Motivating participation in online innovation communities

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Abstract: Understanding what motivates participation in online innovation communities is now possible given the recent explosion of opportunities for joining such communities. This article reports on the results of a survey of participants in a specific online innovation community to characterise and find correlations between motivation and participation styles. An analysis of the survey results show: the reasons for joining collective innovation communities are not always the same as the reason for continuing to participate; primary motivations for participation are consistent with previous studies; intrinsic motivations rated higher than extrinsic; and the participants that are passionate about the online community are either new members, < 1 month, or long standing members, > 6 months. This study of collective intelligence in online innovation communities reveals that while the community is encouraged in the transition from passive visitors to active members, the technical and organisational aspects of the design processes are managed by employed experts.

Keywords: collaborative design; online innovation communities; product design; collective intelligence

1. Introduction

The Internet makes it possible for large numbers of physically distributed people to connect and collaborate on complex, global projects. To utilise such diversity, building, mediating and sustaining community engagement is essential (Nov, Anderson and Arazy 2010). The success of "open source" innovation, initially for software but increasingly across different domains, has led to the intense scrutiny of open innovation practice, in particular the motivations of individuals. Antin and Cheshire (2010) wrote "if active user participation is an explicit goal for designers, accurately characterising users' motivations, behaviours, and knowledge is essential". The success of group intelligence systems lies with their ability to attract people to participate and contribute and support them in continuing to participate and contribute.

Collective innovation is a type of collective intelligence that occurs when universally distributed, open communities collaborate to design or create innovative products or solutions. Online innovation communities work across many domains including science (Fold.it; InnoCentive.com); gaming (ilovebees.com; World of Warcraft); software design (TopCoder.com); combined gaming/graphic/software design (Second Life); product design (Quirky.com); architectural design (OpeningDesign.com; StudioWikitecture.com); and designing solutions for global problems (OpenIDEO.com; OpenPlanetIdeas.com).

A model of community-contributed design is found at Quirky.com, a platform for social product design where the community collaborates and competes to influence the design of a physical artefact with a goal to manufacture. Members can participate in a range of ways: by submitting ideas for projects, voting on which idea is developed, providing constructive criticism, voicing support and influencing the design or marketing of a product. Individuals who have significantly influenced the development of that product receive a percentage of the profits from the sale of the product. The Quirky community is surveyed in this research.

2. Motivation and online communities

Motivation in collective intelligence can be described as the force that brings about, regulates and sustains the continued involvement of members in communities. Motivation theories are widely used to explain human behaviour and provide a framework with which to explore why people participate in online communities. While the literature on motivation theories is extensive, here we focus on those theories or studies that contribute to understanding online communities. A review of recent empirical literature on motivation in online communities is provided in Kosonen (2009), where online communities are defined as: technology-mediated virtual spaces supporting ongoing social interaction among people who share an interest in a certain subject or practice.

According to *Uses and gratifications theory,* the reason people select and use particular media is to obtain satisfaction from having their needs, interests or goals fulfilled (Stafford 2008). Much can be gained from being part of a group, including: information exchange, help with achieving goals, entertainment and searching for friendship (Lakhani and Wolf 2004). These elements are available to online communities, but do not reflect the entire range of reasons why people participate in particular online communities.

The way motivations to participate are formed and reinforced is largely a result of the social culture in which people are situated. The *socio-cultural theory of motivation* originates in Vygotskian notions (as cited in Walker 2010) of interdependence between the internal world of the individual and the external, social world. According to this theory, the formation of motivation is an interdependent function between the individual and the environment. In the case of an individual participating in an online platform, the online community forms the social world, whether it is comprised of individuals, software agents or a combination of real and artificial entities. *Co-regulation* occurs when members influence the community's goals, values and standards in return, resulting in motivations changing over time. Studies of online communities have supported this, for example, Lampe et al (2010) found motivations that originally attracted members to a community appear to change over the course of participation. Change may occur as a result of gratifications sought becoming gratifications obtained, or they may evolve as a result of changing participation styles and/or increased contribution leading to stronger social ties and a greater sense of belonging to the community. The Reader-to-Leader Framework (Preece and

Schneiderman 2009) describes the varying degrees of participant involvement in online communities, from those with passive to very active roles. In a study on Wikipedia, Antin and Cheshire (2010) made a case that 'readers' should also be considered valued participants due to their likelihood of moving towards more active participation.

Many studies of online communities divide motivation into internal and social (Lamp et al 2010), intrinsic and extrinsic or internal and external factors that impel and induce action (Hars & Ou 2002; Bitzer 2007; Ye and Kishida 2003; Ke and Zhang 2010). All of these studies distinguish impelling forces in the psychology of the individual from forces originating outside the individual.

Lepper, Greene and Nisbett (1973) demonstrated the interaction between intrinsic and extrinsic motivations in a study where children were allocated to one of three groups: i) those who agreed to draw in order to receive a reward; ii) those who agreed to draw and received the same reward, but had no knowledge of the reward until after the task was completed; and iii) those who engaged in the activity but neither expected nor received the reward. Children who expected a reward subsequently showed diminished interest in the task and produced a poorer quality of drawing for the task. Those who received the reward without expecting it subsequently showed the same or slightly elevated levels of interest. Those who did not expect or receive the award did not show a difference in interest. These findings suggest online communities may provide ongoing motivation and achieve better outcomes if they encourage intrinsic motivations while providing unexpected rewards.

Intrinsic motivation, which is essentially internal, is described by Nov (2010) as inherent satisfaction from an activity. Rewards associated with intrinsic motivations include: (i) the fun associated with participating; (ii) personal challenge; (iii) competition and other means of social comparison and reputation building (Hertel, Nieder and Herrmann 2003). Studies that draw on intrinsic motivational theory (Deci 1975), and community identification (Hars and Ou 2002), include the hope of future rewards as a pertinent motivation, describing contributions to online communities as a form of investment with rewards including: (i) the possibility of future revenues arising from support services; (ii) building 'human capital' through education, training and learning which can lead to a better portfolio of work and improved job opportunities; and (iii) peer recognition through feedback which leads to increased efforts to contribute.

Extrinsic motivation, associated with external forces, is described by *self-determination theory* as lying somewhere along a continuum between controlled and autonomous regulations (Deci and Ryan 1985). This framework was applied to a study examining how extrinsic motivation affects participation in open source software design (Roberts, Hann and Slaughter 2006). Findings from this study indicated that internal and external motivations might interact; for example, extrinsic motivations actually enhanced intrinsic motivations. Specifically, an extrinsic incentive such as paying for contributions increases the amount of contribution and thus raises a member's status in the community, which supports

an intrinsic incentive. This process can boost, regulate and maintain a member's interest in doing a task, thus assisting with the self-regulation of motivation.

In a self-regulatory system described in Sansone and Smith (2000), extrinsic drivers influence intrinsic motivation and interest-enhancing strategies predict continued contribution and participation. Sansone and Smith conclude that intrinsic and extrinsic mechanisms alone are insufficient and the system must provide the right kind of performance feedback to increase motivation. Others argue that certain motivations can help sustain interest and a range of incentives is best for supporting continued participation as not all motivations affect participation equally or in the same way (Roberts, Hann and Slaughter 2006).

Mechanisms that induce participation can be described as: Money, Love, and Glory (Malone et al., 2009). The promise of financial gain, either with an immediate reward or a delayed reward, such as when participation leads to the enhancement of career goals, can be a strongly motivating force. The Love category describes enjoyment of the activity, the ability to socialise and ideological reasons for contributing. Glory is related to the recognition received by peers and community. Recent collective intelligence systems rely on Love and Glory far more than traditional organisations, which have placed greater emphasis on money as an incentive. Financial gain is not the only reward online communities can offer: points and tokens are also used widely.

Another way to classify participation in communities is across four categories of motivation: (i) egoism – to increase one's own welfare; (ii) altruism – to increase the welfare of one or more other individuals; (iii) collectivism – to increase the welfare of a group or collective; and (iv) principlism – to uphold some moral principle (Batson, Ahmad and Tsang, 2002). Collectivism may be a more appropriate term than altruism for motivations directed towards large groups of people, however, since people usually care most for the collectives they are members of, collectivism might not be a useful motivator for problems that don't directly affect participants. It is likely the four categories are not equally represented in the full range of motivations since most reasons for participating in online communities can be attributed to egoism, including altruism (discussed in 3: Ideology).

3. Motivation categories for a collective design survey

Based on various studies on motivation in online communities, eight categories that describe motivation in online communities were identified: Ideology, Challenge, Career, Social, Fun, Recognition, Reward and Requirement. These categories are derived from Nov (2007) and include six categories of motivation associated with volunteering, originally defined by Clary (1998) as: Values, Understanding, Enhancement, Protective, Career, and Social. Nov's additional categories for understanding motivation in Wikipedia were Fun and Ideology, which are also used in research on motivation in open software development (Zhang and Feng 2006). Malone's et al. (2009) categories of Money, Love and Glory are also found in these categories: money is associated with reward, love is associated with social, fun and ideology, and glory is associated with recognition.

Since innovation communities often include professional designers the motivation categories described here include those that describe the motivation of a designer selected to participate as well as non-designers whose participation may be entirely informal and voluntary.

Ideology - to further a cause or act according to a personal or ethical principle. This includes participation for altruistic and other reasons such as personal beliefs and a sense of personal efficacy. Altruism is an innate desire to enhance the welfare of others at some cost to oneself and is widely thought to be a reason for participation in online communities (see Rafaeli and Ariel 2008). Research has shown that altruism does not rate as highly as expected (Hars and Ou 2002) and is seldom the sole reason for participation. Antoniadis and Le Grand (2009) suggest seemingly altruistic behaviours do not necessarily arise from altruistic intentions. Kollock (1999) proposes that "literal altruism" is a rare phenomenon and three alternate motivations for contribution to online communities are: i) *sense of efficacy*, performing altruistic acts for the express motivation of fulfilling a sense of self; ii) *attachment or commitment*, contributing to a community when personal and collective outcomes are merged or balanced (Rafaeli and Ariel 2008); and iii) *anticipated reciprocity*, the expectation that at some future point help or information is provided in return for past contribution. Rheingold (1993) describes a 'gifting economy' as interaction without any expectation of direct or immediate return. Rafaeli and Ariel (2008) found members assist those who have contributed in the past and avoid those who never give.

Challenge - to obtain a sense of personal achievement through acquiring additional knowledge or skill. Clary (1998) and Nov (2007) describe *understanding* as the opportunity to learn new things and exercise knowledge, skills and abilities that might otherwise go unpractised, while Nov, Naaman and Ye (2010) use *self development* to mean participation for the opportunity to learn new things. Rafaeli, Ariel and Hayat (2005) show strong motivators are: 'learning new things' and 'intellectual challenge'. Challenge ranked second highest (to human capital) in Hars and Ou's study on programmers. Franke and Shah (2003) note that challenge, mental stimulation, control, curiosity and fantasy are elements prevalent in innovation-related activities. Lakhani and Wolf (2005) also found that intellectual stimulation was a strong motivator for project participation among open source software developers. Nov's study on Wikipedia contributors found Challenge (understanding) to be a motivation of average proliferation in their sample.

Career - participation that may lead to an advance in one's career. This is defined in a general manner to allow personal interpretation. Clary (1998) also defines Career loosely: "career-related benefits …". This definition includes the statements (that volunteering): help(s) me get my foot in the door at a place I would like to work; make(s) new contacts that might help my business or career; allows me to explore different career options; will help me succeed in my chosen profession; experience will look good on my resume; and maintaining career-relevant skills. Nov (2007) defines Career as: an opportunity to achieve job-related benefits such as preparing for a new career or maintaining career-relevant

skills". A survey statement reflects this: "I can make new contacts that might help my business or career". Although Nov expected Career to be a significant motivator due to the community signalling career-relevant skills, it was not found to rank highly. Findings in studies of open source software have been inconsistent as to whether Career is an incentive. Hertel, Nieder and Herrmann (2003) find Career is a strong motivation for open source developers to join a community, but diminishes as they learn with time these expectations are not always easily met.

Social - the desire to have a shared experience with others. Clary (1998) suggests individuals participate because friends participate or people close to them want them to participate. Nov (2007) suggests participation in Wikipedia is to allow people "the chance to be with their friends". An example survey question reads: "people I'm close to want me to write/edit in Wikipedia". Many authors writing prior to the widespread emergence of the "social" web around the year 2006, take the view that real-world peers influence online participation. These social pressures are behind sites like Facebook, which rely on real-world relationships to build a network; however, there are social reasons other than peer pressure for which people may join an online community: such as the social support to develop a niche hobby, described in Ridings and Gefen (2004). A definition based on friendship may be why Nov found Social to be a weak motivator of Wikipedians. Lampe et al (2010) define Social as maintaining interpersonal connectivity, social enhancement and social belonging and found the action of creating an account and becoming a member of an online community was preceded by social enhancement motivations and a feeling of importance to the community. According to social theory, the need for belonging to a specific community is strongly linked to enhancing personal identity and is a major reason why people seek out niche communities.

Fun - participation for entertainment, enjoyment, excitement, relief from other experiences, or simply furnishing or structuring the passage of time. Fun has almost consistently been found to be one of the strongest motivators in studies of online contributions: Nov, Naaman and Ye (2010) for online photo sharing; Franke and Shah (2003) for product development; Rafaeli, Ariel and Hayat (2005) for Wikipedia; Antikainen and Väätäjä (2008) for online innovation communities. Hars and Ou (2002) grouped 'fun' and 'enjoyment' with other intrinsic motivations but found that external factors had a greater weight in their study of open source software developers. Frey, Haag and Schneider (2011) found that enjoyment had a positive and significant correlation with the number of contributions made.

Reward - to receive tangible returns such as money, points in a game, a gift or voucher. Rafaeli, Raban, and Ravid (2005) found that higher-paid and better-tipped responders on Google Answers were more likely to participate and contribute, but later (Rafaeli & Ariel 2008) found this effect was mitigated by social factors. Lakhani and Wolf (1995) also show that paid contributors in open source software development dedicated more time to projects than volunteers and that being paid and feeling creative had a positive impact on effort. This goes

against findings by Deci (1975), Thompson, Meriac and Cope (2002) and Rafaeli and Ariel (2008) that show extrinsic rewards have a negative impact on intrinsic motivations and therefore users who were never offered extrinsic rewards were more self-motivated. Shaw, Horton and Chen (2011) found that workers on a paid website were not motivated by financial rewards. Author information removed (2012) show that financial reward was only one of several top reasons that people participate in AMT.

Recognition - to receive private or public acknowledgement. Recognition can take the form of enhancing one's reputation within a community, as reflected in a survey statement by Nov, Naaman and Ye (2010): I post [photos]… to improve my reputation in the Flickr community; and Roberts, Hann and Slaughter (2006): to enhance my reputation in the [open source software] community. The latter hypothesised that conflict existed between intrinsic motivations to participate and the motivation to enhance reputation through performing work to increase status. Findings showed that status motivations enhanced intrinsic motivations rather than diminished them. It seems likely that as an individual forms closer social ties to their community, recognition by peers becomes a stronger motivator.

Requirement - participation in response to a wish or command expressed personally. Requirement elicits a response reflecting external pressures, such as a professor or boss requesting participation. Requirement contrasts incentives of online communities with individual employed to participate in design teams.

4. Survey analysis of a collective design community

Based on the eight categories of motivation defined in Section 3, an online survey was presented to the Quirky.com community to explore the motivation and participation styles in innovation communities. Descriptions from the Reader to Leader framework (Preece and Schneiderman 2009) were formed into distinct statements that categorised participation styles.

4.1 Participants and population size

The quirky.com community participates in an online innovation community for product design. Community success can be measured in terms of the number of online creative collaborations completed, as described by Luther et al (2010). Quirky has a relatively high number of completed collaborative projects: one per week for over two years. The actual population size of the quirky community is unknown. A large proportion of users who obtain accounts drop out soon after joining, particularly if their idea is not selected for development. Estimates at the time of writing place the number of active members at around 1700[1] per day or 6,500 per week. Of the active member population, fifty members completed the survey (N=50).

As with many surveys of a sociological nature, it is not always possible to obtain a large sample size from the population. Others have reported similarly

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[1] Figure taken from the site's forum: http://aquirkyblog.com/2011/10/community-liaison-report-6/ There is no precise record publicly available.

small sample sizes, for example, two frequently cited research studies had a sample size of 49 (Antikainen and Väätäjä, 2008) and 79 (Hars and Ou, 2002). Engman (2011) addresses this common problem and provides a review of models for significance testing, concluding that reporting statistical significance has little value for sociological research and that survey research is particularly susceptible to the fallacy of applying significance tests to non-random samples. The data here has been reported in the context of an exploratory study online innovation communities and the findings report on results that are likely to be indicators of larger trends.

4.2 Survey Method

Standardised questionnaires are a recognised methodology for assimilating responses about individuals' knowledge, beliefs, attitudes and behaviour in an objective manner. Surveys are the predominant method of assessing the motivations of online communities (Hars and Ou 2002; Hertel, Niedner and Herrmann 2003; Oreg and Nov 2007; Ke and Zhang 2010; Nov 2007; Antin and Cheshire 2010; Frey, Haag and Schneider 2011; Antikainen and Väätäjä 2009; Nov, Naaman and Ye 2010; Lampe et al 2010).

A three-part, self-administered questionnaire was advertised on Quirky's community forum. The survey was conducted online and responses were only recorded if all questions were completed. Statistical methods used to analyse the results involved calculating the mean and standard deviation of interaction statements; collapsing Likert responses to the categories of 'agree', 'neutral' and 'disagree'; reversing negatively scaled items; using pivot tables to cross-tabulate dimensions of the data; and creating a multinomial logistic model from the data to assess the relevance of particular statements on predicting the role of members according to the Reader to Leader Framework.

4.3 Survey design

The survey consisted of three sections, participation questions, interaction statements, and motivation statements.

The participation questions were designed to separate respondents into participant-types based on the Reader-to-Leader Framework (Preece and Schneiderman 2009). This first part to the survey comprised four questions relating to the usage of the site including: i) frequency of contribution; ii) number of hours spent on the site weekly; iii) length of membership; and iv) primary use of the site. The first two questions (frequency and hours spent on the site) were derived from the effort levels in a survey on open source programmers by Hars and Ou (2002) and were included to enable comparison between involvement level and participation style. The answer format to the first three questions involved five grouped radio buttons with mutually exclusive answers. The fourth question was a self-assessment of the primary style of participation. Six categories were presented in a mutually exclusive drop-down bar. Their contents represented the six Reader to Leader participation styles: a) Reader; b)

Contributor; c) Regular contributor; d) Collaborator; e) Regular collaborator; and f) Leader.

The interaction part of the survey comprised 28 statements. Participants were asked to indicate the extent to which they agreed or disagreed with each statement along a 5 point Likert scale. The first 12 statements were derived from 4 participation styles: Reader; Contributor; Collaborator and Leader. The next 16 statements related to the 8 motivations - 2 statements for each motivation, worded differently and spaced apart to allow for comparison and checking for reliability.

The 8 categories of motivation were presented with their concise definitions (author information removed), in addition to 16 other statements - 2 statements for each category. The 1st of these paired statements assessed whether the respondent originally joined the site for the named motivation while the 2nd statement assessed whether they continued to participate for that same reason. A five point Likert scale was used to describe responses.

5. Results

The survey collected a rich dataset that would be possible to analyse along more dimensions than the four areas presented here. The areas were selected because they ensured integrity of findings in the dataset with limited degrees of freedom. Results are divided into four sections: 5.1 describes the characteristics of the population and gives an impression of site usage; 5.2 identifies which motivation categories were significant in the sampled population; 5.3 shows changes in motivation over time; and 5.4 lists the questions with the power to predict participant type according to the Reader to Leader framework.

5.1 Characterising the sample population

Table 1 provides an overview of the characteristics of the sampled population by showing the percentage of the population according to the number of hours per week on the site and the duration of their membership in the Quirky community. Fifty percent of the sampled population had been participants on the site for over six months; while 52% had spent between five and twenty hours per week on the site. In our data sample, the more recently a member had joined, the less time they spent on the site per week compared to long-standing members.

Table 1 Duration of membership vs hours spent per week on site

Hours spent per week on site %	Duration of membership %					
	Less than a week	Over a week, less than a month	Over a month, less than six months	Over six months, less than a year	Over a year	Total
Under five	2	12	6	-	6	26
Over five, but under ten	4	4	12	4	6	30
Over ten but	4	4	-	2	12	22

under twenty						
Over twenty but under forty	-	-	2	-	14	16
Over forty	-	-		2	4	6
Total	10	20	20	8	42	100

To determine which respondents had high engagement, the rate of contribution was cross-tabulated with hours spent participating per week. Table 2 shows that over half of the community sampled (56%), spends over five hours on the site per week, posting at least once a day.

Table 2 Hours per week vs rate of contribution

	Hours per week					
Rate of contribution	<5	6-10	11-20	21-40	>40	Grand Total
Once a month	-	8%	2%	-	-	10%
Once a week	14%	4%	-	-	4%	22%
Once a day	8%	14%	8%	6%	-	36%
More than once a day	4%	4%	12%	10%	2%	32%
Grand Total	26%	30%	22%	16%	6%	100%

The participants' response to the statement "I feel passionate about the site/projects" is shown in Table 3. There was a high level of agreement for this statement across participant types, except where membership was between 1-6 months. Low n value for those whose memberships were *Under a week* and *Six months to under a year* means those results should be ignored as low n values indicate low reliability.

Table 3. I feel passionate about the site/project : Length of membership

	n=	2	10	13	4	21
		Under a week %	One week to under a month %	One month to under six months %	Six months to under a year %	A year and over %
Likert Values	1	0	0	15.38	0	0
	2	0	20	15.38	15	0
	3	0	0	15.38	0	14.29
	4	100	80	30.77	75	52.38
	5	0	0	23.08	0	33.3

5.2 Importance of motivation categories

The perceived importance of each of the motivation elements is presented in Table 4, which compares responses for the entire population and the 30% of the population that are long-standing, frequent users. Fun as a motivation scored the highest means (3.97 and 4.09) and had a similar range of opinion (SD=.815 and .733), suggesting that Fun was a strong incentive. The most significant aspect is the low mean (1.57 and 1.22) and standard deviation (.849 and .517) for the

Requirement motivation. The extremely high level of disagreement with the statement and the small difference in opinion shows Requirement was not a strongly motivating factor.

Table 4 Perceived importance of motivation categories

	Entire population		Long-standing, frequent users[1]	
	Mean	SD	Mean	SD
Ideology	3.25	0.130	3.64	0.883
Challenge	**3.73**	**0.962**	**4**	**0.853**
Career	3.31	1.123	3.22	1.085
Social	3.41	0.950	3.6	0.863
Fun	**3.97**	**0.815**	**4.09**	**0.733**
Reward	3.29	1.314	3.31	1.222
Recognition	**3.32**	**1.012**	**3.82**	**0.614**
Requirement	1.51	0.849	1.22	0.517

Long-standing frequent users differ from the sample population in that they have a higher agreement for all categories except Career and Requirement. Recognition has a mean of 3.82 (SD=0.614) compared to the population mean of 3.32 (SD=1.012). The figures in Table 5 were calculated by averaging the Likert responses for the two interaction statement questions for each motivation and the related self-assessment question for the current reason for participating.

To compare Likert value responses, 5 (strongly agree) and 4 (agree) were grouped to provide a measure of agreement in the sample. Similarly, 1 (strongly disagree) and 2 (disagree) were grouped to provide a measure of disagreement in the sample. The value of 3 (neutral) was discounted. Responses to motivation categories showed the highest agreement is 'Fun' with 82% of the sample population. The second significant motivation is 'Challenge' with 78% of the sample population. The third is 'Ideology' with 62%. By far the lowest, at only 4% is the 'Requirement' category.

Table 5 Comparing responses to motivations

		Ideology	Challenge	Career	Social	Fun	Reward	Recognition	Requirement
	1	1	0	0	2	0	16	8	65
	2	15	11	21	18	3	10	18	18
Likert Value	3	22	11	27	26	15	28	25	13
	4	48	64	33	43	55	33	43	4
	5	14	14	19	11	27	13	6	0

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[1] Those who joined over a year ago and contribute from ten to over forty hours a week.

%	100	100	100	100	100	100	100	100

The highest agreement lies in the interaction statement that relates to the motivation of Fun: contributing to this site/project is fun. 86% agreed, 6% disagreed and 8% remained neutral to the statement.

The second highest set of agreement lies in the interaction statement relating to Challenge: participating in the site/project gives me a feeling of competence. 82% agreed, 8% disagreed, 10% were neutral. The third highest was for Career: experience from this site/project helps me improve my skills: 78% agreed, 8% disagreed, 12% were neutral.

5.3 Change over time

To determine whether motivations for participating in the site had changed since joining, members were asked to rate eight motivations at the time of completing the survey and to reflect on their motivations when joining the site. Likert responses were compared in order to measure whether there was a loss, gain or no change in reported motivation levels, Table 5. A reported loss in motivation does not necessarily mean individuals have completely lost that motivation since the calculation includes a move from 'strongly agreed' (a 5 on the scale) to 'agreed' (4), from 'neutral' (3) to a 'disagree' (2), or from 'disagree' (2) to 'strongly disagree' (1). The same in reverse applies to gained motivations. Fully lost and gained motivations are described in Table 6.

Table 5 Percentage of members reporting loss, gain and no change in motivation since joining

Length of membership	%	Ideology	Challenge	Career	Social	Fun	Reward	Recognition	Requirement
< 6 months	Loss	20	16	8	32	24	24	28	24
	Gain	12	24	24	8	24	8	12	8
	No change	64	40	64	52	40	48	36	60
> 6 months	Loss	28	12	20	68	24	44	12	16
	Gain	24	52	36	16	36	16	32	8
	No change	48	36	44	16	40	40	56	76

The results in Table 5 can be described by a loss to gain ratio. Table 5 indicates that for the segment of the community with a membership under six months, the greatest gain is for Career at 1:3, meaning that even though some members did not initially rate Career highly, over time they realized participating contributed toward their career. Reward and Requirement motivations have an opposite effect with a loss to gain ratio of 3:1. In this case, individuals may have joined with the expectation that they would earn significant money, only to find those expectations were not met, or perhaps found that over time their motivation

based on reward and requirement had decreased. The largest loss is for the Social motivation at 4:1, indicating that although members may have joined for social reasons, it did not remain a strong motivation.

For those with a membership over six months, the greatest loss to gain ratio is for the Social motivation at 17:4, followed by Reward at 11:4. This reflects similar trends for members under six months. The largest gain is for Challenge at 3:13, followed by Recognition at 3:8. This suggests long-standing members are likely to be motivated by the feeling of competence, accomplishment and of being noticed for their efforts.

The previous section (5.2) described Fun as the most significant motivation across the population. That this motivation does not show marked losses or gains indicates it is a fairly stable motivator that remains important to members regardless of their length of membership.

A summary of lost motivations and gained motivations is shown in Table 6 This differs to Table 5 as the responses were polarised before being translated into the table format. Responses involving a neutral selection were discounted as they may reflect individuals who were undecided or unsure about how they felt. Only those responses that crossed over from a 1 or 2 (disagreed) to a 4 or 5 (agreed), or vice versa, were included.

Table 6 Lost and gained motivations for length of membership

Length of membership	%	Ideology	Challenge	Career	Social	Fun	Reward	Recognition	Requirement
< 6 months	Lost	4	8	4	8	0	16	12	8
	Gained	4	12	24	8	16	4	8	8
> 6 months	Lost	12	8	0	24	4	16	0	0
	Gained	8	20	12	4	12	4	0	0

Table 6 indicates that regardless of the length of membership, the community gained more than they lost of the motivations for Challenge, Career and to a lesser extent, Fun. This suggests the three motivations may not have been seen as important at the time of joining by a proportion of the population, but were later found to have become important.

Almost a quarter of the population over six months, at 24%, lost the Social incentives. This finding is heightened when compared with Table 5, which shows 68% reported some decrease in Social motivation. Considering Quirky emphasises its social nature across the site and even in the website title "quirky | social product development", this decrease shows members' expectations about social incentives suffered a dramatic drop over time.

5.4 Defining participation by participation types – assessing the Reader to Leader framework

The Reader to Leader framework (Preece and Shneiderman, 2009) consists of 4 distinct participation types: Reader, Contributor, Collaborator and Leader. When presented with the survey, subjects were asked to self-nominate a participation type. Their answers to the subsequent 12 interactions statements were compared to assess the ability of those questions in capturing the type of participation. A discrete choice model with ordered logistic regression revealed which questions had power to predict self-reported user type. The sampled population was comprised of 2% Readers, 42% Collaborators, 52% Contributors and 4% Leaders.

Statements with the potential to predict user type were:

1. Usage: How many hours a week do you spend on this site/project?
2. Reader: I notice when certain members post on different forums or comment
3. Reader: I recognise a useful forum post or comment when I see one
4. Collaborator: I become engaged in discussion and follow up on my posts
5. Collaborator: I sometimes make friendly, social comments that don't strictly relate to the project
6. Leader: I encourage people to participate and mediate disputes
7. Leader: I like to sum up the points raised on a forum in my own post
8. Ideology: I like to contribute to what I think is a noble cause
9. Ideology: I deeply enjoy helping others - even if I have to make sacrifices
10. Ideology: I originally joined this site for ideological reasons
11. Challenge: Participating in the site/project gives me a feeling of accomplishment
12. Challenge: Participating in the site/project gives me a feeling of competence
13. Challenge: I continue to participate to be challenged
14. Career: Experience from this site/project helps me improve my skills
15. Social: I originally joined this site for social reasons
16. Reward: I continue to participate so I can make money from it

Questions that do not predict participation type have a high conformity across all types. Of all the usage questions, only the number of hours spent on the site/project per week was relevant for determining participation type. It is interesting to note that of the included participation types from Reader to Leader, only two of the three statements predict participation type. All three statements for the Contributor type failed to predict participation type.

The participation type statements that may apply more widely across the community include:

1. *Reader: I feel a strong sense of identification with this community.* It appears all sampled members feel this, not only Readers.
2. *Contributor: I will occasionally leave a comment if I think it's relevant, but don't really get too engaged in discussion.* This could mean the population is highly engaged in discussion or may have confused respondents as it is a two-part statement.

3. *Contributor: I participate by voting.* Quirky encourages all members to vote. The easiest way to become involved in a project is to vote for it. All members will have participated by voting and the responses reflect this (nobody answered with 'disagree' or 'strongly disagree').
4. *Contributor: I leave constructive criticism, but rarely follow up on it.* Participants either don't leave criticism or follow up on their criticism. It is also possible the two-part statement may have caused confusion.
5. *Collaborator: I help develop ideas other people have mentioned.* The nature of Quirky is to either present one's own idea for others to develop, or to become involved in helping develop others' ideas.
6. *Leader: I feel passionate about the site/projects.* Although not all respondents answered in the affirmative, the answers ranged across user-types, showing this was not a defining statement for the Leader type.

6. Analysis and Discussion

An analyses of the results reveals: i) which incentives were strong and weak for the sample; ii) whether motivations for participating were perceived by the subjects to change over time; and iii) whether the Reader to Leader categories defined in Preece and Schneiderman (2009) described the nature of member involvement for this collective design community.

Results indicate the strongest motivation is Fun with 82% of the sampled population motivated by this category. This supports other findings ie. a study of Wikipedians found Fun and Ideology ranked highest (Nov 2007); a study of three open innovation communities showed Challenge and Fun ranked highest (Antikainen and Väätäjä's 2008). In this study, Fun appeared to remain stable throughout membership and was rarely a lost motivation.

Despite the strength of Fun, optimizing on this incentive alone can severely limit participation (Wang and Fesenmaier 2001). A significant proportion of the population participated for a sense of achievement through acquiring knowledge or skill (Challenge); for the purpose of contributing to a larger cause (Ideology); and because it may lead to an advance in their career (Career). Antikainen and Väätäjä (2008) propose that multiple and varying types of motivation are required to attract and commit people to participate, as members may have multiple, simultaneous goals behind participating.

Very few (6%) joined because they were required to. Collective design differs from team design in that members generally participate of their own volition. Despite this, there were a small number of users who felt they were required to participate. We can speculate about the reasons for this – perhaps they viewed participation as crucial to an ongoing project, or a friend asked them to gain support for their idea. High levels of requirement may apply to individuals with short or particularly long memberships. Further research is needed to explore this theory.

The results indicate intrinsic motivations (Challenge, Fun, Recognition, Ideology) were more highly rated than extrinsic motivations (Career, Reward, Requirement). Hars & Ou's (2002) study on open source software programmers,

also showed internal motivations rated highly. Cultures of participation, such as Quirky, are described as relying on intrinsic motivations, eg. the sense and experience of joint creativity, common purpose and mutual support (Fischer 2011). In Deci (1975) and Lepper, Greene and Nisbett (1973), extrinsic motivations were shown to produce a detrimental effect: subjects paid to play with a puzzle later played with it less and reported less interest than those without the financial incentive. Performance was worst where reward was insubstantial, even more than when no reward was offered because insufficient extrinsic motivation overrides the effects of the task's intrinsic incentives (Gneezy and Rustichini 2000). Focusing on how paltry the reward was in relation to the effort expended, shifted focus away from intrinsic motivations such as the enjoyment of feeling challenged or having fun completing the task. In an experiment on Amazon Mechanical Turkers, task accuracy was higher when work was produced for a low financial return when that work was said to be for a non-profit organization (Rogistadius, 2011). Contextualizing the work as non-profit appealed to users' internal, ideological motivations.

Motivation has been described as involving self-regulation of interest in a task by using internal motivations to boost external motivations and *vice versa* in a continuous cycle (Sansone and Smith, 2000). When reported motivations at the time of joining were compared with current motivations, a loss was revealed in mostly extrinsic motivations, indicating that the reasons individuals joined were often not the reasons for continued involvement. Although extrinsic motivations may be the reason individuals decide to *participate* in task, it may not be the reason they *engage* with a task. If a site initially appeals to external motivations such as Reward, they may more easily convince visitors to join. Early experiences of participation may appeal to intrinsic motivations and override extrinsic ones, thus promoting continued participation.

The Quirky site offers a variety of rewards for participation. The most heavily promoted on the site is financial reward, which is tied to the percentage of influence a member gains across projects. This information is in the members' profile and is summarized in a weekly report showing available balance and points earned. Members with influence are depicted on each project page, which promotes a sense of co-ownership of the product. Members with high earnings are featured on prominent pages along with their income, providing other members with information on what is possible to achieve, and the added incentive of public recognition. Despite the overt financial incentives emphasised by Quirky, the 'Reward' motivation had the greatest discrepancy in responses (highest standard deviation of 1.240). Offering a combination of monetary and non-monetary incentives may optimise participation rates. Non-monetary incentives include praise, attention, grades, prizes, awards, honour-roll lists, public recognition and privileges (Antikainen and Väätäjä, 2009). In this study Recognition (the desire to receive private or public acknowledgement) has been separated from Reward (the desire to receive tangible rewards including money, points in a game, a gift or voucher). Almost half the population were motivated by recognition.

The primary reason for joining Quirky was social: the desire to have shared experiences with others. Over the course of participation, this incentive decreased for most members. In a study of motivations for class participation, Turner and Patrick (2008) found students' participation changed as their beliefs developed with the affordances and constraints of their environment. Walker et al. (2010) described the socio-cultural influence on motivation as the effect of the community on shaping individual incentives over time. Perhaps members reported a decrease because the incentive was satisfied by the system and no longer represented a desired outcome.

Results indicate that long-standing members spent more time on the site per week than members who joined recently and are particularly motivated by Challenge and Recognition. The meritocratic nature of online communities means individuals are initially given equal opportunities and treated accordingly. Public recognition for past work is a mechanism for establishing credibility, giving weight to future contributions and respect by others –forming a reputation economy to advance capable individuals. Results suggest Challenge and Recognition were not strong reasons for joining the site, but developed sometime during membership. Online collective innovation sites can reinforce Recognition through mechanisms such as visualizations of member status, badges and special privileges. Complexities of design problems provide the mental engagement required for Challenge. Quirky members can work across a range of product designs, each presenting unique problems to overcome.

Studies find that online participation reflects power laws such as Pareto distribution and Zipf's law of participation in an online community (see Rafaeli and Ariel 2008 for examples). Quirky members had a similar distribution for their degree of involvement with 18% of members contributing the most often, at over 20 hours a week, once a day or more.

Members involved for under a month and those involved for over six months were more likely to feel passionate about the site/project. A possible reason for this is that long-standing members include many whose motivations align or have realigned towards the motivations supported by the system, while members under six months have greater enthusiasm and willing to 'make a go' of it. The rate of dropping-out, or leaving the site may be greatest somewhere between one and six months, as experience and familiarity with the site grows and initial, perhaps more naive motivations diminish. This hypothesis warrants further investigation to determine whether there is a window of opportunity when systems can boost and broaden their appeal to users in order to maintain and grow patronage.

The Quirky project forum where this survey was advertised is a place where casual visitors and customers are not likely to engage with content. Those who responded to the survey were active members of product innovation, which may explain why only 2% of respondents identified with the Reader category. Regression analysis showed two of the three statements to describe Readers applied to other user types because all members a) noticed when certain members post on different forums or comment, and b) recognised a useful forum post or comment when they saw one. Leaders were similarly underrepresented in the

sample at only 4%. Their role is described as: promoting participation, taking responsibility when problems occur, mediating disputes, upholding policies and dealing with legal challenges (Preece and Schneiderman 2009). Quirky provides a hybrid design process where many aspects of Leadership are addressed by the site and do not require members to adopt the role. The vast majority of the community identified with either the Contributor or Collaborator user type.

Preece and Schneiderman (2009) describe Leaders as having a coherent online identity that usually matches their real identity, however, it was observed on the forums that most members used their real names on the site. Disclosure of identity is less likely to be a feature of Leader user types and more a reflection on the changing nature of online participation. Definitions of normative privacy are changing; where in the past people preferred anonymity and created aliases, now disparate services are unified under one identity such as a Facebook or Google account. Quirky offers users the option of signing in from Facebook, which has its own measures in place to encourage people to use a single, consistent and 'real' identity. Sites adopt this method of facilitating user accounts to avoid the vandalism, bullying and inappropriate communication that often accompanies anonymous membership. Working under a real identity means online contributions can count toward real world opportunities, for example, experience gained online could be used towards a job application, and Career motivations would have greater significance.

7. Conclusions & Significance
This empirical study enhances understanding of the motivations and participation styles in online communities with a focus on collective innovation. The data provides a snapshot of self-reported perceptions collected from a single source at one point in time. Responses are subjective and reflect a personal interpretation of the survey statements. Future research would benefit from a longitudinal study where data can be collected at multiple points in time rather than relying on subject's memories to recall their initial reasons for becoming involved with the site.

Analysis of the data in the context of wider research reveals: that reasons for joining a social network differ to the reasons users continue to participate; that members are primarily motivated to contribute to projects because they are challenged and have fun; that the frequency of contribution follows a power-law distribution; that to successfully transition passive visitors to active members the system can promote intrinsic rewards but provide unexpected extrinsic rewards; and that not all participation types are represented by the community: i.e. the technical and organisational functions are attributed to the environment and professionals.

Results show that participating in online innovation communities is viewed as a fun experience that can challenge members and work on a range of motivations rather than any specific one. Collective innovation sites may be more successful in producing quality outcomes and retaining members if they do not promote extrinsic motivations as the sole reason to entice people to join and to support

intrinsic motivations throughout involvement. Rewarding participants may be most effective when the reward is unexpected and a secondary reason for contributing to a task. A high degree of agreement with motivations other than financial reward suggests sites can provide incentives for participation beyond the monetary. Findings suggest that not all motivations affect participation equally or in a constant way, for example, self-regulation may cause individuals to prioritise motivating factors at different times based on how well they are satisfied. Further, the study shows that members of the community are passionate about their participation when they are new to the site and when they are long standing members. Those whose memberships were between 1 and 6 months did not respond positively to a statement about passion.

The study is an important gateway for framing further research for incentivising collective innovation communities. Future work can build on these findings by further examining participation styles, leading to a more detailed understanding about the roles members assume, their contributions to the design process and how motivations may differ between participant types. Insights from this research can be used as a basis for studies conducted in a more experimental domain. For example, site developers who may have a greater ability to appraise their community can use these insights to assess the strengths and weaknesses of their environment.

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