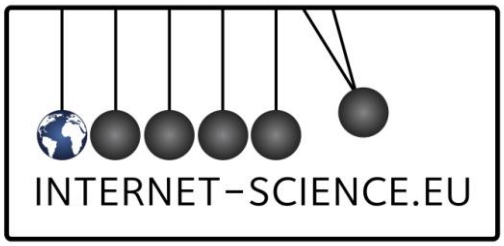
ICT - Information and Communication Technologies



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1 Executive Summary

Online social applications and the integration of sensing devices with mobile communication devices, leverage the heterogeneity of users in terms of interests, preferences, mobility, and enable the generation of various types of virtual (internet-mediated) communities that collectively enrich people's awareness about their environment and promote new forms of participatory processes and approaches to managing its features. Typically, the platforms that host these communities engage autonomous users and deliver a utility that depends on the participants' number and behaviors. In this respect, the challenge for platform designers is to engage people into mechanisms of active contribution and collaboration.

In this deliverable, we investigate different dimensions inherent in these platforms bringing in front the composite socio-psychological incentives that motivate participation, privacy issues and the market viewpoint that may apply to them. We first review formal definitions of virtual communities and related research that introduces criteria for classification of various virtual community paradigms. Relative inputs from theories on the broader context of collective action, public goods' management and social dilemmas have also been accommodated. We then identify and discuss incentives and social mechanisms that are activated in different types of virtual communities, drawing insights and results from social psychology literature and studies on online communities. Finally, we examine existing communities with specific focus on the exposed mechanisms that can affect positively or negatively people's behavior and, ultimately, impact on the community's delivered utility.

2 Introduction

The explosive growth of the Internet since the mid-1990s has fostered the increase of virtual communities in the form of social networking services and online communities. Especially in the last decade, a lot of online systems support massive collaboration in order to produce public repositories of information. These systems cover various areas of interest, such as social networking sites, wikis, open-source software, Q&A sites, internet peer-to-peer (P2P) file sharing networks, Collective Awareness Platforms (CAPs) and many more. The success of these systems relies on the degree of people's contribution and collaboration, so the challenge for system designers is to motivate people to actively participate. Typically, when individuals contribute information or work for a collective benefit, there is a social dilemma involved. Namely, people have to make a decision: *spend effort and time that will benefit others or act selfishly and defer from contributing*?

Because of the diversity of online systems, their purpose and use, it is not trivial to identify an one-fits-all answer as to what motivates people to contribute to them. There are different social psychological incentives that influence individuals' behavior, address their concerns and are related to specific types of contribution. All these aspects and perspectives will be elaborated in this deliverable.

In particular, in Chapter 3 we describe CAPs in the broader context of virtual communities, their various definitions, types and classification rules, and discuss critical concepts applied to them. Further activity in such virtual communities has been studied in the broader context of collective action, public goods and social dilemmas in Chapter 3. Chapter 4 describes incentives and social mechanisms that underlie people's behavior when deciding on their contribution/participation in a collective action system. In Chapter 5, we present different real instances of online cooperation based on recent research and explain how the aforementioned incentives influence contribution in various platforms of virtual communities. This deliverable expands on D1 ("Characterization and typologies of CAPs") and wraps up the work on the information/privacy, market, and socio-psychological dimensions of CAPs (T1.2-T1.4).

3 Background and motivation

3.1 Virtual communities

The definition of term “community” can vary widely in different disciplines and among different individuals [[25]]. A community has both symbolic and functional definitions. People are grouped with respect to physical presence and space, and form urban, rural or suburban communities, but they can also be grouped into symbolic subdivisions based on lifestyle, identity or character and form leisurely, religious or philosophical communities. Raymond Williams in [[56]] in an attempt to discover the essence of community, observed that a community is not just a bounded locale, but also “the quality of holding something in common, as in community of interests, community of goods,… a sense of common identity and characteristics.” The meaning of community evolved so that it encompasses quality and social relationships apart from spatial relations.

The meaning of “virtuality” on the other hand has shifted over the years. “Virtual” and “actual” have not always been opposite and mutually exclusive meanings as we think of them now. As explained by Ryan in [[45]]: “In scholastic philosophy “actual” and “virtual” exist in a dialectical relation rather than in one of radical opposition: the virtual is not that which is deprived of existence but that which possesses the potential, or force, of developing into actual existence.” However in later uses of the notion, especially since the beginning of the eighteenth and nineteenth centuries, this dialectical meaning of actual has been shifting into a binary opposition to real. This means that the virtual becomes the fictive and the non-existent, i.e., as opposed against ‘reality’, illustrated by ideas like ‘virtual reality’. Especially in the popular imagination at the end of the twentieth century, the word ‘virtual’ triggers thoughts of computers and digital technologies.

The term “virtual community” was coined by Rheingold in 1985, when he created the WELL, a "computer conferencing" system, which was one of the first online newsgroups. In his book “The Virtual Community” (1993) he defined the term as “social aggregations that emerge from the Net when enough people carry on those public discussions long enough, with sufficient human feeling, to form webs of personal relationships in cyberspace” [[42]]. In recent literature however, a virtual community has been extended in the following ways: it can include business partners instead of just individuals and it can be partially supported rather than fully supported by technology, thus resulting in the definition:

A Virtual Community can be defined as

- *an aggregation of individuals or business partners*
- *who interact around a shared interest,*
- *where the interaction is at least partially supported and/or mediated by technology and*
- *guided by some protocols or norms* [40].

The term virtual community however seems to include more concepts describing online systems that have emerged during the past decade. For example there seems to be an ambiguity of “virtual communities” and “online social networks” and also between the terms “online collaborative systems”

and “collective awareness platforms”. We will try to give a more detailed description for each of these concepts, which will reveal the similarities and differences between them and position virtual communities in respect to online social networks, online collaborative systems and collective awareness platforms.

Online Social Networks (OSNs): OSNs are online communities among people with common interests, activities, backgrounds and/or friendships. Unlike the Web, which is largely organized around content, OSNs are organized around users. Participating users join a network, publish their profile and any content, and create links to any other users with whom they associate. The resulting social network provides a basis for maintaining social relationships, for finding users with similar interests, and for locating content and knowledge that has been contributed or endorsed by other users [[47]],[[35]]. OSNs are formed through Social Networking Sites (SNSs). An SNS can be defined as a web-based service that allows individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system. An interesting feature of SNS is not that they allow individuals to meet strangers, but rather that they enable users to articulate and make visible their social networks [[13]]. Among the most popular social networking sites are Facebook, Twitter, LinkedIn, Pinterest, MySpace.

Online collaborative systems: These can be defined as systems that enable geographically dispersed teams or individuals, which are action oriented, to work together. Despite of the differing locations, each member’s work or contribution is highly reliant on others’.

Online collaboration is accomplished by providing tools for collaboration, including team areas with member profiles, online discussion areas, document and file-sharing areas, integrated calendaring and collaborative authoring tools. Online collaborative systems are met for learning or working purposes. Weblogs and Wikis can be used for online collaboration, but there are also numerous collaborative platforms [[18]].

Collective Awareness Platforms (CAPs): The Collective Awareness Platforms for Sustainability and Social Innovation are ICT systems leveraging the "network effect" or the “Collective Intelligence” for gathering and making use of open data by combining social media, distributed knowledge creation and data from real environments (Internet of Things - IoT[1]). They are expected to support environmentally aware, grassroots processes and practices to share knowledge, to achieve changes in lifestyle, production and consumption patterns and to set up more participatory democratic

[1] ***Internet of Things (IoT):*** Electronic tags embedded in every item we buy or wear or live in, supporting commerce, maintenance, and operation of countless systems, and offering the means to create a greater pervasive awareness of our surrounding world. IoT brings the promise of providing humans with enhanced sensory capabilities, as well as serious risks to our privacy, depending on the implementation approach that is chosen.

processes. The ultimate goal is to foster a more sustainable future based on a low-carbon, beyond GDP economy, and a resilient, cooperative democratic community. Several efforts have been made by governments and public organizations to cope with environmental problems, however the idea behind CAPs is that much more can be done if citizens are more actively involved, in a grassroots manner [[14]], [[48]].

CAPs apply to different areas, such as systems that create awareness about sustainability impacts on consumers' choice (energy, environment or health), systems for making more efficient and worldwide-scale collaborative consumption (lending, exchange, bartering), systems that gather facts/evidence from citizens for better decision making (at personal or institutional levels), systems that intend to improve public services, urban environments, democracy, Internet, based on open data.

Some examples of the fore mentioned CAPs categories are:

The Eatery: The Eatery provides customized nutritional advice based on actual eating and sharing/comparing eating habits over social networks. Through an iPhone application, the user snaps a photo of his meal, posts it and gets information about his nutrition habits and ways to change habits if necessary.

AIRBNB: renting rooms or places from other people. AIRBNB is a trusted community marketplace for people to list, discover, and book unique accommodations around the world. It gives people the opportunity to monetize their extra space and showcase it to an audience of millions.

Zilok: Rental of objects between professionals or individuals

Eyeonearth: Eye on Earth is a global public information network for creating and sharing environmentally relevant data and information online through interactive map-based visualisations. The overall goal is to improve the environment by sharing information and knowledge.

Safer-streets: Safer Streets allows people to upload pictures or report about accidents.

Safecast: Safecast is a global sensor network for collecting and sharing radiation measurements to empower people with data about their environments.

TheyWorkForYou: a website that monitors the activity of UK politicians.

Collective Intelligence (CI): A definition of the term is given by Malone in [[33]], director of MIT Center for Collective Intelligence (CCI). "C*ollective Intelligence is groups of individuals doing things collectively that seem intelligent"*. The objective of CCI is to find answers to the question: *"How can people and computers be connected so that collectively they act more intelligently than any individual, group, or computer has ever done before?"* Examples of CI systems are Wikipedia, Linux, Google, Ebay, YouTube. Users in these systems work together in effective ways, sometimes even without knowing that they are working together.

Having in mind the definition of a virtual community and the attributes of Online Social Networks (OSNs), Online Collaborative Systems and Collective Awareness Platforms (CAPs), we conclude that they are all virtual communities. A virtual community has four necessary elements (1) a group of people, (2) a shared interest, (3) interaction supported by technology and (4) use of protocols/norms. Overall,

Online Social Networks (OSNs)

1. are formed by a group of people
2. whose shared interest is the creation and maintaining of social relationships
3. where interaction is accomplished through Social Network Sites (SNSs)
4. with protocols defined by the SNS: Create profile, construct list of "friends" and make use of SNS tools for communication.

Online Collaborative Systems

1. are formed by geographically dispersed people
2. whose shared interest is learning or carrying out work
3. where interaction is accomplished through various collaborative platforms (Wikis, Blogs or custom platforms for the specific task)
4. and protocols used are decision making and voting

Collective Awareness Platforms (CAPs)

1. The users of the platform
2. share a common interest like health, environment, society and democracy concern
3. use websites or mobile applications
4. with protocols/norms defined by the specific platform used.

Apparently, there is an ambiguity regarding the terms "online social networks" and "online collaborative systems" as well as the terms "collective awareness platforms" and "virtual communities" since all these terms are closely related yet not identical. In the sequel, we use the term "virtual communities" as an alias for all these related terms.

3.2 Typology of virtual communities

There have been various attempts to systematically categorize and characterize virtual communities. Some of the most recent ones are presented by Markus [[34]], Porter [[40]] and Malone [[33]]. Although these approaches do not deal with the same virtual communities - for example Malone deals only with Collective Intelligence systems - these approaches expose critical similarities.

Markus presents a classification based on the community's social, professional or commercial orientation. At the next level these types can be further broken down based on various attributes of the virtual community, such as member behavior, the community's purpose, or the motives that prompt its members to participate in as shown in Figure 1.

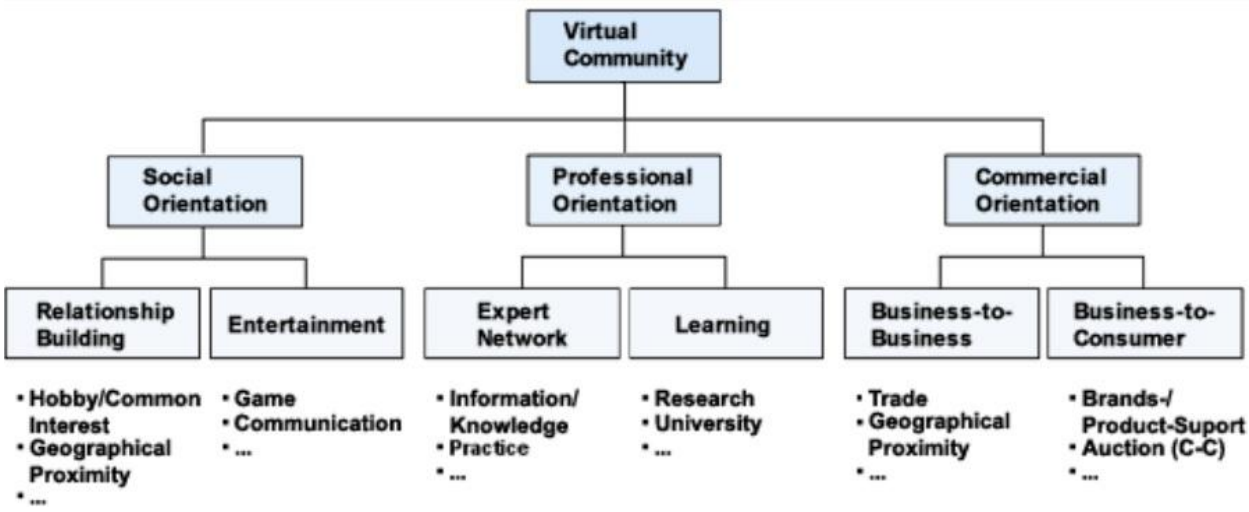

Figure 1: Markus's typology of virtual communities

A couple of years later Porter proposes a different classification of virtual communities. Porter suggests a two-level classification, based on establishment (1st level) and relationship orientation (2nd level) as shown in Figure 2.

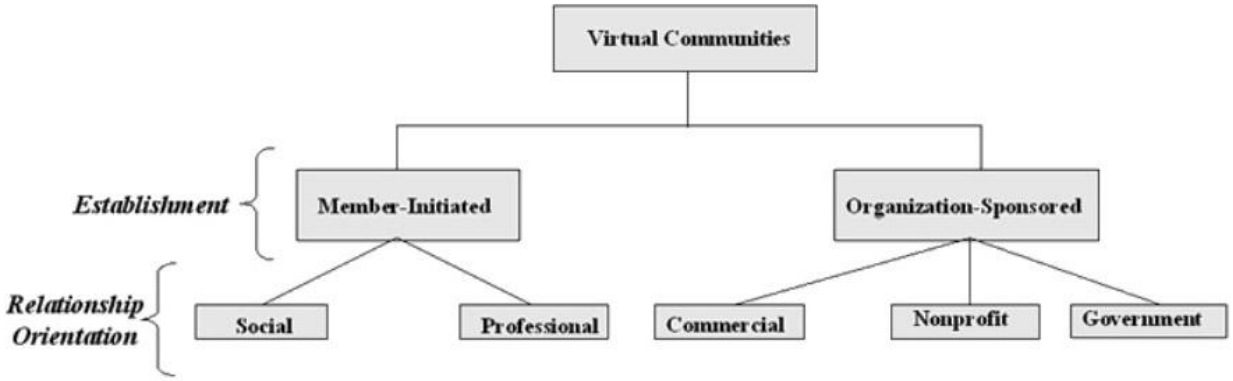

Figure 2: Porter's typology of virtual communities

At the first level we have Member-initiated and Organization-sponsored communities. Member-initiated communities are those where the community was established by, and remains managed by, members. Organization-sponsored communities are communities that are sponsored by either commercial or non-commercial organizations. The second partitioning variable is relationship orientation, because of its importance in virtual communities. This results in having social, professional, commercial, non-profit and government communities in the second level.

Although Markus and Porter use different classification variables, the resulting types of virtual communities show that they have some "blocks" in common. For example both classifications distinguish social, professional and commercial virtual communities. On the other hand, contrary to

Markus methodology, Porter does not use the characteristics of virtual communities in order to classify them. Porter uses this two-level classification and enriched it with an attribute-based description. The reason for not using attributes as categorization variables is that attributes are narrowly focused around disciplinary areas of interest.

The attributes of virtual communities proposed by Porter are (1) *Purpose*, (2) *Place*, (3) *Platform*, (4) *Population Interaction Structure* and (5) *Profit Model*. These are the so-called "Five Ps of Virtual Communities" and when carefully selected in unique combinations when creating a virtual community, are likely to result in successful outcomes for both members and organizational sponsors.

1. The notion of *Purpose* is central in a virtual community, since the community is defined by a shared purpose or interest, which forms the basis of interaction.
2. *Place* is important but difficult to define because of the "aspatial" nature of such communities. In the context of Porter's typology it embraces the notion of "degree of virtualness", meaning that communities can be categorized based on the extent to which community members share virtual space and/or physical space on an ongoing or intermittent basis.
3. *Platform* has to do with the technical design of interaction. The primary factor that distinguishes the capabilities of virtual communities is synchronicity, the degree to which a medium enables real-time interaction. Thus Platform can be conceptualized as having three levels (synchronous, asynchronous and hybrid).
4. *Population Interaction Structure* refers to the pattern of interaction among community members as described by group structure. It can be conceptualized as having three primary levels: small group (where strong ties tend to dominate), network (where weak ties are prominent and stressful ties are likely) and publics (where interaction is variable and likely to include strong, weak and/or stressful ties).
5. Profit model refers to whether a community creates tangible economic value, where value is defined as revenue-generation.

It is important to keep in mind that the classifications proposed by Markus and Porter describe virtual communities of the previous decade. This results in having some differences from the characteristics of nowadays communities. For example, these two approaches stress the existence of commercial virtual communities, that were developed in order for companies to gain more customers, yet this type of community is not so popular any more. Moreover the Profit model described by Porter refers to tangible awards, thus leaving out the importance of non-monetary awards that motivate people, such as social approval, reputation, enjoyment, feeling of contributing to a cause larger than themselves, etc..

In a more recent study focused on collective intelligence (CI) systems, Malone proposed a user's guide to the building blocks of collective intelligence. The idea was to describe the fundamental attributes of collective intelligence systems, thus providing a useful guide for designing a powerful system. After studying 250 examples of web-enabled CI, Malone raised four questions that could

describe a CI system. These questions are (1) *What* is being done?, (2) *Who* is doing it?, (3) *Why* are they doing it? and 4) *How* is it being done. The answers to these questions are the proposed four fundamental attributes for all CI applications. Malone analyzed the possible values for these attributes and by employing an analogy from biology, he described the "genes" of CI systems. A gene is defined as a particular answer to one of the key questions (What, Who, Why or How).

1. *What?* This is the first question to be answered for any activity. It is the mission or goal or simply the task. The task can be to (a) *Create* something new or (b) *Decide* among different alternatives.
2. *Who?* The question is about who undertakes an activity. Possible answers are (a) *Hierarchy*, where someone in authority assigns a particular person or group to perform a task and (b) *Crowd*, where the activity can be undertaken by anyone in a large group who chooses to do so.
3. *Why?* This question deals with incentives, the reason for which people take part in the activity. What motivates them? What incentives are at work? The possible answers are (a) *Money*, where participants earn money from the activity, (b) *Love*, in the sense of intrinsic enjoyment of the activity, the opportunity to socialize, the idea of contributing to something larger than themselves, and (c) *Glory*, which is the recognition of themselves among their community.
4. *How?* The final question is about the structures and processes used. In traditional systems hierarchy is the basic structure used, but novel systems use crowds widely. The proposed "genes" by Malone are focused on answering the *How* question for crowds. The possible values for the How genes are (a) *Collection*, where contributions are made independently of others, (b) *Collaboration*, where members from the crowd work together and there are strong dependencies between their contributions, (c) *Group Decision* like voting, consensus or averaging and (d) *Individual Decisions* where members decide by themselves.

By comparing the building blocks of a CI system proposed by Malone and the attributes of a virtual community presented by Porter, we identify similarities in the proposed attributes/features/modules, as Table 1 suggests. This leads us to the conclusion that these attributes, although described by slightly different names, are indeed fundamental attributes of a virtual community, based on which they can be characterized and classified.

Table 1: Comparison of attributes of virtual communities

Malone's CI genes	Porter's VC attributes
What?	Purpose
Who?	Population
Why?	Profit Model
How?	Platform

3.3 The Free-Rider Problem

In general, participants in collective action can opt for being active contributors or free-riders. In economics, collective bargaining, psychology, and political science "free-riders" are those who consume more than their fair share of a public resource, or shoulder less than a fair share of the costs of its production. Free-riding is usually considered to be an economic problem, only when it leads to the non-production or under-production of a public good, or when it leads to the excessive use of a common property resource. The free-rider problem is the question of how to limit free-riding or its negative effects in these situations.

The classic example and origin of the term is a free-rider on public transportation. Someone who hops on a bus without paying the fare, benefits from the bus paid for by other riders, as well as tax levies that raise money for transportation. If enough people evade the fares, the bus becomes unsustainable to run. Another example of the free-rider problem is defense spending: nobody can be excluded from being defended by a state's military forces, and thus free-riders may refuse or avoid paying for being defended, even though they are still as well guarded as those who contribute to the state's efforts. Therefore governments avoid relying on volunteer donations and use taxes instead.

In the context of virtual communities, free-riders can put the viability of the community at risk. According to Beenen et al. in [[28]], many online communities fail due to low contributions. Even the ones that survive have low contributions. In Gnutella two thirds of the users free-ride and 10% of the users provide 87% of all the music. In open source development communities 4% of developers contribute 88% of new code and 66% of code fixes. Although not everyone needs to contribute in order for the community to be successful, when there is a large proportion of free-riders, it is difficult to provide nominal services to the members.

3.4 Game Theory

Contribution in virtual communities can be examined in the broader context of public goods and social dilemmas. When individuals contribute information or work for a collective benefit, there is a social dilemma involved. That is, they have to make a decision either to spend effort and time that will benefit others or act selfishly and don't contribute at all.

Social dilemmas are situations in which self-interest is at odds with collective interests. A social dilemma has been described as a conflict in which most beneficial action for an individual will, if chosen by most people, have a harmful effect on everyone. This behavior, people being selfish or cooperative, is met in various fields of research like economy, biology, psychology, sociology and political science and in order for researchers to study social dilemmas, game theory is used.

Game Theory is the logical analysis of situations of conflict and cooperation. Game Theory is so named because it abstracts from and generalizes the study of traditional games, e.g., chess, bridge and

poker, but this abstraction and generalization is powerful enough to include a wide variety of important social situations. For example, companies pursuing corporate strategies or political candidates trying to win the elections are both playing a game.

In Game Theory a *game* is built, which models some important features of the real situation. A game is defined by as a situation in which:

1. There are at least two *players*
2. Each player has a number of possible *strategies*
3. The strategies chosen by each player determine the *outcome* of the game
4. Each possible outcome is a collection of numerical *payoffs*

So, Game Theory investigates how players should rationally play games. Each player selects one of his possible strategies (one of which can amount to free-riding) and anticipates the game to end with an outcome that gives him as large payoff as possible. But the outcome is not determined by his choice alone, but also upon the choices of other players, and this is where conflict and cooperation arise.

3.4.1 Prisoner's Dilemma

The most widely studied and used game in social science is the *Prisoner's Dilemma*. It is the simplest possible case of a social dilemma, which involves two people faced with the decision of whether to cooperate or behave selfishly (defect). Both can gain by cooperating, but there is a temptation to be selfish, since the payoff is bigger for the one who defects. If both people behave selfishly, however, they are both worse off than they might have been otherwise. In Prisoner's Dilemma there is a conflict between individual rationality and group rationality. When individuals rationally pursue their own best interest, this results to an outcome which is unfortunate for both of them.

The importance of Prisoner's Dilemma is that many social phenomena seem to have Prisoner's Dilemma at their core. Because this kind of conflict between individual rationality and group rationality is so widespread, there have been a number of attempts to resolve the Prisoner's Dilemma, usually by finding some argument which can justify playing the cooperative strategy. One way to do this is to play iterated Prisoner's Dilemma. Axelrod in [6] invited professional game theorists to write computer programs to play iterated Prisoner's Dilemma. The one that won, called Tit-For-Tat, was the simplest one, and its strategy was simple reciprocity which cooperates on the first move and then does whatever the other player did on the previous move. Axelrod noticed that the most successful strategies of the tournament shared some common properties: *avoidance of unnecessary conflict by cooperating as long as the other player does, provocability in the face of an uncalled-for defection by the other, forgiveness after responding to a provocation, and clarity of behavior so that the other player can recognize and adapt to your pattern of action*.

These kinds of strategies that reinforce cooperation prove that cooperation based on reciprocity can prove helpful where there is a conflict between individual rationality and group rationality.

3.4.2 Public Goods Game

In economics, a *public good* is a good that is both non-excludable and non-rivalrous in that individuals cannot be effectively excluded from use and where use by one individual does not reduce availability to others. Public goods are closely related to the "free-rider" problem, since someone can benefit from resources, goods, or services without paying for the cost of the benefit. Public goods are also related to the "Tragedy of the commons", where consumption of a shared resource by individuals who act independently and rationally according to each one's self-interest – and not according to the group's interest - may result to the depletion of a common source.

The social dilemma of public goods situation is that although a group of cooperators is always better off than a group of defectors, defectors exploit cooperators in groups. Since the late 1970s, economists, social scientists and evolutionary biologists have used the public goods game as a model to study the problem of maintaining cooperation in a group of unrelated individuals. The Public Goods Game is a standard of experimental economics, where a typical public goods experiment involves a group of people who must decide whether to contribute to a group project or account.

The basic ("one-shot") Public Goods Game consists of a group of individuals who are asked to secretly choose how many of their private tokens to contribute to a public pool. The items in the pool are then multiplied by a factor (greater than one and less than the number of players - N) and they are divided and equally distributed to all the players of the group, either they contributed or not. Any remaining tokens are allocated to a private account. At the end of the round participants see either the individual contributions made by members of the group or the total (and therefore average) contributions to the public account without learning the identity of the group members. A variation of this game is "repeated-play", where this one-shot game is played over a finite number of rounds, which proceeds in the same manner.

Rational self-interest suggests that an individual player has no incentive to contribute, so economists' prediction is that the outcome of this process will be zero contribution. Experimental research on public goods games though has shown that after 10 rounds of repeated play, contribution is rather high in the beginning and decreases over time, but never drops to zero. This means that people are not as self-interested as theory suggests, given that contributions are high in the beginning, but over time, self-interested behavior becomes more pronounced and free-riding increases.

Fehr and Gächter in [[15]] identified punishment as a mechanism to maintain cooperation in public goods experiments. Free riding generally causes very strong negative emotions among cooperators and there is a widespread willingness to punish free riders. Fehr and Gächter conducted an experiment with and without punishment opportunities and proved that when punishment was not possible, complete free-riding was the dominant strategy. On the contrary, in the treatment with punishment contribution rates increased, even though punishment was costly for the punishers.

Fischbacher et al. in [[19]] investigated how conditional cooperation can improve contribution in a public goods experiment, i.e., people who want to contribute the more to a public good the more others contribute. Conditional cooperation can be considered as a motivation on its own or be a sequence of some fairness preferences like altruism, warm-glow or reciprocity. Researchers conducted a novel experiment, where the main task of the individuals was to indicate for each average contribution level of other group members, how much they wanted to contribute to the public good. The results of the experiment showed that a third of the subjects can be characterized as free-riders and that roughly 50% of the subjects showed conditional behavior, meaning that their own contribution increased in the other group members' average contribution. Considering this result, Fischbacher et al. suggested that the often observed decay of cooperation in a repeated public goods game can be explained as a reaction to other players' contributions.

Anderson and Holt in [[2]] in their study on Experimental Economics and Public Choice summarized the factors that affect contribution. Among the ones that have a positive effect are: a) Marginal per capita return – MPCR, which is the private benefit of the contributors, b) Internal Return (one's private return), c) External Return (benefit to others), d) Group Size and e) Communication. Repetition and Experience have a negative effect on contribution whereas Anonymity seems to not influence contribution at all.

4 Contribution in virtual communities

As discussed earlier in the typology of virtual communities, there is a fundamental question as to *Why* people get engaged and cooperate in virtual communities. What motivates them to participate, invest time and effort and help others that they have not met before and probably will never meet in the future? Motivation is a powerful mechanism that underlies people's behavior. It is a psychological feature that arouses an individual to act towards a desired goal and elicits, controls, and sustains certain goal-directed behaviors. It can be considered a driving force that makes people act in a certain manner.

4.1 Motivation Types

Motivation can be divided into two types, *intrinsic* and *extrinsic* motivation. Intrinsic motivation is the one that arises from within the individual. It refers to motivation driven by a personal interest or enjoyment in the task itself and does not rely on external pressure or rewards. Intrinsic motivation occurs when an activity satisfies basic human needs for competence, control, and autonomy. This makes the activity interesting and likely to be performed for its own sake. Extrinsic motivation, on the other hand, comes from outside the individual. It involves engaging in a behavior in order to earn external rewards or avoid punishments. These rewards can be tangible, e.g., money, trophies or psychological such as social recognition, glory or praise. Sometimes people do not get direct payments or recognition, but hope that participating in an activity will increase the likelihood of their earning future payments, as in cases where people perform a task in order to enhance their professional reputation or improve their skills.

Between intrinsic and extrinsic motivations there exist some motivations that are considered as a mixture of intrinsic and extrinsic; they are clearly not intrinsic at the outset, but undergo an internalization process that moves them away from strictly extrinsic motivations. These incentives are called *internalized extrinsic motivations*. This internalization occurs when individuals assimilate external incentives and transform them into their own motives and lead to self-regulation. This type of incentive will be discussed in the sequel5.3.

Apart from the intrinsic and extrinsic incentives that motivate people, there are also a number of social mechanisms that generate incentives, which in turn influence people's behavior. The ones met most frequently in virtual communities will be also discussed in this section.

4.1.1 Motivation Crowding Effect

The phenomenon that external intervention (e.g., monetary incentives or punishment) may either undermine (crowd-out) or strengthen (crowd-in) intrinsic motivation is called the motivation crowding effect. This effect was first mentioned by Titmuss in his book *The Gift Relationship* (1970), who argued that paying for blood would reduce the willingness to donate blood. At that time there was not any empirical evidence, but since then this phenomenon has been widely researched in social

psychology. The theories of intrinsic motivation emanating from social psychology have been integrated into economic theory. But the crowding-out effect is one of the most important anomalies in economics, as it suggests the opposite of the most fundamental economic law, that raising monetary incentives increases supply. Now it is admitted by both social scientists and economists that motivation can be negatively affected when a previously non-monetary relationship is transformed into an explicitly monetary one.

Standard economic theory does not usually differentiate between intrinsic and extrinsic motivation and the reason for this is that it is difficult to determine which part of the employee's motivation to perform his task is intrinsic and which not. Motivation Crowding Theory tries to mediate between the standard economic model and psychological theories.

Motivation Crowding Theory suggests that the psychological conditions under which the crowding effect appears are:

a) External interventions crowd-out intrinsic motivation when people perceive it as controlling. In this case people feel controlled and self-determination decreases.

b) External interventions crowd-in intrinsic motivation when people perceive it as supportive. In this case people feel that they are given more freedom, so self-determination increases.

An extensive meta-study in psychology that reviewed more than 120 studies about the motivation crowding effect confirmed that tangible rewards indeed crowd-out intrinsic motivation. The only case when this does not apply is when the reward is unexpected or not contingent on task behavior. The main negative effect of rewards is that they undermine self-regulation, so people take less responsibility for motivating themselves. Also, when external motives are given in order to lead people towards more efficient choices from a welfare point of view, this fails because it absolves people from moral obligations.

The motivation crowding effect has been researched in other areas such as children's learning behavior, work conditions in a firm, the reaction of managers to various forms of supervision by their superiors, the readiness to accept nuclear waste repositories ("not in my backyard" or NIMBY-problem), the amount of civic virtue exhibited (e.g., tax morale). All these cases have revealed that rewards can control people's behavior. The crowding-in and crowding-out effect exist when external rewards are given [[21]].

4.2 Social Comparison

Social comparison can be described as the process where people compare themselves to others. It was first described and analyzed by Festinger in [[16]], who proposed nine hypotheses under which social comparison processes take place. His theory was based mostly on comparisons of abilities, emotions or personality traits and very little on comparisons of opinions.

Festinger set the basics for social comparison theory and a lot of research has been done after that. There are three fundamental questions that Social Comparison theory addresses: a. *Why Do people Engage in Social Comparisons?* b. *To Whom Do People Compare Themselves?*, c. *How do Social Comparisons Influence the Self?*

a. *Why Do People Engage in Social Comparisons?*

People's tendency to engage in social comparisons is based on motivational considerations. One basic reason is the need to know themselves. People have a basic need to maintain an accurate self-view, therefore they seek information feedback about their characteristics and abilities. Another reason is the need to create and maintain a positive self-image. A third need that is fulfilled by social comparison is the need to self-improve. All these can be characterized as strategic processes, which are executed in order to satisfy certain motives and needs such as *self-evaluation*, *self-enhancement* and *self-improvement*. People not always engage in social comparison intentionally. There are times when this happens spontaneously and without intention. This means that there are additional reasons why people compare with others. One reason is that information about characteristics, abilities and performance concerns attributes that are defined in a relative rather than absolute manner. Moreover comparisons allow people to process information in a more efficient way compared to the processing of information of absolute models. Social comparison requires less processing capacity, so it can be an efficient way of self-evaluation, because the less information people have to consider, the faster they come to a conclusion.

b. *To Whom Do People Compare Themselves?*

People compare themselves with others in different ways according to the motive they need to fulfill. Since there are three basic motives that underlie social comparison, there are also three kinds of comparisons respectively. In the case of self-evaluation the selection of similar others is important, because only comparisons with similar standards provide diagnostic information about one's self. A comparison with someone with much different characteristics provides little information and cannot be helpful for a person to evaluate himself. Comparison with similar others is also called lateral comparison. In the case of self-enhancement, that is the need to maintain a positive self-view, people make comparisons with inferior others (downward comparison). This kind of comparison has the potential to protect or enhance one's self-view and people with a threatened self-view have a tendency to engage in downward comparisons. Finally the need to self-improve is fulfilled by comparisons to superior others (upward comparison). This kind of comparison motivates people and provides information on how to make progress. Usually one selects people with slightly superior characteristics for comparison. If comparison is made to someone with extremely superior standards, this could have the opposite result, because people could react defensively.

Finding a comparison standard is not always a simple task. Often, there seem to be too many choices and too little time. There is a case where people follow routines in selecting social comparison standards, in order to simplify the complex task of selecting a standard. In this case people simply compare with those standards they routinely use for comparison. The more often a particular

comparison is carried out, the more accessible and efficient the process of relating one's attributes to this standard becomes, and the more likely one is to further engage in this specific comparison.

c. *How Do Social Comparisons Influence the Self?*

Social comparisons influence self-perception, affective reactions, motivation and behavior. Research has shown that there are a lot of consequences of social comparisons on the self. The question however is to which direction this influence goes. When people compare themselves to others, this comparison can result to *assimilation* or to a *contrast effect*.

Assimilation happens when people take in new information or experiences and incorporate them into their own existing ideas. In this way they tend to modify experience or information somewhat to fit in with their preexisting beliefs.

The contrast effect is a phenomenon where people perceive greater or lesser differences than are actually present as a result of immediately prior or simultaneous exposure to a stimulus with similar base characteristics, but different value.

When assimilation occurs, judgments are correlated positively, meaning that people evaluate themselves to be better after a comparison with a high than a low standard. When contrast effect occurs, judgments are correlated negatively, meaning that people evaluate themselves to be worse after comparing to a high than a low/inferior standard.

One important factor that comparison leads to assimilation or to a contrast effect is self-construal. Construals are how individuals perceive, comprehend, and interpret the world around them, particularly the behavior or action of others towards themselves.

There are also additional factors that make comparisons lead to assimilation or contrast. These are the extremity of the standard, the ambiguity of self-knowledge, whether the standard belongs to the ingroup or outgroup, whether one cooperates or competes with the standard, logical closeness between the self and the standard, etc.. The contrast effect is more likely to happen if the standard is an extreme standard, if it belongs to an outgroup or if the self-knowledge holds clear implications for the upcoming self-evaluation. On the other hand, social comparison may result in assimilation if the standard is a moderate one, if it belongs to the same category as the self (ingroup), or if the self-knowledge is ambiguous concerning the dimension on which self-evaluation occurs.

Finally, another factor which determines whether comparison may lead to assimilation or contrast is the perceived similarity of the self and the standard. When people believe that the standard is similar to them (similarity testing) this leads to assimilation, whereas when the standard is perceived to be different that the self, this leads to the contrast effect.

4.3 Social Identity - Similarity

In social identity theory the self is reflexive in that it can take itself as an object and can categorize, classify or name itself in particular ways in relation to other social categories or

classifications. This process is called self-categorization and through this process an identity is formed. A social identity is a person's knowledge that he or she belongs to a social category or group. A social group is a set of people who view themselves as members of the same social category, in which they share common attitudes, beliefs, values, affective reactions, behavioral norms, styles of speech etc.. Through a social comparison process, persons who are similar to the self are categorized with the self and are labeled the "in-group", whereas persons who differ from the self are categorized as the "out-group". When people form a social identity, there are two basic processes involved: self-categorization and social comparison. The perceived similarities between the self and other members of the in-group and the perceived differences between the self and members of out-group make people categorize themselves accordingly. The social categories in which people place themselves are part of a structured society and exist only to other contrasting categories; each has more or less power, prestige, status and so on. These categories precede people. People are born into an already structured society. A person derives his identity from the social category he belongs. However, he can become a member of unique combinations of categories over the years; therefore the set of social identities making up the person's self concept is unique [[52]].

The need to identify communities is of great importance in sociology, biology and computer science where systems are often represented as graphs. When a social network is represented as a graph, *community detection* is finding groups of vertices within which connections are dense, but between which connections are sparser. This heterogeneity of connections suggests that the network has certain natural divisions within it. In social networks for example, nodes tend to create tightly knit groups characterized by high density of ties, which is measured by the clustering coefficient - a measure of the degree to which nodes in a graph tend to cluster together. Identifying meaningful community structure in social networks is a hard problem, because of the extreme size of real networks and also because of the sparseness of it.

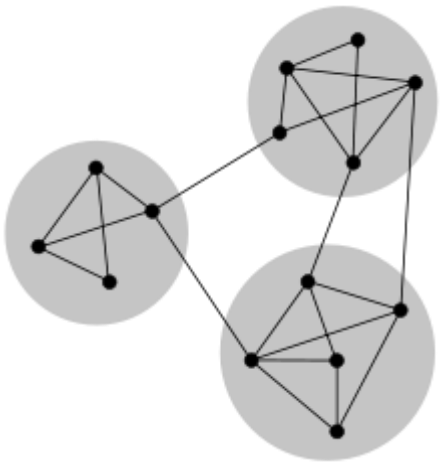

Figure 3: A small network displaying community structure, with three groups of nodes with dense internal connections and sparser connections between groups

In the simplest case, a network can be represented by a set of nodes or vertices joined in pairs by lines or edges. The problem of finding good divisions of networks has been studied for some decades in

computer science and sociology, which have developed different approaches. Newman in [[36]] presented both traditional and more recent approaches for community detection as follows. The method used in computer science is graph partitioning – the division of vertices of the network into a number of groups with roughly equal size, which is done by algorithms like Spectral Bisection or The Kernighan-Lin algorithm. In sociology the principal technique is hierarchical clustering. The idea behind this technique is to define a similarity measure quantifying some type of similarity between node pairs. Having this similarity measure, one groups similar nodes into communities according to this measure. Apart from these traditional approaches for community detection, other more recent algorithms have been implemented that can apply to general network analysis, like the Girvan and Newman algorithm and its variations.

4.4 Social Loafing and Social Facilitation

Social loafing and social facilitation are both social mechanisms that are closely related with co-operation or at least with the presence of others. These two mechanisms were originally considered as separate areas of research in social psychology, but it turns out that they are closely related.

Social loafing has been described as the process where participants working together put out less effort than participants working alone. The phenomenon was originally reported by Ringelmann (1913), who noticed that students working together pulled on a rope with less force than was expected on the basis of their individual efforts. The term social loafing was introduced later by Latane (1979), who described it as a reduction in effort and demonstrated results for both sexes on tasks requiring physical effort (clapping, pumping air, shouting) or cognitive effort (reacting to proposals, brainstorming, solving mazes). In Latane's description the loafing effect is a "group vs individual" effect, meaning that the only criterion that mattered was the number of people performing a task and not other parameters that influenced people's performance.

Social facilitation on the other hand is the tendency for people to act better on simple tasks in the mere presence of others. This effect was first noticed by Triplett (1898) who found that children reeled more fishing line when working alongside other children compared to working alone. The term "social facilitation" was coined later by Allport (1924), who is considered the founder of social psychology. The usual findings in social facilitation research were that working together leads to enhanced performance on simple tasks and debilitated performance on complex ones. The explanation given by Triplett was that people acted competitively in the presence of others, while later Zajong (1965) offered a drive interpretation of this phenomenon. This activation theory that Zajong introduced was the most parsimonious theoretical explanation for facilitation effects for a decade, although there was controversy over whether it was the mere presence of others that increased drive or the fact that these others were associated with evaluation.

A quick observation of these two paradigms of social facilitation and social loafing leads to a contradictory result: Both tasks (reeling line and pulling rope) are similar and simple tasks, but in the first one working together leads to better performance than working alone, while in the second

working together has the opposite effect. Harkins (1987) examined both effects under another perspective, which was evaluation. He showed that the two effects are closely related and not contradictory, in fact they are complementary. Harkins in [[24]] argued that experimental conditions in loafing and facilitation fall into three cells of a 2 (Alone vs. Co-action) x 2 (Evaluation vs. No Evaluation) factorial design. He ran experiments that realized these conditions and concluded that the most important factors that influenced the participants' behavior were the number of participants and evaluation. This agrees with the idea that the mere presence of others plays an important role in performance (facilitation). Harkins also showed that there is no difference in the research results in the two theories, but that they are complementary. In facilitation research, when people work together, they produce better results than working alone. In loafing research, the results are pooled (meaning that there is no evaluation) and that explains why participants do not try as hard as they would if they were alone. In both cases evaluation is critical: the possibility of evaluation is increased by co-action in facilitation cases whereas the possibility of evaluation is small in loafing cases.

4.4.1 The N-Effect

Another factor that has an impact on social facilitation is the number of participants that take place in a task. As mentioned above social facilitation is the tendency for people to act better on simple tasks in the mere presence of others. This holds for a limited number of participants. But when "a few others" become "many", then competitive motivation decreases resulting in decrease of the facilitation effect. A recent study by Garcia and Tor in [[23]] regarding the number of participants in a task revealed that there is a boundary condition in social facilitation. This phenomenon is called the *N*-Effect and it is the discovery that increasing the number of competitors (N) can decrease the motivation to compete.

Garcia and Tor conducted a number of experiments that showed that the *N*-Effect is an important factor linked to the social comparison process. The factors that were originally examined by Festinger [[16]] as those that amplify competition were subjective factors. Later studies introduced that also objective, contextual factors influence the motivation to compete. The *N*-Effect continues in this direction revealing the impact of a ubiquitous contextual factor – the number of competitors – on social comparison and thus on competitive motivation.

4.4.2 The Collective Effort Model

The importance of social loafing and the free-rider problem has led to the development of research in this area. Karau and Williams in [[26]] developed the Collective Effort Model, a theory to explain why people often work harder individually than in groups. According to this theory, people work hard when they think their effort will help them achieve outcomes that they value. Working in a group can influence how hard people work, because it can change their perception of the importance of their contribution to achieving a specified level of performance, their likelihood of reaching the goal, and the value they place on the outcomes they gain by their efforts.

Karau and William analyzed 78 studies and stated that social loafing is a robust phenomenon and generalizes across tasks and populations. They found that variables such as evaluation potential, expectations of co-workers' performance, task meaningfulness and culture, have strong influence on social loafing.

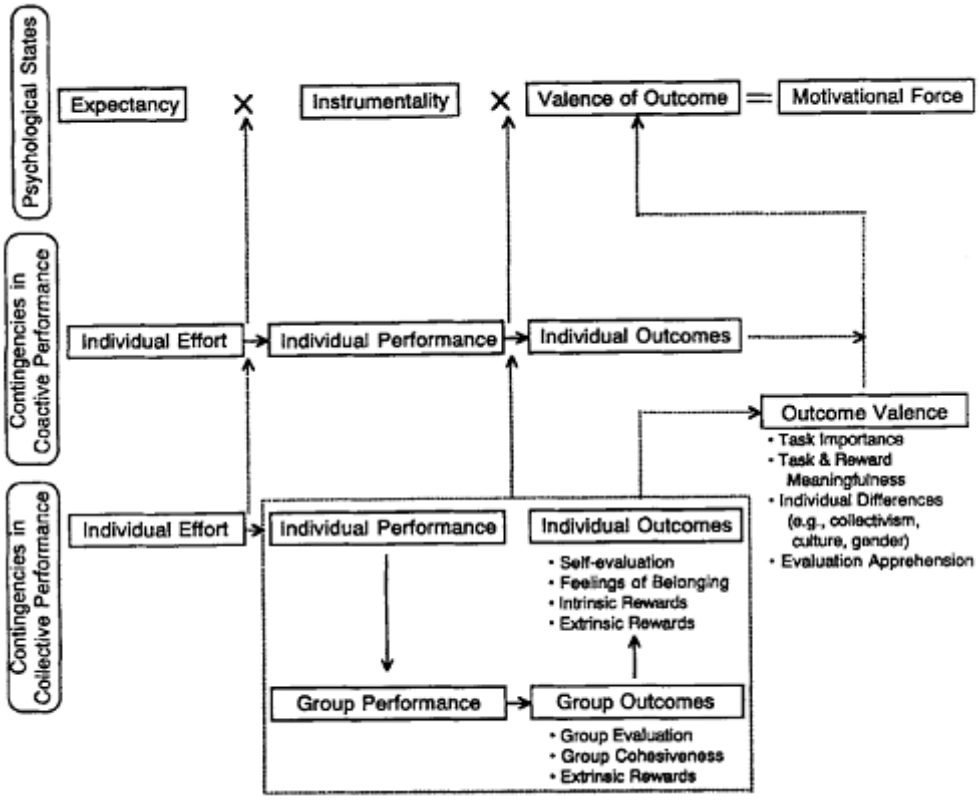

Figure 4: The Collective Effort Model

The studies examined by Garcia and Tor showed that there is evidence of the N-Effect across different contexts. People can experience or anticipate social comparison concerns, when there are a few competitors. As the number of competitors increases, these concerns – which are an interpersonal information based process – become diffused by the sheer number of competitors, because it becomes less viable and informative for them to compare themselves with a great multitude of targets.

Having this in mind, we may argue that in order for social facilitation to exist, the number of participants should remain low, because adding too many competitors may dampen rather than enhance the motivation to compete.

4.5 Privacy/Trust

All various instances of virtual communities are fundamentally dependent on grassroots participation and information sharing. However, the information that a platform requires to properly work and deliver a targeted utility is acknowledged as a sensitive asset. People have a right to privacy,

and if their privacy is compromised, their trust in the platform could decrease and even make them cease contributing. A domino effect is possible if news about privacy breaches reach other users.

4.5.1 Privacy/Trust in Virtual Communities

According to Ridings et al in [[43]] trust can be defined as an implicit set of beliefs that the other party will refrain from opportunistic behavior and will not take advantage of the situation. In traditional communities research has shown that people work together with others they trust and avoid contact with those they do not trust. In virtual communities however, trust is somehow different because people may never actually meet in person. This luck of face-to-face contact and visual cues and also the fact that people can present a fake identity regarding age, gender or other personal information do not favor the development of trust. On the other hand there are factors that foster the development of trust, such as, the closeness developed by the common mutual interest in the community's topic, repeated interaction with others, open public replies and debate of messages. In any case however, when rules do not provide sufficient guarantees that others will behave as they are expected to, which is often the case in virtual communities, trust serves as a subjective substitute for such rules, creating the necessary atmosphere that makes engagement with others more open.

Research on trust has supported that trust is multidimensional, consisting of three distinct beliefs or factors: ability, benevolence and integrity. Ability is skills or competencies that enable an individual to have influence on a certain area. This applies to virtual communities, because they are centered around a specific mutual interest, hobby, event or occupation. Benevolence is the expectation that others will have a positive orientation or a desire to do good to the trustee. Integrity is the expectation that someone will act in accordance with socially accepted standards of honesty or a set of principles that the trust accepts, such as not telling a lie and providing verified information. Ridings et al. in [43] argue that the three dimensions of trust that apply in traditional communities can be combined into two dimensions in the context of virtual communities: ability on the one hand and benevolence/integrity on the other. Benevolence and integrity both lead to the same behavior, which is reciprocity in the form of maintaining the community conversation, and therefore are combined in this research. Ridings et al. also present a research model that comprised of three antecedents of trust that acted as the input parameters of the model, the two dimensions of trust (ability, benevolence/integrity) and the output parameters, which is the desire to exchange information (get or give). The antecedents of trust are a) Perceived responsiveness, b) Others' confiding personal information and c) Disposition to trust.

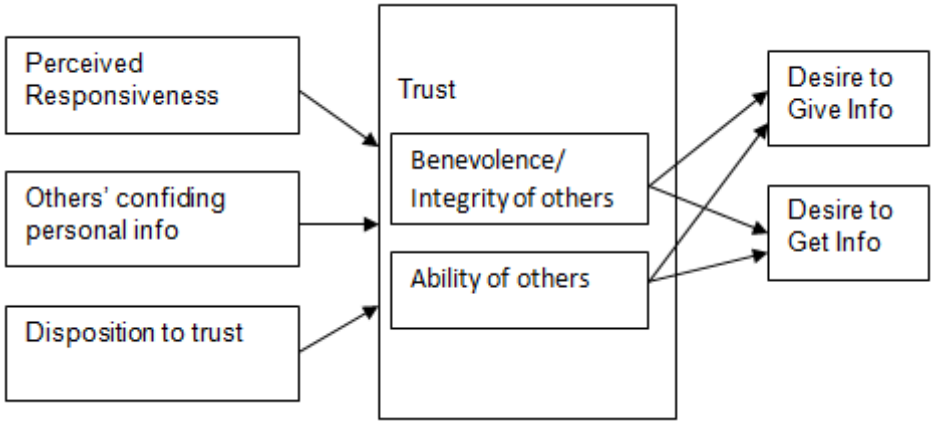

Figure 5: Ridings et al. Research Model

The methodology used to test the research model was a cross-sectional survey of virtual community members. In contrast with older research that took place in laboratory settings, Riding's research used field survey methodology in order to maximize external validity of the actual membership perception regarding trust in real virtual communities. The results showed that trust is indeed a significant predictor of members' desire to exchange information, and especially to get information. The effect of trust for getting information, rather than giving, was stronger, because trust is based on people's need to depend upon others given that no enforcement rules exist to guarantee this behavior.

Another finding of the research was that perceived responsiveness builds trust. When others reply quickly and often to messages, members in the community will have higher levels of trust. Also when people confide personal information, trust in others increases. Members of a community will trust others more when they know something personal about them. Finally disposition to trust is also positively related to trust in others, indicating that people who are generally trusting, exhibit more trust in others.

Preserving the privacy of information that users share is acknowledged as a necessary condition for the success, and sustainability operation of the platforms that host the virtual communities. The trade-off between privacy and application utility has mostly been studied in the context of publishing data in a database [27]. In this context, privacy is equated with re-identifiability, rather than with, for example, the quantity of data disclosed: The data is anonymized and the attacker tries to link it to the user who produced it (i.e.,, re-identify the user). Moreover, for the most part, privacy in data publishing has not been studied with a specific application in mind, and hence utility metrics could only be generic: for instance, an anonymized database is useful if it preserves the average of all entries, or, more strictly, if it preserves the distribution of entries [41]. Only recently have specific privacy-utility frameworks been proposed for concrete applications (smart meters, [46]). There, (negative) utility is measured as the distortion between the true and the perturbed value of data.

4.5.2 Privacy/Trust in Websites

Trust has been investigated in different perspectives in recent literature. One of them is Chesire's et al. research in [[11]], which focuses on general and familiar trust in websites. *General website trust* is the individual's context-independent attitude about trustworthiness of typical websites. The term *familiar website trust* refers to the perceptions of trustworthiness of websites and information systems that an individual visits frequently. Perceptions of trust related to websites that are a part of people's daily habits are more circumscribed than for the general category of all websites. These attitudes are not only context specific but also informed by particular histories of contact and established patterns of regular interactions. These two types of web trust are comparable to *system trust*, which exists when a computer or information system is assumed to operate in a predictable or reliable way. Thus, general and familiar website trust only deal with the perceptions that individuals develop about websites or systems, not their interpersonal relationships mediated through communication technology.

Chesire et al. examine four parameters that influence website trust. These were

a) Online activity,

b) General trust and caution,

c) Information technology knowledge and

d) Experience of adverse online event.

Each parameter had a different effect or relationship to website trust. For example, increased activity was positively related only to general website trust, which means that experience with web-based systems is part of a reciprocal cycle of online activity and general website trust. The same did not hold for familiar website trust. Saying that someone who visits certain websites on a regular basis (familiar websites), has reduced trust in these, sounds like a paradox. One explanation is that frequent users become informed critics of websites in general or another explanation is that individuals who engage in more online activity also build a clear sense of prudence about their frequently visited websites.

In order to examine their research hypotheses, researchers analyzed data from a survey of online behaviors and attitudes. The survey included questions regarding socio-demographic characteristics, frequency of online activity questions, attitudinal questions about general trust and caution and agreement statements related to website trust. The survey was distributed by using the open-source survey tool to a sample of 970 people.

General trust and general caution showed strong positive relationships with general and familiar website trust. Individuals with the greatest levels of general trust and caution were associated with the highest amounts of general and familiar website trust. Just as in offline interactions, the most rewarding and prudent long-term strategy may couple high trust with high caution on the Internet.

The next factor examined was the knowledge of information technology. Research showed that it has a positive influence on both general and familiar website trust. People with high IT knowledge believe they have the capability to assess accurately the trustworthiness of the sites they use on a regular basis (familiar website trust) as well as websites more broadly (general website trust).

Trust is also related to with the experience of adverse events on the web, but not in the way we may think. Results showed that general website trust decreases after a bad incident on the web, but familiar website trust does not. This happens because people could change their daily habits, thus making familiar websites self-correcting. Moreover, familiar websites become a part of life in the same way preferred organizations or companies do. When individuals develop a loyal relationship with websites and then experience an adverse event, it can create a contradictory relationship between perceptions known in social psychology as "cognitive dissonance". When an individual is faced with a salient contradiction between a belief and a relevant behavior, the individual will either escape the conflict entirely or change the belief or behavior to reduce the importance of any one of the dissonant elements [[17]]. In the online context, the positive emotions and attitudes that people experience from website dependability can conflict with the negative consequences of a major adverse event such as a phishing attack or significant loss of data. If it is too difficult or impractical to change daily habits by avoiding certain websites, many individuals may resolve the cognitive dissonance created by an adverse event by choosing to believe that the adverse event was not so bad after all or that it is unlikely to reoccur.

Table 2: Comparison of factors related to trust

Ridings et al.	Chesire et al.
Perceived Responsiveness	Online activity
Ability	Information Technology Knowledge
Disposition to trust	General Trust and Caution

Comparing the two researches presented in this review, Rindings' and Chesire's, we can see a few differences. First, Ridings deals with trust in virtual communities, whereas Chesire deals with trust in websites, which include virtual communities. Although the two approaches examine different factors that influence trust, it is possible to draw parallels between them (Ref.Table 2). In any case, trust is indisputably a major issue that influences individuals' behavior in virtual communities, and has to be examined carefully when a virtual community is developed.

4.5.3 The Privacy-Utility Tradeoff

We contribute original research that quantifies the tradeoff between user privacy and utility in the context of a user community in a location-based service [50]. We also refer the reader to EINS JRA5 Deliverable 5.2 [7] in which this research has also been reported.

4.6 Altruism

Altruism is the principle or practice of concern for the welfare of others. It is a traditional virtue in many cultures and a core aspect of various religious traditions. Altruism is the opposite of selfishness. Pure altruism consists of sacrificing time, energy or possessions for someone other than the self without expecting any compensation or benefits, either direct, or indirect. Altruism has been a topic in various areas of research, like psychology, sociology, anthropology, neurobiology. Regardless of the perspective of each research though, altruism is always caring about the welfare of other people and acting to support them.

In this deliverable, we examine altruism from the psychological perspective. The International Encyclopedia of the Social Sciences defines *psychological altruism* as "a motivational state with the goal of increasing another's welfare". There has been some debate on whether or not humans are truly capable of psychological altruism. Some definitions specify a self-sacrificial nature to altruism and a lack of external rewards for altruistic behaviors. However, altruism ultimately benefits the self in many cases. Thus, the selflessness of altruistic acts is brought to question. The social exchange theory postulates that altruism only exists when benefits outweigh costs. Also the theory of psychological egoism suggests that no act of sharing, helping or sacrificing can be described as truly altruistic, as the actor may receive an intrinsic reward in the form of personal gratification. But the validity of this argument depends on whether intrinsic rewards qualify as "benefits."

The empathy-altruism hypothesis states that psychological altruism does exist and is evoked by the empathic desire to help someone who is suffering. Research has found that people are most likely to help if they recognize that a person is in need and feel personal responsibility for reducing the person's distress. Individuals are also affected by the number of bystanders witnessing distress (the Bystander affect). Usually when the number of bystanders increases, people feel that it is not their responsibility to help, so they act less altruistically. However, a witness with a high level of empathic concern is likely to feel personal responsibility regardless of the number of bystanders.

Finally, volunteerism can be seen as a form of altruism. Several studies on this area have shown that volunteers have increased life satisfaction and significantly resulted in less depression and anxiety. People who volunteer have better physical and mental health. This adds to the assertion that when people act altruistically, they indeed receive intrinsic rewards and feel personal gratification [[1]].

4.7 Social Approval

Social approval, in the context of virtual communities, is analyzed by Chesire in [[9]] as a selective incentive that influences people's behavior regarding contribution. It involves the ability to have one's contributions evaluated by others in the community and/or evaluate the contributions of others. People care about what others think about the information they share, so the rating they will get will affect their future contribution in the community. When individuals contribute to a virtual

community, they gain some intrinsic satisfaction from the popularity of their own contributions in the form of psychological efficacy, leading to an increased desire to share more in the future. As more people acknowledge someone's contribution as desirable, the popularity of his contribution increases. Social approval is a two-direction process, since members of a virtual community in addition to receiving social approval, may participate in giving social approval by rating the popularity of other's contributions. Thus, it is possible for giving and receiving social approval to affect behavior. Individuals may cooperate because they care about their popularity rating (receive social approval) and/or because they want to vote on the contributions of others (give social approval). Social approval is a combination of both processes.

This kind of social approval is completely restricted to the individual, meaning that the person that receives social approval is the only one who knows his popularity rating and thus, is totally different from public reputation, where someone's popularity is available to other members of the group. In the latter case, the incentives that motivate people to contribute are different and more related to the social desirability bias incentive, which is presented next.

4.8 Social Desirability Bias

Antin and Shaw in [[5]] describe social desirability bias as the tendency of people to deny socially undesirable traits or qualities and admit to desirable ones. The theory of social desirability bias suggests it is primarily the result of two underlying social psychological processes. First, it is impression management, in the sense that because one wants to be socially desirable, makes an effort to mold his/her public image and to construct a favorable presentation of self based on expectations, norms, and beliefs about a given context. Secondly, social desirability can be a form of self-deception. In this respect, social desirability is often an attempt to deny one's "true" attitudes, or mask an underlying belief by expressing a contradictory one. Social desirability is often subtle, unconscious, and based on implicit attitudes which individuals are not aware of or able to express.

Researchers have found social desirability bias in survey responses on many controversial topics such as immigration, affirmative action, and racial prejudice. Several studies have documented pervasive biases in behavioral and attitudinal scales commonly used in organizational behavior research and also in marketing research. When survey studies are conducted, this effect has to be taken into account, because it can produce inaccurate results which misrepresent the "true" prevalence of attitudes.

4.9 Observational cooperation

Chesire in [[9]] described observational cooperation as the ability to monitor the total amount of contributed information in a generalized information exchange system. Observing cooperation in the network can influence contributions because individuals tend to orient themselves towards the average behavior of other group members. When people observe how much others are contributing, they stimulate a normative response to reciprocate by cooperating as well. Thus reactive behavior is closely

tied to reciprocity. Chesire argued that individuals are likely to imitate the perceived aggregate actions of others when observing cooperative behavior either through a sense of normative compliance or a sense of obligation.

4.10 Uniqueness

Apart from people's need for similarity which brings affiliation, belief validation, emotional security, liking and social influence, people also have the need for uniqueness. Interpersonal difference or uniqueness contributes to self-identity, attracts attention and enhances self-esteem and social status. Uniqueness theory was developed by Snyder and Fromkin in 1980 in their book "*Uniqueness: The Human Pursuit of Difference*", where they stated that people seek to establish and maintain a sense of moderate self-distinctiveness, because perceptions of either extreme similarity or extreme dissimilarity are experienced as unpleasant. The basic idea of uniqueness theory is that everyone has a need or desire to be moderately dissimilar to others. As described by Snyder and Fromkin, the uniqueness motivation has three explanations. The first one is that people are in fact moderately different form one another and have learned to perceive themselves accordingly. Second, people learn to value a sense of uniqueness in environments that encourage freedom and independence. Third, people prefer a moderate level of self-distinctiveness because they have needs for social acceptance, approval and validation as well as for uniqueness.

Snyder and Fromkin developed the first scale for measuring the need for uniqueness, known as the NU scale, by incorporating 32 items that were correlated according to uniqueness. Critics of NU scale argued that it put too much emphasis on public and socially risky displays of uniqueness, whereas people also pursue uniqueness in more private and socially acceptable ways. Another approach to measure uniqueness was made by Lynn and Harris in 1997, who created the self-attributed need for uniqueness (SANU) scale. This scale was accepted as a valid measure of uniqueness motives and it also approached distinctiveness in more socially acceptable ways.

There are many dimensions where people can pursue self-uniqueness. For example, when people are asked to describe themselves, they mention their abilities, appearance, beliefs, behavior, families, friends, possessions or hobbies. Snyder and Fromkin suggested that people prefer to be unique on attributes that are highly relevant to their self-concepts and that do not lead to social rejection. Lynn and Snyder in [[32]], who analyzed previous research regarding uniqueness, suggested that people are more likely to pursue uniqueness on attributes that are already self-defining, on attributes whose rarity is difficult to falsify, and on attributes whose rarity satisfies more than uniqueness needs.

When uniqueness theory was first presented, the dominant view of interpersonal differences had a negative meaning. The message from social psychology was that similarity leads to social acceptance. It was after the research conducted by Snyder and Fromkin, that uniqueness gained a more positive meaning and proved itself to bring personal and social benefits.

4.11 Reciprocity

Reciprocity in social psychology refers to responding to a positive action with another positive action. Reciprocity is an extrinsic incentive, when seen from the contributor's view, in the sense that when one cooperates or contributes, he expects a return. But besides been driven by incentives, reciprocity can also derive from a desire to repay the help or knowledge received from the community before.

4.11.1 Reciprocity Types

Reciprocity is one of the fundamental ways that enhances cooperation. Novak in [[37]], who is the director of the Program for Evolutionary Dynamics at Harvard University, states that *direct reciprocity*, *indirect reciprocity*, *network reciprocity* and *group selection* are four of the five rules for the evolution of cooperation.

Direct reciprocity

Direct reciprocity happens when repeated encounters between the same two individuals take place. In every round each player has a choice between cooperation and defection. If one cooperates now, then the other one may cooperate later and this way it might payoff to cooperate. As mentioned in Section 3.4.13.4.1, this is the case of repeated Prisoner's Dilemma. Also, the best strategy according to Axelrod in [[6]] was Tit-for-Tat. Novak argues that this strategy is an efficient catalyst of cooperation in a society where nearly everybody is a defector, but another strategy called "win-stay, lose-shift" exposes stronger potential to maintain cooperation. "Win-stay, lose-shift" is a simpler strategy of Tit-For-Tat and the idea is to repeat a previous move when doing well and changing otherwise.

Indirect reciprocity

Although direct reciprocity is a powerful mechanism for the evolution of cooperation, it does not cover all aspects of human nature. There are cases when a person who receives help, cannot help the donor directly. For example people donate to charities that do not donate back to them. Direct reciprocity is like a barter economy based on the immediate exchange of goods, whereas indirect reciprocity is like the invention of money. Indirect reciprocity is the case where randomly chosen pair-wise encounters between members of a population take place. In this case, it is not possible for two individuals to constantly interact with each other. One individual acts as donor and the other as recipient and the same two individuals need not meet again. The mechanism that helps indirect reciprocity is reputation. When someone helps somebody else, this establishes a good reputation, which will be rewarded by others. This interaction – helping behavior – is observed by individuals who might inform others. In this way reputation allows evolution of cooperation by indirect reciprocity.

This kind of reciprocity is met in animals in simple forms, but only humans are able to engage in the full complexity of the game. The reason is that indirect reciprocity has high demands of cognitive skills. People must remember their own interactions and also be aware of the ever-changing social

network of the group. Moreover language is needed in order to spread the gossip (reputation) associated with indirect reciprocity.

Network reciprocity

The argument that defection is the natural selection is based on a well-mixed population, where everybody interacts equally likely with everybody else. But real populations are not well mixed and spatial structures or social networks imply that some individuals interact more often than others. In order to study how spatial structure affects evolutionary dynamics, evolutionary graph theory is introduced.

In evolutionary graph theory, individuals of the population occupy the vertices of a graph and the edges determine who interacts with whom. In network reciprocity a cooperator pays a cost for each neighbor to receive a benefit. A defector pays no costs and his neighbors receive no benefit. In this setting, cooperators can prevail by forming network clusters where they can help each other.

Group selection

Selection exists not only on individuals but also on groups. In a simple model of group selection, a population is subdivided into groups. Cooperators help others in their own group and defectors do not help. When individuals contribute, they reproduce proportionally to their payoff and offspring is added to the same group. If a group reaches a certain size, then it splits into two. Because there is a constraint on the population size, another group will become extinct. In this scenario, there is competition between groups. Some groups grow faster than others and split more often. In fact, pure cooperator groups grow faster than pure defector groups, whereas in a mixed group, defectors reproduce faster than cooperators. This model is based on "group fecundity selection", where group of cooperators have a high rate of splitting into two. There is also "group viability selection", where group of cooperators have small probability to go extinct. In any model of group selection though, group selection favors cooperation.

Novak supported that all these types of reciprocity under certain conditions, which take into account the cost-to-benefit ratio of the altruistic, the reputation and the number of neighbors (according to the reciprocity type selected) lead to the evolution of cooperation.

4.11.2 Reciprocity Motives

The concept of reciprocity and its types, as presented above, has been studied in the context of evolutionary biology, but reciprocity applies to social phenomena as well. Ye et al. in [[57]] examined the motives that develop reciprocity in online communities. They examined reciprocity from the receivers' perspective based on equity theory and social identity explanation of the de-individuation Effects model (SIDE). The research was based on a large-scale survey in an online forum for English language learning. The parameters measured were a) community norm, b) indebtedness and c) perceived anonymity and how these parameters influence the intention to reciprocate.

Equity theory focuses on an individual's perception of fairness or equity in social exchanges. An equitable relationship exists when individuals perceive that they are receiving relatively equal outcomes from the exchange compared with their inputs. A perception of inequity in an exchange results in the feeling of indebtedness, which motivates individuals to commit to a reciprocal behavior in order to avoid being perceived as socially insensitive.

The *social identity model of de-individuation effects (SIDE model)* is a theory that explains the effects of anonymity and identifiability on group behavior. Anonymity depersonalizes social perceptions of others and the self. In online communities the de-individuating features (perceived anonymity, physical isolation and selective self-presentation) decrease perceptions of individual differences. This leads individuals to focus more on their self-conception, increase their adherence to community norms and form more positive impression about online communities.

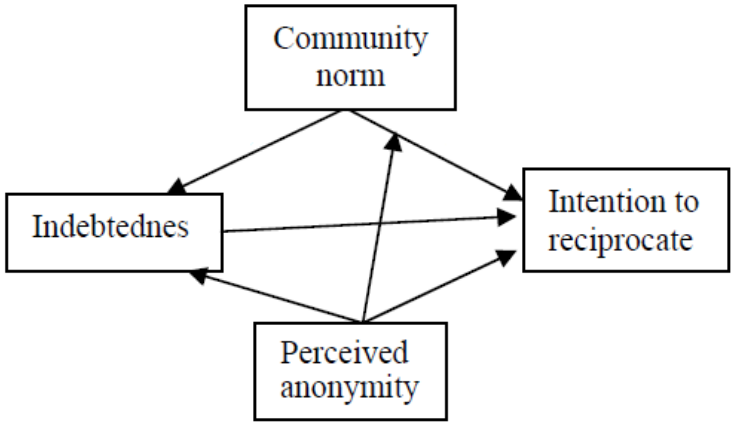

Figure 6

Figure 6: Ye et al. Research Model for Reciprocity in Online Communities

Intention to reciprocate is defined as the intention of beneficiary to return help to the benefactors or those who are in the benefactors' group.

Community norm is defined as a belief of how one ought to behave. It refers to a rule for what should be done, accepted, and internalized by the group members. It triggers the enforcement of the prescribed behavior by informal social sanctions. The more individuals are motivated to conform to community norms, the more their attitudes tend to be community determined than individual-determined.

Indebtedness is defined as a state of obligation to repay another in the context of receiving a benefit from another. In online communities, when members receive help from other members, they compare it with their own contribution. After comparison, if they find an inequity in the exchange, they will feel indebtedness because this is in conflict with their own positive impression and self-perception.

Perceived anonymity refers to the extent to which community members cannot identify other members or the source of a particular contribution to the group. In online communities face-to-face interaction and self-regulation is absent. Anonymity of others leads to heightened self-awareness, and thus to greater adherence to group norms. The heightened self-awareness leads members to focus more on their own feelings and behaviors in the community.

The research model showed that perceived anonymity is not only positively related to indebtedness and intention to reciprocate, but positively moderates the relationship between community norm and intention to reciprocate. Also, community norm was found to positively influence intention to reciprocate and indebtedness. This can be explained by the fact that anonymity increases individuals' self-awareness and hence their intent to maintain a good self concept. If community norm is strong, perceived anonymity increases individuals' intent to conform to community norms and hence reciprocate. A strong norm indicates a strong peer expectation and individuals tend to conform to this expectation in order to be legitimate and be liked by others. The results also showed that indebtedness positively affects the intention to reciprocate.

The most interesting result of this research was the influence of perceived anonymity on reciprocity. Counter-intuitively, it showed that perceived anonymity enhances the intention to reciprocate. The de-individuating features of online communities like visual anonymity, physical isolation, and selective self-presentation, lead to decreased perceptions of individual differences and increased adherence to group norms. In order to sustain positive impression formation, people tend to be more prosocial and helpful to others. Thus, during the knowledge exchange in online communities, members who perceive people as anonymous tend to be active in reciprocating the community to maintain their self perception.

Moreover, the feeling of indebtedness increases the will to reciprocate. Individuals who receive help in online communities are likely to believe that they are receiving help from the community as a whole and not from a specific individual, thus they reciprocate the community to repay the favors of the community.

4.12 Goal Setting

In [[30]] Locke and Latham summarized findings from previous research on goal setting theory. Goal setting theory was developed within industrial/organizational psychology during a 25-year period based on about 400 laboratory and field studies. These studies showed that when goals are specific and high, this leads to better performance, than if goals are easy or vague such as the usual "do one's best". It has been proven that when a person is committed to a goal, has the ability to attain it and does not have conflicting goals, then there is a positive linear relationship between goal difficulty and task performance.

There are four mechanisms or moderators of the relationship between goals and performance. These are *feedback*, which people need in order to track their progress; *commitment to the goal*, where one has to view the goal as important; *task complexity*, where one realizes that task knowledge is

harder to acquire on complex tasks; and *situational constraints*. One such constraint is role overload - when the resources available are not enough for a goal to be accomplished, then goals cannot affect performance positively.

Some important aspects of goal theory are the following:

Goal Choice: The level at which a goal is set depends on self-efficacy, past performance and social influences.

Learning Goals: Sometimes people focus on reaching the goal rather than on acquiring the skills to accomplish it. This is known as the "tunnel-vision". In such cases, it is better if a learning goal is assigned, that is a goal to acquire the required task knowledge.

Framing: The framing effect in psychology means that people react to a particular choice in different ways depending on whether it is presented as a loss or as a gain. Regarding goal setting, it has been proved that when one perceives a goal as threatening, then this influences performance negatively.

Group Goals: Apart from individual ones, goals can be effective when set in groups. Groups add a level of complexity, because there may be conflicting goals among group members. Besides that, group goals have the advantage of sharing information among members, which leads to better performance.

Goals can be effective when they come from different sources. They may be assigned by others, they can be set jointly through participation or they can be self-set. In the latter case, goals are a key element in self-regulation. In the context of incentives, goal setting is an intrinsic motive, when it comes from within the individual, whereas in all other cases goal setting is considered an extrinsic motive.

4.13 Feedback

Feedback is defined by Chesire and Antin in [[10]] as the interactive process in which information is returned in response to a contributor's action. Feedback incentives take place in order to encourage repeat offerings to an information pool once an individual has already made at least one contribution. Feedback mechanisms are also called retention incentives that encourage people to contribute over time, in contrast with capture incentives, which aim to encourage people to contribute for the first time.

Feedback can be synchronous, when it immediately follows an action and asynchronous which occurs at a later time, perhaps as an email or other message. In the case of synchronous feedback, Chesire and Antin examined 3 different types: *Gratitude*, *Historical Reminder* and *Relative Ranking*. Gratitude can be expressed as a positive emotional response to a contribution. A mild positive emotion such as gratitude can affect behavior in a positive way, when cost of contribution is low. Historical reminder simply informs contributors about their prior contribution behavior. An individual's own

past behavior has been shown to be a predictor of future contributions in collective action problems. If people are reminded of their previous actions in the system, they may continue to contribute to it. Finally relative ranking is an important type of feedback and is defined as aggregated information that combines one's own behavior with the average behavior of others. Research has shown that when people have very specific knowledge of others' past contribution behavior, they actually reduce contributions to a public good. But when they have knowledge about cumulative group behavior, this can positively affect contributions.

4.14 Monetary Incentives

As discussed earlier, there are extrinsic incentives that motivate people to act towards a desired goal. Monetary incentives are a case of extrinsic incentives and according to the context used, they are designed accordingly.

Monetary incentives have been used widely in the labor market, in the form of bonuses, stock options, profit sharing, raises, in order to inspire employee loyalty and increase productivity. The promise of a financial gain is an important motivator in markets and traditional organizations.

Monetary incentives are also used in virtual communities to encourage the participation of their members. For example, a website, Wall Street Survivor, offers their members the opportunity to test their knowledge and hone their skills on a virtual stock market. Investors can compete to win real cash rewards for the best managed weekly, overall and risk-adjusted stock portfolios. Another example is a travel community that uses gifts to encourage participants to contribute more content on the website. People write reviews and upload photos for the rewards or gifts offered by the community [[29]].

The effect of monetary incentives has also been studied in open source software projects (OSS) by Roberts et al. in [[44]]. Although OSS communities do not have a profit motive and hence don't offer monetary compensation to contributors, the commercial interest in the software industry is so pervasive, that private companies assign many of their paid employees to work on OSS projects that are particularly important to the company. Such cases are IBM's involvement in Linux and Apache projects and Time Warner's engagement in Mozilla. In Roberts' research the results showed that monetary incentives were associated with a higher level of contributions to the source code. This is rather an unexpected result, since monetary and extrinsic motives in general cause the so-called *crowding-out effect*.

4.15 Reputation

Reputation of a person, social group or organization is an opinion about that entity, as a result of social evaluation on a set of criteria. Reputation may be considered as a component of identity as defined by others. Reputation is important in various areas like business, education, online communities, because it influences peoples' behavior and decisions.

In the context of virtual communities, where people are asked to contribute information, evaluate others for their contribution or make use of information from the virtual community, reputation matters because it enhances trust. Reputation is an important motivator for those who are influenced about others' opinions. In this case a social desirability component is present, which motivates people to act towards a way that will improve their reputation, in order to become more socially accepted.

4.16 Gamification

We could argue that the social mechanisms and intrinsic motives that affect collaboration mentioned in previous sections, follow human evolution from its early stages. The mechanism presented in this section though, is a rather new one. Gamification is the concept of applying game mechanics and game design techniques to make products and services more fun and engaging. The term was coined by Nick Pelling in 2002, a computer programmer who had the idea of using game-like accelerated user interface design in order to make electronic transactions both enjoyable and fast [[38]]. At that time gamification was intended for electronic devices and not for Web. The concept received a lot of attention in 2010 and 2011, when marketers realized that applying this technique would increase loyalty and interaction in various applications. Since then the term gamification became widespread in a more specific sense, referring to applying aspects of games into software.

Gamification is based on three different areas, a) Loyalty Programs (marketing efforts that reward, and therefore encourage, loyal buying behavior), b) Game Design Techniques and c) Behavioral Economics and it has been proven that when applied to a website or platform, user interaction and loyalty increase drastically. The effects of gamification were soon noticed and its use accelerated. In a 2011 announcement, Gartner, the world's leading information technology research and advisory company, predicted that *"over 70 percent of Global 2000 organizations will have at least one gamified application, and that gamification is positioned to become a significant trend in the next five years"* [[8]]. Nowadays there are already a lot of companies that use this technique and also companies that have created gamification platforms and provide game mechanics as a service for the purposes of marketing and customer retention. The most prominent of them are Bunchball, BigDoor, Badgeville and IActionable.

Some of the game mechanics used are badges, bonuses, levels, points, progression bars, countdown, epic meaning (when participants believe they are working to achieve something great and bigger than themselves), ownership (that creates loyalty), competition with other players and also virtual currency. According to gamification.org, i.e.,, the leading information site and community for the gamification trend, these techniques can be applied on various industries, such as Gamification of Art, Gamification of Education, Gamification of Entertainment, Gamification of Design, Gamification of Environment, Gamification for Social Good, etc. [[22]].

The importance of gamification is based on incentives. Gamification techniques strive to leverage people's natural desires for competition, achievement, status, self-expression, and altruism.

People are highly motivated by recognition. For example, making the rewards for accomplishing tasks visible to other players or providing leader boards are ways of encouraging players to compete. When people gain points, they receive psychic reward, but this reward is amplified when they can share it with others.

Critics of gamification argue that this trend creates an artificial sense of achievement or that it can encourage unintended behaviors. In the marketing business critics argue that gamification can be a trick for increasing customers in the beginning and marketers should think of what will happen when the point system gets old, as well as what type of relationship they want to have with their customers [[49]].

In any way, various examples have shown that gamification has indeed a positive influence in getting people to engage and participate in virtual communities. Picking the correct mechanics and procedures is the key for a successful design in each case.

4.17 Summary

Table 3 summarizes the incentives and social mechanisms presented in this chapter and shows whether the underlying motive is intrinsic or extrinsic. Most of the incentives and social mechanisms described have intrinsic motives and only a few have purely extrinsic motives. An interesting observation is that intrinsic and extrinsic motivations are not mutually excluded - they may coexist in human behavior.

By definition, intrinsic and extrinsic motives are both present in the motivation crowding effect. For example when external intervention undermines (crowd-out) or strengthens (crowd-in) intrinsic motivation.

Reciprocity is an extrinsic incentive, in the sense that when one contributes, he expects a return. But from another point of view, reciprocity can also stem from a desire to repay the help received, making it an intrinsic incentive.

Gamification can also be considered to have both intrinsic and extrinsic motives. Although game mechanics like badges, bonus, points etc. can be considered as external motives, the social mechanisms that underlie like social comparison, reputation or group identification have to do with intrinsic motives.

Table 3: A complete list of incentives and social mechanisms where intrinsic and/or extrinsic motives are present

Incentive / Social Mechanism	Intrinsic	Extrinsic
Motivation Crowding Effect	X	X
Social Comparison	X	
Social Identity	X	
Social Loafing and Social Facilitation	X	

Trust	X	
Altruism	X	
Social Approval	X	
Social Desirability Bias	X	
Observational Cooperation	X	
Uniqueness	X	
Reciprocity	X	X
Goal Setting	X	X
Feedback		X
Reputation	X	
Monetary Incentives		X
Gamification	X	X

5 Cooperation in virtual communities

This chapter presents examples of cooperation based on recent research, which have investigated how different types of incentives and social mechanisms affect contributions in online communities. According to the type, purpose, quantity of contribution, context or other characteristics of each virtual community presented, different incentives are important. The examples are thus classified according to *Environment/Type of virtual community, Number of users*, *Cooperation*, *Experiment method*, and *Incentives and/or social mechanisms present*. For each experiment, results follow.

5.1 Selective Incentives and Generalized Information Exchange

In [[9]] Chesire investigated how generalized exchange systems emerge, when information, as the object of exchange, produces a collective good. When people contribute information for a collective benefit, they are engaged in a social dilemma. Two properties of information, replication and high jointness of supply, are crucial for understanding the nature of social dilemma in this kind of exchange systems. Chesire argues that these special features of information combined with low cost of contribution, can allow social psychological selective incentives to significantly encourage cooperation in generalized information exchange systems. The two incentives examined were social approval and observational cooperation.

Environment/Type of virtual community

The area where research was conducted was generalized information exchange systems. A generalized exchange system can be defined as a system where the reward that an actor receives is usually not directly contingent on the resources provided by that actor. When the object of exchange is information, then this is the case of generalized information exchange. Such systems are open source software and P2P file sharing networks.

The nature of the object of exchange plays an important role in social exchange. Information, which was examined in this paper as the object of exchange, has two important properties: a) information has the quality of replication, which means that information can be transferred without the original owner losing his copy. As a result the contributor does not lose the information he shared. b) information can be consumed by many individuals without losing much or any value at all. Thus information can have high jointness of supply. Jointness of supply refers to the way that consumption of the public good affects the availability of that good for other individuals. Information that is transmitted over the internet is an ideal example of how jointness of supply and replication can operate in information exchange.

Number of users that participate in the virtual community

P2P networks have millions of users. For example, BitTorrent, which is the most widely used file sharing network on the Internet, has 150 million users as of January 2012 (according to

BitTorrent.inc). Gnutella, which was the first decentralized P2P network, had a user base of millions in 2010 and eDonkey had three million nodes measured in 2005.

Cooperation in the virtual community

Peer-to-peer file sharing networks are systems where individuals share digital files such as music, movies, software and images. In a peer-to-peer network, tasks (such as searching for files or streaming audio/video) are shared amongst multiple interconnected peers who each make a portion of their resources (such as processing power, disk storage or network bandwidth) directly available to other network participants, without the need for centralized coordination by servers. P2P networks reach their full potential only when large numbers of nodes contribute resources. But in current practice P2P networks often contain large numbers of users who utilize resources shared by other nodes, but who do not share anything themselves (often referred to as the "freeloader problem"). Freeloading can have a profound impact on the network and in some cases can cause the community to collapse. According to various studies on P2P networks researchers found that only 30% of users share files in Gnutella and the files they share are not necessarily the most desirable ones. Another study on KaZaA showed that people who shared files were only 9% of total users.

Experiment method

The experiment that was conducted in this study though, was not made in a real P2P network. The experiment situation was designed to approximate a simplified version of a real world system of digital information exchange, like those found on the internet. The experiment took place in the Department of Sociology at Stanford University. A total of 179 students participated in the experiment, which consisted of 10 rounds in which participants had to decide whether or not to contribute digital information goods to a collective information pool. Participants did not know in advance how many rounds there would be. In the beginning of the experiment participants were asked to give a list of their 20 favorite songs, movies or books and were told that they would use these items in a series of internet exchanges. Each item had a value of 10 points. In each round they had to decide whether to contribute one item or not. When contributing one item, all participants would gain 10 points except from the contributor. Moreover, the contributor would pay a small transfer cost of 5 points. So, the only way for someone to gain points was if other individuals contributed.

Incentives and/or social mechanisms present

The incentives studied were social approval and observational cooperation. As discussed in Section 4.74.7, social approval is the ability to have one's contributions evaluated by others in the community and/or evaluate the contributions of others. The social approval condition was realized by allowing the participants who contributed in the previous round to vote for up to five items from the list of information goods as "the best items". After the voting ended, each participant saw a bar chart on the screen that displayed his popularity rating from the previous round if he had contributed. If the participant had not contributed in this round, then he saw a message saying "no current contribution".

In the high social approval condition, participants' contribution rate is 75-95% and in the low condition, participation rate falls at 5-25%.

The observational cooperation condition was manipulated similarly to the social approval condition. A bar chart was used to display the amount of observational cooperation in each round. In the high condition the individual saw that 75-95% of users contributed in the previous round and in the low condition the individual saw a percentage of 5-25% of contribution. The difference with the social approval condition was that, in this case, participants would see the observational cooperation bar chart whether they had contributed in the previous round or not.

Results

Studying the results of this experiment led to interesting conclusions. Regarding social approval, the experiment showed that both high and low social approval positively influence contribution. Even when social approval is low, participants – especially in the early stages – want to contribute to the system. This was an unexpected and exiting finding in this study. The kind of social approval used in this study was different than public reputation which may motivate contribution behavior for different reasons. In this study, social approval was restricted to the individual, which meant that no one else knew anyone else's popularity rating. The popularity ratings that produced feelings of social approval were only known to the individual who made a contribution, whereas in other types of social approval, there may be a social desirability component like a public reputation. This implies that individuals really care about how their contribution (and perhaps by association, their own selves) is evaluated by the network, thus making social approval a powerful motivator for cooperation.

Regarding observational cooperation, the experiment demonstrated that simply observing high amounts of cooperative behavior had a positive effect in contribution especially in the initial stages. On the other hand, observing low amounts of cooperation did not have a negative influence in contribution. This means that the ability to observe the amount of cooperation may be useful for fostering cooperation in real P2P systems, though the effects are likely short lived. So, normative compliance in the sense of reciprocity did not have a very strong impact on cooperation, as expected, although it was not clear how much cooperation would be affected if participants did not have any information about the behavior of others in the network.

Based on the findings of the experiment, Chesire suggested that cooperation in generalized information systems like P2P networks can be encouraged if popularity ratings or other social approval techniques are used.

5.2 The Effects of Feedback on Internet Information Pools

Chesire and Antin in [[10]] examined cooperative behavior in information pools that produce a public good and argued that extremely low costs of contribution, combined with very large networks, facilitate the production of online information pools, despite the plethora of free-riders. They demonstrated that feedback incentives, like gratitude, historical reminders or relative ranking

influence contributions in such online systems. Apart from that, they showed that feedback has different effects according to the context in which people interact. Chesire and Antin made a dichotomous division between *internal* and *external* websites, where the first one is directly associated with the information pool and the latter is unrelated to the information pool, but provides opportunities for someone to contribute.

Environment/Type of virtual community

The environment where the experiment was conducted was a custom-built internet system called Mycroft. Mycroft is a web-based network, which allows large tasks to be widely distributed and the results efficiently collected so that thousands of individual contributors can work on the same project at the same time. Mycroft accepts large jobs which cannot technically or efficiently be completed by computers and breaks them down into many constituent parts called 'puzzles.' The puzzles are distributed via banner ads on existing websites, in place of traditional advertising materials. As each puzzle is answered, the results are combined with others at successively larger levels until the top-level job is complete. These banners exist on a primary website and on many diverse websites.

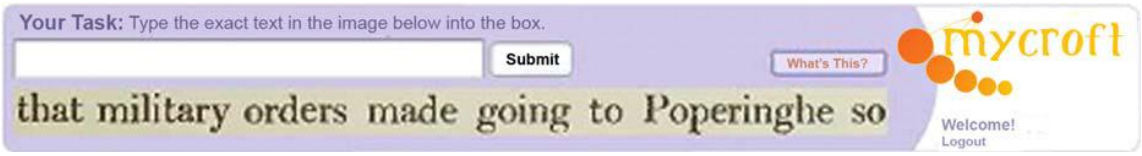

Figure 7: The Mycroft banner interface

Number of users that participate in the virtual community

Thousands of people viewed the Mycroft banners more than 100,000 times between March 2006 and October 2006. The banners were hosted on more than 20 websites, which were named "external" websites and an "internal" home website hosted the banners. For the test period of the study, there was a sample of 791 individuals who contributed at least once to the system (467 internal contributors and 324 external contributors).

Cooperation in the virtual community

People in this system had the opportunity to contribute in the system in a very simple and without cost way. During the experiment period Mycroft distributed puzzles that asked individuals to type in small portions of a text. After that, contributors would receive (or not) a type of feedback.

Experiment method

All users who saw the Mycroft banners, either in an external website or in Mycroft home website, had the potential to contribute. Since this experiment was meant to examine retention incentives, there were no incentives provided for someone to contribute for the first time. Individuals who made at least one contribution were placed in one of the four feedback conditions (gratitude,

historical reminder, relative ranking and no-feedback). In the first three groups people constantly received the relevant feedback type, whereas in the control group contributors did not receive any feedback.

In order to measure retention researchers used the repeat contribution rate (RCR), which is the average number of contributions that a given individual makes over all contribution sessions. Since there was the case for one user to have multiple sessions, Mycroft used "cookies" in order to uniquely identify those who contributed to Mycroft through multiple sessions.

The *Gratitude* feedback.

The *Historical Reminder* feedback.

The *Relative Ranking* feedback.

Figure 8: Examples of three types of feedback

Incentives and/or social mechanisms present

The gratitude feedback had the form of a simple static "Thank you" message, which was presented to the contributor immediately after a contribution and it was the same every time. The historical reminder feedback presented a simple count of the number of times an individual had contributed (e.g., 'You have contributed 12 times'). The number was dynamic, counting upwards each time a contribution was made. Finally, the relative ranking feedback was a percentage ranking of one's contributions compared to all other current contributors. For example, a first-time contributor might see that he was in the top 99% percent of all contributors, whereas a frequent contributor might find himself in the top 5 or 10 percent of all contributors.

Apart from the feedback type researchers examined the context of interaction, which was the internal or external website. All four feedback conditions were examined in both contexts (internal and external), thus resulting in a total of eight conditions.

Results

The experiment showed that *when people in the external websites received feedback of any type, contributions increased compared to the users who did not receive any feedback*. On the

contrary, feedback did not have the same effect in the internal sites. More precisely, *only the relative ranking type increased contributions in the internal sites*. Another result of the experiment was that if people in the internal or the external websites all received the same feedback, contributors who interacted through the internal website had higher repeat contributions compared to those who contributed through external websites.

The case of external websites, where a banner exists in an unrelated website, is representative of much real world activity on the internet where various forms of content are displayed in or around the periphery of unrelated websites. Thus, these results may apply to similar situations in which individuals contribute via small areas of larger websites.

The interesting finding of this study was that the context in which people interact has an important influence in the effectiveness of some types of feedback. *Internal users did not increase contributions with all types of feedback*. This can be explained by the fact that people who interact through the home website consider their task as a primary activity, whereas people in the external websites do this as a secondary activity. In the first case *people have strong collective identity, which promotes feelings of reciprocity and obligation and by applying extrinsic motives like feedback we get the opposite effect*. This is another example of the crowding effect, where extrinsic motivation can undermine intrinsic incentives.

5.3 Understanding the Motives for Contribution in Open Source Software

Roberts et al. in [[44]] made an extensive research in the area of Open Source Software (OSS) to investigate the incentives that motivate software developers to contribute to Apache projects. In previous studies several motivations had been revealed, but there was no consensus to which motivation is most dominant. Roberts et al. investigated how the different motivations of OSS developers are interrelated (i.e., independent, complementary of contradictory), how these motivations influence participation leading to performance, and how past performance influences subsequent motivations.

Environment/Type of virtual community

The research was focused on the three major OSS projects under the control of the Apache Software Foundation (ASF). The ASF includes a number of subprojects related to the development of a full-featured Web server product. These were the Apache web server project, the Jakarta project and the XML project. The Apache Web Server is a freely available source code implementation of a hypertext transfer protocol (http) server and is the project around which the Apache Group initially formed. The Jakarta project consists of 19 Apache-related Java subprojects and the XML project consists of 16 Apache-related XML subprojects.

Number of users that participate in the virtual community

Hundreds of people have made contributions to the Apache project so far. For the purpose of this research 1,301 uniquely identified contributors were invited via email by the chairman of ASF to

participate in the survey. 18% of the emails were undelivered and from the remaining ones, 325 contributors accepted to participate in the research. Because of some missing pieces of information, a few responses were dropped, resulting in a usable sample of 288 responses.

Cooperation in the virtual community

Apache projects are based on the contributions of high motivated developers, who are often self-employed freelancers and volunteers. The Apache projects were not originally organized around a single person or primary contributor. The projects are organized using a meritocracy and the motto is "The more work you have done, the more you are allowed to do". There are several levels of recognition within ASF; *developer, committer, project management committee member* and *ASF member*. A developer contributes by submitting a "patch" to the project, which is analogue to modification requests in traditional software development environments.

When a developer contributes to an Apache project, his commitment is recognized by advancing in the ASF hierarchy. Promotion to a higher rank is awarded after one or more cycles of contribution followed by a positive peer review. Although the number of attainable ranks is limited, the number of promotion opportunities at any rank is not constrained. For example, there is no limit to the number of contributors who can achieve the rank of developer or to the number of developers who can be promoted to the rank of committer.

Experiment method

Researchers developed a theoretical model that included measures of motivation, participation and performance. They evaluated this model by using archival data regarding contributions in the Apache projects and also by conducting a survey addressed to existing Apache contributors.

The archival data was collected from OSS records, which included all contributions from 1999 to 2002. Apache products include developer websites, change logs, documentation, and developer communications in the form of e-mail archives. From these products, the data extracted were each contributor's progression along the Apache career path, and each contributor's source code contributions to the project.

The survey conducted was a secure web based survey of Apache contributors, who responded what motivated them to contribute. The number of accepted responses was from 288 contributors.

In order to quantify variables for the theoretical model, researchers defined the following measures. Some of them were measured by the participants' answers through the survey and others were calculated through the archived data collection.

1. EXTRINSIC (monetary): The average number of hours per week for which respondents were paid for their work.
2. USE VALUE (How important it is to solve bugs or problems or add needed features): Two-scale items answer.
3. STATUS (How important status is): Four-scale items answer.

4. INTRINSIC (The task itself is enjoyable): Four-scale items answer.
5. PARTICIPATION[2]: Several measures were derived.
    a. The cumulative number of patches submitted and accepted.
    b. The cumulative number of lines of code submitted and accepted for a year.
    c. Convert each contribution to a common function point metric using industry standard language conversion factors and use this as a metric.
6. PERFORMANCE: The number of changes in the ASF rank hierarchy.
7. EDUCATION: A respondent's years of education.
8. EXPERIENCE: A respondent's years of work experience.

Incentives and/or social mechanisms present

The incentives examined in this research fall into three categories of incentives: *intrinsic, extrinsic* and *internalized extrinsic motives*.

The intrinsic motive to contribute work to OSS is the enjoyment of the task itself. Software development is an inherently motivating task, because it is complicated and creative. Software development in OSS, compared to that in a company, offers developers greater opportunities to express their creativity, enjoy their work and experience a sense of satisfaction and accomplishment.

The extrinsic motive investigated in the survey was monetary. Although OSS communities do not have a profit motive and hence do not offer monetary compensation to contributors, there are third parties who employ programmers to contribute to specific parts of OSS projects. An example is IBM's involvement in Apache OSS projects.

Regarding internalized extrinsic motives, there were two motives examined. The first one is related to status and career opportunities. OSS communities offer an ideal setting in which a participant motivated by career concerns can signal his abilities to the labor market. Status is also an important motivator, when one tries to increase his standing in a reference group. The next internalized motive was "use value", which could be the desire to fix a bug or solve a problem with is related to the contributor.

Results

The evaluation of the model revealed several results. The first one was that contributors have multiple motivations to contribute and that some of them are complementary whereas others are not.

[2] *Although OSS volunteers provide many different kinds of services to Apache projects, the principal participation behavior is authoring and maintaining the software. Thus, this kind of participation was measured by Roberts' et al. research.*

Regarding how monetary incentives are related to the other types of incentives, the results showed that a) *monetary incentives did not crowd out intrinsic motivations*; being paid to contribute was positively related to participants' status to contribute and b) *monetary incentives were negatively related to use-value motivations*.

Findings about intrinsic motives were contrary to researchers' predictions. *No significant relationship was found between intrinsic motives and participations levels*. One explanation of this could be that OSS contributors are self-directed and it is possible that their intrinsic incentives were not fully aligned to the mission of the OSS community. For example, a potential contributor may be intrinsically motivated to work on perfecting one feature of the code that performs a relatively minor function, and may spend inordinate amounts of time perfecting the single feature rather than implementing a large number of contributions.

Contributors who declared use-value incentives were not found to have high contributions. *This can be explained because developers motivated by use-value want to solve a particular bug that is causing them trouble or to add a particular feature that they need to use. Once they have solved the immediate problem or added the particular feature they may lose interest in making future contributions if there are no further salient problems or issues to motivate them*. This means that these users will need different types of incentives in order to sustain their level of participation.

Another finding was that the Apache meritocracy is operating effectively, *and that promotions within the community are indeed based on actual contributions to the Apache projects*. This is important for a community like Apache that depends on shared leadership and the contributions of participants for its success.

Finally, *status motivation was positively related to contributions*. When a contributor motivated by status climbed in AFS hierarchy, his status motivation to participate increased.

According to the above findings, Roberts' et al. made some suggestions that could be useful for encouraging contributions in OSS communities. *First, OSS communities should largely welcome commercial efforts by companies. Second, since developers with higher status motivations were the most substantive contributors, OSS systems could perhaps devote distinct website space to recognize distinguished developers or promote OSS development as a way to enter the labor market. Third, OSS communities should use a more effective feedback system that stresses the competence of the contributor and that provides detailed information and feedback on performance. The current feedback system, which is an announcement of a rank increase, failed to enhance intrinsic motivations, whereas feedback that indicates personal competence could increase intrinsic motivation.*

5.4 Social Desirability Bias and Self-Reports of Motivation in Amazon Mturk

Antin and Shaw in [[5]] examined how social desirability bias affects self-reports of motivation in a crowd sourcing service such as Amazon Mechanical Turk (MTurk). Many studies on motivation

rely on survey based techniques where participants explicitly state their motivations. This kind of response however is vulnerable to social desirability bias or the tendency to respond in ways that participants believe would appear desirable to others. By using "list experiment", a survey technique that mitigates social desirability bias, Antin and Shaw proved that this motivation was indeed present among workers in MTurk.

Environment/Type of virtual community

Mturk is a crowd sourcing system, which is part online community and online labor market. In this platform "requesters", who can be individuals or businesses, co-ordinate the use of human intelligence to perform tasks that computers are currently unable to do. This is done by distributing small chunks of work to thousands of workers around the world. These chunks of work are called Human Intelligence Tasks (HITs) and the people who undertake them, called the "workers", spend a few minutes or seconds to answer them and earn small payments, which typically range from a few cents to a few dollars.

Number of users that participate in the virtual community

The population of Amazon Mechanical Turk workers has altered over the years after it launched publicly in 2005. In 2007, there were reportedly more than 100,000 workers in over 100 countries, whereas in 2010, as reported by Amazon, there were 200,000 workers and about 50,000-100,000 HITs to work on at any given time. This workers population is spread around the world, but several studies regarding MTurk have revealed that the vast majority of visits come from USA and India, with percentage 46.8% and 34% respectively.

Cooperation in the virtual community

Participants in MTurk are of two types, requesters and workers. The first group designs HITs by using different templates according to the HIT type and then these HITs are available for workers to pick up. Some HIT types are podcast transcribing, rating, image tagging, writing or rewriting sentences, writing paragraphs or whole articles. Other kinds of HITs are linking to or commenting on a blog and "friending" a person on Facebook.

Workers complete HITs by looking through the large database of HITs that are available through Mechanical Turk. Some HITs, however, require qualifications, which workers earn through either taking a qualification test or by acquiring certain benchmarks such as completing a certain number of HITs or having an approval rate above a certain percentage. According to their performance, some workers can be characterized as Masters and have access to higher levels of work. Each worker can monitor his/her performance and earnings through their account in Mturk.

Experiment method

The method used in the experiment was the "List experiment", which is a type of indirect questioning. The list experiment asks each participant to report only how many he selects from a list of possible choices. If the participant does not answer thoughtlessly, then the list experiment provides an

opportunity for the respondent to express support for his "true" attitudes without explicitly naming them.

Having in mind that most workers come from two main populations, Antin and Shaw examined two different groups in the following experiment. One India-Based group with 1216 Turkers and one US-Based group with 1200 Turkers.

To assess motivations for doing HITs on MTurk, participants were asked survey questions using traditional agreement statements and the list experiment. First, randomly selected participants were asked to make a binary choice to agree or disagree with four motivation statements. These motivation statements were based on previous survey research on MTurk and were the following: "I am motivated to do HITs on Mechanical Turk…" (1) "to kill time", (2) "to make extra money", (3) "for fun" and (4) "because it gives me a sense of purpose". Participants were randomly assigned to one of five groups. In the control group participants were shown a list of all 4 motivations, whereas in the other 4 groups participants were shown only 3 out of 4 motivations – each of four motivations was absent in one group. By using this technique, even though participants did not explicitly say which motivation they preferred, the difference in means between each treatment group and the control group can be considered as the item preferred by the participant.

Incentives and/or social mechanisms present

The basic incentive examined in this study was social desirability bias, which is the tendency of people to respond in ways that perceive as socially desirable by others. This incentive is possible to exist in survey self-reports of motivation for two reasons. First, there are often socially desirable connections between motivations and activities. Secondly, one's motivation is often interpreted as a signal of other characteristics.

The questions raised in this experiment were a) whether survey self-reports of motivation are subject to social desirability bias and b) whether there is evidence of similar or distinct profiles of social desirability effects across Mturk's two primary sub-populations.

A secondary incentive that was not exactly examined in this study, but for which certain conclusions were drawn, were monetary incentives. MTurk offers small amount of money for each HIT, so this is a motive that a few collective intelligence systems have.

Results

The results of agreement statement survey were compared to the list experiment for each MTurk sub group. There were numerous differences in the motivations expressed by the different method and the different groups, meaning that social desirability bias did affect participants' responses. For example, within the US sample, agreement statements modestly over-reported three of the four motivations compared to the list experiment: "killing time" (36% over-reported), "fun" (32% over-reported), and "sense of purpose" (33% over-reported). Over-reporting was more intense in the case of "money" as a motivation (40% over-reported). *This means that social desirability appears to*

encourage individuals in the US group to say that money is a motivator even though that may not be the case.

In the Indian population social desirability effects were also evident and even greater and more diverse than in the US population. Agreement statements under-reported 2 motivations, "killing time" (–142%) and "fun" (–62%), and dramatically over-reported "sense of purpose" by almost 200% compared to the list experiment. Results showed *no social desirability bias was related to money as a motivator*. So, in the case of Turkers in India, *social desirability appears to encourage individuals to over-state the importance of "sense of purpose" as a motivator, and under-state the importance of both "killing time" and "fun".*

Although social desirability did not alter the rank-order of motivations between the agreement-statement and the list experiment conditions, the findings are important. So, regarding the two questions raised by the researchers, the answer is: a) reports of online motivation can be subject to social desirability bias and b) the cross-national comparison indicates that the precise contours of social desirability depend on the context of interaction, the task at hand, and the populations involved.

The general lack of social presence in the MTurk user interface makes it a conservative test for social desirability bias effects in online collaborative settings. Social desirability bias is magnified by the actual or perceived presence of others when answering questions. In the context of MTurk, however, there are few user-to-user interactions or signs of social presence. This reduced social presence in a compute mediated context should make social desirability effects less likely. Since it was proven by this experiment, that social desirability effects exist among MTurk workers, then this increases evidence that social desirability bias is present in other contexts with greater social presence.

This research added further evidence that monetary incentives represent just one part of a complex motivational array behind paid work. *Incentive systems that rely solely on paying users for content, ignoring other key motivations such as fun and providing a sense of purpose have the risk to fail. Likewise, collaborative systems that seek to engage workers or collaborators from diverse backgrounds may benefit from context-specific adaptations to sub-populations with divergent attitudes about money or employment.*

5.5 Energy Saving through Social Comparison

Sustainable HCI research has focused on changing individuals' behavior in order to help address large-scale societal concerns such as climate change. Sustainable HCI research draws from theories and concepts from psychology and behavioral economics and integrates them into IT technology aiming to motivate people to adopt environmentally friendly behavior. Petkov et al. in [[39]] investigated how social comparison and feedback can motivate users to conserve energy, through the mobile application EnergyWiz.

Environment/Type of virtual community

The platform used was a mobile application called EnergyWiz, which was designed and developed for this experiment. Users were able to see live data of their energy consumption, their consumption history and also a comparison with neighbors who also participated in the program.

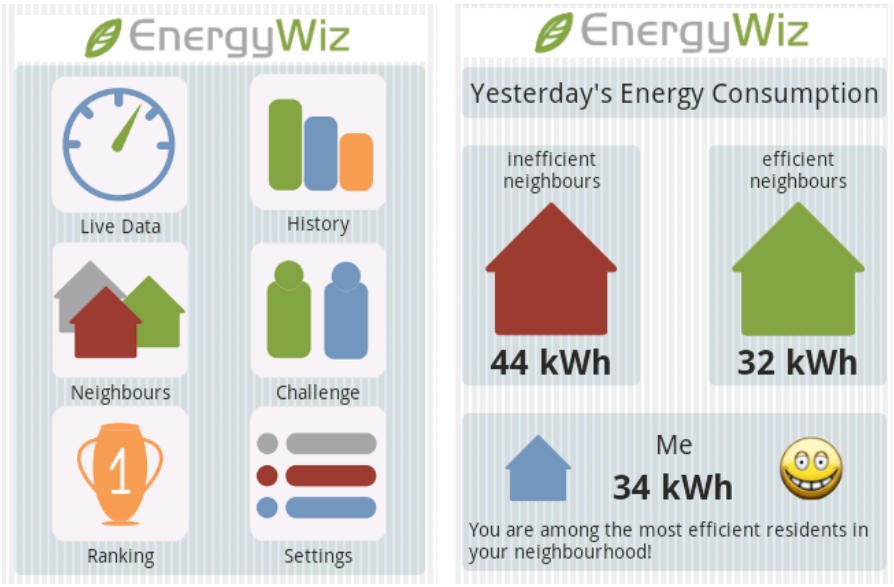

Figure 9: EnergyWiz - Main menu (left), Neighbors (right)

Number of users that participate in the virtual community

The number of users that participated in the program was 17 users, most of them between 25 and 34 years old – 14 were full-time employees and the rest of them were students.

Cooperation in the virtual community

The EnergyWiz application contained five main features which correlated with different types of comparative feedback. These main features included 1) Live Data, 2) History, 3) Neighbors, 4) Challenge, and 5) Ranking. The application relied on direct, real-time consumption data from the household, and the game was designed so users could switch between different units (kWh, cost, and CO2). Users could share their current energy consumption on Facebook, as well as challenge their friends to an energy saving competition.

Experiment method

The first step was to design and develop the EnergyWiz application. Then researchers organized personal interviews with the 17 prospective EnergyWiz users. The interview process was two-fold: First researchers examined each application and gave the participant meaningful tasks in the form of scenarios. During the experiment period, EnergyWiz was filled with real data. At the end of the experiment period, users were interviewed again and shared what motivated them to compare with others and their experience in energy conservation at home.

Incentives and/or social mechanisms present

Research used feedback in order to monitor and evaluate behavior combined with different types of social comparison. The three types of social comparative feedback used were *normative*, *one-to-one* and *ranking*.

In normative comparison an individual or a group is compared to the average performance of the group. In EnergyWiz this was implemented by the "Neighbors" feature, where a user could compare his energy consumption with the average performance of two groups of neighbors - efficient and inefficient (Figure 9 right).

One-to-one comparison involves only two persons who compare between themselves. This was realized in EnergyWiz by a challenge between two friends in Facebook who compared their energy consumption during a week (Figure 10 left).

Finally ranking was realized by showing an ordered list of EnergyWiz users with similar attributes, like household size and residence type (Figure 10 right).

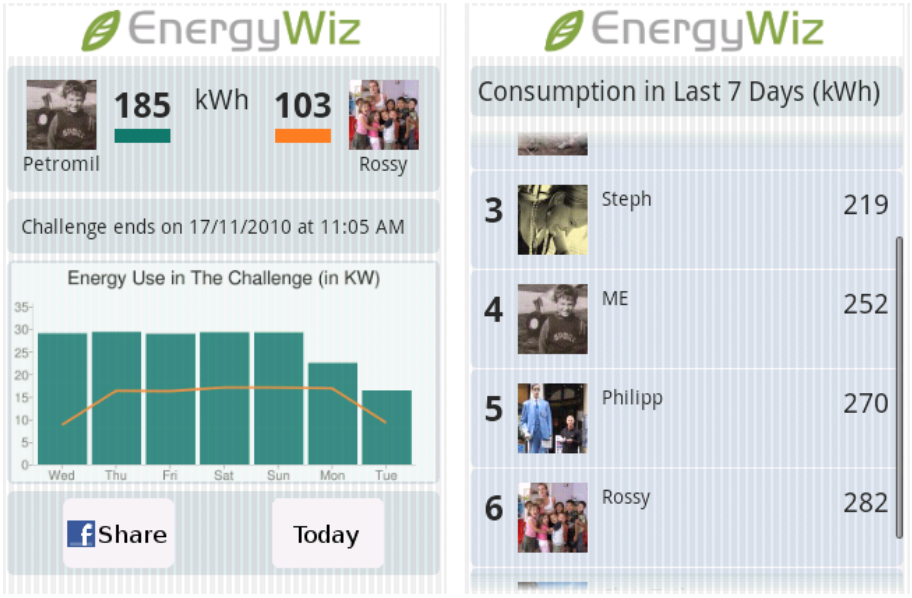

Figure 10: EnergyWiz – Challenge (left), Ranking (right)

Results

Results showed that normative comparison (realized as the "Neighbors" feature) was partially supported as a motive for conserving energy. This was because users were not convinced that the people they were compared to had similar characteristics with them. One-to-one comparison ("Challenge") did not receive much support, because most friends are dissimilar concerning their energy consumption. The ranking feature was partly suitable, but interviewees were concerned about the difference experience levels among the ranked users.

The results of this study were restricted because of the small number of users who participated, but also because the study group was homogenous. Researchers planned to expand the experiment to more households with greater diversity in order to reach more accurate findings.

5.6 Badges in Social Media

Gamification is a rather new concept which applies game mechanics and game design techniques to make products and services more fun and engaging. Some of these techniques have been integrated also in virtual communities. Antin and Churchill in [[4]] presented how badges can be used in social media, by giving some examples of social systems such as Foursquare, StackOverflow and Wikipedia that use badges in order to motivate users.

Environment/Type of virtual community

Foursquare [[20]] is a location-based social networking website for mobile devices, such as smartphones. Users "check in" at venues using a mobile website, text messaging or a device-specific application by selecting from a list of venues the application locates nearby. Location is based on GPS hardware in the mobile device or network location provided by the application. Foursquare has clients for smartphones such as iPhone, BlackBerry, Palm and the Android platform. Thus, Foursquare lets users "check in" to a place, when they are there, tell friends where they are and track the history of where they've been and who they've been there with.

StackOverflow [[51]] is a question and answer (Q&A) site on a wide range of topics in computer programming. StackOverflow serves as a platform for users to ask and answer questions. Participants who become members can ask questions regarding programming issues they have faced, vote for questions and answers raised by others, edit questions and answers and also give answers. StackOverflow members can earn reputation points and badges.

Wikipedia [[55]] is a collaboratively edited, multilingual, free Internet encyclopedia that is supported by the non-profit Wikimedia Foundation. Volunteers worldwide collaboratively write Wikipedia's 30 million articles in 287 languages, including over 4.5 million in the English Wikipedia. Anyone who can access the site can edit almost any of its articles, which on the Internet comprise the largest and most popular general reference work.

Number of users that participate in the virtual community

Foursquare community is formed by 50 million people worldwide, who make millions of check-ins every day. Stackoverflow has over 2.7 million registered users who have raised more than 7 millions questions.

Wikipedia users are of two types, the "Wikipedians", who contribute to the site and the "Readers", who simply read articles. Wikipedia has more than 21 millions of named accounts with different user rights. The people who contribute regularly are a minority of these account holders.

Apart from registered users, there is a relatively large number of unregistered Wikipedians who also contribute to the site.

Cooperation in the virtual community

When people participate in Foursquare by checking in, they gain virtual rewards. These rewards come in the forms of points, badges, and mayorships visible in one's public profile. Badges are awarded for a variety of reasons, e.g., for starting to use the service, checking-in on a boat, checking in with 50 people at the same time, or checking-in at a special event. Mayorships are awarded to a single individual for having the most check-ins in a given place in the past 60 days, where only one check-in per day is counted.

Since Stackoverflow members have the ability to vote answers and questions, good answers are voted up and rise to the top. One's reputation goes up, when others vote up his questions, answers and edits. As this reputation increases, this person has also the ability to vote, comment and even edit other people's posts. Apart from reputation, StackOverflow members earn badges, which are special achievements for participating. There are badges for Questions, Answers, Participation or other actions and they all come up in three levels: bronze, silver and gold. For example, a bronze medal for an answer is given if this answer has score of 10 or more. A gold medal for a question is awarded to someone who asked a question with 10,000 views.

In Wikipedia everyone can edit an article without permission, even without making an account. In different language editions these rules may slightly differ, for example only a registered user can create an article in the English edition. But in general, an article becomes immediately available for editing right after it has been published. No article is considered to be owned by its creator or any other editor, nor is it vetted by any recognized authority. Instead, editors are supposed to agree on the content and structure of articles by consensus. Each article has a "History" page, so editors can use this page to restore lost content or undo changes. There are also "Talk" pages, which are associated to a specific article or associated to particular contributors. These "Talk" pages are used for coordinating work among multiple editors and also as a tool for reaching consensus for an article.

Contributors on Wikipedia are awarded with "barnstars" [[54]]. Everyone can award a barnstar to someone, as long as he provides relevant text as to why he is awarding it. There are different kinds of barnstars, like the "Barnstar of Diligence", which is awarded to someone who shows a combination of extraordinary scrutiny, precision and community service, the "Citation Barnstar" which is for users who provide references to unsourced articles, the "Working Wikipedian's Barnstar", which is for users who work tirelessly and endlessly on the more laborious or repetitive of Wikipedia tasks, and many more. These barnstars have been added to Wikipedia by the users themselves, after discussing it in a relevant "Talk" page.

Incentives and/or social mechanisms present

Badges are considered as virtual goods in online social media, which are awarded to users who complete specific activities. Antin and Churchill in [[4]] argued that although badges are valuable and

useful, they do not inherently produce social engagement or enhance motivation. Badges serve several individual and social functions that depend on the nature of the activity. Thus, Antin and Churchill presented five primary functions for achievements that exist in badges.

The first function and most obvious one is *goal setting*, which is known to be an effective motivator. Goals presented in a badge are not always explicit, either because system designers choose only to outline how to earn a badge or because the necessary activities are subjective. Another important aspect of goal setting is when users can see their progress towards a goal.

The second function for achievements is *instruction*. Badges provide instruction about what types of achievements are possible in a given system. This function is useful, because it teaches new users into the system. Instruction provides social shaping of user activities and badges can benefit the system even if users never actually earn the badges.

The next function examined is *reputation*. Badges provide information on the basis of which reputation assessments can be made. They encapsulate user's interests, expertise and past experience. When someone examines another user's badges, he can shape an opinion of the user's interests and engagement levels. By providing an encapsulated assessment of engagement, experience and expertise, badges are a valuable tool that increases trustworthiness of other people and reliability of content.

Status and affirmation are the next functions of achievement. Badges can be motivating as status symbols. The power of status rewards derives from the expectation that others will look more favorably upon someone who has earned a badge. Also badges provide personal affirmation in that they serve as reminders of past achievements.

The last function for achievement is *group identification*. Badges communicate a set of shared activities that bind a group of users together around shared experience. Achieving badges can provide a sense of solidarity and increase positive group identification through the perception of similarity between an individual and the group. This type of group identification is valuable in social media because increased group identification promotes increased cooperation in collaborative situations.

Results

Studying the use of badges provided ample evidence that badges are an important motivator for collaboration in social systems. This does not mean that all badges favor contribution. For example in Foursquare, only some types of badges are considered as useful my most users. Furthermore, since badges are extrinsic motives, the extensive use of badges may undermine intrinsic motivation, leading to the conclusion that they should be carefully designed.

5.7 Similarity vs. uniqueness in MovieLens

Research on this paper focused on two conditions that can positively influence people's participation in online communities. The researchers carried out a field experiment in the MovieLens film recommender system and manipulated two factors that according to social theory would influence

participation in a group: similarity of group members and uniqueness of a member's qualification for a group task [[31]].

Environment/Type of virtual community

The virtual community in which the study was made is MovieLens.org, an online community for film recommendation, administered by the University of Minnesota. MovieLens collects users' opinions about movies in order to generate personalized recommendations for other movies. MovieLens uses a technology called collaborative filtering to generate movie recommendations. It works by matching together users with similar opinions about movies. Each member of the system has a 'neighborhood' of other like-minded users. Ratings from these neighbors are used to create personalized recommendations for the target user.

Number of users that participate in the virtual community

MovieLens has over 70,000 registered users. In the time period when the study was made, the number of active users was over 2,000 in a given month. Thus, a large potential user base was available for the experiment.

Cooperation in the virtual community

Members of MovieLens contribute to the community by rating movies and writing movie reviews. When there are a lot ratings for a movie, then the recommender algorithms can make more accurate predictions about whether subscribers will like this movie or not.

Experiment method

The researchers expanded MovieLen's functionality by adding new online discussion groups with controlled design parameters in order to study how contribution in the community is affected by uniqueness and group similarity. People who participated in the experiment were MovieLens users that had rated at least 50 movies in the past. The total number of the experiment participants was 245 users.

The participants formed different groups, e.g., some groups consisted of members with similar ratings (similar groups), some groups consisted of members with less similar ratings (dissimilar groups) and some other groups received weekly emails advising them of a unique perspective they could bring to the current discussion topic (groups with uniqueness condition). The different groups participated in a different forum that they were assigned to. The experiment lasted 5 weeks and the research team posted a discussion topic every week.

Finding the participants' characteristics that are similar or not in order to group them into different groups, was done by mining MovieLens data to find how subjects' movie ratings differed from others in the group.

Incentives and/or social mechanisms present

The first parameter tested was *uniqueness* of a member's qualification for a group task. People in the uniqueness condition received a weekly message telling them how their MovieLens ratings differed from others in their group relative to a discussion topic. The person in the "unique" group was informed that a movie he/she had previously rated was a rather rare one, in the sense that few others had only rated it, thus implying that this person had unique information and that he/she could probably contribute to the discussion group.

The other parameter tested was similarity of the group members. "Similarity" for two users means they tend to see the same movies and agree on their evaluations of the movies. "Dissimilar" users either see different movies or disagree on whether they like movies they have both seen.

Results

The results of the experiment showed that both factors influence participation in the virtual community. The key finding was that dissimilar groups who were given uniqueness information were the most active communities throughout the experiment.

Regarding the uniqueness condition, *community members liked receiving information about the unique perspective they brought to the group and participated more because of it*. One interesting result regarding the similarity condition was that *participants from similar groups contributed less than those in dissimilar groups*. This result was unexpected, because social theory suggests that people are attracted to others similar to themselves. As discussed earlier in previous sections4.3, a social group is a set of people who view themselves as members of the same social category, in which they share common attitudes, beliefs, values, affective reactions, behavioral norms, etc.. As a result of this, it was expected that people with similar characteristics would contribute more. Practice showed a different behavior, where people with dissimilar views had longer exchanges, appearing to banter back and forth defending their positions. This agrees with social loafing theory (Ref. Section 4.44.4), where people working together put less effort that if they were alone. In the case of MovieLens, it looks like people in similar groups were not motivated enough to contribute, because they expected that others "similar" to them would contribute.

This study concluded that both uniqueness and similarity affect participation in a virtual community and if combined so that dissimilar groups are formed and given information about the uniqueness perspective, then participation in the community can be increased. Based on the findings of the experiment, researchers proposed two guidelines to encourage participation: "*tell people how they are special with respect to the community and its purpose*" and "*create dissimilar groups in situations where disagreement can be tolerated*".

5.8 Uniqueness, Benefit and Goal Setting in Online Communities

MovieLens was chosen also by Ling et al. in [[28]] as a platform for testing the motives that influence contributions in online communities. Apart from uniqueness, that was also examined in the previous research, the incentives examined were benefit and goal setting. Researchers carried out two

studies on MovieLens, where uniqueness and benefit to self and others was tested in the first study and individual or group goal setting was tested in the second study.

MovieLens predictions are based on recommender algorithms that work better when there are a lot of ratings for each movie. More than 20% of the movies listed in the system have so few ratings that the recommender algorithms cannot make accurate predictions about whether subscribers will like a movie or not. Since this research investigated the uniqueness incentive, it focused on rarely-rated movies.

Experiment method

The subjects selected for the experiment were active MovieLens members who had rated rare movies in the past. They received an email inviting them to participate in a movie rating campaign. Researchers identified the abstract mental state for each incentive examined and designed persuasive messages for each case. Then the subjects' contribution behavior was tracked. The number of participants was 830 for the first study and 834 for the second.

Incentives and/or social mechanisms present

The research was based on and tried to confirm the Collective Effort Model (Ref. Section 4.4.24.4.2), which supports that when people believe that their effort is identifiable and important to others, then people will contribute more. So the first incentive examined was uniqueness and subjects received an email reminding them about their unique contributions.

The second incentive examined was benefit to self and others. Benefit to self means that raters personally gain benefit because predictions for them become more accurate. Benefit to others means that ratings help the whole MovieLens community, because accurate recommendations can be made for all members. Finally there can be benefit for both self and others by combining the two. Regarding the incentives presented in Chapter 4, benefit to self can be compared to monetary incentives (Section 4.144.14) and benefit to others corresponds to altruism (Section 4.64.6).

The third incentive examined was goal setting. Although MovieLens provides users with feedback information about the number of ratings they have made, it does not give an indication of the number of ratings they should make or which movies would be most helpful to rate. This was the first attempt to test whether goal-setting theory applies to contribution in an online community. For this purpose, some participants were told that they participated in a group of 10 people and some others had no information about belonging to a group, so these were the individual subjects. The goals were set in a specific way (e.g., specific number of ratings that should be completed) or in a generic way (e.g., participants do their best). The different cases of group vs. individual and specific vs. generic goals were examined.

Results

As demonstrated as well by the previous sections, *uniqueness proved in this paradigm to positively affect contribution*. People who received a message that emphasized their uniqueness, made more ratings than others.

Results about benefit were diverse and complex regarding benefit to self and benefit to others. Users who made more ratings were the ones who a) received no information about benefit or b) received information about benefit for both self and others compared to users who received information about benefit only for self or only for others.

Results regarding goal setting showed that specific goals will motivate greater contributions than non-specific goals. On the other hand members assigned individual goals do not contribute more than members assigned group goals.

The interesting findings of the two studies of this paper were, first that *benefits negatively affect contribution*. This is consistent with the crowding-out effect mentioned before, which states that external motives undermine intrinsic motivation.

The other interesting finding was that *participants contributed more when they were assigned group goals instead of individual ones*. This finding was counter to researchers' initial predictions, but Ling et al. used the notion of social facilitation to explain it. Social facilitation suggests that individuals who perceive that their contributions can be evaluated by others will be likely to increase their contributions toward the group task. In the current study individuals knew that their efforts would be evaluated, because certain goals were set, so they would be evaluated whether they had reached their goals or not.

5.9 Summary

Table 4 summarizes the incentives and social mechanisms described in Chapter 5 that are present in the different types of virtual communities analyzed in this chapter.

Table 4: Incentives present in different types of virtual communities

	P2P systems	Information Pool (Mycroft)	Open Source Software (Apache Project)	Crowd Sourcing System (MTurk)	CAPs (EnergyWiz)	Foursquare StackOverflow Wikipedia	MovieLens	MovieLens
Social Comparison					X			
Social Identity – Similarity						X	X	

Social Loafing							X	
Social Facilitation								X
Trust						X		
Altruism								X
Social Approval	X							
Reputation						X		
Social Desirability Bias				X				
Observational cooperation	X							
Uniqueness							X	X
Reciprocity		X						
Goal Setting						X		X
Feedback		X	X		X			
Monetary Incentives			X	X				X
Gamification						X		
Task Enjoyment			X	X				
Use Value			X					
Status			X			X		

6 Conclusions

In this deliverable, we investigate dimensions that motivate human behavior within virtual communities, with specific focus on identifying those types of mechanisms, with reasonable levels of segregation or even personalization, which engage humans into mechanisms of active contribution and sharing of knowledge. The reported research spans various existing virtual communities and highlights the difficulty of suggesting an one-fits-all success rule for the sustainability of the community.

In a nutshell, effective mechanisms that potentially motivate contribution in virtual communities include setting goals, promoting and leveraging users' uniqueness, implementing monetary incentives, providing feedback and hosting modules for gamification. Setting personalized goals in a community is considered as a key motivator to increase contribution. Although similarity in a group constitutes a significant motive for participation, uniqueness appears as a more powerful mechanism. Informing people about their uniqueness with respect to the community and its purpose appears more inspiring. Regarding uniqueness, particular benefits emerge if dissimilar groups are created (by operators of virtual communities) in situations where disagreement can be tolerated. Monetary incentives should be carefully implemented since in several cases personal benefits undermine intrinsic motivations. When feedback is provided as an extrinsic incentive, it should account for the context of interaction (e.g., if users are highly motivated because of other incentives, such as loyalty or reciprocity, feedback is not encouraging). Gamification, which is based on people's interest for competition, achievement, status, self-expression, and altruism, could also trigger creative reactions. Overall, all different mechanisms reported in this deliverable should be properly implemented to achieve consistent and nominal user commitment to communities' activities and thus, secure the sustainability of platforms/systems/applications.

Abbreviations - Acronyms

ASF	Apache Software Foundation
CAPs	Collective Awareness Platforms
CCI	Center for Collective Intelligence
CI	Collective Intelligence
GDP	Gross Domestic Product
GPS	Global Positioning System
HCI	Human-Computer Interaction
HIT	Human Intelligence Task
ICT	Information and Communication Technology
IoT	Internet of Things
MPCR	Marginal Per Capita Return
NIMBY	Not In My Backyard
OSN	Online Social Network
OSS	Open Source Software
P2P	Peer to Peer
Q&A	Questions & Answers
SIDE	Social Identity Model of De-individuation Effects
SNS	Social Networking Site
VC	Virtual Community

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