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THE CROWDING EFFECT OF REWARDS ON KNOWLEDGE-SHARING BEHAVIOR IN VIRTUAL COMMUNITIES

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Abstract

Knowledge sharing is an important activity in virtual communities (VC). Recently, some researchers have explored various motivators that may influence VC members' contribution. Although providing rewards has been found to significantly motivate employees to share knowledge in organizational research, it also has been found to diminish intrinsic motivation and lead to reduced efforts in in some cases psychology literature. The phenomenon that external intervention (e.g. monetary incentives or punishments) may either undermine (crowd-out) or enhance (crowd-in) intrinsic motivation is called the motivation crowding effect. Based on the motivation crowding theory, this study investigated the moderating effect of monetary incentives on the relationships of motivations and members' intention for knowledge sharing. The research framework includes two motivational factors, intrinsic and extrinsic motivation, for knowledge sharing in virtual communities. The model was tested using a field experiment on 204 VC members of two different virtual communities. The results confirmed the existence of the crowding effect. That is, the relationship between intrinsic motivation and knowledge-sharing intention was significantly lowered after the treatment of monetary incentives. The findings suggest that VC managers should carefully consider providing monetary rewards in promoting their websites because monetary incentives can potentially affect the knowledge-sharing behavior of VC members.

Keywords: Knowledge Sharing, Virtual Community, Rewards, Intrinsic Motivation, Extrinsic Motivation, Motivation Crowding Theory.

1 INTRODUCTION

Virtual communities (VCs) are online platforms for building social networks in which people with common interests, goals, or practices interact to share information and knowledge, as well as engage in social interactions (Chiu et al. 2006). It is the rich knowledge that creates the value of the virtual communities. Due to the nature of time-consuming and high cognitive load, however, it is often challenging for VC managers to encourage their members to share more knowledge. Hence, understanding the motivation for knowledge sharing of VC members and how external incentives may be provided to motivate more knowledge sharing is an important research issue.

Recent literature has explored various motivators, including intrinsic (enjoyment from helping, knowledge self-efficacy, and satisfaction) and extrinsic factors (career advancement, reputation enhancement, reciprocity, and commitment), that may influence members' content contribution behavior (Kuo et al. 2003; Sharratt and Usoro 2003; Wasko and Faraj 2005; Chiu et al. 2006; Hsu and Lin 2008). In these existing studies, monetary incentives are a popular means for organizations to promote knowledge sharing (Bock et al. 2005; Kwok and Gao 2005; Cabrera et al. 2006; Kulkarni et al. 2006; Lin 2007). However, contrary to common belief, Bock et al. (2005) found that extrinsic rewards actually have a negative effect on individuals' knowledge sharing attitudes. Literature in psychology (Deci et al. 1999; Frey 1994) also indicates that extrinsic rewards diminish intrinsic motivation and lead to a reduced effort in the corresponding activity. This is called the *motivation crowding effect*, referring that external intervention (e.g. monetary incentives or punishments) may either undermine (crowd-out) or enhance (crowd-in) intrinsic motivation (Frey and Jegen 2001).

The motivation crowding theory has been applied to study open source projects (e.g. Roberts et al. 2006; Alexy and Leitner 2008; Alexy and Leitner 2010) and has successfully demonstrated the important role of monetary rewards on knowledge transfer (Osterloh and Frey 2000). However, its role in knowledge sharing in virtual communities, such as professional forums or social networks, is yet to discover. Although open source projects may be considered to be special-type of virtual communities, these projects often have clear shared goals toward which their members work. They are different from many other types of online virtual communities. Open source project development is also different from making online content contributions. Thus, this study extends previous findings in open source projects to investigate whether providing rewards may affect the motivation of VC members to share their knowledge in the communities. A field experiment using monetary incentives as treatment was conducted to test the proposed model.

The rest of the paper is organized as follows. Section 2 reviews the literature related to knowledge-sharing and motivations that may influence individuals' knowledge sharing behavior. The research model and hypotheses on the moderating effects of rewards are proposed in Section 3. The research method is provided in Section 4. Data analysis and results are presented in Section 5. Section 6 concludes the paper.

2 LITERATURE REVIEW

2.1 Knowledge Sharing in Virtual Communities

Knowledge sharing is the behavior of an individual who disseminates his knowledge to other members within an organization (Ryu et al. 2003). In VC context, knowledge sharing refers to activities of VC members transferring or disseminating ideas, information, and suggestions with other members. Past studies have explored antecedents of knowledge sharing in VC context from three major perspectives: technology acceptance, social interaction, and personal motivation. The first perspective was proposed due to the development of VCs using the Internet. Researchers investigated the role of ease of use and perceived usefulness system functions on knowledge sharing based on the technology acceptance model (Sharratt and Usoro 2003; Noor et al. 2005). The second perspective

focuses on social interaction in the community; that is, VCs was considered as a platform to help people connect with other individuals and build social networks (Chiu et al. 2006; Hsu et al. 2007; Hsu and Lin 2008; Taylor and Murthy 2009). The third perspective examines internal and external factors that motivate for people to share knowledge in VC context. For example, Wasko and Faraj (2005) explored commitment (intrinsic motivation) and reciprocity (extrinsic motivation) in the electronic network of practice. Fan et al. (2009) examined intrinsic motivators (enjoyment to help others, self-efficacy, and commitment) and extrinsic motivators (reputation, reciprocity, community-related outcome expectation) to identify motivational differences between contributors and lurkers. Although several studies have examined individual's motivation on knowledge sharing (or content contribution) in VCs, not much research has examined the crowding effect among those motivations. This issue is important because the existence of the effect is likely to undermine the knowledge sharing outcomes.

2.2 External rewards and the Motivation Crowding Theory

Motivation crowding theory states that interaction effects exist between intrinsic and extrinsic motivations. That is, an increase in extrinsic incentives may reduce the intrinsic motivations for conducting certain behaviors. In management practice, rewards are commonly used to shape employees' behavior and enhance their work performance. Rewards appear to be particularly effective for motivating voluntary behaviors. For example, Maurer and Tarulli (1994) found consistent links between tangible rewards and voluntary learning. Hence, it is natural to believe that monetary rewards are effective in motivating knowledge sharing.

Indeed, many organizations have utilized rewards to motivate employees to share knowledge. The effects of external rewards in knowledge sharing are confirmed in existing studies (Burgess 2005; Kwok and Gao 2005; Cabrera et al. 2006; Kulkarni et al. 2006). In some cases, rewards are also provided by virtual communities to encourage the participation of their members. For example, a website, Wall Street Survivor, offers their members the opportunity to test their knowledge and hone their skills on a virtual stock market. Investors can compete to win real cash rewards for the best managed weekly, overall and risk-adjusted stock portfolios (Doyle 2007). Another example is a travel community that uses gifts to encourage participants to contribute more content on the website. People write reviews and upload photos for the rewards or gifts offered by the community.

An underlying assumption of the research on knowledge sharing is that the relationship among external rewards and motivations is independent and invariant. For example, Bock et al. (2005) didn't explore the interaction between extrinsic rewards and reciprocity when they investigated the influences of these two factors on the attitude toward knowledge sharing. Lin (2007) treated enjoyment helping and organizational rewards as independent motivators that affect employees' willingness to contribute knowledge. However, this independence assumption may be wrong. Findings in experimental psychology (Deci 1971; Lepper et al. 1973) have shown that external rewards displace intrinsic motivation under certain conditions. In particular, Bock et al. (2005) reported that external rewards actually have a negative effect on individuals' knowledge sharing attitudes. Lin (2007) also concluded that organizational rewards did not have a significant impact on employee's knowledge sharing. One possible reason for these observations is the effect of motivation crowding.

A large number of studies in psychology (e.g. Deci and Ryan 1980, 1985) and economics (Frey and Oberholzer-Gee 1997) have strongly suggested that, under specific conditions, there is a tradeoff between extrinsic rewards and intrinsic motivation. When extrinsic rewards are introduced for doing an intrinsically interesting activity, people tend to feel controlled by the rewards, prompting a shift in the benefits for the behavior from intrinsic to extrinsic. For example, parents motivate their children with rewards for doing their homework. In the short run, this method is often successful. However, the long-term consequence often becomes a lower willingness to do their homework without a reward (Osterloh and Frey 2000). A meta-analysis by Deci et al. (1999) examined the results of 128 laboratory studies to show that most types of extrinsic motivations—especially those specifying contingencies related to the task being performed—undermined intrinsic motivation. Thus, external

rewards and individual's intrinsic motivations may have interactions. Therefore, it is interesting to examine whether the crowding effect exists in knowledge sharing in virtual communities.

3 MODEL AND HYPOTHESES DEVELOPMENT

Previous literature shows that people are more likely to share knowledge when they believe that engaging in such activity will result in rewards. For instance, Burgess (2005) found that employees will share more if they perceive that the organization gives credit for doing so. Cabrera et al. (2006) also indicated that rewards have a positive influence on employees' knowledge-sharing behavior in a large IT multinational company. Kulkarni et al. (2006) showed that incentives are positively associated with knowledge content quality. It seems reasonable to predict that rewards will change the relationship from intentions to the actual knowledge-sharing behaviors. When this finding is applied to the VC context, we can posit the following hypothesis

H1: The relationship between VC members' knowledge sharing intentions and behavior will increase when they are offered monetary rewards for their contribution.

Intrinsic motivation refers to motivation that makes people respond to an activity for its inherent enjoyment and satisfaction rather than for separable consequences (Ryan and Deci 2000). Past studies have confirmed that intrinsic motivation is an important determinant of the knowledge contribution of employees. For example, Cabrera et al. (2006) reported that individuals who perceived higher intrinsic rewards will be more likely to engage in knowledge sharing. Lin (2007) also found that employees' intentions of knowledge sharing are strongly associated with their intrinsic motivation. In virtual communities, members contribute knowledge based on their voluntary participation (Chiu and Wang 2007). Intrinsic motivation has been argued to be important when it comes to volunteering (Freeman 1997). Therefore, intrinsic motivation is a determinant on knowledge contribution in virtual communities (Marett and Joshi 2009).

Although this discussion suggests a positive relationship between intrinsic motivation and intention of knowledge contributors, the relationship is likely to be contingent on external rewards. When organizational rewards were provided, people may reduce the willingness to intrinsically conduct behavior. For example, an experiment by Deci (1971) showed that leading individuals to engage in an interesting activity in order to receive rewards led to a subsequent decrease in subsequent situational intrinsic motivation toward the activity. Moreover, a study on the support for the public facility demonstrated the negative effect of monetary compensation (Frey and Oberholzer-Gee 1997). Therefore, we can posit the following hypothesis.

H2: The relationship between VC members' intrinsic motivation and knowledge sharing intention will decrease when they are offered rewards for their contribution.

In addition to intrinsic motivation, human intentions are also affected by extrinsic motivation (Frey and Jegen 2001), the motivation that makes people respond to an activity in order to attain some separable consequences outside of the activity itself (Ryan and Deci 2000). People pursue extrinsic goals because these goals provide some benefits or act as a substitution for their need satisfaction (Deci and Ryan 2008). In work behavior research, extrinsic motivation has been found to significantly affect worker participation (Fenwick and Olson 1986). Prior studies also reported that extrinsic factors will affect individual's willingness to share knowledge. For example, the results of Bock and Kim (2002) indicated that extrinsic motivation imposed by management is an important trigger for employees to share knowledge. If VC members believe that offering their knowledge can generate external benefits, they will be more willing to contribute.

A common extrinsic motivation is to use monetary incentives to reinforce the desired behavior (Skinner 1953). Expectations of future incentives can continually strengthen the effect of extrinsic

motivation for an individual to engage in rewarded activities (Roberts et al. 2006). Thus, most organizations utilize monetary compensation to encourage or to prevent certain behaviors. Therefore, we can expect that providing monetary incentives will increase the motivation for VC members to share their knowledge and hence posit the following hypothesis was posited.

H3: The relationship between VC members' extrinsic motivation and intention of knowledge sharing will increase when they are offered rewards for their contribution.

Figure 1 shows the research model and the hypotheses.

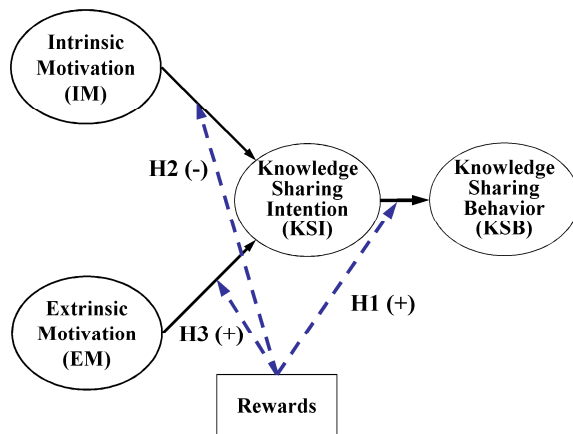


Figure 1. Research Model and Hypotheses

4 METHODOLOGY

In order to test the proposed research model, a field experiment was conducted. The experiment included three stages and the data collected prior and after the treatment were compared to examine the effect of the treatment. First, subjects were recruited and an online survey and message retrieval were performed in the VCs. Then, monetary incentives were offered to encourage VC members to post more articles in their virtual communities. Finally, the same online survey and message retrieval were conducted again after the treatment.

4.1 Measurement Development

We collected motivations and intentions data using questionnaires and collected behavior data by downloading their actual posts.

Knowledge-sharing behavior was the dependent variable in the study. It referred to a member's actual posts that replied to the questions posted by other community members. Following Chiu et al.'s (2006) suggestion, the level of knowledge-sharing behavior was measured in two ways: (1) the quantity of the contributed knowledge, and (2) the quality of the contributed knowledge. The quantity of knowledge sharing was measured by the number of replies that an individual member had posted. Our quality measure of knowledge sharing, which was different from the self-report measure in Chiu et al. (2006), was assessed by the scores rated by knowledge seekers. The scores were summarized and averaged by individuals to obtain the quality score of the knowledge they had shared. To normalize the data, we followed the procedure implemented in Chiu et al. (2006), both quantity and quality were divided into five levels.

Other constructs, including knowledge-sharing intention, intrinsic motivation and extrinsic motivation, were measured using a self-reported questionnaire. Knowledge-sharing intention was assessed using items adapted from Bock and Kim (2002). The measure focused on the willingness and intentions of

respondents to share knowledge with other members in the virtual community. Intrinsic and extrinsic motivations were assessed using items adapted from the Intrinsic Motivation Inventory (IMI). The IMI (Ryan et al. 1990; Deci et al. 1994) is a multidimensional measurement device intended to assess participants' subjective experience related to a target activity. Although the overall questionnaire is called the Intrinsic Motivation Inventory, the instrument includes seven subscales: (1) interest/enjoyment, (2) perceived competence, (3) effort, (4) value/usefulness, (5) perceived pressure and tension, (6) perceived choice, and (7) relatedness. Based on the IMI developers' suggestion, only the items of the interest/enjoyment subscale were used to measure intrinsic motivation. Extrinsic motivation was measured by the value/usefulness of the items, with respect to knowledge sharing in the VCs that the participants experienced as useful or valuable. For all the measurement items, a five-point Likert scale was adopted with values ranging from strongly disagree (1) to strongly agree (5). Some items were slightly modified to accommodate the context of virtual communities.

To ensure the reliability of the question items and the feasibility of the survey process, a pilot test was conducted in December 2009, involving 98 members from two virtual communities. The wording of the questions in the final questionnaire was slightly modified based on the feedback from the pilot test. All Cronbach's alpha values of the question items were greater than 0.8.

4.2 Survey Site Selection

We chose two different virtual communities for the study: a professional discussion forum (VC1) and a social network community (VC2). VC1 is a global knowledge sharing community for information technology professionals. Thousands of IT groups, such as software, hardware and networking skills, programming language, enterprise application, business & project management, and IT strategy, are available for members to seek, post, and reply IT related questions. It has more than 1.7 million members all over the world, and a average of about 3,000 messages are posted on the website every day. The second selected virtual community, VC2, is an online social network community that allows its members to find, connect and communicate with classmates, colleagues, friends and business partners. It has approximately 6.5 million registered members.

4.3 Data Collection

Data were collected in two stages. First, we sent out a call for participation during the period of November 2009 and February 2010. In February 2010, an invitation letter was randomly sent to members who had replied to the call for participation. Those who indicated interests in the study were then directed to fill out a web-based questionnaire. A total of 2,449 invitation letters were sent to members in VC1 and 240 valid responses were received, yielding an effective response rate of 9.8%. There were 332 responses from members in VC2, with a response rate of 13.1%. We also retrieved the replies posted by the participants from the selected VCs to measure their actual knowledge-sharing behavior. A total of 3,515 valid replies, posted by valid participants within 30 days (from March 02 to Mar 31 2010), were collected in April 2010.

After the first stage of data collection, participants were notified of an incentive program for their knowledge contribution in the VCs. A total of US\$2,100 was offered as rewards for knowledge contribution. An invitation letter was distributed on April 02, 2010 to 572 valid participants who had responded in the first stage. Two reminding emails were subsequently sent to give them two weeks to respond to the incentive. Participants were notified of the rules that they will be rewarded based on the quantity and quality of replies they posted from April 11 to May 10, 2010. Three reminding emails were sent to participants to continuously encourage them to post during the treatment period. Finally, a hyperlink to the web-based questionnaire (QS2) was distributed with the last reminding email to all participants on May 11, 2010. Two follow-up reminders for filling out the questionnaires were subsequently sent, and the survey was closed 14 days after the last reminding email. In total, 204 VC members (87 from VC1 and 117 from VC2) completed the second questionnaire, yielding an

effective response rate of 58.2%. We also calculated the actual posts MR2 after the questionnaire. A total of 2,691 valid replies, posted by 204 respondents during the experiment period (from April 11 to May 10, 2010), were collected.

Demographic information about the participant was also collected. Most of the participants were male (87.1% in VC1; 71.1% in VC2). The average age of the participants was 41 years old. Most participants were educated workers (almost 80% held a bachelor degree). The sample profile was similar to the previous virtual community's studies (Chiu et al. 2006; Ma and Agarwal 2007; Hsu and Lin 2008).

5 DATA ANALYSIS AND RESULTS

The base model (i.e. without the treatment effect of rewards) is a multistage model that suggests the need for structural equation modelling (SEM) to simultaneously test multiple relationships. In this study, PLS was chosen to test the hypotheses. PLS can be used to analyze multi-item constructs and is widely used in knowledge sharing research (Wasko and Faraj 2005; Ma and Agarwal 2007; Staples and Webster 2008; Morris and Venkatesh 2010). In addition, PLS makes no apriori assumptions about the normality of the data and has a lower demand for sample size, compared with covariance-based approaches (Chin 1998; Qureshi and Compeau 2009). The particular software we used was SmartPLS 2.0 (Ringle et al. 2005).

To test the moderating effects of monetary incentives, the procedure implemented by Keil et al. (2000) was used to calculate differences of the path coefficients in the two models prior and post treatment. One model was built from the data collected from the first stage, representing participants' status before the experiment (BE). Another model was built from the data collected after the experiment, representing their status after the introduction of monetary incentives (AE). These two models were then compared using between groups analysis to examine the effect of the monetary incentives.

5.1 Measurement Reliability and Validity

Internal consistency for all constructs in the model was investigated using Cronbach's alpha (Cronbach 1951). Table 1 summarizes the descriptive statistics and reliability of the measurement of constructs. As the Cronbach's alphas for all constructs were greater than 0.70, the collected data show adequate reliability.

Construct (Abbreviation)	Mean	Std. Deviation	Cronbach's Alpha
Knowledge Sharing Behavior (KSB)	2.43	1.381	0.701
Knowledge Sharing Intention (KSI)	1.45	0.722	0.800
Intrinsic Motivation (IM)	1.61	0.930	0.843
Extrinsic Motivation (EM)	1.61	0.726	0.903

Table 1. Descriptive Statistics and Measurement Reliability

Convergent validity is the degree to which multiple items of a scale attempting to measure the same construct are in agreement. It is verified by the average variance extracted (AVE) that measures the variance that a latent variable component captures from its indicators relative to the amount due to measurement error. The AVE values should be higher than the generally recognized .50 cut-off, indicating that the majority of the variance is specified by the construct (Fornell and Larcker 1981). The AVEs shown in Table 2 demonstrate that this requirement was met.

	KSB	KSI	IM	EM
KSB	0.879			
KSI	0.171*	0.766		
IM	0.170*	0.469**	0.729	
EM	-0.05	0.388**	0.484**	0.776

Note: The shaded numbers in the diagonal row are square roots of the average variance extracted (AVE).

⁺: $p < 0.1$; *: $p < 0.05$; **: $p < 0.01$

Table 2. Construct Correlations and Discriminant Validity

	KSB	KSI	IM	EM
Quantity	0.93	-0.20	-0.20	-0.02
Quality	0.83	-0.14	-0.14	0.08
KSI1	0.22	0.85	0.47	0.32
KSI2	0.08	0.68	0.21	0.28
KSI3	0.13	0.81	0.40	0.28
KSI4	0.16	0.81	0.41	0.28
KSI5	0.13	0.65	0.36	0.36
IM1	0.09	0.24	0.69	0.30
IM2	0.13	0.52	0.88	0.50
IM3	0.08	0.26	0.77	0.23
IM4	0.12	0.34	0.80	0.37
IM5	0.13	0.27	0.71	0.32
IM6	0.29	0.45	0.85	0.44
EM1	-0.13	0.31	0.42	0.79
EM2	-0.10	0.23	0.30	0.76
EM3	-0.03	0.16	0.26	0.75
EM4	-0.01	0.42	0.37	0.73
EM5	0.10	0.34	0.40	0.72
EM6	0.03	0.30	0.54	0.84

Table 3. Construct Correlations and Discriminant Validity

Discriminant validity describes the degree to which a given construct is different from other constructs. The measures of the constructs should be distinct and the indicators should load on the appropriate construct. Two criteria may be adequate for evaluating discriminant validity. First, the square root of AVE should be larger than the correlations between the constructs (Fornell and Larcker 1981; Chin 1998). Table 3 contains the constructs correlation matrix and the square root of AVE as the diagonal elements. All diagonal elements are greater than the off-diagonal elements in corresponding rows and columns, hence demonstrating discriminant validity.

5.2 Results

We use MANOVA to test the overall effect of monetary incentives on participants' behavior, the quantity and quality. The value of Wilks's lambda was 0.888 ($F=21.904$, $p < 0.001$), indicating that the change of participants' behaviors was significant between the two stages. Then, ANOVA was adopted to compare the differences of means for quantity and quality of shared knowledge. The results, presented in Figure 2, show that the quantity was significantly increased (from 2.23 to 2.63) while the quality was slightly decreased (from 1.97 to 1.86).

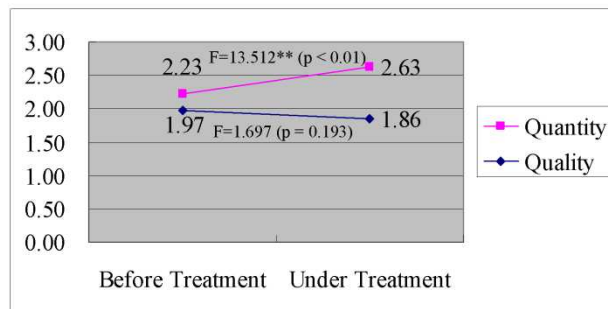


Figure 2. Results of Monetary Incentives Effect on Behavior

Further analysis was conducted to investigate the effect of treatment on three groups of participants, classified according to the level of their participation in the experiment:

- Reject rewards: the participants who responded to QS1, but did not attend the treatment experiment. Only the invitation letter of experiment was sent but they rejected or did not respond for the experiment. They were expected to be least influenced by the treatment.
- Accept rewards but not responding to questionnaires: those participants who agreed to attend the experiment, but did not respond to QS2. Some of them may be influenced by the treatment because they were aware of the game rule and the incentive program.
- Accept rewards and responding to questionnaires: the participants who completed the full experiment and filled out the survey of QS2. Their behavioral change was anticipated if the crowding effect of extrinsic rewards did exist.

Figure 3 shows the effect of monetary incentives in these different groups. Participants who accepted rewards and Responded posted more than those who were in the reject rewards group. However, the quality of replies did not have significant difference among the three groups. The findings suggest that monetary incentives can increase the amount of knowledge sharing, but it will not affect the quality of the shared knowledge.

For the effect of monetary incentives on intention and motivations, the data of questionnaires QS1 and QS2 responded by 204 participants (87 from VC1 and 117 from VC2) were analyzed. The value of Wilks's lambda was 0.721 ($F=6.803$, $p < 0.001$), indicating there were differences of participants' intention and motivations between the two studies. Then, ANOVA was adopted to compare the changes of these variables individually. The results in Table 4 show a significant decrease of -0.24 in the average level of intrinsic motivation. There were no significant changes in participants' intention and extrinsic motivation.

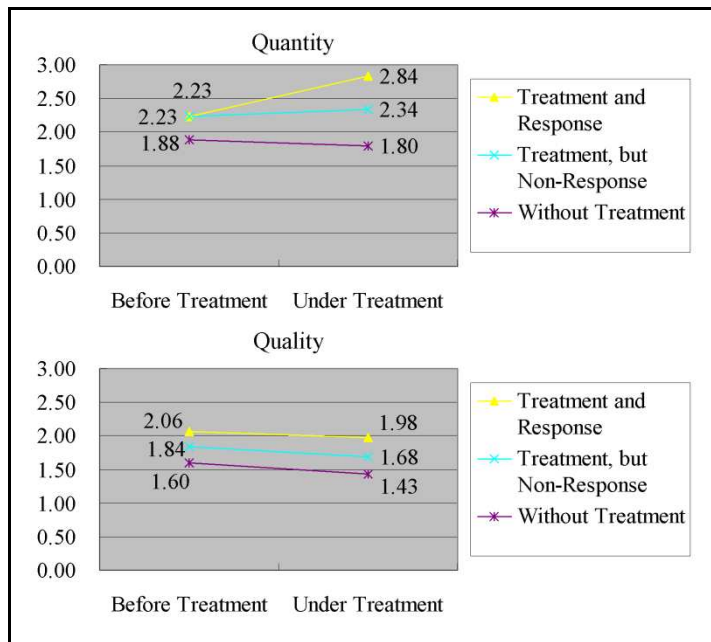


Figure 3. Results of Monetary Incentives Effect for Different Participant Groups

Construct	Before Experiment	After Experiment	Mean Changed	F statistics	p Value
KSI	1.48	1.45	- 0.03	1.173	0.321
IM	1.85	1.61	- 0.24	5.594	0.000**
EM	1.63	1.61	- 0.02	1.222	0.746

Note: ⁺: $p < 0.1$; *: $p < 0.05$; **: $p < 0.01$

Table 4. Effects of Monetary Incentives on Intention and Motivations

Table 5 shows the results of the monetary incentives effect in two different datasets. The results indicated that the extrinsic motivation had an increased effect on the intention to share knowledge, but that intrinsic motivation had a negative effect after the rewards were introduced.

Relationships	Before Experiment (204 participants)	After Experiment (204 participants)	Pooled t value
KSI -> KSB	0.266**	0.214*	-0.328
IM -> KSI	0.575**	-0.234**	-7.805**
EM -> KSI	0.300**	0.940**	7.420**

Note: ⁺: $p < 0.1$; *: $p < 0.05$; **: $p < 0.01$

Table 5 Results of Monetary Incentives Effect for Overall Data

6 DISCUSSION AND CONCLUSION

This study sought to investigate whether extrinsic incentives will affect the intrinsic motivations for knowledge sharing, as the motivation crowding theory argues. A field experiment was conducted in two virtual communities. A major finding was that when monetary rewards were given based on the performance of knowledge-sharing activities, individuals posted more messages but members' level of intrinsic motivation and its influence on intention diminished. This shows the presence of the crowding-out effect from rewards. **Though these findings implied that monetary rewards could enhance the volume of knowledge sharing, it also reduced individuals' intrinsic motivation for contributing.** The result may explain why rewards will increase knowledge providing (Cabrera et al. 2006), but will not enhance the contributors' attitude toward knowledge sharing (Bock et al. 2005). Another finding was that rewards raise the effect of extrinsic motivation on members' intention of knowledge contribution. Finally, we found that monetary incentives will not significantly enhance the relationship between intention to share and the actual sharing behavior. A possible reason is that monetary incentives have different influences on the two knowledge-sharing indicators (i.e. quantity and quality). Another reason is that the moderating effects of monetary incentives on intention and behavior may differ in different types of VCs. Thus, it could be an interesting area for further research that compares the effects of monetary rewards with other types of virtual communities to see whether there are differences in the different contexts.

This study contributed to a theoretical understanding of the nature and the influence of rewards on intrinsic and extrinsic motivations in affecting knowledge sharing in virtual communities. By including intrinsic and extrinsic motivations, the results demonstrated that rewards diminish intrinsic motivation. This finding provided evidence pointing to the presence of the crowding-out effect of rewards on intrinsic motivation for knowledge sharing in the VC context. This strengthened the findings of the laboratory experiment conducted by Cameron et al. (2005). Consistent with the motivation crowding theory, rewards based on performance were postulated as controlling and reducing intrinsic motivation. The results suggested that motivation crowding theory provides a useful framework for understanding the effect of rewards on VC members' motivations and intention of knowledge sharing. Researchers have argued the impact of rewards on knowledge sharing for more than ten years (Lee and Kim 2001; Bock and Kim 2002; Bock et al. 2005; Kwok and Gao 2005; Cabrera et al. 2006; Kulkarni et al. 2006; Lin 2007; Kang et al. 2008; Reyhav and Weisberg 2009). The motivation crowding theory may provide a theoretical explanation why the past studies produced opposite conclusions for the role of rewards.

The findings have some implications for VC practitioners desiring to encourage knowledge sharing within their communities. First, although rewards may drive members to contribute more knowledge temporarily, they should not be the primary mechanism for knowledge sharing because the crowding out effect may backfire. Participants' intrinsic motivation to share knowledge is likely to diminish at the same time. Furthermore, the quality of the provided knowledge decreased after the reward treatment. Therefore, extrinsic rewards may not be a good motivator for fostering knowledge sharing in virtual communities in the long run. VC managers should consider other measures to encourage the knowledge sharing of their members.

Several limitations of this research should be noted, which require further examination and additional research. One limitation is that this study examined only the aspect of individuals' motivation. While it can be argued that motivation is key to sustaining VC members' behavior, future research should also examine how social factors in VCs affects individuals' knowledge sharing. For example, Ferrin and Dirks (2003) have argued that reward structures have a strong influence on trust which is an important indicator of why individuals choose to contribute knowledge. Kankanhalli et al. (2005) found that several contextual factors (e.g. generalized trust, pro-sharing norms, and identification) moderate the impact of organizational reward on EKR usage. Another limitation of this research is its focus on active participants. This research did not investigate members who read but do not post, or those who did not log onto the VCs at all. Thirdly, we tested the hypotheses of the research using a field experiment that is difficult to totally control the environment for the experiment. Though we know that there was no incentive programs were offered by VC owners in the period of the research,

we could not ensure that no other factors that may affect their intention and behaviour at the same time. Finally, this study was based on two months of study, we cannot conclusively confirm the long-term impact of rewards on intrinsic motivation and behaviors.

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