Technology-Mediated Citizen Science Participation: A Motivational Model

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Abstract

We propose and test a framework of the antecedents of contribution in two technology-mediated citizen science projects, with different degrees of task granularity. Comparing earlier findings on the motivations of volunteers in a web-based image analysis project (high granularity), with new findings on the motivations of volunteers in a volunteer computing project (low granularity), we found that participation task granularity is correlated with motivation levels. Further, we found that collective and intrinsic motives are the most salient motivational factors, whereas reward motives are less important for volunteers. Intrinsic, norm-oriented and reputation-seeking motives were most strongly associated with participation intentions, which were, in turn, associated with participation. Finally, comparing the relationship between motives and participation among the two volunteer populations, we found that active-participation volunteers are characterized by significantly stronger association between collective motives and contribution intention, whereas passive-participation volunteers are characterized by significantly stronger association between identification with the community and contribution intention. Implications for research and practice are discussed.

Introduction

Many aspects of scientific research, such as observation, classification and analysis, are labor-intensive, time-consuming, and as a result, costly. Citizen science offers a participatory approach for conducting scientific research. In online citizen science projects (Hand 2010) participation takes place primarily online. Some examples include volunteer computing projects and web-based image analysis projects. Recent reports in Science and Nature about the discovery of a pulsar by Einstein@home volunteers (Knispel et al. 2010), and the success of Foldit, a multiplayer online game in which citizen scientists compete by folding proteins into chemically stable configurations (Cooper et al. 2010), illustrate the potential of the participatory approach as a viable part of the scientific research process.

Thus, technology-mediated citizen science represents a low-cost way to strengthen the infrastructure for science and at the same time engage members of the public in science. Online citizen science is based on two pillars: a technological pillar - computer systems to manage large amounts of distributed resources, and a motivational pillar, which involves attracting and retaining volunteers who contribute their skills, time, and effort to a scientific cause. While the technological dimension has been extensively studied (Anderson 2007; Anderson et al. 2002; Luther et al. 2009), the motivational dimension received relatively little attention to date. In the present work we compare earlier reported findings on the motivations of volunteers in a web-based image analysis project (high granularity), with new findings on the motivations of volunteers in a volunteer computing project (low granularity). Understanding the motivational aspect is crucial for the design and management of technology-mediated citizen science projects, especially given the low retention rate many projects experience.

Background and related work

Citizen science projects differ substantially in the “task granularity” required of volunteers. Task granularity is defined as the smallest individual investment necessary in order to make a contribution (Benkler 2006). Low granularity contribution is represented by passive participation such as in volunteer computing, which is based on the division of a large computational task into many small tasks that are then distributed over the internet and completed on computers of volunteers who contribute to the project. Two of the best known volunteer computing projects are SETI@home (http://setiathome.ssl.berkeley.edu) and Folding@home (http://folding.stanford.edu). More recently, this approach has been extended through the creation of BOINC (Berkeley Open Infrastructure for Network Computing; boinc.berkeley.edu/) an open-source platform that enables running large scale volunteer computing projects. Currently, the BOINC platform serves over thirty projects in various scientific fields, including astronomy, climate modeling, mathematics, biology and medicine. BOINC contributors can determine their level of contribution by setting up a number of contribution parameters, including the allocation of disk space, CPU time, and others. Higher task-granularity contribution is represented by more active volunteer tasks such as in image analysis. In such projects, volunteers engage not only in monitoring, but also in analysis, in a variety of scientific areas. Examples include projects such as Galaxy Zoo (www.galaxyzoo.org), or U.C. Berkeley's Stardust@Home (stardustathome.ssl.berkeley.edu), in which volunteers analyze images of interstellar dust particles.

In non citizen science settings, mass collaboration of large numbers of individuals distributed across time and space represents a new and productive trend in the creation and dissemination of information (Benkler 2006). This phenomenon is characterized by distributed groups of volunteers, who split up work into modular tasks, and are supported by information systems that facilitate collective action and social interaction online. Sustained contribution by individual volunteers is critical for the viability of such communities (Butler 2001). Reflecting this, understanding the motivations of contributors has been viewed as critical for successfully managing and sustaining web-based information sharing communities, as well as for designing the systems contributors use for contribution (Cheshire and Antin 2008; Ling et al. 2005). Thus, in recent years much research has been done to identify contributors' incentives for contribution to a wide range of information sharing communities such as Flickr, Delicious, Twitter, YouTube and Wikipedia in which contribution is made by volunteering amateurs (Hertel, Niedner and Herrmann 2003), (Nov 2007; Peddibhotla and Subramani 2007; Rashid et al. 2006). Extrinsic motivations for contribution in such communities include improvement of skills and enhancement of status (Lakhani and Wolf 2005). Intrinsic motivations, on the other hand, include altruism, fun, reciprocity, intellectual stimulation and a sense of obligation to contribute. In addition, researchers have examined other factors associated with participation in information sharing communities, at the individual or group level, including social network properties (Sohn and Leckenby 2007), group membership size (Butler 2001), and feedback (Joyce and Kraut 2006).

There are important differences between contributions made to technology-mediated citizen science and those made to other types of community-based projects, which stress the need to investigate motivations for participation in the specific context of citizen science. First, in online citizen science there is a clear distinction between the volunteers making the contribution and those benefiting from the aggregate effort (i.e. the scientists who run the project). This asymmetric structure differs from most other community-based projects (e.g. Wikipedia, YouTube), where the distinction is blurred. Second, it often takes a long time for the output of the scientific project to be made public, in contrast to community-based projects where the contributions are viewable immediately, which may provide instant gratification to contributors. Third, a single contribution to an online citizen science project is sometimes too small to be attributed to a specific individual, whereas in other communities the deliverables (e.g. text, code, photos) can stand on their own and are usually attributable to their contributor.

Citizen science participation

Research on the factors driving online citizen science participation has been scarce (Raddick et al. 2009; Raddick et al. 2010). Examples include (Holohan and Garg 2005), a descriptive study of volunteer computing motivations at SETI@home, which exposed the desire to help scientific research, competition, and gaining technical knowledge as the top motivations of contributors. In that study, respondents stated that being part of a team and having social ties with other contributors were important for maintaining and increasing contribution. Results from an internal survey administered to contributors to BOINC (Boinc 2009) suggests that contributors with different longevity levels have different motivations. Both these studies, however, did not link motivations to contribution activity, and in particular, did not present a causal model that explains how to increase contribution. A study of Galaxy Zoo contributors (Raddick et al. 2010) classified ten motivational categories, including excitement, learning, desire to discover, social interaction, use the project as a resource for teaching, the beauty of the images, fun, amazement by vast scale of the universe, desire to help, interest in the project, interest in astronomy, and interest in science in general. Here, too, no link was made between motivations and actual contribution.

Recent attempts to examine the relationships between volunteers' motivations and their participation levels include (Nov, Anderson and Arazy 2010) and (Nov, Arazy and Anderson 2011). In the present study, we extend earlier work by comparing the results reported by (Nov, Arazy and Anderson 2011) about the relationship between motivations and participation among volunteers in active-participation projects, with data on the same relationships among volunteers in passive- participation projects.

Research Model

For the empirical study of citizen scientists' motivations, we follow the extended Klandermans model, a theoretical framework used for explaining voluntary participation in social movements (Klandermans 1997), (Simon et al. 1998). This framework includes four classes of volunteers' motivations for participation: collective motives (the importance attributed to the project's objectives); norm-oriented motives (expectations regarding the reactions of important others, such as friends, family or colleagues); reward motives (benefits such as gaining reputation, or making new friends); and identification (identification with the group, and following its norms). This conceptualization has been recently extended to include a fifth factor, a hedonistic or intrinsic motivation, operationalized as the enjoyment associated with participation in the project in studies of participation in open-source software development (Hertel, Niedner and Herrmann 2003) and Wikipedia editing (Schroer and Hertel 2009). Given the broad range of possible 'reward motives' (Hertel, Niedner and Herrmann 2003), we divided this factor to two specific motives, which were identified in studies of previous online communities: community reputation benefits and social interaction benefits (Butler et al. 2002), (Roberts, Il-Horn and Slaughter 2006).

The modeling approach used in the present study follows two influential theories – the theory of reasoned action (TRA) (Fishbein and Ajzen 1975), and its application in the technology adoption literature (Venkatesh et al. 2003). According to these theories, an intention to perform a certain behavior links the actual behavior to upstream antecedents. We used the intention to increase participation and (Bhattacherjee 2001), as the constructs linking motivations to behavior, and in our case, to citizen science participation (see Figure 1).

This model was used in an early work on the motivations of volunteers in a high-granularity citizen science project (Nov, Arazy and Anderson 2011). In the present study, we compare the results found with new findings on the motivations on volunteer computing (low granularity) volunteers.

Following the approach developed in the extended Klandermans model (Hertel, Niedner and Herrmann 2003), (Klandermans 1997), we expect all motivations to be positively correlated with participation intention, which is, in turn, expected to be related to contribution by the projects' volunteers. Furthermore, assuming that greater effort and time investment required of volunteers carrying out high-granularity tasks is associated with greater commitment, we expect task granularity to be positively correlated with motivation levels.

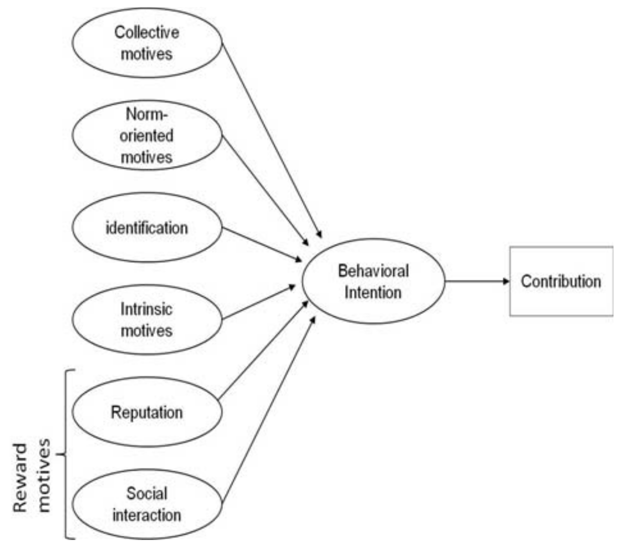

Figure 1. Research model

Method

We examined two citizen science projects, representing different task granularity levels. The first project, in which participation is active, is Stardust@home, an online citizen science project in which volunteers (also known as "Dusters") classify online images from NASA's Stardust spacecraft. Using a virtual microscope developed by the Stardust@home research team, dusters classify images using their home computers and search for tracks left by very small interstellar dust particles impacting Stardust's aerogel tiles. The second project, in which participation is largely passive, is SETI@home, one of the best known volunteer computing projects, which is hosted at U.C. Berkeley. To contribute, a participant needs to download a client application which is then used for managing the volunteered computer's allocated tasks. After the initial download and installation, contribution is made without any human intervention, and without a need for the contributor to interact with the system. A participant's contribution level is determined by the setting of her profile. The participant can set (and later change) her level of contribution in a number of ways, for example, by determining the disc space, memory and CPU time to be used by the project, by contributing constantly or only when the computer is idle, or determining whether or to contribute when the computer operates on batteries. The BOINC system grants computation credit denominated in "Cobblestones" to participating computers – a measure of how much work the contributing computer did. Cobblestone credit is calculated as the CPU time contributed multiplied by the CPU benchmarks as measured by the BOINC system.

The survey was developed based on the extended Klandermans model (Hertel, Niedner and Herrmann 2003; Klandermans 1997), with additional sources (Butler et al. 2002; Hertel, Niedner and Herrmann 2003; Roberts, Il-Horn and Slaughter 2006; Schroer and Hertel 2009) for specific questionnaire items reflecting the model. Survey items adapted from previous studies were adjusted to the citizen science context (see Figure 2).

We used intention to increase participation (Bhattacherjee 2001), as the construct linking motivations to behavior, and in our case, to citizen science participation. Contribution, our dependent variable, was measured in the case of Stardust@home as the number of weekly hours spent in active contribution, following the operationalization used in previous studies of online voluntary participation (Hertel, Niedner and Herrmann 2003; Lakhani and Wolf 2005; Nov 2007). For SETI@home, participation was measured using volunteers' Recent Average Credit (RAC), used by the BOINC system as a measure for users' contribution of computing resources.

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Collective motives: "advancing
the goals of Stardust@home is
important to me."

Identification: "I identify with
the Stardust@home community."

Norm-oriented motives: "My
friends think positively about my
contribution to Stardust@home."

Intrinsic motives: "Participating
in Stardust@home is fun."

Reputation: "Gaining reputation
in the Stardust@home community is
important to me."

Social interaction: "Developing
personal exchange with others in
the Stardust@home community is
important to me."
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Figure 2. Sample questionnaire items

The survey was administered to volunteers in the project who were active in the 30 days prior to the survey date, and respondents were asked to rate the importance of the different motives on a 1-7 Likert scale. 139 Stardust@home volunteers and 1843 SETI@home volunteers, participated in the survey, representing response rates of 27.1%, and 22.1% respectively, which are relatively high compared to similar studies.

Structural equation modeling (SEM) was used to analyze the survey results and estimate the relationships between the constructs. Partial Least Squares (PLS) was applied (Chin, Marcolin and Newsted 2003) using SmartPLS 2.0 (Ringle and Wende) for the measurement validation and structural model testing. PLS is used extensively in information systems research as it offers a number of advantages that are pertinent to the present study: In addition to the verification of a complex model, PLS enables testing of individual hypotheses and provides amount of variance explained for each endogenous variable. Compared to covariance-based SEM and regression, it is better suited to dealing with data nonnormality and small sample size (Chin, Marcolin and Newsted 2003). Similar to other structural equation modeling techniques, PLS allows measurement validation and model verification to be performed in a single step.

Results

To confirm the reliability of survey items, we conducted a factor analysis. Seven factors emerged, corresponding to our framework of six motivational factors and one intention factor. All items' factor loadings on the intended construct were higher than their cross-loadings, as expected. Furthermore, to confirm convergent and discriminant validity, we calculated the average variance extracted (AVE) for each construct. For each construct, AVE exceeded 0.5, and the square root of AVE (RAVE) exceeded the correlation with other constructs - thus displaying convergent and discriminant validity. In addition, all constructs exhibited Cronbach's alpha values above the generally accepted level of 0.70, indicating measures reliability.

The analysis of the results reveals a diverse set of volunteers (see Figure 3a and 3b for the distribution of participation in terms of time and RAC gained; the Y axis represents the number of volunteers), with the majority of volunteers spending less than two hours per week, and a minority of volunteers spending more.

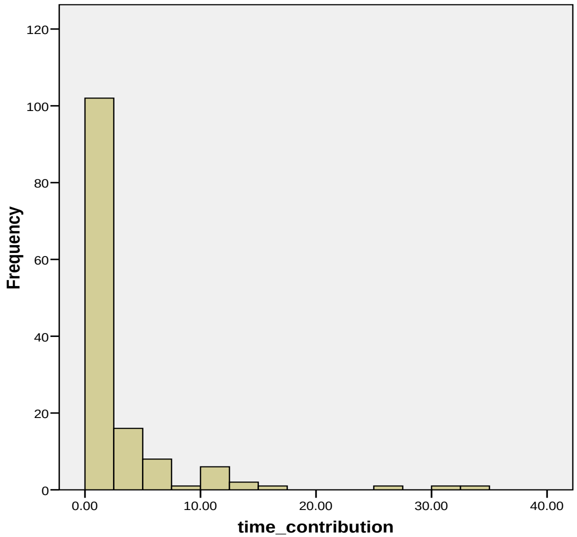

Figure 3(a). Distribution of Stardust@home volunteer participation levels (in hours/week).

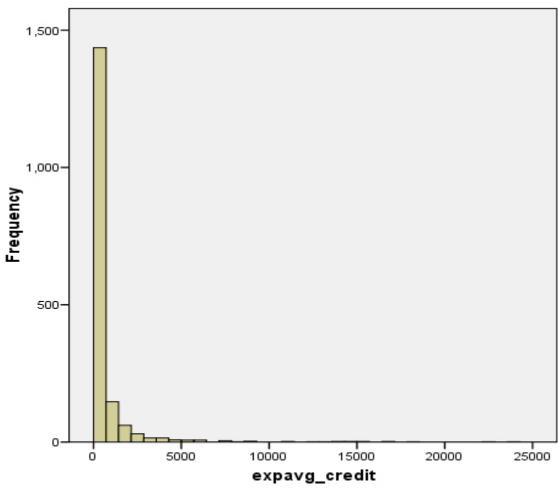

Figure 3(b). Distribution of SETI@home volunteer participation levels (in RAC).

Motivation levels rated by the respondents are presented in Figure 4. Collective motives were rated highest (6.44 out of 7 in the case of active-participation, and 6.25 in the case of active-participation), followed by intrinsic motives (5.98 and 5.56); identification and norm-oriented motives were found to be of secondary importance, and the reward motives of reputation and social interaction did not seem to play an important role. A comparison between the active and passive participation projects, using t-test, revealed that all motivation levels of active-participation volunteers were significantly higher (p<0.05).

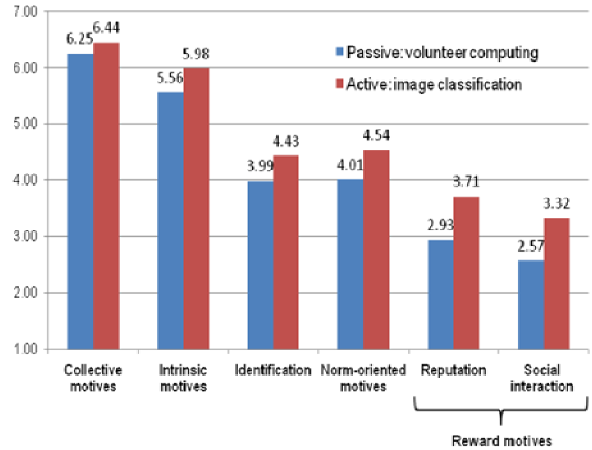

Figure 4. Motivation levels in both projects

The PLS results of testing the model are presented in Figure 5. We used the log-transformed participation data in the analysis because of the highly skewed distribution of the participation variable (see Figures 3a and 3b). In both models, intention was significantly related to participation, and intrinsic motives were most strongly related to participation intentions (the path coefficients were 0.294 in the active-participation project, and 0.241 in the passive-participation project).

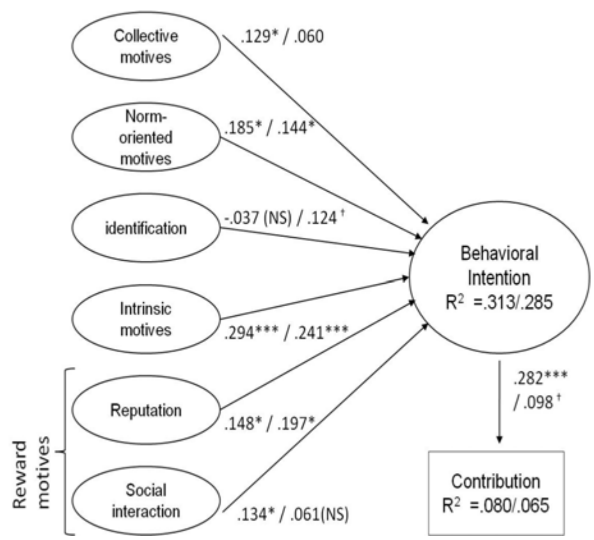

Figure 5. PLS analysis results (values on the lines represent path coefficients of active/passive participation respectively)

Finally, to compare the differences in the strengths of the relationships between motivations and intentions in the two task-granularity cases, we performed a Chow test (Dougherty 2007). We found that in among active-participation volunteers, the correlation between collective motives and intentions was significantly higher than among passive-participation volunteers, whereas the correlation between identification and intentions was significantly lower than among passive-participation volunteers.

Discussion and Conclusion

Online citizen science is emerging as a powerful way to conduct scientific research by drawing on large numbers of geographically distributed volunteers. Online citizen science is founded on two pillars, technological and motivational. While the technological aspects of online citizen science have been investigated extensively in recent years, the motivational aspects remain largely unexplored. In the present study we proposed and tested a framework of the antecedents of contribution in two online citizen science projects with different degrees of task granularity. We tested our proposed framework and used structural equation modeling to examine the influences of the antecedents identified on volunteers' participation intentions and contribution.

The findings demonstrate that task granularity is positively correlated with motivation levels; however, additional research, however, is needed to determine the direction of this relation. Furthermore, with the exception of identification (among active-participation volunteers), and social interaction (among passive-participation volunteers), all motivations were found to be positively and significantly correlated with contribution intentions, which were, in turn, found to correlate positively and significantly with contribution levels. Thus, the findings demonstrate the applicability of the motivation-intention-contribution framework to the modeling of volunteers' participation in online citizen science projects.

The findings have important implications for the design and management of online citizen science projects; we recommend that designers and leaders of such projects focus their recruiting and retention efforts on motivational factors that are more salient and have a positive relation with intention and participation.

While both collective and intrinsic motives were found to be the two highest rated motivations, it is important to note that only intrinsic motives were found to be both highly rated and highly correlated with contribution intentions. Thus, the high level of the intrinsic motives, as well as the positive correlation with contribution level found among both active and passive –participation volunteers, stresses the need to develop enjoyable contribution mechanisms, such as the one used in Foldit (Cooper et al. 2010). Collective motives were not found to be significantly related to intentions among passive-participation volunteers, and only moderately related to intentions among active-participation volunteers. This finding is consistent with results from previous studies on community-based projects such as Wikipedia. The finding suggests that sharing the attributing importance to the project's objectives is a characteristic that helps explain why people join the project in the first place, however once active contributors, attributing importance to the project's objectives is not linked to intentions and contribution levels. Thus, especially among new volunteers, citizen science designers and leaders should strive to increase volunteers' commitment to the project and its goals. This could be done by communicating the project's mission, achievements and its scientific contribution to the volunteers.

The moderate levels observed for identification and norm-oriented motives suggest that - although of secondary importance – project designers and leaders should not neglect the necessity to establish a community of volunteers who share beliefs, interact regularly, (possibly using existing channels such as social media), and work collectively towards a common goal. The significantly weaker relationship between identification and participation intentions observed among active-participation volunteers seems surprising – we would have expected that more active participation would be related to greater emotional involvement in the project (which Figure 4 shows – the reported identification level is higher for in active-participation volunteers), and that this increased involvement will be associated with greater intention to increase participation. However, we believe that the findings can be explained by the option of belonging to a team (an artificial social structure whose accumulated credit is the sum of of credit accumulated by the team members); this available to SETI@home volunteers but not to Stardust@home volunteers. Thus, we believe that being in a team, or the possibility of it, strengthen the relationship between volunteers' identification and their participation intention.

The significantly stronger relationship observed between collective motives and participation intentions in the active-participation project (compared to the passive-participation project), may suggest that the combination of active participation and a project whose objectives volunteers strongly support (collective motives were rated highest among the motivations – see Figure 4) strengthen the translation of motivations into participation intentions and actual contribution. The relation between task granularity and motivations raises the need to create dynamic contribution environments that allow volunteers to start contributing at lower-level granularity tasks, and gradually progress to more demanding tasks and responsibilities. Many community-based projects, such as open source software development and Wikipedia, have long realized this, and they allow interested contributors to progress in the tasks they perform and the responsibilities they assume. This mechanism is currently absent in online citizen science projects, where volunteers' tasks are usually restricted in their scope, and the governance and decision making is left in the hands of the scientists managing the projects. Adopting a more symmetric governance structure, closer to the one in community-based projects such as Wikipedia, represents a major paradigm shift, even for those scientists who appreciate the potential benefits of citizen science. However, as online citizen science develops, and competition for volunteers' resource increase, such a trend toward greater empowerment of volunteers may be inevitable.

The present study has a number of limitations that can be addressed in future research. The study was conducted in two specific citizen science projects. Studies of other citizen science projects, in different fields, with different goals, and covering more task granularity levels could help verify the generalizability of the findings. Further, in this study we applied a cross-sectional research design, which allows establishing correlations between constructs, and thus arguments regarding causal relationships should be taken with caution. In addition, the study focused solely on volunteers, and did not consider the motivational effects of the interaction between volunteers and professional scientists.

A number of questions warrant future research; some of the future research directions we identify are (a) examining the mechanisms by which participants increase or decrease their participation levels over time, possibly through a longitudinal study (b) identifying additional factors that may have an effect on contribution, such as personality traits, other motivations not studied here, and (c) exploring how changes in the design of online citizen science systems could possibly help increase volunteer participation.

References

Engelmore, R., and Morgan, A. eds. 1986. *Blackboard Systems.* Reading, Mass.: Addison-Wesley.

Anderson, D. 2007. "Volunteer computing: Planting the flag." in *Proceedings of the PCGrid 2007 Workshop*. Long Beach, CA.

Anderson, D, J Cobb, et al., 2002. "SETI@ home: an experiment in public-resource computing." *Communications of the ACM* 45(11):56-61.

Benkler, Y. 2006. *The wealth of networks: How social production transforms markets and freedom*: Yale Univ Press.

Bhattacherjee, A. 2001. "Understanding information systems continuance: An expectation-confirmation model." *MIS Quarterly* 25(3):351-70.

Boinc. 2009. "Contribution to BOINC: internal report."

Butler, B, L Sproull, S Kiesler, and R Kraut. 2002. "Community effort in online groups: Who does the work and why?" *Leadership at a Distance*:346-62.

Butler, Brian S. 2001. "Membership Size, Communication Activity, and Sustainability." *Information Systems Research* 12(4):346-62.

Cheshire, C, and J Antin. 2008. "The social psychological effects of feedback on the production of Internet information pools." *Journal of Computer Mediated Communication* 13(3):705-27.

Chin, WW, BL Marcolin, and PR Newsted. 2003. "A partial least squares latent variable modeling approach for measuring interaction effects." *Information Systems Research* 14(2):189-217.

Cooper, S, F Khatib, et al., 2010. "Predicting protein structures with a multiplayer online game." *Nature* 466(7307):756-60.

Dougherty, C. 2007. *Introduction to econometrics*: Oxford University Press, USA.

Fishbein, M, and I Ajzen. 1975. *Belief, attitude, intention and behavior: An introduction to theory and research*: Addison-Wesley Reading, MA.

Hand, E. 2010. "Citizen science: People power." *Nature* 466(7307):685-87.

Hertel, G, S Niedner, and S Herrmann. 2003. "Motivation of software developers in Open Source projects: an Internet-based survey of contributors to the Linux kernel." *Research Policy* 32(7):1159-77.

Holohan, A, and A Garg. 2005. "Collaboration online: The example of distributed computing." *Journal of Computer-Mediated Communication* 10(4):article 16.

Joyce, E, and RE Kraut. 2006. "Predicting continued participation in newsgroups." *Journal of Computer Mediated Communication* 11(3):723-47.

Klandermans, B. 1997. *The social psychology of protest*: Blackwell Oxford.

Knispel, B, B Allen, et al.,. 2010. "Pulsar Discovery by Global Volunteer Computing." *Science* 329(5997):1305.

Lakhani, KR, and RG Wolf. 2005. "Why hackers do what they do." in *Perspectives in Free and Open-Source Software*, edited by B. Fitzgerald J. Feller, S. Hissam, & K. Lakhani MIT Press.

Ling, K, G Beenen, et al., 2005. "Using Social Psychology to Motivate Contributions to Online Communities." *Journal of Computer-Mediated Communication* 10(4).

Luther, K, S Counts, KB Stecher, A Hoff, and P Johns. 2009. "Pathfinder: an online collaboration environment for citizen scientists." *CHI 2009*.

Nov, O. 2007. "What motivates wikipedians?" *Communications of the ACM* 50(11):60-64.

Nov, O, D Anderson, and O Arazy. 2010. "Volunteer computing: a model of the factors determining contribution to community-based scientific research." *WWW2010.*

Nov, O, O Arazy, and D Anderson. 2011. "Dusting for science: motivation and participation of digital citizen science volunteers." *iConference 2011*.

Peddibhotla, NB, and MR Subramani. 2007. "Contributing to public document repositories: A critical mass theory perspective." *Organization Studies* 28(3):327-46.

Raddick, M, G Bracey, et al., 2009. "Citizen Science: Status and Research Directions for the Coming Decade." *ASTRO2010 Decadal Survey.*

Raddick, M, et al., 2010. "Galaxy Zoo: Exploring the Motivations of Citizen Science Volunteers." *Astronomy Education Review* 9(1):010103.

Rashid, AM, K Ling, et al., 2006. "Motivating participation by displaying the value of contribution." *CHI 2006*.

Ringle, C.M., and S Wende. "SmartPLS 2.0."

Roberts, Jeffrey A., Hann Il-Horn, and Sandra A. Slaughter. 2006. "Understanding the Motivations, Participation, and Performance of Open Source Software Developers." *Management Science* 52(7):984-99.

Schroer, J, and G Hertel. 2009. "Voluntary engagement in an open web-based encyclopedia: Wikipedians and why they do it." *Media Psychology* 12(1):96-120.

Simon, B, M Loewy, et al., 1998. "Collective Identification and Social Movement Participation." *Journal of Personality and Social psychology* 74(3):646-58.

Sohn, D, and JD Leckenby. 2007. "A structural solution to communication dilemmas in a virtual community." *Journal of Communication* 57(3):435-49.

Venkatesh, V. et al., 2003. "User Acceptance of Information Technology: Toward a Unified View." *MIS Quarterly* 27(3):425-78.