

Considering the control variables, only trust had a significant effect (coefficient = 0.30, $p < 0.001$).

Discussion

Following an emerging research interest in crowdsourcing contests [9, 43, 44], we develop and test a research model that examines the motivational factors influencing a solver's participation. In addition, we investigate the effect of contest task features on intrinsic motivation. With the exception of two causal paths, all the hypotheses were supported at different significant levels.

Participation intention was found to be an effective predictor for actual participation (H1), which is consistent with previous literature (e.g., [41]). However, the prediction power was relatively low. Several reasons may account for the low R^2. First, many crowdsourcing contests could be considered as trial-and-error efforts [65, 70]. In our case, solvers might have failed to work out a solution and therefore did not participate, although they intended to. Second, perceived behavior control was not included in the research model as a predictor of actual behavior, although proposed by the theory of planned behavior [1]. Some solvers might have started to work on the contest but withdrew later because of issues beyond their control. Third, there might have been other constraints, such as time and availability of other contests. The solvers might have been limited by availability of time to work on the contest. They might also have found another contest more attractive than the one we asked them to evaluate and participate in. However, we did not investigate these factors.

The motivation to gain money (H2a) was not significantly associated with participation intention. Although this finding contradicts several studies (e.g., [9, 55]), it is consistent with Howe [35] and Terwiesch and Ulrich [64]. Both studies suggested that winning the award was not always the driving motive. Our finding is also consistent with Ke and Zhang [40], who found that compensation was not related to the level of effort devoted to OSS development. Leimeister et al. [44] also found that direct compensation was not the strongest motive.

At the same time, the motivation to gain recognition was positively associated with participation intention (H2b), consistent with previous studies (e.g., [44, 55]). For example, Jeppesen and Frederiksen [37] found that users who participated in firm-hosted user communities were motivated by recognition from firms that sponsored the communities. The results of H2a and H2b reveal an imbalance between the two types of extrinsic motivation, consistent with studies that found differing strengths of different extrinsic motives (e.g., [33, 44, 55]).

Intrinsic motivation was found to have a strong significant effect on participation intention (H3). In comparing the effects of intrinsic motivation and extrinsic motivation, the effect of intrinsic motivation was approximately twice the effect of the motivation to gain recognition (coefficient = 0.28 vs. 0.16). This finding suggests that intrinsic motivation was more important than extrinsic motivation for contest solvers to participate in crowdsourcing contests, consistent with the notion of self-determination theory [21], the findings of Howe [35] and of Terwiesch and Ulrich [64], and OSS studies (e.g., [40]).

Because the empirical study was conducted in China, the specific cultural background of Chinese contestants might provide an alternative explanation

for the stronger effect of intrinsic motivation on participation. The cross-cultural literature suggests that Americans are more driven by utilitarian aspects and the goal of an action, whereas Chinese are more driven by the procedural and subjective experience of performing the action [68]. In the use of instant messenger, for example, Li et al. [45] found that Chinese were more driven by perceived enjoyment (intrinsic motivation) and Americans were more driven by perceived usefulness (extrinsic motivation).

Four antecedent factors of intrinsic motivation were found to be significant. The positive impacts of autonomy (H4) and variety (H5) on intrinsic motivation were consistent with the job design literature (e.g., [32, 50, 66]). These two findings confirm the practical observations and suggestions from the crowdsourcing and innovation contest literature [35, 64].

This study makes a major contribution to the literature by finding a significant negative effect of contest tacitness on intrinsic motivation (H6). This finding was one of the first reported in the literature and contributes to knowledge about the relationship between tacit knowledge and intrinsic motivation. In addition, we found that two dimensions of task complexity had different levels of impact on intrinsic motivation. Analyzability was positively associated with intrinsic motivation (H7a), consistent with the literature about the negative association between job/task complexity and motivation (e.g., [18, 73]).

However, the impact of variability was not significant (H7b). The nonsignificant relationship may be explained by the context of this study, which examines the contest solver's participation in a crowdsourcing contest before the solver actually participated in the contest. We note that at the data collection stage the contest solver was given a description of the contest and had not started the participation process. Therefore, the solver might not have been able to accurately respond to questions about contest variability or unexpected events occurring during the process of participation.

Regarding control variables, trust was found to positively affect participation intention, consistent with other EC research [48, 62]. The effect of the hobbyist was not significant, inconsistent with Jeppesen and Frederiksen [37]. This may be because the community of contest solvers is very homogeneous, that is, the Taskcn community includes hobbyists rather than professionals. All other control variables were not significant. This is consistent with the speculation from Howe, who stated, "Gone are pedigree, race, gender, age, and qualification. What remains is the quality of the work itself" [35, p. 13].

Conclusions

Limitations

We note several limitations in this study and that the interpretations of the findings should be generalized to other contexts with caution. First, the data were collected from Taskcn, a specific crowdsourcing contest platform in China. The platform has unique features that may be different from other crowdsourcing contest environments, such as InnoCentive. Second, we randomly selected 123 contests from three specific categories of the overall list of contests. These

categories and the contests in these categories may not represent the diverse range of crowdsourcing contests. We notice that these contests are more like idea competition and therefore may be less sophisticated than those innovation challenges on InnoCentive, which involve higher R&D and a prolonged innovation process to accomplish. Third, we randomly selected 283 Chinese contest solvers who had recently been involved in crowdsourcing contests on Taskcn. These individuals may possess some characteristics that were not representative of the overall populations. One salient factor regarding this sample is that Chinese contestants may be more driven by intrinsic motivation than by extrinsic motivation. Fourth, we measured contest features using subjective measures reported by the survey respondents, instead of manipulating contest features in an experiment. We examined the common method bias using a sophisticated statistical approach and did not find the presence of bias. Fifth, we measured participation using a binary scale that did not reveal the richness of participation level. Several items used to measure the research constructs were dropped in order to achieve satisfactory reliability and validity.

Implications for Research

This study contributes to the literature in several ways. First, this study is one of the first studies using two data collection rounds, from both contestants and the platform, to explain participation in crowdsourcing contests. Previous studies used objective data collected from the platform (e.g., [65, 74, 75, 76]) and examined contests from the macro perspective, with the focus on contests and tasks (e.g., [65]). Our study, however, collected both subjective and objective data to provide stronger methodological support for examining the causality from solvers' participation intention to actual participation behavior. More important, the observation of the actual participation behavior reveals some important implications for crowdsourcing research. Furthermore, we adopted the motivational perspective and collected subjective data directly from participants so that we were able to reveal motivations that drive participation at the individual level. Together with Brabham [9] and Leimeister et al. [44], we believe our micro-level and behind-the-scenes findings complement previous findings. A complementary view of crowdsourcing contests from both the front end and back end may emerge.

Second, the current study is also one of the first to examine the effect of a contest solver's intrinsic motivation in crowdsourcing research. In addition to extrinsic motivation, which has been carefully examined in previous literature [9, 43, 44], this study provides an alternative focus on intrinsic motivation to explain a contest solver's participation. Following Zwass [78], we suggest that an inseparable and balanced view of both extrinsic and intrinsic motivation, based on the motivational perspective [21], can shed light on crowdsourcing research, which has been so far focused on external motives and incentives [9, 43, 44].

Third, the current study attends to a neglected research domain in the IS literature by examining the antecedent factors of intrinsic motivation. To the

best of our knowledge, except for Thatcher et al. [66], no other literature in the IS discipline has investigated task factors that contribute to the development of intrinsic motivation. In addition to autonomy, variety, and complexity (analyzability and variability) from the job design literature, we have examined and built one of the earliest arguments for the relationship between tacitness and intrinsic motivation. Practically, like Leimeister et al. [44], who investigated how the design of contest platforms affects individuals' participation in ideas competition, this study examines how the design of contest tasks influences contest solvers' participation. Future studies of co-creation on the Internet should continue to investigate task features [78], especially the moderating role of task characteristics.

Future studies could also continue to inquire about crowdsourcing in the following manner. First, the generalizability of our research model and findings should be assessed by means of different samples and study contexts. Second, the effect of contest tacitness on intrinsic motivation could be studied to test the generalizability of the relationship. We have hypothesized and found a negative relationship between these two variables, given the context of our study; the relationship may be argued in a different direction in other contexts.

Third, future studies could expand the horizon of the antecedent factors of intrinsic motivation by including other perspectives, such as the personalities of the contest solvers and the features of the platform. For example, it would be worthwhile to investigate how the design features of the platform affect intrinsic motivation, a perspective similar to Leimeister et al.'s [44]. Fourth, it is worth investigating how the characteristics of the individual solver affect the relationships between the contest task attributes and intrinsic motivation, from which some moderating effects may be revealed. Fifth, a different research design strategy, that is, an experimental design, could be applied to manipulate some aspects of the contest features. Sixth, the imbalance of the effects of intrinsic motivation and extrinsic motivation deserves further investigation because people in different cultural backgrounds emphasize the two types of motivation differently. Future studies might compare contestants from different cultural backgrounds to examine how different types of motivation affect participation differently.

Implications for Practice

The findings of the current study also highlight some crowdsourcing contest design elements for sponsors. First, the two types of extrinsic motivation (motivation to gain monetary rewards and motivation to gain recognition) were found to have different impacts on participation intention. Financial rewards in the current study did not seem to be as important as in other contexts. This indicates that given the nature of the contest, contest solvers may not be universally driven by financial awards. Therefore, contest sponsors can design different financial rewarding strategies for different contest tasks. But contest solvers' motivation to gain recognition was very important in their motivation to participate. Sponsors should interact closely with problem solvers so that the contributions from problem solvers can be recognized.

Sponsors are encouraged to provide timely feedback to contestants' solutions. (Timely feedback is also needed for contest solvers regarding contest task requirements.) However, we suggest platform providers provide convenient communication tools integrated into the platform, for both contest sponsors and contestants, in addition to some of the design suggestions proposed by Leimeister et al. [44]. Service providers and contest sponsors should also develop reputation systems in order to rate contest solvers, as a way of recognizing the contributions of the contestants.

The significant effect of intrinsic motivation on participating in crowdsourcing contests suggests contest sponsors and platform providers should develop various contest tasks and platform design features to induce the development of intrinsic motivation. According to self-determination theory [21], autonomy, competency, and relatedness are important factors leading to intrinsic motivation. Contest sponsors should carefully design the contest task so that contestants have a sufficient level of autonomy while doing the task in order to feel competent in their search for solutions. Regarding relatedness, platform providers should develop online communities to complement the design of crowdsourcing contests. By participating in these online communities, a contestant may develop connections with other contestants who may share similarities and experiences. Contest sponsors may also need to utilize these online communities to interact with contestants to develop a close and trusting relationship.

We also conducted some post hoc analyses of the compositions of the sample to look at whether different groups existed. First, we simply examined each individual response to the three types of motivation. We counted 141 solvers whose intrinsic motivation was greater or equal to the other two extrinsic motivations. We also counted 112 solvers whose motivation to gain money was greater than or equal to the other two motivations, and 102 solvers whose motivation to gain recognition was greater than or equal to the other two motivations. Second, we found three clusters of participants on Taskcn from a cluster analysis of the whole sample. The first cluster ($n = 41$) was high in terms of motivation to gain money. The second cluster ($n = 92$) was high in terms of intrinsic motivation and motivation to gain recognition. The third cluster ($n = 150$) was high in all three dimensions. These analyses suggest that a majority of the contestants had a mixture of intrinsic motivation and extrinsic motivation, which is consistent with Blohm et al. [8] and Ebner et al. [23]. Therefore, practitioners need to keep a balanced view of the motivations of different groups/clusters of participants.

We found that several task attributes had significant impacts on contestants' intrinsic motivation. Regarding task autonomy, we suggest that contest sponsors and platform providers should grant contestants more freedom to solve contest tasks independently. Also, regarding contest variety, sponsors should not publish contests that include simple and repetitious activities, which may be boring to solvers. The effect of contest tacitness suggests that crowdsourcing contests are suitable for solving precisely formulated problems and that they are not a proper option to solve problems that need much tacit knowledge. Contest sponsors should not design tasks that are ill structured and vaguely defined. For this kind of task, online auctions or

problem-solving activities within the firm are more appropriate. Platform providers should work closely with contest sponsors [15] to ensure that task requirements are defined clearly before publishing contests. Last but not least, contest design should be as simple as possible. Unlike most jobs in the workplace, where complex jobs trigger intrinsic motivation, participants of crowdsourcing shy away from complex tasks.

A sponsor's trustworthiness inspires trust in contestants. However, as we observe from this study, the fraudulent behavior of a sponsor has a negative impact on contestants. For example, some sponsors register two accounts in the same crowdsourcing platform. The sponsor may choose himself as the winner after getting solutions submitted by other solvers. Negative influence from this behavior may spread, and the overall reputation of the platform may be affected. Consistent with Howe [35] and with Terwiesch and Ulrich [64], we suggest that more actions should be taken by the provider of the crowdsourcing platform to improve contestants' trust in sponsors and in the platform itself.

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Appendix. Measures

Participation Intention (source: [3])

1. I intend to participate in this innovation contest.
2. I will try to participate in this innovation contest.
3. I am determined to participate in this innovation contest.

Extrinsic Motivation to Gain Monetary Award (source: [4])

1. I am keenly aware of the winning award goals I have for myself.
2. I seldom think about the contest award.
3. I am concerned about the award in the innovation contest.

Extrinsic Motivation to Gain Recognition (source: [4])

1. I am strongly motivated by the recognition I can earn from the sponsor.
2. I want other solvers to find out how good I really can be at solving this innovation contest problem.
3. I am concerned about the recognition from the sponsor.

Intrinsic Motivation (source: [4])

1. No matter what the outcome of the contest, I am satisfied if I feel I gained a new experience.*
2. What matters most to me is enjoying what I do in this innovation contest.
3. Curiosity is the driving force behind much of what I do in this innovation contest.*
4. I want to challenge myself to solve the problem in this innovation contest.
5. I want to find out how good I really can be at this innovation contest.

Autonomy (source: [60])

1. I receive much information from the sponsor on the solution performance.
2. I have pretty much freedom to do what I want on this innovation contest problem.
3. I have a lot of opportunities for independent thought and action.

Variety (source: [17])

1. I have little chance to do different things to solve the innovation contest problem.
2. I will use different skills and talents to solve the innovation contest problem.
3. I will do the same things over and over again in this innovation contest process.*

Tacitness (source: [39])

1. Knowledge used in this innovation contest is complex.
2. Knowledge used in this innovation contest is codifiable.
3. Knowledge used in this innovation contest is observable without experience.

Analyzability (source: [12])

1. To what extent is there a clearly known way to solve this innovation contest?
2. To what extent is there an understandable sequence of steps that can be followed in carrying out this innovation contest?
3. To what extent do you understand the sequence of steps in doing this innovation contest?

Variability (source: [69])

1. To what extent are the troubles you face the same when you solve these kinds of contest tasks?*
2. To what extent do you need to think out new methods to solve these kinds of contest tasks?*
3. What is the frequency at which you follow the same method or steps to solve these kinds of contest tasks?

Trust (source: [41])

1. I think this sponsor is trustworthy.
2. I think this sponsor keeps its promises and will not be fraudulent.
3. I think this sponsor keeps solvers' best interests in mind and will not be fraudulent.

Hobbyist (source: [37])

1. To what extent do you earn your income with the technique or ability used in this innovation contest?

*Items dropped in data analysis.

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