Motivation and Collective Intelligence: Design Lessons

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Abstract
Designing for successful collective intelligence includes a consideration of motivation. Using design as a focus we can extend our understanding of how advances in computing technology supports individual work to team collaboration to collective intelligence. Moving towards large scale collective intelligence requires a new conceptualization of computer supported work that includes a better understanding of motivation. This understanding draws on research in volunteering from social psychology and the open source software phenomena, and observations of successful collective intelligence web sites. The analysis in this paper develops and illustrates several categories of motivation that can be considered and combined when designing an environment for collective intelligence.

The Case for Collective Design
We are facing design challenges on a much larger scale as we become an increasingly global and technological society. Our design solutions not only need to respond to the needs and desires that may be stated in a specific design problem, but they also need to be environmentally sustainable, attractive to multiple cultural groups, adaptable as technology changes, and intuitive to potential users. In Cradle to Cradle, McDonough and Braungart [1] argue that design for environmental sustainability has lost its way by focusing on reducing the impact of our designs on the environment, and they advocate designing for reuse of natural resources when a product is no longer required. Tim Brown from IDEO proposes that designers cannot meet all of these challenges alone in his talk about design thinking for everyone[1]. Both of these accounts, and a growing number of others, propose that we need to rethink design and extend the capability and responsibility of design thinking to all people. This translates easily to the concept of collective intelligence and social participation.

Many innovative World Wide Web application developers, including Amazon, Google, Second Life and Wikipedia, have successfully implemented novel uses of the internet for large scale communication and collaboration. These developments offer us the opportunity to reconsider designing as a vital role of collective intelligence. There are many examples of the collective construction of knowledge and collective problem solving on the WWW, but we have not yet seen design on a large scale. Collective design can facilitate a more inclusive design process by designers and non-design specialists by motivating the broader community to participate in design thinking.

The Case for Motivation as a Key Consideration in Collective Intelligence
We can conceptualize systems that enable collective intelligence by looking at the progression of computer support for individual work through team collaborative to collective intelligence. For the individual, the primary computational support is the digital file or model. For a team, computer support for communication is an additional necessary component of successful collaboration. When developing new technologies for team collaboration, a space of possibilities is framed by two key considerations: how to provide a shared digital model that serves as an external mental model and how to support communication. A new conceptualization for large scale collective intelligence builds on these two key considerations and adds a third: how to motivate popular participation. To engage the broader population, motivation becomes critical.

[1] http://www.ted.com/talks/tim_brown_urges_designers_to_think_big.html

A shared representation is required for collective intelligence. A (near) real-time external representation acting as shared memory is described in [2], considering the role of representation in reference to theories in philosophy and psychology. Halpin [2] asserts that the wide uptake of socially-generated content provides a community with the ability to influence each other for their greater collective success, and that Web 2.0 is a powerful facilitator for this. Since the individual has a limited and finite memory, they are able to record their thoughts onto the external environment of Web 2.0 and bring about social and collaborative creation and sharing of content. This is possible through intuitive interfaces, social networking tools and shared documents.

Communication enabled by advances in computing technology can be characterized in many dimensions, including mode and type. The mode of communication depends on whether the participants are present at the same time. Synchronous communication requires that participants be present at the same time, and is supported by chat or voice. For asynchronous communication the participants need not be aware of each other's presence and can contribute at different times; this is supported by blogs, wikis, email, discussion forum, or documents. The type of communication can be direct or indirect. Direct communication occurs when one participant sends or posts a message to one or more other participants with the intention of communicating about the problem. Indirect communication occurs when one participant makes a change to the shared representation that can then be seen by other participants. Wikipedia is an example of collective intelligence that occurs with both direct and indirect communication. Individuals can edit Wikipedia articles and thereby engage in indirect communication, and an individual can post a notice on the discussion forum and engage in direct communication.

A key dimension of the conceptual space that describes collective intelligence is motivation: that is, the technologies and organizing principles that attract people to participate. Understanding the range of motivations is an essential dimension of collective intelligence that leads to guidelines for achieving participation from people who may be participating because it is part of their job and society at large who may be volunteering their effort. Motivation theories have been developed from a range of perspectives: from Darwin's evolutionary theory contributing a biological basis for human motivation to intrinsic motivation as described in Maslow's hierarchy of needs which spans from the purely physiological to self-actualization. Merrick and Maher [3] provide an overview of motivation theories and their relevance to computational models of motivation as the basis for implementing a curious agent. Here we focus on studies of motivation as related to volunteer activities and collective intelligence.

Malone et al [4] present an analysis of mechanisms that induce mass-individual participation in several computer-enabled collective intelligence systems. In this study the range and instances of four parameters, or "building blocks" of a collective intelligence task, are framed as question pairs. Who is performing the task? Why are they doing it? What is being accomplished? How is it being done? Malone et al. identify three personal motivations, associated with the question, Why are they doing it? as money, love, and glory. The categories, money, love and glory, are useful generalizations, and are embedded in our categories: money is what we more generally refer to as reward, love is what we more generally refer to as social, and glory is what we more generally refer to as recognition.

Nov [5] identified 8 categories of motivation in a survey of people that contribute to Wikipedia, starting with 6 categories of motivation associated with volunteering defined by Clary [6]: values, understanding, enhancement, protective, career, and social. Nov's additional categories for understanding motivation in Wikipedia are fun and ideology, which are also used in research on motivation to contribute to open software development. Nov's survey found that the top motivations were fun and ideology.

The following categories of motivation are drawn from categories of motivation identified in collective intelligence, open source software, and social psychology literature, and are based on observations of several successful examples of collective intelligence as summarized in Table 1.

These categories go beyond volunteering to include the motivations associated with team collaboration that may be required by en employer or educator.

- *Ideology* – participation for the purpose of contributing to a larger cause.
- *Challenge* – participation that provides a sense of personal achievement through acquiring additional knowledge or skill.
- *Career*– participation that may lead to an advance in the individual's career.
- *Social* – desire to have a shared experience with one or more individuals.
- *Fun* – participation for the purpose of entertainment, enjoyment, excitement, relief from other experiences, or simply furnishing or structuring the passage of time.
- *Reward* – participation to receive tangible rewards includes money, points in a game, a gift or voucher.
- *Recognition* – participation in order to receive private or public acknowledgement.
- *Duty* – participation in response to a wish or command expressed personally.

Table 1: Analysis of Successful Examples of Collective Intelligence

	NASA Click-workers	Google Image Labeller	Wikipedia	Kasparov vs The World	Second Life	I Love Bees
Ideology	X		X		X	
Challenge			X	X	X	X
Career			X	X	X	
Social			X	X	X	X
Fun	X	X	X	X	X	X
Reward		X		X	X	
Recognition		X	X	X	X	X
Duty			X	X	X	

- NASA Clickworkers[2]: The NASA Clickworkers web site shows portions of NASA's image library and encourages individuals to identify features within the images, such as craters on the Martian terrain.
- Google Image Labeler[3]: Google's Image Labeler presents a game-like scenario, to add tags to images, inviting users to work at categorizing online pictures in order to improve Google's search engine in exchange for points and gifts.
- Wikipedia[4]: Wikipedia is often cited as an example of a kind of collective intelligence where many individuals work together to create a vast and socially constructed knowledge base. Any one individual contributes to only a few specific articles of interest, adding their knowledge to them.
- Kasparov vs The World [7]: A 1999 game played over the Internet by Gary Kasparov, the (now former) reigning world chess champion, against Team World, which comprised five consulting chess champions, chess clubs distributed internationally, any person with an internet connection wishing to participate, and chess analysis software. Through their combined effort, a novel move was played by Team World; one never made before in a recorded game.

[2] tinyurl.com/nasaclick
[3] images.google.com/imagelabeler
[4] en.wikipedia.org/wiki/Wikipedia:About

- Second Life[5]: A massive, multiuser online virtual world with anywhere from 120,000 to 1.28 million participants who are able to purchase virtual land, shape the environment, make things, conduct ebusiness and form relationships. The entire world is a collaborative effort and there is a high level of interaction between players.
- I Love Bees [8]: A detective game that was played by over 600,000 participants, most of whom were avid fans of an earlier game, Halo, and were eager to learn more about the sequel to their game. Abstract clues were provided across a variety of media, including a "corrupted" web site. Users were not given any explicit instruction, although the game's designers intended the output to be a narrative providing the back-story to the Halo 2 game. Levels of collaboration were extremely high, with information amassed and elaborated on by many players as the narrative structure evolved.

Summary

This paper presents a conceptual space for collective intelligence that highlights motivation as a key consideration in the way in which the technology is presented and participation is encouraged. Developing successful collective intelligence begins with an understanding how individual and collaborative work is supported with computing technology. Scaling up goes beyond team collaboration to structure and organize the tasks so that large numbers of people are able and motivated to participate. The analysis in this paper develops and illustrates several categories of motivation to be considered when designing an environment for collective intelligence. The paper then shows that successful sites for collective intelligence include more than one motivator and that addressing several categories of motivation encourages more interactive participation.

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[5] secondlife.com/whatis