Internet, Politics, Policy 2014: Crowdsourcing for Politics and Policy
Oxford, UK, September 25-26, 2014

A Community-based Crowdsourcing Service for Achieving a Sustainable Society through Micro-Level Crowdfunding

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Abstract: This paper proposes a new social media infrastructure, named micro-crowdfunding, for motivating people to participate in improving our society. Increasing people's awareness of how they participate in solving serious social problems is central to achieving a sustainable society. Micro-crowdfunding is a new type of community-based crowdsourcing architecture that is based on the micro-level crowdfunding concept and designs the values as a tool for encouraging busy people who live in urban environments to increase their awareness of the importance of participating in activities to improve society through minimal efforts. Because our approach is lightweight and uses a mobile phone, people can participate in micro-crowdfunding activities with little effort anytime and anywhere.

After introducing the basic concept of micro-crowdfunding, three scenarios are demonstrated to show the effectiveness of this new social media infrastructure. The first scenario adopts virtual currency, and its basic operation is similar to that of traditional crowdfunding. We analyze how the current design described in the scenarios influences participants in *micro-crowdfunding* activities and show some pitfalls of the design that cause problems when some users do not find the service valuable. We then present two more scenarios to improve upon the first scenario. The second scenario incorporates virtuality, and the third scenario incorporates fictionality to enhance *micro-crowdfunding* activities. These scenarios adopt popular strategies used in games to increase people's motivation to participate in more *micro-crowdfunding* activities. We also analyze how the enhancements influence participants' behavior in the scenarios. Finally, we describe experiences with using a real working prototype system to validate the scenario-based analysis.

Keywords: Crowdsourcing, Crowdfunding, Gamification, Scenario-based Analysis, Persuasion, Virtuality, Fictionality, Virtual Economy.

1. Introduction

We are developing a new approach, community-based mobile crowdsourcing [65], in which people voluntarily contribute to help other people anytime and anywhere using mobile phones. The task required is usually trivial and consequently can be performed with minimal effort and low cognitive load. This approach offers a new way to develop services to address serious problems, such as achieving social sustainability from the bottom up. This approach differs from traditional crowdsourcing, which uses monetary rewards to encourage performing tasks [29] because in community-based mobile crowdsourcing, service architecture designers should consider the tradeoffs among several types of incentives when designing a basic architecture.

Micro-crowdfunding, a type of community-based mobile crowdsourcing service, adopts a micro-level crowdfunding concept to increase communities' awareness of the importance of sustaining our society. A member of a community proposes a small mission to contribute the sustainability of its shared resources to the community. Typically, the mission is trivial and easily completed, such as emptying a shared garbage can. It helps motivate people in urban areas to participate in working toward a sustainable society. *Amazon Mechanical Turk*[1] is currently the best-known commercial crowdsourcing service and uses monetary rewards to encourage people to undertake micro-tasks. The system, then, uses only economic incentives. However, monetary rewards are not always the best way to motivate people to perform micro-tasks [2]. In *UbiAsk* [42], a typical crowdsourcing service based on social incentives, the completion of micro-tasks is motivated through the use of social incentives, and individuals complete the tasks through their own spirit of reciprocity with strangers. This incentive is not strong enough to motivate completion of more complex micro-tasks. In *micro-crowdfunding*, a variety of incentives introduced through increasing values are taken into account because each person needs a different incentive to reach the same goal [56, 65]. The completion of micro-tasks is motivated based on the social incentive within a community whose members know each other. An economic incentive is also used to motivate the community members to complete the tasks; however, the incentive is not in the form of a monetary reward. Instead, *micro-crowdfunding* increases people's awareness of the meaning behind the completion of micro-tasks, thereby increasing their intrinsic motivation to complete the tasks. Using mobile phones is a key factor in reducing the barriers to contributing to the community. Community members increase their activities in the face of smaller incentives because the activities can be performed anytime and anywhere by accessing the services through mobile phones.

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[1] https://www.mturk.com/mturk/welcome

In this paper, after introducing the basic concept of *micro-crowdfunding*, three scenarios are presented to show the effectiveness of the new social media infrastructure. The first scenario adopts virtual currency, and its basic operation is similar to that of traditional crowdfunding. We analyze how the design of the scenario influences participants in *micro-crowdfunding* activities and show some pitfalls of the design that causes problems when some users do not find the service valuable. We then present two more scenarios to improve on the first scenario. Incorporating virtuality and fictionality enhances products and services by increasing their values. [68] This approach makes gamification possible—thereby encouraging human activities to use—these products and services. The second scenario incorporates virtuality and the third scenario fictionality to enhance *micro-crowdfunding* activities. These scenarios adopt popular strategies used in games to increase people's motivation to participate in more *micro-crowdfunding* activities. We also analyze how the enhancements influence participants' behavior in the scenarios. Finally, we share some experiences with using a real working prototype system to validate the scenario-based analysis.

This paper is organized as follows. In Section 2, we present an overview of *micro-crowdfunding*. Section 3 presents three scenarios and their analysis to identify the pitfalls in the scenarios. In Section 4, some experiences with a real working prototype system are described. Section 5 presents related studies of *micro-crowdfunding* and discusses related concepts for designing and analyzing the scenarios. Finally, Section 6 concludes the paper.

2. Value-based Micro-Crowdfunding: A Framework to Guide Human Behavior

In *micro-crowdfunding*, we aim to provide an opportunity to everyone who wishes to contribute and take part in improving our world. The project in this service is called a *micro-mission* because it requires only a small amount of time to be completed and because it attempts to achieve the sustainability of a small, common resource in a person's spare time with minimal effort.

Free resources that are shared by a number of people, such as public toilets or the natural environment, tend to be overused as a consequence of the *tragedy of the commons* [27]. This problem occurs because each individual derives a personal benefit from using the resource, whereas any costs are shared among all of the users; this circumstance leads to use that is inconsiderate toward others. An example of this behavior is the wasteful use of free plastic shopping bags, which are filling landfills. A common strategy to address the tragedy of commons is to impose a tax on the use of the resource. An environmental tax can be widely adopted to cover the cost of maintaining the resource. However, for taxpayers, it is not clear how the tax is used to maintain each common resource that is shared by the members of the

community. People must experience a feeling of having contributed to the sustainability of the resource to be motivated to pay the necessary cost.

Technological advances alone are not sufficient to achieve the goal of a better future. People must alter their behaviors and attitudes [32, 62, 73]. In [21], designing activism is an important direction for solving various serious social issues. It aims to alter human behavior and attitude through design. Governments embed persuasive strategies in public policies; however, this method has limits, particularly because setting public policy is a long process [73]. Persuasive technologies are promising and effective approaches to altering human behavior and attitudes. In a research community, several prototype services have been developed [11, 52, 75], and they have shown the effectiveness of the persuasive technologies. This preliminary research suggests the possibility of an information infrastructure to effectively alter human behavior and attitudes toward a desirable sustainable society. Of course, today, social media, such as *Facebook*[2] and *Twitter*[3], have very strong influences on human behavior and attitudes; however, current social technologies do not explicitly guide people's behavior and attitudes. In a new infrastructure to direct human behavior and attitudes, a mission to steer people toward a goal should be a central abstraction. Additionally, to involve more people, these missions should be designed by a variety of stakeholders who contribute social issues based on participatory design [17].

A community-based approach overcomes this issue. With this approach, a community member can propose a mission for maintaining the community's sustainability, and other members of the community can then complete the mission. However, members usually do not have enough time to contribute to a mission. In particular, people who live in urban areas are busy and have many commitments. Therefore, they usually forget the importance of sustainability in our society. In our daily environments, we have numerous small, common resources that are costly to maintain if maintained by the government, nonprofit organizations or individual companies. However, maintaining these resources typically necessitates missions that can be achieved with minimal effort in a person's spare time. In our urban lives, we usually have plenty of opportunities to take advantage of small amounts of spare time.

The basic idea of *micro-crowdfunding* resembles that of traditional crowdfunding, such as Kickstarter[4]. In *micro-crowdfunding*, a member of a community related to a small common resource, called a *mission organizer*, proposes a new micro-mission when he or she becomes aware that an activity must be

[2] http://www.facebook.com/

[3] http://www.twitter.com/

[4] http://www.kickstarter.com/

completed to maintain the sustainability of the resource. Typical examples of these common resources are a public sink on a floor of a building or a public shelf used by a university laboratory. The proposal includes a summary of the micro-mission, which specifies the necessary activities and the value of achieving the micro-mission. In typical crowdfunding, the price of performing a project is specified; however, our approach can use anything of value, rather than only money. For example, any aesthetic objects, precious objects, empathetic creatures and even useful information can be used as value. The micro-mission proposal is published to all other participants by touching the common resource with the *mission organizer*'s smartphone and sending a photograph showing the current status of the resource.

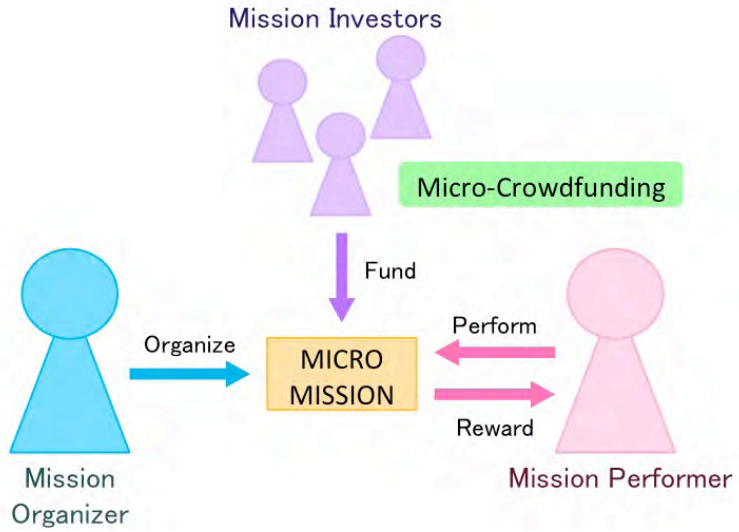

Figure 1: Overview of Micro-crowdfunding

When other members, called *mission investors*, receive a request to fund the micro-mission, they decide whether they want to do so based on the delivered photograph representing the micro-mission. Members wishing to fund the micro-mission simply click on the requests on their phones to notify the *mission organizer*. The micro-mission can be performed by any member who can access the resource in his or her spare time when the total contributed value satisfies him or her. This member is called a *mission performer*. The micro-mission is usually a simple task, such as cleaning a public sink or putting a shelf in order. After completion, the *mission performer* takes a photograph of the resource to show that the micro-mission has been completed and sends it to the *mission organizer*. Finally, the *mission organizer* verifies the quality of the achievement, and notification of the completion of the micro-mission containing a photograph of the resource is delivered to all the members who funded the micro-mission.

The important difference of our method from the original *micro-crowdfunding* [19] is that we use an

abstract concept called value rather than the virtual currency used in the original *micro-crowdfunding*. The following two points are important in this enhancement. First, it offers the opportunity to add various incentives for proposed micro-missions. As described in [36, 56, 65], different people may value the same mission differently based on their personalities or cultures. Not everyone, then, will necessarily be interested in gaining virtual money. In the enhanced approach, different *mission investors* can add different values, such as aesthetics or scarcity, increasing the possibility that more people will join the *micro-crowdfunding* activities. Second, *mission investors* can enhance the attractiveness of a micro-mission by independently adding values, increasing the possibility that a micro-mission will be more attractive to a variety of people through participatory design.

In value-based *micro-crowdfunding*, we consider two approaches to add values to micro-missions. The first approach is to incorporate virtuality into *micro-crowdfunding* activities. In this approach, each *mission investor* adds virtual items or creatures as additional values. The micro-mission becomes more attractive through the added values. The second approach is to incorporate fictionality. Here, each stakeholder is assigned a fictional role to perform in a micro-mission. This enhancement increases the values of existing micro-missions because achieving the micro-missions becomes more important in the fictional world.

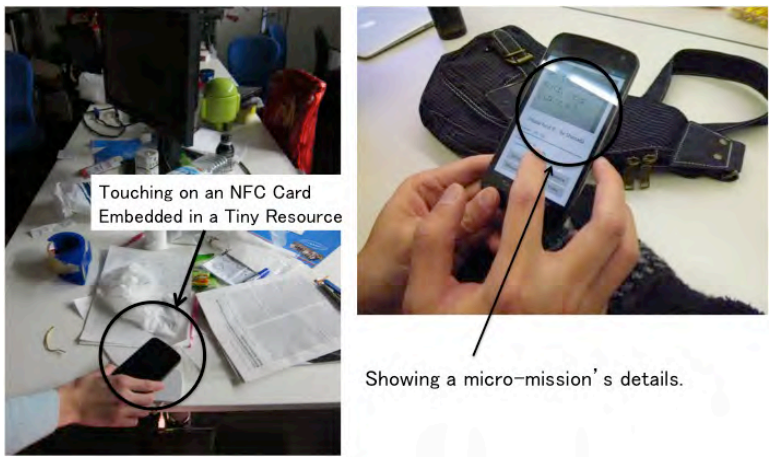

Figure 2: Micro-crowdfunding Prototype System

We have developed a micro-crowdfunding prototype system [59] to demonstrate the effectiveness of our idea. The prototype system has three components. The first is an Android phone that possesses an NFC reader as shown in Figure 2. The second is a computer that is connected to a server—named *Resource Management Server*—embedded in a small, common resource. The last component is a server that stores various information related to the *micro-crowdfunding* activities in a database. This second server is

named *micro-crowdfunding Server*, which knows all *Resource Management Servers*. The system has been implemented as an HTML5[5] web application. Thus, the participants can easily begin using the *micro-crowdfunding* service with minimal effort.

3. Scenario-based Analysis

In this section, we present three scenarios to enhance the basic operation of *micro-crowdfunding* to increase the motivation of its participants. The first scenario uses the economic incentive of virtual currency to encourage participation in *micro-crowdfunding*. The second and third scenarios gamify *micro-crowdfunding* activities through two different approaches. The second scenario incorporates virtuality to motivate participants, adding some virtual items or creatures to *micro-crowdfunding*. The final scenario incorporates fictionality with the notion of adding agency and immersion properties that are typically used in video games. We also analyze how both the enhancements in and shortcomings of these scenarios affect participants' motivation.

3.1 Scenario 1: Using Aging Money to Activate the Local Economy

In these scenarios, participants exchange virtual currency to increase their motivation as the economic incentive. Using economic incentives is a powerful technique for motivating people to change their behavior. An economic incentive is a tangible reward that users consider to be valuable; however, the reward is not necessarily actual money or goods. Instead of using real money, *micro-crowdfunding* adopts a special mechanism, called a local currency [71], from an economic perspective. A local currency is a currency that is not backed by a national government and is intended to be traded only in a small geographic area. As a tool of fiscal localism, local money can raise awareness of the local economy. One of the most important aspects of local currency is the possibility of adopting different money models, which cannot be used as legal tender. For example, the aging money model [71] that is adopted in *micro-crowdfunding* has been a popular example of the local currency idea. Aging money has been widely used to encourage monetary circulation within a community because people do not want to save their money for their future. Thus, the aging money is effective in increasing a community's economic activity. In the aging money concept, the value of money gradually decreases with time, and people naturally want to contribute to micro-missions before the value of the money is degraded; thus, they want to fund micro-missions as quickly as possible. To encourage community members to contribute to a micro-mission, we set the rule that the value does not degrade when a person funds a micro-mission with

[5] http://www.w3.org/TR/html5/

his or her money. When a micro-mission is completed, half of the money provided by a participant is returned as a reward to him or her. This arrangement provides an incentive for participants to fund more micro-missions. Because the proposed *micro-crowdfunding* concept uses virtual currency, all of the transactions occur electronically.

The following scenario presents how each stakeholder in *micro-crowdfunding* experiences his or her participation in and contribution to a micro-mission.

(1) Jun is a university student; he is very busy with his research and must go to his laboratory every day. He worries about the use of some small, common resources in his laboratory. In particular, he is bothered by a table that has been left in disorder. There is a "mountain" of papers, trash, and gadgets on the table. He wants to use the table but has no time to clean it up because of his busy schedule. "It would be great if someone could help me," he thinks.

(2) Jun decides to create a micro-mission with the title, "Please clean this table", and he makes an appeal for funds from other people who use the table. He takes a picture of the disorderly table with his smartphone to show others its status. Somewhat later, when he has spare time, he sets the requisite amount of money at 10 bells, with a bell being the unit of the virtual currency used in the micro-crowdfunding service, and he provides 3 bells himself as an initial contribution to the micro-mission using his smartphone.

(3) Kazuya, Aki and Haruka are colleagues of Jun in the laboratory. They all receive the micro-mission proposal through an email delivered due to Jun's micro-mission registration. Kazuya agrees with Jun that the table must be cleaned. Thus, he contributes 3 bells to the micro-mission's fund with his smartphone. The total amount of money contributed is now 6 bells. Kazuya often uses the table as well, and he very much wants the micro-mission to be achieved.

(4) Aki and Haruka are together when they receive the proposal. When they receive the email, Aki says, "I feel that it is a good idea for our laboratory members. I want to join the micro-mission." Haruka agrees; each then contributes 2 bells with his smartphone. The total amount of money contributed reaches 10 bells, which is the target amount that Jun has chosen. As a result, the micro-mission "Please clean this table" becomes executable, and all of the potential mission performers are informed of this status.

(5) The next day, Ryosuke, who is also Jun's colleague, comes to the laboratory at 13:00 to prepare for his presentation. He concentrates on his tasks and finishes at 16:00.

(6) He has a part-time job that begins at 17:00, leaving him some spare time. He checks the available micro-missions in the laboratory and finds Jun's micro-mission. Ryosuke says, "Oh, I can do this micro-mission before going to my part-time job. It is convenient for me!" He decides to execute the mission.

(7) A few minutes later, Ryosuke has completed the micro-mission. The table is now relatively clean. He takes a photograph of the clean table and reports the micro-mission as being complete, including the photograph. Jun is impressed with the report. Of course, he confirms the completion of the mission. Ryosuke then receives 10 bells as a reward.

(8) Jun is grateful to all who participated in the micro-mission. He is now able to comfortably use the table. Kazuya, Aki and Haruka, who have co-funded the micro-mission, can also use the table comfortably. Ryosuke also feels happy because he not only received a reward but was also thanked by every participant in the micro-mission. Consequently, he is proud of completing the micro-mission. All the participants are satisfied by using the service.

We conducted a small experiment to evaluate how the social and economic incentives designed for *micro-crowdfunding* are useful using a role-playing evaluation method [53]. We found that money can be used to increase awareness of the importance of social sustainability through the support of micro-missions by investing funds. This increase occurs because the awareness of the importance of the micro-mission is high if participants frequently invest funds. Additionally, *aging money* encourages people to invest more before the value of their money decreases. The results show that participating in activities to achieve social sustainability is most important to increasing the awareness of sustainability. However, analysis of the above scenario reveals the possible pitfalls described below.

As shown in [8], *Cialdini* noted that the influence named *commitment and consistency* is important to altering people's behavior. If people make a small effort to contribute to reaching a more difficult goal, the possibility of reaching the goal sooner is increased. In *micro-crowdfunding,* it is important to ensure that all stakeholders are aware of the importance of the goal. In the experiment presented above, we informed participants of the objective of *micro-crowdfunding* in advance; consequently, all the participants knew the goal. However, in the real world, people do not usually fully understand the goal, and we must offer an alternative way for participants to gain knowledge of the goal.

Cialdini also explained that the influence named *social proof* is important in altering people's behavior [8]. In the current version of *micro-crowdfunding*, each *mission investor*'s contribution is visualized on

his/her mobile phone so that notifications of people's contributions encourage others to participate in *micro-crowdfunding* activities as well. However, there is a possibility that no one will contribute to the activities—a phenomenon named *social loafing*. Therefore, it is important to add another mechanism to encourage contributors to join the activities as early contributors. Competition among participants also increases the effect of *social proof*. Game elements, such as *badges* and *leaderboards* [76], which are also commonly used in *gamification*, are effective tools to introduce competition into *micro-crowdfunding* and enhance the influence of *social proof*.

This early experiment assumes that participants in a micro-mission belong to the same community. The setting has a significant influence on participants' behavior because the influence named *reciprocity* typically affects community members [8]. Thus, when a *mission organizer* is an influential community leader who contributes significantly to the community, other members are likely to participate in *micro-crowdfunding* activities. However, in the real world, all participants may not be members of the same community. In this case, we must enhance the basic scenario to exploit *reciprocity* among strangers.

This scenario adopts a virtual currency in a *micro-crowdfunding* activity. The currency is not real money and cannot be exchanged for real money, which may cause a problem because people may not feel any reality with the virtual currency. However, with the aging money adopted in the scenario as our currency model, a participant is immediately aware of the decrease of its value. This awareness increases a feeling of ownership because the value reduction is visible and tangible in the real world. Thus, the strategy increases the materiality of the virtual currency. In particular, some findings in behavioral economics show that people are more sensitive to the decrease in the value of money than to its increase [74]. These findings provide evidence that the aging money increases a feeling of the reality of the virtual currency.

3.2 Scenario 2: Incorporating Virtuality in Micro-crowdfunding Activities

Our daily life is becoming increasingly dematerialized and virtual as our surrounding daily artifacts become more intelligent [44]. We define a virtual object as something that does not really exist but that has a real effect on our daily life as though it did as a digitally implemented object. Additionally, we consider a virtual creature to be a real living creature if the creature interacts with us as we expect. *Baudrillard* has explained our consumption behavior as consuming symbols that are associated with things rather than the things themselves [5]. Because the symbolization of things will accelerate as we further embed computers in our lives, our virtual consumption will progress rapidly. Today, the virtual economy is rapidly growing, and the effectiveness of the virtuality introduced by virtual items has already been proven [40]. Virtuality is also introduced in the real world through *gamification*. The boundary

between real and fictional will become further blurred in the near future [48]. If the incorporated virtuality becomes more realistic, then the virtual economy will truly become part of our daily economy.

In the following scenario, we add virtuality to enhance the scenario described in the previous section. As discussed, the first scenario may not work well when participants are not acquainted with each other. The first enhancement is to replace strangers with favorite or empathetic virtual characters, which increases the likelihood of participation in the *micro-crowdfunding* activities. We may also use a virtual character that has some visual similarities to a participant. For example, when a virtual character's typical behavior closely resembles that of a participant, that participant strongly empathizes with the character [57].

The second enhancement is that a favorite or empathetic virtual character gives a participant a valuable present before asking him/her to contribute to *micro-crowdfunding* activities. The reciprocity effect has a strong influence on people's behavior as described above. In particular, when the present is tangible, the participant feels a strong sense of ownership. Similarly, the rarity of a present has a strong influence on people's behavior [39].

The final enhancement is to show the visual effect of participants' current contributions toward the goal. This visualization significantly increases people's willingness to contribute to the *micro-crowdfunding* activities because the goal setting becomes obvious when the goal and the distance to the goal are clearly presented.

(1) The environment is one of the most important topics to be discussed in modern society because it will greatly influence our future lifestyle. Ryuko wants to contribute to improving the current situation and begins advocating addressing various environmental problems with others who live in her city.

(2) As a small first step, she proposes a micro-mission to clean up a shared table and asks others for their cooperation in micro-crowdfunding activities because a small start is essential to spreading awareness of the importance of helping improve the current situation.

(3) Each participant is represented as a virtual idol that will particularly resonate with the potential mission performer because all the participants are fans of an anime in which the virtual idols grow with each others' help.

(4) Each virtual idol gives a game that involves exploring precious and beautiful cities to all the potential mission performers because visiting cities in foreign countries is currently considered one of the most fun pastimes by young people—who constitute most of the participants in micro-crowdfunding activities—and

they like to learn about cities that they will be able to visit in the near future.

(5) One potential mission performer, Satsuki, strongly favors the virtual idol Nonon, who represents one of the mission investors. Satsuki enjoys playing a game that Nonon gave her on her mobile phone. In particular, the city explored in the game is one that Satsuki wants to learn more about and visit in the near future.

(6) While Satsuki is playing the game, Nonon appears in the game and asks Satsuki to perform the micro-mission proposed by Ryuko. Of course, Nonon does not know Ryuko directly; however, Nonon tells Satsuki that Ryuko is a good friend of Nonon, making Satsuki feel a sense of closeness to Ryuko.

(7) Satsuki performs the micro-mission and reports its completion to Nonon, and Nonon appreciates Satsuki's efforts. A person who is an owner of Nonon also makes a small contribution to the micro-crowdfunding activities. The scoreboard shows that his/her contribution advances the total one step toward its goal, which increases the possibility that participants will take part in other micro-crowdfunding activities in the near future.

(8) A shared table is now clean due to Satsuki's efforts. Returning to the table, Ryuko is impressed with the work. She indicates that the group is one step closer to the goal and appreciates all who have helped her.

In the previous scenario, we assume that the participants are members of the same community and that helping each other is essential in their daily lives. Therefore, the influence of *reciprocity* works well in the scenario without an extra mechanism to increase the influence of *reciprocity*. In the second scenario, some virtual items and characters are introduced to address the shortcomings of the previous scenario. At first, in the second scenario, we assume that none of the participants knows any other but that the participants will feel favorably toward virtual characters representing other participants. Specifically, if a virtual character appears on popular television programs, most participants will likely know the characters well, and some will feel strong positive feelings toward the characters. Additionally, in the scenario, a virtual character gives presents to a participant before asking the participant to join the *micro-crowdfunding* activities, increasing the *reciprocity* effect to encourage participants to perform a proposed micro-mission [8].

Gamification adds some virtuality to our daily lives to encourage people to participate in more activities. Adding *batches* and *leaderboards* is a typical approach to achieving *gamification* [76]. As described by *Denny*, goal setting is essential to making *gamification* successful [16]. Consequently, collecting batches

should have the consistent purpose of achieving the goal. *Asif* also asserted that goal setting increases human intrinsic motivation [3]. In the above scenario, while the current status of the progress toward the goal is shown, the importance of the goal is not clearly presented. Therefore, most participants may not be aware of the importance of improving the current situation. In particular, organizing and cleaning a shared table is not directly related to a sustainable society. Thus, it is not easy to discern the importance of merely joining the *micro-crowdfunding* activities. We must consider an alternative approach to raise awareness of the goal of the *micro-crowdfunding* activities and of how the current mission contributes to achieving the goal.

A sense of reality in virtuality is essential when virtuality is incorporated in the real world. If a sense of reality is lost, a participant's motivation will significantly decrease [56, 66]. For example, when people shown on a *leaderboard* do not offer a sense of reality and may be considered artificial, potential participants' lose their motivation to participate in the activities. This concern is particularly important when names on a *leaderboard* are represented as virtual names. If participants consider the ordered list on the *leaderboard* fictional, then it is difficult to induce them to increase their activities.

As discussed in [66], materiality is essential to increasing a sense of reality in virtuality. However, it is challenging to add this materiality to the virtual items used in the scenarios. In the second scenario, we use a game as a present for addressing the problem. The game explores a precious and beautiful city in which a player has a strong interest. While playing the game, he/she has an aesthetic experience, and the experience is precious for him/her. In the scenario, the present is a game rather than other virtual items, such as virtual goods or clothes. This fact has a strong impact on the player's appreciation for the present because the interaction with the game is a realistic and tangible experience for him/her.

Finally, the scenario also visualizes the status of the progress toward achieving the goal, which makes participants aware of the goal; however, as in the first scenario, it is difficult to show the importance of the goal. Thus, participants are not easily made aware of the goal, and consequently, we need an alternative way to solve this problem. Additionally, the influence named *social proof* may not motivate enough *mission investors*. In this case, a scoreboard showing each *mission investor*'s contribution may be effective if some *mission investors* participate in *micro-crowdfunding* activities and others expect better scores than the participants who have already joined the activities.

3.3 Scenario 3: Incorporating Fictionality in Micro-crowdfunding Activities

Fictional stories already play an important role in product advertisements because they increase the appeal of the advertised products [46]. Incorporating fictionality into stories enriches our experiences because stories can more easily translate abstract real-world meanings in a manner that is attractive and easily understood. For example, fictional stories can represent either nonexistent or future stories. These stories can flexibly offer us a broad range of information using nonexistent artifacts, such as magical and mysterious creatures. It is also easy to embed ideological messages in fictional stories, thus making it possible to teach about the importance of various social issues. Specifically, in Japan, animations, video games, and comics are very popular. Even adults are familiar with their stories because those stories represent the essence of our lives. There are also several emerging infrastructures that create new stories from already-existing stories about characters such as *NicoNico Douga*[6]. Exporting this emerging content is one of the primary aspects of *Cool Japan*[7], Japan's national branding strategy.

Incorporating fictionality into the real world makes it possible for a person who achieves a goal to play a role in a fictional story because the story makes us believe in the importance of achieving the goal, making it possible to increase our inclination to become activists [29]. Because a typical fictional story describes brave heroes, dignified heroines and mysterious magicians whose strong self-efficacy enables them to achieve difficult goals, when we play these roles in the real world, our attitudes and behavior are altered and our own self-efficacy increases. Role playing by playing a fictional role in the real world without losing one's grasp on reality is effective in incorporating fictionality into the real world. This type of role-playing is called *pervasive role-playing* [49]. A person's fictional experience becomes tangible if he or she feels that the embodied fictionality is realistic. Reality is the most important criterion for the success of *pervasive role-playing* [60, 64]. The important aspect of the role-playing is to increase a player's autonomy through the game's agency property. As shown in [13], this autonomy is essential to building the intrinsic motivation of a player. Therefore, incorporating fictionality is an effective tool to help people understand embedded ideological messages and induce their participation by increasing their intrinsic motivation.

The following scenario shows how fictionality is incorporated into *micro-crowdfunding* activities.

(1) A force infringes on the beautiful world, with each member asserting his or her power. Then, a shared

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6 http://www.nicovideo.jp/

7 https://www.ana-cooljapan.com/

table also becomes dirty. Hajime plays the role of a heroine who saves the world but is caught by a monster who destroys nature. The beautiful world suddenly becomes dreary or colorless.

(2) Her friends Rui, Sugane, and Utsutsu are assigned roles as team members to work together to find a person who can perform a micro-mission to organize the shared table and release Hajime from the monster. Hajime asks her team members to complete their quest.

(3) Each team member has a mobile phone that presents his/her contribution as an inner world. If the team cannot find a person to perform the micro-mission before their deadline to save Hajime, the world will be devastated, and they will lose their powers forever.

(4) Hajime's team members are aware of their powers. They notice that three independent powers are necessary to activate the ability of Jo, the hero, to accomplish the proposed mission. According to the team members' individual personalities, Rui's power is intelligence, Sugane's technique, and Utsutsu's strength.

(5) Each member learns how to save the world from environmental pollution to increase his/her power. Rui increases her knowledge in various areas, Sugane learns various techniques and Utsutsu studies the importance of political power to solve the environmental pollution problem.

(6) Jo's mobile phone has a status bar showing which power is currently given to Jo, and he waits to collect all three powers. Finally, all the team members possess their powers and identify Jo as the right person to perform the micro-mission.

(7) Once Jo possesses the three powers, his mobile phone informs him that this is the right time to perform the micro-mission, and he can finally clean the table. Rui, Sugane, and Utsutsu notice that Jo has completed the micro-mission because their inner worlds revert to the original beautiful world where many flowers bloom.

(8) Hajime is released from the monster, and the monster departs for his galaxy. She appreciates her team members and Jo and that the world is again bright and clean. Now, Rui, Sugane and Utsutsu also have knowledge and know techniques to avoid environmental pollution. On the next occasion, they want to contribute to other micro-missions to achieve the goal.

The first issue in implementing this scenario is how to represent fictionality in the real world. A *virtual form* is an abstraction to blend fictional expressions in the real world by using ubiquitous displays and projectors [64, 68]. In the scenario, *micro-crowdfunding* adopts three *virtual forms* as shown in Figure 3.

The first *virtual form* shows our fictional daily environment. When a monster appears, the expression showing fictional nature becomes colorless. In the scenario, the monster represents a concrete symbol of environmental pollution, which facilitates reminding participants that pollution is a serious problem in our society. The second virtual form is shown on each team member's mobile phone and represents his/her inner world. The third virtual form shows a status bar of the growth of the power of each team member and a deadline for a *mission performer* to perform the micro-mission.

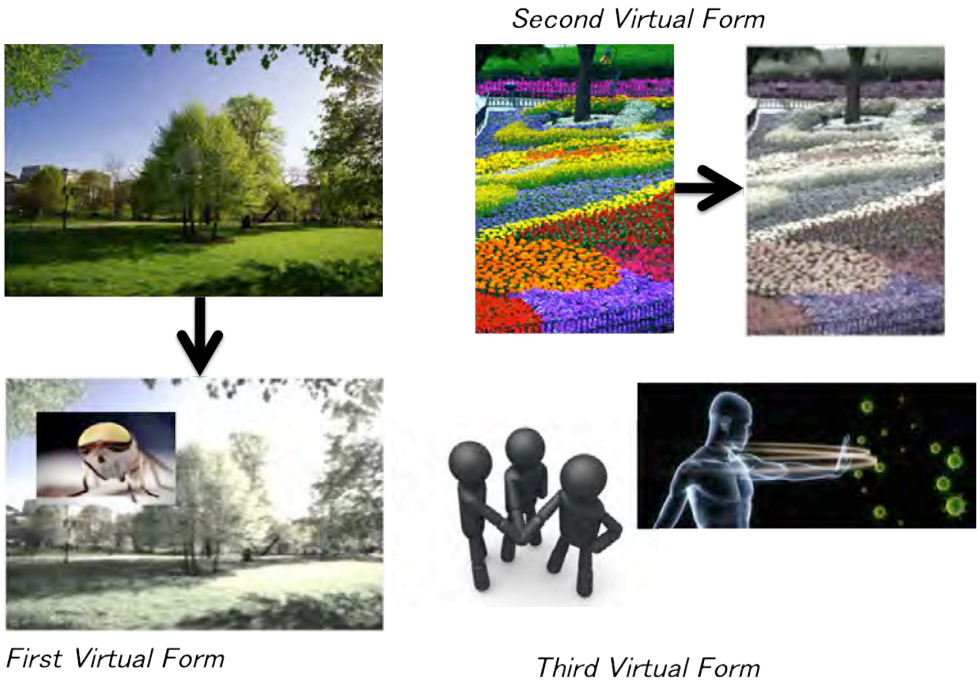

Figure 3: Virtual Forms in Micro-crowdfunding

Each person has a fictional role in the scenario in which fictionality is incorporated. The *agency* and *immersion* properties are useful concepts that are used in video games [23]. The *agency* property is realized by assigning roles to participants; however, the current virtual form technologies do not offer enough *immersion* property to make people play these roles in a fictional story. *Live Action Role Playing* (LARP) participants usually wear costumes to play roles in a fictional world [48]. Recently, *cosplay* has become popular among young people; in this practice, participants play the roles of fictional anime characters by wearing the characters' typical costumes [38]. Additionally, the "sacred land" of anime refers to the places that form the backgrounds or the scenery of the anime, and many anime fans visit these places [60]. An *Alternate Reality Game* (ARG) seeks to blend fictionality into the real world by embedding each fragment in a fictional story into a different medium [47]. The *GamiMedia model* is a semiotic model to develop a fictional story using transmedia storytelling [63]. The model has three

components: *Visual*, *Narrative* and *Dynamics*. Specifically, *procedural rhetoric* embedded in *Dynamics* gives a strong persuasive effect to the immersive fictional world [6]. These new approaches will improve the *immersion* property that can be achieved through the current virtual form technologies.

The next challenge is increasing the sense of reality in the fictionality embedded in the real world. When a participant loses a sense of the reality of the fictionality, he/she cannot play a fictional role because he/she is aware that he/she remains inside the fictional world, which has no direct relationship to the real world. In [64], the authors develop several design patterns to increase a sense of reality in fictionality when the fictionality is incorporated in the real world. Currently, the virtual forms and the fictional stories they portray are simple. For more effective fictionality, we need better fictional stories to offer participants in the playing of more attractive roles. However, the story will become complex and the time to learn the story longer—contradicting the assumption that *micro-crowdfunding* activities are lightweight.

Incorporating fictionality into *micro-crowdfunding* by assigning fictional roles to community members motivates them to propose and complete a micro-mission toward the goal defined in *micro-crowdfunding* if a fictional story embedded as transmedia storytelling presents ideological messages that identify the micro-mission's importance to achieving the goal [57, 58, 68]. Because the real world can be represented abstractly and sometimes ironically in a fictional story through framing to simplify or exaggerate essential and important concepts in our daily lives [63], people easily notice the concepts that are relevant to achieving an ideal, sustainable society. Fiction also allows people to use more appropriate metaphors than documentaries or other nonfiction. In particular, Japanese animation stories contain complex ideological social messages toward futuristic lifestyles [63] to increase people's intrinsic motivation. These stories can offer many effective metaphors to increase our self-efficacy through the positivity they express. This approach also allows *micro-crowdfunding* to incorporate ideological incentives alongside the psychological incentives—for example, by highlighting empathetic, aesthetic, religious, and luxurious/precious values [68]—and improves on our current approach as a pervasive game that blurs the spatial, temporal, and social boundaries between fiction and reality by making the magic circle disappear [48]. This approach can be used to inform participants of the importance of *micro-crowdfunding* activities.

3.4 Discussion

In this section, we discuss several issues in implementing and improving the above scenarios. As described in Section 2, we have already implemented the first scenario, and we will describe some early

experiences in doing so [59]. In the next section, we analyze our experiment in terms of the participants' motivation with a real working prototype system. We mainly discuss the second and third scenarios here.

A *virtual economy* is one that exists within a fictional world, usually gaming, or a virtual social world [40]. These economies are primarily found online in multi-player, real-time virtual worlds. *Virtual economies* have virtual currencies. While these currencies typically cannot be traded for real-world currencies at a bank or currency exchange, this trading does occur. In the first scenario, virtual currency is used to fund people who perform micro-missions. When fictionality is incorporated, a participant may use his/her own money to buy something in a fictional world. This approach is useful to blend real and fictional worlds because virtual currency used in the *micro-crowdfunding* activities that are performed in the real world can also be affected in a fictional world. This potential creates a new possibility of proposing micro-missions that can be performed in a fictional world. This approach blurs real and fictional micro-missions, where fictional micro-missions are used to motivate participants because the fictional micro-missions are more related to people's favorite fictional stories and the importance of the *micro-crowdfunding* activities can be presented more clearly.

As shown in Section 3.2, the scenario incorporates several virtual items and characters to gamify *micro-crowdfunding* activities. This approach is similar to the existing *gamification-based approach* of adding game mechanics to real world activities. Participants must feel a sense of reality of the virtual items and characters appearing in the real world. We need a more systematic approach to analyze how participants feel a sense of reality and attractiveness on the part of virtual items and characters. In most gamification-based approaches, virtual rewards, such as points and leaderboards, are used as game elements; however, these approaches do not address whether the virtual rewards are attractive to users. For example, in [77], while points and leaderboards are added to promote physical activities, the paper does not take into account whether the rewards are meaningful for the users and concludes that the effect of the gamification-based approach is limited. However, the game's power comes from the meanings given to the virtual rewards. The *value-based analysis framework* is an approach to analyzing the meaning of virtuality [55, 68]. The framework proposes a set of values and a way to construct their intrinsic motivation as shown in Figure 4. Currently, the framework includes six values as described in Figure 4. To design persuasive *virtual forms* that can change people's attitudes and behavior, the figure shows a framework for creating *virtual forms* based on the *value-based analysis framework*. While participants continue to join *micro-crowdfunding* activities, they gradually change their behavior and attitudes. First, values to increase *extrinsic motivation* are used to give people *notice* of why they must change their attitudes and behavior. Next, more information is provided to make people *think* about the

reasons for their changes. These values encourage people to participate in more *micro-crowdfunding* activities. *Extrinsic motivation* increases people's *pleasure, happiness, excitement, satisfaction,* and *comfort* and stimulates positive emotion. However, to make people into real activists who *act* to make changes, *intrinsic motivation* should be taken into account. In this case, the *ideological value* and the *persuasive value* play more important roles. These values increase people's *intrinsic motivation,* and their *self-efficacy* to change their attitude and behavior helps them *maintain* their changes. Thus, they autonomously join *micro-crowdfunding* activities to achieve the goals and propose more missions to achieve a sustainable society. In order to embed the *ideological* value and *persuasive* value in virtuality, a story component is necessary to understand the values when joining *micro-crowdfunding* activities.

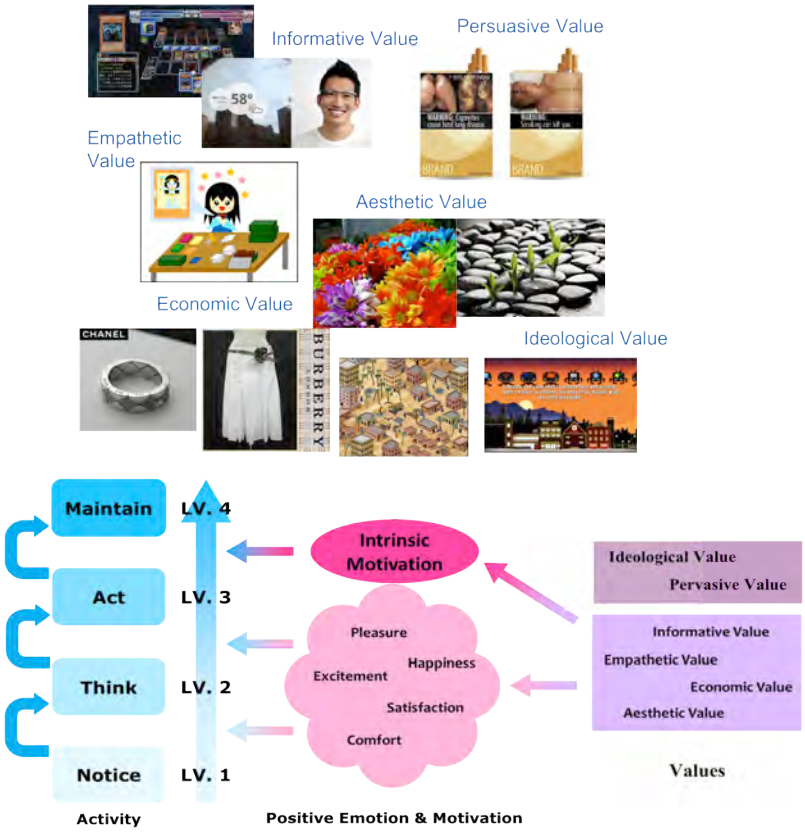

Figure 4: Value-based Analysis Framework

To change participants' behavior and attitudes as shown in the lower diagram of Figure 4, participants must take part in *micro-crowdfunding* activities over a long time. To increase a community's long-term activity and maintain the members' participation to achieve the goal, multiple micro-missions must be coordinated with a game-based technique to create a fictional drama for participants that encourages them to complete the micro-missions [35, 61]. The third scenario only contemplates performing one micro-mission. However, in typical games, players perform multiple missions step by step. Typically, a

player starts by performing a simple and easy mission and seeks to perform a complex and difficult mission in the final stage. Most participants have difficulty performing a challenging mission at the beginning. While performing multiple missions, a participant can also learn the importance of achieving the goal if each mission offers enough information to teach the importance step by step. This progression is effective, then, in increasing intrinsic motivation, and this motivation is essential to completing a difficult mission. One approach is to use incentive-Web [61] to organize multiple missions in a web structure. Until a participant completes one mission, he/she cannot perform the next. He/she, then, must perform several missions to achieve the goal. However, the current approach requires a *puppet master* or a *game master* to organize missions [61]. In *micro-crowdfunding*, a *puppet master* is a fake *mission organizer*, and he/she proposes micro-missions step by step according to a participant's status toward achieving the goal. In a realistic situation, it is difficult to assign a *puppet master* for each specific purpose. However, it may be effective to organize a special event in which multiple micro-missions are performed to educate participants about the importance of achieving the goal of *micro-crowdfunding* activities.

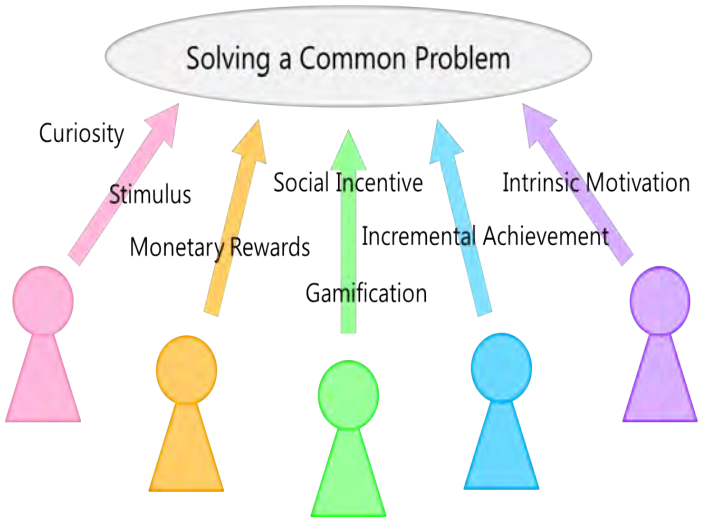

Figure 5: Multiple Incentives and Participants' Personalities

In [65], we show several different incentives that are used in social media to encourage usage. In the second scenario, virtual idols and rare presents are used to motivate participants. If participants are interested in the virtual item or character, most will participate in the *micro-crowdfunding* activities. However, as shown in Figure 5, the same incentive does not motivate all participants, and each person has a different personality and culture. Therefore, it is desirable to offer a variety of micro-missions with different incentives in *micro-crowdfunding* activities. The goal of social sustainability is achieved by

performing these various micro-missions.

We also must take into account the fact that people change their feelings regarding the importance of values according to their current situations because people may not always think rationally about issues. For example, if people have too many choices, they may not value a favorite choice among the many options [69]. Additionally, if we have too much information, we must rely on heuristics when making a decision and may have serious biases in the decision [72]. These facts also show that supporting multiple incentives is important in attracting more participants to *micro-crowdfunding* activities. How to balance different tradeoffs is an important design decision, and the decision strongly affects the use of incentives.

In animations and games, each virtual character has its own personality and story, which can be used as a medium to convey special information and messages to people. If people are familiar with the fictional story of an animation or game, then the story's characters can recall the leitmotif of the story easily without much additional information but simply by performing some action/interaction with the story's character [1]. In particular, many Japanese animation and game stories contain serious ideological messages that are important to improving our daily lives. We believe that this observation is important in considering how to use virtual characters in various future information services in the real world. As described above, when coordinating multiple micro-missions, it is important to be aware of the main goal: that participants need to contribute *micro-crowdfunding* activities for a long time.

When incorporating virtuality and fictionality, it takes a long time to understand the meaning of virtuality and fictionality because constructing these meanings is a lengthy process. Understanding the ideological messages presented in virtuality and fictionality is also time consuming. In the original design of *micro-crowdfunding*, lightweightedness is one of the most important aspects to encourage participation by busy people living in modern urban areas. As described in [57], embodying a virtual character through transmedia storytelling [14] may be used as a leitmotif to reinforce an ideological idea behind a complex story without requiring a long time to learn the story if a participant knows the characters and the story contains a well-defined ideology. This approach allows us to increase human intrinsic motivation unconsciously by presenting a virtual character as a leitmotif of a story to convey ideological messages.

3.5 Using Game Concepts and Fictional Stories to Motivate Human Behavior

Incorporating a fictional story is a promising approach to complement a *gamification-based approach* as described in Section 3.3. In the last decade, there was an intense debate over *narratology* versus *ludology* [24]. The main point in the debate was how games convey narratives. In video games, a player chooses

his/her way by him/herself. A player, then, creates his/her own story while playing the game, and a scenario writer must meet the challenge of writing a well-defined story. In a game, a player sometimes determines the conclusion of the story. However, when a story is used to increase a player's activism, he/she must follow the story as defined by the writer. One of the game's essential properties is the *agency* property; however, it is difficult for a traditional narrative to offer this property in a predefined story because it is difficult for a player to become one of the characters presented in the story. This difficulty is fundamental in creating the third scenario. Currently, a participant can behave in a way that violates the story, in which case other participants cannot follow the story. A *puppet master* is introduced in ARG or a game master in table-top role-playing games for this reason—to coordinate all the participants so that they can follow the defined story. Another approach is to offer a *meta-story*, in which a player feels the *agency* property although the property is only an illusion [4]. We believe that this is an interesting approach to solving the problem of incorporating a fictional story into *micro-crowdfunding*.

One of the important tensions between a story and a game is that each approach uses a different way to offer people a flow condition. During flow, people typically experience deep enjoyment, creativity, and total involvement with life [9]. While playing a game, people's physical action is a source of a flow condition, and offering an extreme flow condition is one of the typical goals of well-designed games. However, people focus more on thinking and understanding a story while reading it. For understanding an ideology behind a story, a video game may not be an ideal medium because human actions sometimes obstruct people's deep thought. In particular, during flow, people think only about strategies to achieve a game's goal rather than about the philosophy behind the game. In the third scenario, the focus is to offer the *agency* property to participants. However, if we want to include a deep story to make participants understand why they must be activists to achieve a goal, they must stop their actions and have time to think about or understand the reason deeply, which may obstruct the flow in game play. One of the solutions separates the two media of a game and a book, and they are integrated though transmedia storytelling. When a player plays a game, he/she concentrates on the play, and when reading a book, she/she concentrates on thinking and understanding the story; however, both are parts of the same story. The player can choose which aspect he/she prefers to experience according to his/her current situation.

4. Experiment-based Analysis

In this section, we present the results of some experiments with the *micro-crowdfunding* prototype system shown in Section 2. In the experiments, we focus on the following three factors regarding the influence on human behavior: *reciprocity, commitment and consistency*, and *social proof* [8]. The goal of this

section is to discuss some psychological factors that influence human attitude and behavior in the *micro-crowdfunding* prototype system, referencing the results of user studies and the experiments with the prototype system.

Eleven people (eight males and three females) participated in the experiments, and their ages ranged from 20 to 39. The participants were of several nationalities, including Japanese, Chinese and Mexican; however, eight of the eleven were Japanese. Each participant was presented with the following two scenarios. In the first scenario, a participant played the role of a member of a community whose members were all well known to each other. We called this community consisting only of close friends *Friendly Community*. In contrast, in the second scenario, *Stranger Community,* consisted of members who did not know each other, and each participant played the role of a member of *Stranger Community*. The participants answered a questionnaire under the conditions of the above two scenarios; we then conducted semi-structured interview sessions with all the participants.

In *micro-crowdfunding*, the influence of *reciprocity* among participants depends on the relationships among community members. In Section 4.1, we investigate the differences in this influence between *Friendly Community* and *Stranger Community* in the experiments. In the case of *Friendly Community*, the influence works well in the scenario without an extra mechanism to enhance the influence, and each member actively participates in micro-missions.

As mentioned above, the influence of *commitment and consistency* is defined such that if people make a small effort to achieve a more difficult goal, the likelihood of reaching the goal sooner tends to increase. Applying this influence to *micro-crowdfunding*, a small effort is investing funds in a micro-mission as a *mission investor*, and the *mission investor* will contribute to more *micro-crowdfunding* activities as either a *mission organizer* or a *mission performer* in the near future. In Section 4.2, we investigate whether a member who has supported a micro-mission as a *mission investor* in the past tends to participate in other micro-missions as either a *mission organizer* or a *mission performer* in the same community.

In *micro-crowdfunding,* the influence of *social proof* may increase among *mission investors* who invest funds in the same micro-mission. As presented in [59], almost all participants answered that other people's funds affected their decisions of how much to invest in a micro-mission; as a result, we assume that many participants investing in a micro-mission increases other people's participation. In Section 4.3, we investigate whether others' activities have this influence in both *Friendly Community* and *Stranger Community.*

4.1 The Influence of Reciprocity

We asked the following questions to each participant when belonging to *Friendly Community*.

Q-RX1: *Aki, who is one of your close friends, identifies a problem and organizes a micro-mission to solve it. You currently have fifteen minutes of spare time. Can you cooperate with the micro-mission organized by Aki as either a mission performer or a mission investor? You must take ten minutes to perform the micro-mission as a mission performer. Please select your answer from "Cooperate", "Cooperate under some conditions" or "Do not cooperate".*

Q-RX2: *Please answer this question if your answer in Q1-RX1 is "Cooperate". Do you want to participate as a mission investor or a mission performer? Additionally, please state the reason for your choice.*

Q-RX3: *Please answer this question if your answer in Q1-RX1 is "Cooperate under some conditions". What type of condition does your cooperation require?*

Additionally, the following questions were asked when participants belonged to *Stranger Community*.

Q-RY1: *Mr. Ichinose, who is a stranger to you, identifies a problem and organizes a micro-mission to solve it. You currently have fifteen minutes of spare time. Can you cooperate with the micro-mission organized by Mr. Ichinose as either a mission performer or a mission investor? You must take ten minutes to perform the micro-mission. Please select your answer from "Cooperate", "Cooperate under some conditions" or "Do not cooperate".*

Q-RY2: *Please answer this question if your answer in Q1-RY1 is "Cooperate". Do you want to participate as a mission investor or a mission performer? Additionally, please state the reason for your choice.*

Q-RY3: *Please answer this question if your answer in Q1-RY1 is "Cooperate with some conditions". What type of condition does your cooperation require?*

In Q-RX1, eight of eleven participants answered "Cooperate", and three answered "Cooperate under some conditions". Additionally, the results show that most participants wanted to be *mission performers* when the *mission organizer* was their friend in Q-RX2. Some of the reasons given included *"I want to contribute to help my friends as much as possible" and "I show my good faith through my activity"*. These results indicate that the influence of *reciprocity* works well within a close community regardless of

a mission's goal. In contrast, in Q-RY1 and Q-RY2, only two participants answered "Cooperate" in the case of *Stranger Community*, and all of them wanted to participate in the micro-mission as *mission investors*. Reasons given in Q-RY3 included *"I will help provided that the mission organizer has cooperated with my micro-mission" and "If he/she can help me when I need some help [, then I will participate in the micro-mission]"*. These results show that people are conscious of the influence of *reciprocity* when they focus on the relationships among the benefits to themselves, indicating that a stranger may become a friend if approached with kindness.

There are clear differences among participants' consciousness of the use of the economic incentive. In interviews, participants stated *"I want to apply the monetary reward in Stranger Community, but I do not want to do so in Friendly Community", "I am resistant to the employer-employee relationship among friends"* and *"I do not like a clear mechanism to show the amount of debt"*. Although visualizing information about a community is one of merits of using information technology, it is not always the best method of motivating participants. When designing a social information infrastructure, the influence of *reciprocity* should not be introduced as a support tool, and it should be designed as a process to alter human attitudes and behavior. However, introducing this mechanism is not easy. For example, a participant stated *"I cannot feel others' feelings of gratitude if there is an easy mechanism to represent 'thanks' to others."* An easy mechanism, such as "*Like!*" on *Facebook*[2], is useful to show one's interest but seems superficial in representing gratitude. Finally, when the economic incentive is effective, we must carefully address monetary rewards to show the participants' achievement.

From the results of the experiments, we conclude that extrinsic motivational mechanisms, such as monetary rewards, points and badges, become less important when participants are all close friends. The mechanisms that make participants feel that others are real friends are more effective than the extrinsic motivational mechanisms. Using a virtual character, as explained in Scenario 2 and described in Section 3.2, is a promising approach to making other participants feel like close friends. These results indicate that incorporating virtuality and fictionality to strengthen the bonds among friends increases participants' motivation to cooperate.

4.2 The Influence of Commitment and Consistency

For the experiment on the influence of *Commitment and consistency,* the following scenario was provided to the participants:

"So far, Friendly Community's members have performed some micro-missions, and you have also

participated in a micro-mission as a mission investor. All the community members except you actively participate as mission organizers and mission performers. You know generally that these micro-missions are good for environmental sustainability in your community but do not understand their importance."

Additionally, the participants were asked the following question:

Q-C1: *Under the conditions of the above scenario, will you become either a mission organizer or a mission performer at some time? Please choose among "Become a mission organizer or performer", "Become a mission organizer or performer under some conditions" and "Do not become either". Additionally, please state the reasons for your answer.*

Most of the participants answered that they wanted to become either *mission organizers* or *mission performers* provided that their friends made efforts to perform micro-missions and had participated in some past missions as *mission investors*. The reasons for participation in the experiments are classified into the following two types: curiosity-oriented and cooperativeness-oriented. One cited reason supporting the former type was *"I want to experience the activity that my friends are really into"*, and one supporting the latter type was *"We need cooperativeness for a community's sustainability"*. In the scenario, we did not inform participants of the micro-mission's clear goal; however, these answers show an influence of *commitment and consistency*. Understanding the clear goal of a micro-mission is not important in the first step of participating in the micro-mission. However, to maintain desirable activities, the goal of the micro-mission appears to become more important. Two of the eleven participants answered *"I will not become a mission organizer or a mission performer because the presented mission's goal is not clear"*. Another participant answered *"I will try the mission because I may understand its importance"*. If the participants understand the goal of a micro-mission with a small effort, then the participants are more likely commit to contributing to the micro-mission.

In the interviews, participants also discussed the risk of the *bystander effect*[8] (*Social loafing*). Some stated *"I ask others to contribute to a mission if they perform it better"* and *"I feel that I must do it by myself when a community is small"*. Although the visualization of the reward or achievement does not always work well as noted earlier, visualizing participants' contributions as social achievements is effective. Like the influence of *commitment and consistency*, attracting participants to micro-missions through virtuality initially and conveying their importance through fictionality to commit to reaching the goal at a later stage is also effective. If a fictional story contains ideological messages representing the

[8] http://psychology.about.com/od/socialpsychology/a/bystandereffect.htm

importance of the micro-mission, participants can understand the meaning of the goal with minimal effort [57, 64, 68].

4.3 The Influence of Social Proof

To gauge the influence of *social proof*, participants are asked the following questions:

Q-SX: *Assume that you often play at Akihabara with Friendly Community's friends. The members of the community start a micro-mission to clean Akihabara. One of the friends in the community is a mission organizer, and the other three members serve as mission investors. Each mission investor funds 200 units of the virtual currency used in micro-crowdfunding to support the micro-mission. You now have 1000 units of the virtual currency. How much do you want to contribute to this micro-mission?*

Q-SY: *Some members of Stranger Community start a micro-mission to clean area S, which is unknown to them. One community member is a mission organizer, and the other three serve as mission investors. Each mission investor funds 200 units of the virtual currency to support the micro-mission. You now have 1000 units of the virtual currency. How much do you want to contribute to this micro-mission?*

Although the goals of the micro-missions were not clear, all the participants wanted to fund over 200 units of the virtual currency in Q-SX. The influence of *social proof* provided by close friends, then, has a strong influence on people's activity. However, the amount of funds differed among participants in Q-SY. Regarding Q-SY, one participant stated *"It depends on the purpose of the micro-mission"*. The goal of the mission becomes more important than other members' behavior in this case. However, we found an anchoring effect [34] in both *Friendly Community* and *Stranger Community* because almost all the participants decided the amount of funds they would contribute based on 200 units of the virtual currency, which is the amount funded by others specified in the questions. The anchoring effect is effective in steering participants to more desirable situations. Incorporating the anchoring point through fictionality seems natural to motivate participants to fund the appropriate amount of the virtual currency. For example, a virtual character may offer an anchoring effect to advance a micro-mission. As shown in Scenario 2 and presented in Section 3.2, when a participant becomes familiar with the virtual character, he/she begins to empathize with the character. Then, if the character in the fictional story funds the specific amount as an anchoring point, it induces the participant to fund a similar amount. We suppose that the influence of *social proof* among strangers will work well when a participant finds information on other participants' contributions in various places. If participants feel more reality with this information, the trustworthiness of the information increases the power of *social proof*. Transmedia storytelling is a promising way to

present information in various places to encourage human behavior [58, 63]. In particular, ambient and ubiquitous visual expressions of the information are useful techniques to offer information with a low mental load [52]. Strengthening the bonds within a community and increasing the trust among community members enhances the influence.

4.4 Discussion

The results of these experiments show that the influences of *reciprocity, commitment and consistency*, and *social proof* have strong impacts on participants within a community whose members are close friends. The results are consistent with those of the scenario-based analysis discussed in Section 3.1. We suppose that the trust within a community is one reason for the results. Additionally, introducing virtuality and fictionality encourages *micro-crowdfunding* activities; however, the reality of the introduced virtuality and fictionality is an important factor in increasing the activities. As described in the previous subsection, understanding the importance of the goal of a micro-mission is essential to appreciating the value of reaching the goal in the future. When people are sure that there will be value for them in achieving the goal, they actively perform micro-missions to do so. The value is not always offered as the extrinsic motivation like the monetary reward, points and visible achievements. It can instead offer the intrinsic motivation, such as the close bonds through friendship, honor and life satisfaction. Additionally, the discussion presented in this section shows that the influences of *reciprocity, commitment and consistency* and *social proof* may be strong even in a community consisting only of strangers if the community members can feel closer to each other through virtuality and fictionality.

Finally, we present our findings to gamify information/social services to encourage their participation. As noted above, *gamification* is one of the most popular topics in building future information/social services. Of course, games offer pleasure, and embedding game elements into the services to encourage participants seems promising. However, our experience shows that the *gamification-based approach* does not work well if the underlying infrastructure service is not well designed. First, we found it essential to identify the major psychological factors, rather than system factors such as key performance indicators (KPI), to increase participants' motivation. Then, service designers must identify when the psychological factors have pitfalls that obstruct the service operation and remove those pitfalls through *gamification*. An underlying infrastructure service should therefore work well in some cases. *Gamification* does not compensate for bad design of an underlying infrastructure service.

Micro-crowdfunding uses several types of techniques to spur activism, and the basic scenario works well when participants belong to the same community. Additionally, we identify several psychological factors,

such as *reciprocity*, *social proof*, and *commitment and consistency*. Then, we can adopt a *gamification-based approach* to enhance the strength of these psychological and social concepts to motivate participants who do not belong to the same community. The role of *gamification* is therefore to push people from behind to encourage certain behavior such that they believe that the idea to change their behavior was their own. One of basic principles of design is that it is desirable to explicitly identify psychological or social factors that can be measured and discuss how the concepts can work well.

Additionally, people may not alter their behavior without intrinsic motivation. As shown in [15], incorporating ideological messages is essential to increasing human intrinsic motivation and altering people's behavior and attitudes toward a better lifestyle. One essential element in increasing human intrinsic motivation is encouraging users to create their own stories while participating in the activities. Perhaps the success of gamification depends on whether a user can create his/her own story with the gamification elements. While incorporated fictional stories help a user create his/her own story, some people can create their own stories from even a few game elements, such as when playing a board game or working on a puzzle. We think that the question of whether gamification is effective depends on users' ability to create their own stories. We believe that virtuality and fictionality help create a user's story to enhance his/her intrinsic motivation. We must investigate whether our approach is better than the traditional gamification-based approach in increasing human intrinsic motivation.

5 Related Work

UbiAsk [42] is a mobile crowdsourcing platform that is built on top of an existing social networking infrastructure. It is designed to assist foreign visitors by enlisting the local population to answer their image-based questions in a timely fashion. Existing social media platforms are used to rapidly allocate micro-tasks to a wide network of local residents. This approach allows us to enhance existing social media by leveraging end-users. Participants are critical to the evolution of social media. The personality analysis framework [56] is essential for analyzing end-users' participation because people with different personalities have different reasons for participating in social media. When designing a community-based crowdsourcing system, the user's motivation is a key issue, and people who have different personalities should enjoy participating in a community for crowdsourcing.

Amazon Mechanical Turk is currently the best-known commercial crowdsourcing service. It uses monetary rewards to encourage people to perform micro-tasks [37]. The system, therefore, only considers economic incentives. However, as shown in [2], monetary rewards are not always the best way to motivate people to perform micro-tasks. Instead, contributors appreciate many intangible factors, such as

community cooperation, learning new ideas and entertainment.

The non-monetary motivations were represented successfully in examples such as *Yahoo!Answers* and *Answers.com*[9]. Moreover, if money is involved, quality control becomes a major issue because of the anonymous and distributed nature of crowdworkers [28]. Although the quantity of work performed by participants can be increased, the quality cannot, and crowdworkers may tend to cheat the system to increase their overall rate of pay if monetary rewards are adopted. In [41], Liu et al. also showed that their crowdsourcing system, *MoboQ,* worked well without monetary rewards.

More recently, digital designers have begun to adopt ideas from game design to incentivize desirable user behaviors. The idea of taking entertaining and engaging elements from computer games and using them to incentivize participation in other contexts has been studied in a variety of fields. In education, the approach is known as serious gaming, and in human computing, it is sometimes called games with a purpose [12]. Most recently, digital marketing and social media practitioners have adopted this approach under the term gamification. The idea is to use game mechanics, such as online games, to make a task entertaining, thus engaging people to conscientiously perform tasks. *Foursquare* is a typical pervasive service that uses a gamification approach [54]. However, as shown in [15, 42], gamifying crowdsourcing services may not work well because game mechanics, such as points and badges, are not sufficient to encourage people to increase their target activities. Because ideological incentives are essential in increasing people's intrinsic motivation, as shown in [57, 58, 63], many successful games offer ideological incentives with well-designed psychological incentives that stimulate people's emotions effectively.

Although several studies have already investigated existing crowdfunding infrastructures [22, 25, 26, 31], little research has been devoted to the design and experience of building new crowdfunding infrastructures. In spite of this dearth of research, [50, 51] provided an experiment in enterprise crowdfunding as a useful example. Employees allocated money for employee-initiated proposals on an enterprise Intranet site, including a medium-scale trial of the system in a large multinational company. The results showed that communities in a large company propose ideas, participate and collaborate and that their activities can be encouraged through crowdfunding. This approach details a new collaboration opportunity and shows that crowdfunding is a promising method for increasing activity within communities.

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[9] http://www.answers.com/

Persuasive technologies are information technologies that alter a user's attitude and behavior [18]. The technologies are based on several psychology models, and several case studies have been developed. The user studies of the case studies show that persuasive technologies are effective in changing users' attitudes and behavior. For example, *UbiFit Garden* is a mobile application that changes a user's physical activity by using positive feedback if the user's behavior is desirable [11]. *Nakajima et al.* reported four case studies [52], which use both positive and negative incentives to control a user's behavior. The appropriate feedback is chosen according to a user's current situation, which is acquired by sensors attached to daily artifacts. In a recent study [30], several problems with the current persuasive technologies are presented. The paper presents some insights of behavior science when HCI research is used to develop services for which persuasiveness is an important factor.

Maslow claims that human motivation is based on a hierarchy of needs [45]. In *Maslow*'s hierarchy, the basic needs are physiological, such as the need for food. Other needs are *safety* needs, *attachment* needs, *esteem* needs, *cognitive* needs and *aesthetic* needs. At the highest level, when all the other needs are satisfied, we can start to satisfy *self-actualization* needs. Because a user feels that a product has value when it satisfies his/her needs, satisfying needs is closely related to defining values. In [13], *Deci* proposed the following three basic needs: a *need for relatedness*, a *need for competence*, and a *need for self-determination*. For each individual, one of the needs is typically stronger than the others, which influences each person's personality. *Jordan* proposes four pleasures: *physio-pleasure*, *psycho-pleasure*, *socio-pleasure* and *ideo-pleasure* [33]. *Nakajima et al.* also propose five incentives: *physical incentive*, *psychological incentive*, *social incentive*, *economic incentive*, and *ideological incentive* [52]. The differences among their proposals come from their research backgrounds and contexts. However, we still need more discussion to identify a set of values based on more case studies.

The concepts of psychology can be applied to the economic decision-making processes of individuals and institutions. Behavioral economics explores why people sometimes make irrational decisions and why and how their behavior does not follow the predictions of economic models [34]. As described in [56], a person's unique personality determines the importance that he/she places on different values. The results of behavioral economics also show that each person assigns different importance to the same value according to his/her current environmental or emotional situation. The *feeling as information theory* indicates that it is difficult to think rationally while experiencing a positive feeling [70]. In contrast, the user tends to think rationally when she perceives her situation as negative. Sufficient information is necessary to make the right decision. In modern society, we receive too much information every day, and it is difficult to think rationally even when making an important decision [72]. Similarly, when faced with

too many choices, people may not choose anything. Micro-payments have also been explored as a method for altering consumer behavior to improve sustainable habits [74].

Identifying values among stakeholders is essential in *participatory design* [17]. *Value-sensitive design (VSD)* integrates ethics and design [20]. The design methodology emphasizes the values of direct and indirect stakeholders, accounts for human values throughout the design process and is influenced by participatory design experience. *Worth-centered design (WCD)* [10] claims that HCI should incorporate the concept of values as a goal of design. A priori usability evaluation and context fit cannot distinguish between bearable design problems and problems that have a major impact. *WCD* moves the focus from the context of use to the context of impact, meaning that understanding outcomes is more important than understanding the way to reach the outcomes. *Boztepe* proposes four values: *utility value*, *social significance value*, *emotional value* and *spiritual value* [7]. The *design with intent toolkit* [43] helps identify a design that is intended to influence or result in certain user behavior, offering a useful pattern to guide designers.

In [39], *Lendonvirta* proposed three attributes that make virtual items valuable in the game. The first is the functional attribute consisting of two categories: performance and functionality. The performance is the skill to play a game well, and the functionality of the equipment increases the possibility of winning the game. The second attribute is the hedonic attribute. This attribute consists of six categories: visual appearance and sounds, background fiction, provenance, customizability, cultural references and branding. The hedonic attribute offers the value to satisfy a user's emotional desire. The third attribute is the social attribute. This attribute consists of one category: rarity. The value is strongly associated with the ability to distinguish a group of owners from non-owners. The above attributes are effective in providing economic value to virtual forms by making the items with the attributes shown in the forms exchangeable with other people.

When virtuality is incorporated in the real world, a sense of reality may be lost. For example, in [66], using virtual cards decreases a sense of reality significantly. Additionally, in [67], a sense of reality is important to design human computer interaction in a digital-physical hybrid world. These senses of reality vary according to people's personalities [56]. Incorporating fictionality also affects a sense of reality. In [64], several design patterns are proposed to increase the reality of semiotic objects that may not exist in the real world. The reality is also related to values, and we must investigate how values are used to increase a sense of reality [68].

6 Conclusion and Future Directions

The paper proposed a new *community-based mobile crowdsourcing* system named *micro-crowdfunding*. We presented three scenarios, and two of them involve gamifying the basic scenario. The analysis shows that the possibility of incorporating virtuality and fictionality is promising.

However, our current technologies are not yet mature enough to fully realize the scenarios because it is difficult to offer completely immersive experiences that allow participants to lose their sense of reality and be motivated to join the *micro-crowdfunding* activities. Future technological progress will seamlessly blend virtuality and fictionality in the real world. At that time, a participant may not be aware of the boundary between reality and fiction. However, this seamless blending will create new ethical issues. Additionally, this approach offers a way to consider our future society. For example, what should our government do? What is our desirable lifestyle? What is our future work style? Because our ultimate focus is guiding human behavior, a *community-based mobile crowdsourcing* infrastructure will become an underlying infrastructure for various daily activities to shape our behavior and attitudes.

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