

Motivational, Structural and Tenure Factors that Impact Online Community Photo Sharing

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Abstract

In recent years, we have witnessed a significant growth of “social computing” services, or online communities where users contribute content in various forms, including images, text or video. Content contribution from members is critical to the viability of these online communities. It is therefore important to understand what drives users to share content with others in such settings. We extend previous literature on user contribution by studying the factors that are associated with users’ photo sharing in an online community, drawing on motivation theories as well as on analysis of basic structural properties. Our results indicate that photo sharing declines in respect to the users’ tenure in the community. We also show that users with higher commitment to the community and greater “structural embeddedness” tend to share more content. We demonstrate that the motivation of self-development is negatively related to photo sharing, and that tenure in the community moderates the effect of self-development on photo sharing. Directions for future research, as well as implications for theory and practice are discussed.

Introduction

Social computing systems have demonstrated a dramatic rise in popularity in recent years. Such systems “facilitate collective action and social interaction online with rich exchange of multimedia information and evolution of aggregate knowledge” (Parameswaran & Whinston, 2007). Some of the best-known examples for social computing systems are content sites such as Wikipedia, Flickr, and YouTube, social networks such as FaceBook, and social bookmarking services such as del.icio.us, all based on user content contribution and online community formation.

Sustained participation and content contribution from individual members are critical for the viability of all online communities (Koh et al, 2007), and in particular those content-based services where the content is contributed entirely by the community members. Reflecting this premise, researchers have focused their attention on identifying the motivations of content contributors (e.g. Ames & Naaman, 2007; Nov et al., 2008).

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Artifact-sharing services are an important sub-category of online communities. Unlike other forms of contribution such as writing blog posts or editing Wikipedia articles, the act of contribution in artifact sharing communities is distinct from the act of content creation. Photographs are an example of such an artifact: people may take photos that have uses and benefits even when not shared online in photo-sharing communities. Conversely, it is not common for us to edit an encyclopedia entry unless we intend to publish it on Wikipedia or a similar venue; or to write a product review for the drawer. This separation of creation and sharing of artifacts may have implications related to motivations for contribution. On the one hand, the “second act” of contributing online is a completely optional action separated from the “first act” of artifact creation; on the other hand, once the artifact had been created, sharing can often become a fairly easy step that requires little additional mental effort. The studies on online content sharing and social computing have mainly focused on those services where creation is tightly coupled with sharing (e.g. Ames & Naaman, 2007; Nov, 2007). It is important to investigate users’ motivation for contribution that is somewhat decoupled from creation.

We focus here on photo sharing as an example for artifact-sharing communities. In general, an online photo sharing services such as Flickr enable users to upload, organize, and share their digital photos (Marlow et al., 2006). On Flickr, any uploaded photo is by default “public”, shared with the entire community and viewable by anyone on the web (of course, the privacy settings for each photo can be edited by the user).

The research questions we therefore address in this study are: what factors are associated with public photo sharing in online communities? Does the tenure of the user’s membership in the community likely to affect sharing? In addressing these questions we follow the approach of Wasko and Faraj (2005), and take into consideration the effects of two sets of factors that are salient in the context of content sharing: individual motivations on the one hand, and network structure factors on the other. In individual motivations, we consider both intrinsic and extrinsic motivations, including enjoyment, commitment to the

community, self-development, and reputation attainment. In network structure, we consider structural embeddedness – the degree to which the user is embedded in the community. In particular, we study these factors in the context of the users' tenure in the community – the amount of time since they had joined the community.

In this work we present a quantitative study that builds on the theories mentioned above. The study allows us to explore the effects of the various motivations and the structural embeddedness on actual photo sharing behavior in respect to a user's community tenure on the Flickr site. The contributions of this work, then, are:

- A research model connecting motivation theories to actual data collected from an online community.
- A study of sharing in respect to the tenure in the community, on a highly popular online community.

We begin by laying out the research model and hypotheses, describe the study method and results, and then discuss the implications of the study.

Related Work

The motivational factors we consider range both intrinsic and extrinsic motivations, a distinction made by scholars of motivations and self determination theory (Deci and Ryan's, 1985), as well as researchers of participants in online communities and open source software projects (Oreg & Nov, 2008; Roberts et al., 2006). Extrinsic motivations are instrumental and represent a focus on extrinsic rewards and expected benefits (Lerner & Tirole, 2002). These include, for example, improvement of skills (Lakhani & von Hippel, 2003) and the enhancement of professional status (Lakhani & Wolf, 2005; Wasko & Faraj, 2005). Intrinsic motivations, on the other hand, emphasize inherent satisfactions rather than the separable consequences of the act (Ryan & Deci, 2000). They include motivations such as fun (Torvalds & Diamond, 2001), reciprocity (Wasko & Faraj, 2005), and a sense of obligation to contribute (Bryant et al., 2005; Lakhani & Wolf, 2005).

In our study, we consider both intrinsic (enjoyment, commitment to the community) and extrinsic (reputation attainment, self-development) motivations. Enjoyment-based intrinsic motivations are key drivers of voluntary activities in general (Clary et al, 1998). Furthermore, enjoying the act of sharing in an online community has been shown to be a prominent reason for contributing to open source software projects (e.g., Lakhani & Wolf, 2005) as well as open content projects such as Wikipedia (e.g., Nov, 2007). Commitment, or obligation to the community have been shown to motivate individuals to share knowledge in various settings, such as open source software projects (Lakhani & Wolf, 2005), and open content projects (Bryant et al, 2005). Gaining reputation among like-minded people have been shown to motivate

sharing in online communities and open source software projects (Parameswaran & Whinston, 2007; Raymond, 1999). Finally, the self-improvement motivation involves self-development through learning from others in the community, receiving feedback, and enhancing one's abilities and skills. The self-development motivation is associated with knowledge sharing (Lakhani & von Hippel, 2003) and is one of the motivations for sharing in open content projects communities such as Wikipedia (Oreg & Nov, 2008).

In addition to the individual motivations, we consider the structural properties of the community as a factor that influences sharing of artifacts. Nahapiet and Ghoshal (1998) view structural embeddedness as describing the impersonal configuration of linkages between people or units. Structural embeddedness can be operationalized as the number of ties a user has to others in a network (Cao et al, 2006; Wasko & Faraj, 2005). In line with the view that highly structurally embedded individuals are likely to cooperate and comply with groups norms and expectations (Rogers & Kincaid, 1981), prior research has found a positive effect of individuals' structural embeddedness on their knowledge contribution in electronic networks of practice (Wasko & Faraj, 2005). Similarly, in an online community we would expect to see a positive relationship between structural embeddedness of users in an online community and their level of sharing.

Finally, we need to examine whether the length of membership in the community affects contribution. Existing research provides conflicting intuitions: on the one hand, evidence from small-scale qualitative research shows that over time, after the fading of the initial excitement, community members often become bored, disappointed or otherwise less enthusiastic, and as a result decrease their level of community participation (Brandtzaeg & Heim, 2008). On the other hand, we expect that as users get used to the system, get feedback on their postings, create connections with others and start to get viewed by others, they increase their participation. Some evidence for this was provided by Huberman et al (2008), who showed that viewing by others actually leads to an increase of video sharing on YouTube. The conflicting intuitions call for further research. However, no empirical study, to the best of our knowledge, has of yet looked at motivational factors, tenure, and users' posting. In this study we intend to address this research gap and conduct an exploratory study of the relations between these aspects of users' participation in an online community.

The Flickr (www.flickr.com) community received much research attention in the last years in various qualitative and quantitative studies. Miller and Edwards (2007), in a qualitative study, identified two types of users: "Snapsr" and "Kodak Culture", different in their habits and practice of capture and upload. Our study here of motivations is certainly related although it does not map directly to Miller and Edwards' categories. Ahern et al (2007) looked at privacy decisions in Flickr and identified (again,

qualitatively) various factors that contribute to marking photos as private; these of course create an initial link between a person's personality (that was not examined in their study) and the number of their public photos, our dependent variable. Van House (2007) also describes qualitative findings on user's social actions and motivations on Flickr.

Quantitatively, Prieur et al. (2009) suggested that Flickr users could be clustered (using PCA analysis on key usage statistics) into three groups: "social media", "MySpace-like" and "photo stockpiling". The "social media" group uploads photos and focuses on the interaction around the content; "the MySpace-like" group is more likely to use the social aspects of Flickr, perhaps independently from photo uploads; and the "stockpiling" group mostly uploads photos without using the social functions on Flickr.

Research Model

To study possible factors that influence photo sharing in respect to the user's community membership tenure, we consider a combination of various factors. These factors include, on one hand, motivational factors that can be measured via surveys, and on the other hand, structural properties that are obtained from system data. We first outline the theory that underlies our research model, and then expand on the considerations for its operationalization in our study.

Our research model attempts to explain community participation in respect to membership tenure in the community, using the elements listed above. By using a large-scale dataset of different users in different stages of their tenure in the community, we can gain insight to how tenure affects users' photo posting activity. The dependent variable we measure, therefore, is the number of public photos uploaded by the users to their Flickr account *per year* of the user's Flickr activity (i.e. per community-membership year). We expect that this dependent variable be influenced by user motivations (measured using a survey), by structural embeddedness (retrieved using system data), and by the tenure of the user in the community (also retrieved using system data).

Overall, then, our study includes three parts: first, we explore the relationship between tenure in the community and users' photo posting. Second, drawing on the motivational factors reviewed above, we plan to test the following research hypotheses:

H1 – Enjoyment will be positively correlated to photo sharing.

H2 – Commitment will be positively correlated to photo sharing.

H3 – Self Development will be positively correlated to photo sharing.

H4 – Reputation will be positively correlated to photo sharing.

Based on the theory of structural embeddedness, we also expect that:

H5 – Structural Embeddedness will be positively correlated to sharing.

Third, we examine interaction effects, and in particular, the interaction between self-development and tenure, and their effect on photos posting. If indeed the community provides feedback and support functions for its members, we expect that users motivated by learning and self development will change their behavior as they gain tenure in the community and get exposed to feedback by others. The overall research model is summarized in Figure 1.

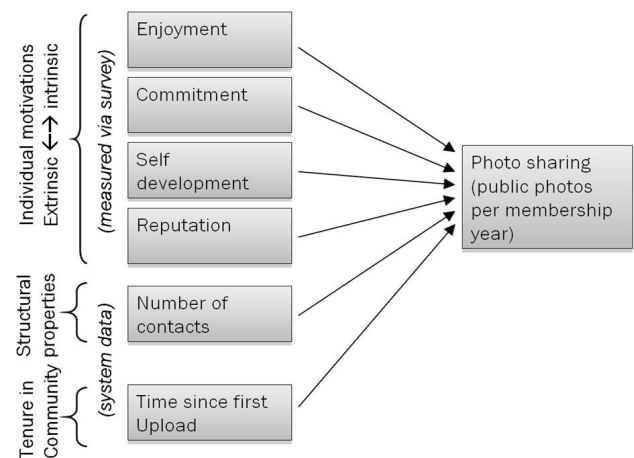


Figure 1. Summary of the research model

Methods

We collected data for this study from Flickr, a large photo (and recently, video) sharing community. Flickr is a prominent example of an online community and artifact-sharing system where content is created, annotated and viewed by users (Lerman & Jones, 2007; Parameswaran & Whinston, 2007).

We used a combination of survey responses and independent system data about each user. Among the independent variables, the four motivation factors were measured using responses to a web-based survey. To measure the photo-sharing motivations, we used existing scales adjusted to the Flickr context. Self-development was adapted from Oreg and Nov (2008), commitment and reputation were adapted from Wasko and Faraj (2005), and enjoyment from Venkatesh (2000). Sample questionnaire items are shown in Table 1.

System data, such as number of users' photos, and the users' tenure in the Flickr community, is available via Flickr's API (Application Programming Interface). The

Flickr API allows third parties to communicate with Flickr and to get information with the user's authorization. Respondents were asked, as part of the web-based survey, to authorize the researchers to access the respondent's Flickr account via the survey website. This way, key data about the respondents' activities was automatically extracted. We used the system data to measure the dependent variable and some independent variables. The data was recorded together with the responses to the questionnaires.

Our dependent variable, photo sharing over the user's tenure, was measured by using the number of public photos uploaded by the user and designated as available for the public to view, divided by the number of years (or fraction of years – e.g. 2.374 years) the user has been posting photos on Flickr.

To operationalize the structural embeddedness independent variable, we used the number of other users in the network a user has ties to (Cao et al, 2006; Wasko & Faraj, 2005). To do that, we used the API to extract the number of contacts the user had marked in the Flickr social network. Note that in the Flickr community, contacts are not a symmetric relationship by default. In other words, Robyn can mark Neko as a contact, to follow her new posts; Neko can choose to reciprocate, but she is not required to do so. One may suggest that the important measure here is the number of people who had marked *our* user as a contact: these people are likely to see new photos the user had uploaded. However, since we are operationalizing structural embeddedness, we chose to measure the number of people our respondents marked as contacts. From a participant point of view, the number of people they are following might be reflective of the strength of their sense of embeddedness.

One potential methodological issue in interpreting survey results is common method bias (Straub et al., 2004) whereby all variables are measured using a single data source. In our study, the motivations were measured using survey responses, while other variables, including the dependent variable, were retrieved directly through the Flickr API, therefore eliminating the risk of common method bias.

Commitment: I feel a great deal of loyalty to Flickr. Enjoyment: I have fun posting public photos on Flickr. Reputation: I post my photos publicly on Flickr to improve my reputation in the Flickr community. Self development: Posting my photos publicly on Flickr gives me an opportunity to learn new things.
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Table 1. Sample questionnaire items

Data Collection and Exploratory Analysis

A randomly chosen sample of 2740 Flickr users who had at least one publicly viewable photo were emailed an invitation to participate in our web-based survey. A total of 422 valid responses were received. This represents a 15.4% response rate, with is typical of similar studies. To eliminate any effect of posting restrictions by the Flickr system, we only included in our analysis "Pro" users, who pay a yearly fee and can upload unlimited number of photos (among other restrictions, non-Pro users are limited to sharing the 200 most recent photos uploaded to their account). In addition, we limited the analysis to users with at least three months of tenure, to make sure we consider members of the community with established motivations and habits. In particular, we aimed to eliminate the effect of the very initial intensive posting that is associated with joining a new service.

Overall, the sample used in the analysis consisted of 278 users, whose average age was 36.1 (median = 33, SD = 10.8) and of whom 49.8 percent were female.

An analysis of the data reveals a diverse set of users. The number of public photos posted per year varied greatly across users (see Figure 2 for a distribution of the number of photos per year in our sample; the Y axis represents the number of users). On average, the users in the sample had posted 2848.5 public photos on Flickr (median = 1195, SD = 7309.7). The respondents' tenure on Flickr was 20.3 months on average (median = 18.8, SD = 11.4) and the respondents had an average of 73.6 users marked as contacts (median = 12, SD = 437.4 – note that with two outliers removed, the contacts mean dropped to 42.2 and SD = 99.7).

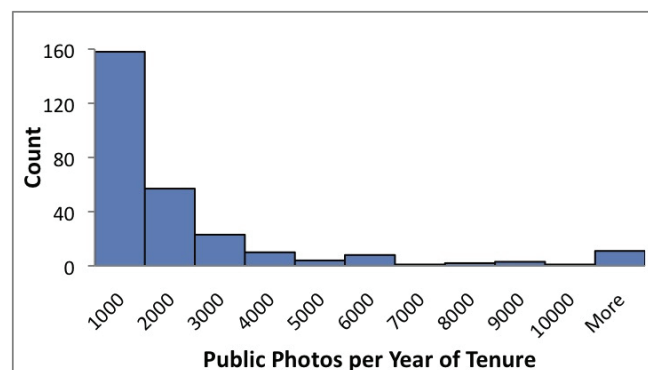


Figure 2 – Histogram of the number of photos per tenure year for our sample

To validate the survey instrument used in this study, we conducted a principle component analysis (PCA) with varimax rotation using SPSS. Three factors emerged in the PCA with 76% total variance explained. Each item had factor loading higher than 0.6 on the intended construct and less than 0.4 cross-loadings. We also calculated the

average variance extracted (AVE) for each construct and confirmed convergent and discriminant validity. Further, all constructs had Cronbach's alpha values greater than 0.7.

We first checked what is the relationship between tenure in the community and photo sharing. Figure 3 is a scatterplot of the user's average number of photos shared per year versus the tenure of the user in the community. For example, notice that many of our respondents' tenure on Flickr ranges between 1 and 3 years. The figure shows that most users in this particular group share between 100 and 1000 photos on average per year. As Figure 2 suggests, photo sharing per membership year declines with tenure in the community. In the next section, we use regression analysis to estimate the magnitude of the effect of tenure on photo posting as part of the overall model, including the motivational and structural factors.

Before proceeding with the statistical analysis, we had to check whether the differences observed over the different levels of users' community tenure can be attributed to some inherent differences between early and late community members, and not to the effect of the community membership tenure. To do that, we compared the populations of early and late community members using ANOVA: we divided the sample of users to a sub-sample of users whose tenure in the community is below the median tenure, and a sub-sample of users whose tenure in the community is above the median. We compared these two sub-samples on a number of variables, such as age, sex and a number of personality traits that were checked (extroversion and openness to experience). No significant differences were found between the two sub-samples on any of the factors compared, thus lending support to our assumption that the differences in photos sharing activity can be attributed to the effect of tenure in the community, rather than to any other differences between these populations.

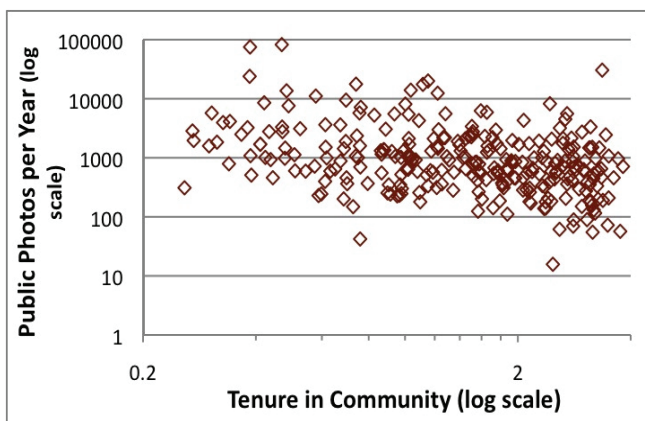


Figure 3 – Photos per year versus tenure in the community.

Summary of Findings

To test the hypotheses, we performed a regression analysis using the mean result of the constructs as extracted from the survey's responses, the logarithms of the two system-derived independent variables (tenure and number of contacts), and the logarithm of the dependent variable (public photos per membership year). As is common in studies of social computing activities, we used logarithms because of the highly skewed distribution of the latter three variables.

The results are summarized in Table 2, showing that the model is statistically significant. In addition to the tenure in the community, the coefficients of log(contacts) and commitment were significant in the predicted directions. Contrary to our expectation, the coefficient of self development was negative, and the relationship with enjoyment and reputation were not significant. Among the hypothesized factors, structural embeddedness (contacts) show the strongest predicting power on contribution, followed by commitment and self development (negative).

	Independent Variables	β	t	p
Predictors	Constant	-		
	Tenure: log(years)	-.460	-7.821	.000
	Structural embeddedness: log(contacts)	.179	2.942	.004
	Self Development	-.182	-2.654	.008
	Enjoyment	.022	.339	.735
	Commitment	.169	2.743	.006
	Reputation	.038	.530	.597
Overall model	R ²	.201		
	Adjusted R ²	.183		
	F	11.343 (df = 6, $p < .001$)		

Table 2. Regression results (coefficients are standardized)

Interaction Effects

When examining the interactions, we found that tenure moderates the effect of self development on photo sharing per community membership year. As Figure 4 demonstrates, new community members (= Low years) who are more motivated by self-development share less per year than those who are motivated by other things, whereas veteran community members (= High years), who are more motivated by self-development, share more per year than those who are less motivated by self-development. An explanation to this phenomenon is likely to be that new learners may be careful about showing their photos, and seek feedback only for a small, possibly high-quality photos. However, as they gain confidence and learn to appreciate the feedback gained from the community, learners tend to share more, to the extent that they surpass the amount of photos per membership year shared by non-learners.



Figure 4

The overall model, including the interaction effect, is summarized in Table 3. In addition to the relation between tenure and photo sharing per year, the analysis had supported our hypotheses regarding a significant positive correlation between commitment and the number of public photos per year (H2); and a significant positive correlation between the number of contacts and the number of public photos per year (H5). H1 and H4 were rejected, and the results indicate that the opposite of H3 holds: there is a significant negative correlation between the motivation of self development, and the number of photos shared per year.

	Independent Variables	β	t	p
Predictors	Constant	-		
	Tenure: log(years)	-.462	-7.878	.000
	Structural embeddedness: log(contacts)	.170	2.801	.005
	Self Development	-.167	-2.246	.016
	Enjoyment	.020	.323	.747
	Commitment	.182	2.947	.003
	Reputation	.023	.317	.751
	Self_development X tenure	.098	1.787	.075
Overall model	R ²	.210		
	Adjusted R ²	.190		
	F	10.257 (df = 7, p < .001)		

Table 3. Overall results (coefficients are standardized)

Discussion and conclusions

With the substantial growth of online communities and the importance of user contributed content for these systems, the Human-Computer Interaction community may need a better understanding of what factors drive or moderate user contribution in various stages of their tenure in the community. Such understanding may generate better opportunities and guidelines for design and architecture of such online communities and services. A user-centric understanding the dynamics of content contribution in these environments is important to researchers and practitioners alike.

In this study we have extended the body of literature on user contribution in online community environments by developing a framework to help understand users' motivations to contribute in an artifact-sharing community. By studying the factors that are associated with users' posting of photos, we examine a specific example of "artifact sharing" services; others can include video sharing, music sharing; art, or any other service where the

act of creation and publication are, by and large, separate. We differentiate between artifact-sharing communities and online knowledge sharing communities such as Wikipedia, where the actual act and the motivation of the creation of content are not distinct from sharing or publishing that content.

Our data provides an indication that the level of sharing decreases with the user's tenure in the community. At the same time, our results demonstrate that, expectedly, users characterized by higher commitment to the community and greater structural embeddedness tend to share more photos. Enjoyment and reputation, however, show no correlation with the magnitude of contribution. The lack of correlation may be attributed to the peculiar two-step characteristics of artifact sharing. The users may be motivated more by the enjoyment in the content creation part of the process (taking pictures), and the enjoyment of sharing per se become less salient.

Unexpectedly, we found a negative correlation between the self-development motivation and the magnitude of photo sharing per year. A possible explanation may be rooted in the tradeoff between contribution quality and quantity: the more a user is motivated by self development, the more the user will focus their efforts on the quality (rather than the quantity) of the photos shared. Presumably, those who are using photo-sharing websites for learning might be more cautious about posting, and select to post only their best photos in order to get feedback. The same argument may hold for the relationship between reputation and posting: those motivated by gaining reputation may not focus on the quantity of the photos they post. As this paper represents research-in-progress, we would like to address these explanations in further research.

Another possible explanation for the findings is the number of different uses of Flickr by members of the community. Such different modes of use include (Van House, 2007) self expression; relationship maintenance; life recording etc; yet other tentative classifications for the Flickr community members exist (Miller and Edwards, 2007; Prieur et al., 2009). We would expect different motivational characteristics for posting photos in each use mode, while structural embeddedness is still expected to have an effect for all of them. Indeed, the interaction effect we report above between tenure in the community and self-development shows that different factors may have opposite impact on sharing, perhaps for different types of users. A further study that will consider the different sub-cultures within the Flickr community may help shed light on this question.

This study's findings should also be taken with caution, as it was conducted on a specific artifact sharing service – the Flickr online photo sharing community. Studies of other types of artifact-sharing communities – such as video sharing or blogging – can help verify the generalizability of our findings. In addition, the study applies a cross-sectional design and therefore we cannot make a claim for

causality among the variables. Although theoretical arguments are made for the causal relationships between the independent variables and the dependent variable, our data analysis only permits us to demonstrate correlations in those hypothesized links.

Findings from this study have several implications for theory and practice. Social computing services such as Flickr and YouTube enable a vast number of individual users to be contributors and users of content. The negative association between the self-development motivation and the amount photos shared warrants further research on the tradeoff between quantity and quality of contribution in a social computing context. Designers and community managers may need to consider the tradeoff and, perhaps, encourage “tentative” contributions that are clearly marked, say, as “work in progress”. Otherwise, our study revealed that structural embeddedness and motivation to help the community are the strongest factors associated with contribution. If the correlation indeed suggests causation, designers of such communities may wish to explore ways to make the user feel more strongly attached to the community. Opportunities for social interaction could prove essential; inclusion of avenues for social interaction as part of the design of such systems needs to be encouraged. In addition, emphasizing the user's centrality in the community, or even highlighting the ways in which the user is similar to other community members (Ling et al., 2005) may influence the user and lead to additional contribution.

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