Effects of Framing on User Contribution: Story, Gameplay and Science

Emergent Research Forum Paper

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Abstract

Gamification in citizen science systems combines play elements with scientific tasks. We posit that gamified elements are connected through "framings," layers of meaning overlaid onto core tasks to shape an overall experience. Drawing upon self-determination theory, we propose a research model to investigate how users' perceptions of framings contribute to motivational needs and contribution behavior. In a full study, we plan to conduct an online survey to validate our research model and elaborate upon the promise of gamification in information systems.

Keywords

gamification; story framing; gameplay framing; science framing; citizen science; contribution behavior

Introduction

Citizen science systems are a type of crowdsourced information system purpose-built to support scientific inquiry via an open call for contribution over the web. Gamification is a design approach that integrates purposeful activities with play to motivate and engage crowdsourced workforces. In gamified citizen science systems, game elements are integrated with tasks to fashion interactive environments with various meanings for players to perceive. Researchers in game science literature indicate that framing the framing of tasks and play can effectively impact players' psychological needs (Lieberoth, 2015; Rigby & Ryan, 2011). In gamified citizen science systems, play can be framed by scientific tasks and scientific tasks can be framed by play. That is, players experience a citizen science game through playful elements – story and gameplay mechanics – as well as scientific tasks and activities. Based on our previous explorations of play and citizen science (e.g.,Prestopnik & Crowston, 2011; Prestopnik & Tang, 2015; Tang & Prestopnik, 2016), we propose three frames through which to understand citizen science games: story framing, gameplay framing, and science framing.

Games have the ability to satisfy basic psychological needs as proposed in self-determination theory (Ryan & Deci, 2000), including autonomy, competence, and relatedness (Rigby & Ryan, 2011). Games have also been found to lead to eudaimonia gratification, that is, appreciation of insight and meaning-in-life (Oliver & Bartsch, 2010; Oliver & Raney, 2011). This proposed research uses story, gameplay, and science framing to investigate the effects of gamification on user motivation and contribution. In recent years, gamification has been recommended by information systems researchers to attract and engage participants (Schlagenhaufer & Amberg, 2015). Despite a growing number of examples, however, research has mostly focused on individual elements, such as rewards, status, and achievements (Suh, Wagner, & Lili, 2015). Unlike prior explorative and descriptive research (Bowser et al., 2013; Rotman et al., 2012), our research aims to structuralize the associations that exist between framings and user motivation, tying these to users' contribution behaviors via a systematic research model. In this emergent research paper, we consider relevant literature, propose a model, and describe future directions for empirical study.

Related Work

In IS research, gamification is not a completely new area for study, but it has offered a relatively new paradigm for system design and introduces a new perspective for IS research (Broer & Poeppelbuss, 2013;

Schlagenhaufer & Amberg, 2015). Game elements have been found to stimulate positive psychological outcomes and behavioral outcomes from citizen science participants (Hamari, Koivisto, & Sarsa, 2014). In addition, games can lead to thought-provoking and meaningful experiences even as they serve as vehicles for entertainment (Oliver et al., 2015). IS researchers have found that game-like environments play an important role in influencing technology use behavior (Broer & Poeppelbuss, 2013). Gamification is considered a significant motivating technique for engaging users, making some repetitive tasks more fun and enjoyable (Flatla, Gutwin, Nacke, Bateman, & Mandryk, 2011) and improving motivation and performance in organizational activities (Liu, Li, & Santhanam, Forthcoming).

Game environments are technology-enabled settings designed to motivate behavioral responses from players, and research in citizen science, crowdsourcing, and games has found complicated patterns of contribution behavior (Prestopnik & Crowston, 2011; Sauermann & Franzoni, 2015). Yet, these studies either view gamification as merely the sum of individual game elements, such as rewards, incentives, and scores, or treat gamification design as background and context for tasks (Broer & Poeppelbuss, 2013). In this research, we argue that gamification design profoundly impacts the player experience and citizen science outcomes through the way core tasks are framed, and we intend to investigate the motivational effects of framings such as story, gameplay, and science in gamified citizen science systems.

Framings: Story, Gameplay, and Science

Story refers to the narrative of the game, including characters, plot, and virtual worlds (Lu, 2015, p. 19). Story framing is a lens through which game designers inform the significance of in-game behavior by providing narrative-driven goals for players to accomplish and various characters to interact with.

Gameplay refers to the mechanics of play, including achievement-oriented goal systems, obstacles, rewards, punishments, game controls, or other actions invoked by agents while interacting with the game world (Sicart, 2008). Gameplay framing allows us to distinguish the significance of mechanics (rules) from narrative (story) in a play experience, especially for aspects of gameplay that are about establishing quantitative values, e.g. scorekeeping, the game economy, health, or power-ups.

Science framing leverages the significance of a player's behaviors, articulating the value of working on embedded scientific tasks so players are aware of their contribution to real world science. Science framing is separate from story and gameplay framing, but can enhance both through the importance it lends to those ostensibly entertainment-oriented aspects of play.

Motivational Needs

Our model adopts four key concepts related to the motivational needs of players: autonomy, competence, relatedness, and meaningfulness. According to self-determination theory (Ryan, Rigby, & Przybylski, 2006), *autonomy* is concerned with control or volition during in-game actions; *competence* relates to a player's confidence in their own ability; and *relatedness* indicates a sense of social connectedness. *Meaningfulness* relates to eudaimonia gratifications satisfied through play, that is, the appreciation of understanding and insight beyond the experience of fun or pleasure (Oliver et al., 2015).

Stories give players events to focus upon within the game, transporting them into a narrative (Green and Brock, 2000) and establishing a concrete and realistic environment for them to interact with. Within story-oriented game worlds, players most often adopt the identity of an avatar, forming a relationship with their own character in the game and with other NPCs who they can interact with. Players become part of the story and are likely to feel a strong connection with game characters. Narrative also inspires and motivates players, casting them in an important role in the experience. Story framing turns players into meaningful agents, immersing them in the narrative; their actions become meaningful to the story. Therefore, we hypothesize:

> ***H1:*** *Story framing positively associates with (a) autonomy, (b) relatedness, and (c) meaningfulness.*

Gameplay is about game control and game actions that comprise the mechanical component of the game. If the game is intuitive and easy to master, players will have more flexibility to control their character and decide the way they would like to play the game, as well as more confidence in their capabilities to progress in the game. Game control is correlated with both competence and autonomy

when playing video games (Tamborini, Bowman, Eden, & Organ, 2010). Gameplay mechanics define the options available to a player and are critical to the play experience. Therefore, we hypothesize:

H2*: Gameplay framing positively associates with autonomy (a) and competence (b).*

Science framing explicates the real-world value of player contributions, even if players engage with a game ostensibly for its entertainment value only. Incorporating game elements into repetitive or monotonous tasks can make such tasks more fun and enjoyable (Flatla et al., 2011), while science framing may help to elicit more serious responses from players. When players make progress and receive positive feedback from in-game characters, they will feel more competent in scientific inquiries. Moreover, informing the value of contributing to core tasks beyond the game context is important for players to understand its significance. Prior studies have also argued that the framing of tasks can profoundly affect user experiences and behavior (Cyr & Head, 2013). Therefore, we hypothesize:

H3: *Science framing positively associates with competence (a) and meaningfulness (b).*

Contribution Behavior

User behavior varies in time, length, and data quality. A small percentage of users typically contribute the majority of scientific data, but most contributors participate only a few times and with little effort (Sauermann & Franzoni, 2015). Contribution behavior in citizen science is motivated by self-interest, the sense of belonging and relatedness, and the desire to contribute to science (Jennett et al., 2016; Preece, 2016; Rotman, 2013). Prior studies have identified positive effects of autonomy, competence, and relatedness on the feeling of enjoyment and appreciation (Tamborini et al., 2010, Oliver et al., 2015). Satisfaction of these needs can make players more willing to contribute. Therefore, we hypothesize:

H4: *Autonomy (a), competence (b), relatedness(c), and meaningfulness (d) have positive influences on contributing behavior.*

Research Model and Hypotheses

Drawing upon self-determination theory, we propose the research model as depicted in Figure 1.

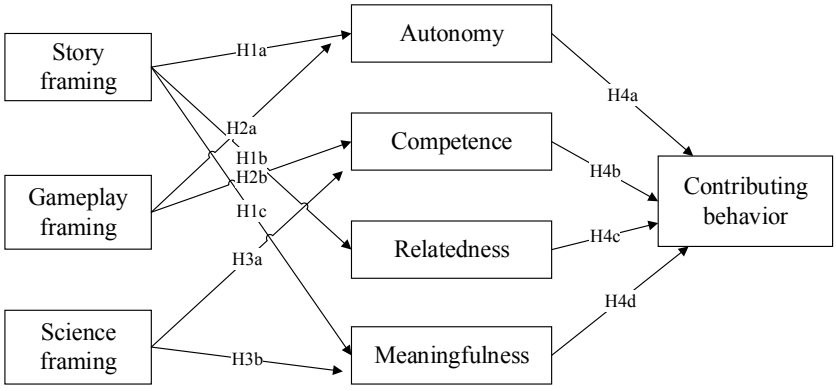

Figure 1. Our Research Model

Research Methodology

Forgotten Island: A Gamified Citizen Science System

We developed a gamified citizen science system called *Forgotten Island*, a story-based point-and-click adventure game (See Figure 2, Figure 3). *Forgotten Island* embeds a science task, taxonomic classification of photographs from the life sciences, into a narrative-driven adventure.

Forgotten Island strongly emphasizes story. The game takes place on a whimsical island where an archive of photographs has just been destroyed. The player character doesn't remember who he or she is or why this has happened, and must explore the island to regain his or her memories. All the while, an antagonistic robot with delusions of grandeur forces the player to reclassify photos to restore the archive.

Forgotten Island focuses on several core mechanics, including puzzle solving and exploration. *Forgotten Island* also frames the taxonomic classification task itself as a mechanic. Players are rewarded for correct classifications (based on a gold-standard data set) but punished for poor performance.

Players are also explicitly told (through a series of comic book style pages integrated into the main narrative) that the game is using real photographs of living things taken by real scientists in furtherance of their work. Players are encouraged to be proud of their contributions to this scientific initiative.

Data Collection and Analysis

We intend to reach out to players who have used the system (available to the general public online since fall 2012) to follow-up about their participation and interest. Data will be obtained from two sources: 1) play data recorded in the game system, and 2) an online survey designed around our research model.

Play data, including response time, accuracy, duration of play, and player retention, recorded in the game system, are objective measures to evaluate players' contribution patterns. Subjective measurements of the constructs described in previous sections of this paper will be adapted from the extant literature on gamification, game design, motivation, and user behavior research (Mehrabian & Russell, 1974; Oliver & Bartsch, 2010; Oliver et al., 2015; Ryan et al., 2006).

From a qualitative standpoint, we are also interested to understand how story, gameplay, and science framing motivate and inspire people to participate in a public, crowdsourced scientific activity. Collected data will be analyzed in two ways. For the structured quantitative data, we will use PLS-SEM to validate our research hypotheses. For the qualitative data from open-ended questions, we plan to use content analysis to identify emerging themes from answers to open-ended questions.

Limitations

Our participants are people who opted to play *Forgotten Island* "in the wild" after hearing about it online, mainly from citizen science-oriented media. This has undoubtedly produced a group of participants with a particular mindset toward science, citizen science, and games, calling into question our ability to generalize to other populations or contexts. However, we also view this as an opportunity to characterize our citizen science environment and the citizen scientists themselves in context.

Expected Contribution

Our research contributes to the advancement of gamification research in information systems by adopting and expanding upon the notion of framing, and by elaborating upon the ways that story, gameplay, and science framing contribute to satisfying players' motivational needs and contribution behavior. Theoretically, we aim to validate a proposed research model. Methodologically, we will address the call for more survey research to attain accurate linkages among game design elements, psychological effects, and behavioral outcomes (Hamari, 2015). Practically, we hope framing can become a more common approach for system designers, engaging more people and resulting in more potent crowd-based scientific inquiry.

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References

Bowser, A., Hansen, D., He, Y., Boston, C., Reid, M., Gunnell, L., & Preece, J. (2013). *Using gamification to inspire new citizen science volunteers*. Paper presented at the Proceedings of the First International Conference on Gameful Design, Research, and Applications, Toronto, Ontario, Canada.

Broer, J., & Poeppelbuss, J. (2013). *Gamification-A New Phenomenon in IS Research?* Paper presented at the 24th Australasian Conference on Information Systems, Melbourne, Australia.

Cyr, D., & Head, M. (2013). The impact of task framing and viewing timing on user website perceptions and viewing behavior. *International journal of human-computer studies, 71*(12), 1089-1102.

Flatla, D. R., Gutwin, C., Nacke, L. E., Bateman, S., & Mandryk, R. L. (2011). *Calibration games: making calibration tasks enjoyable by adding motivating game elements.* Paper presented at the Proceedings of the 24th annual ACM symposium on User interface software and technology.

Hamari, J. (2015). Do badges increase user activity? A field experiment on the effects of gamification. *Computers in Human Behavior*. doi:http://dx.doi.org/10.1016/j.chb.2015.03.036

Hamari, J., Koivisto, J., & Sarsa, H. (2014). *Does gamification work?--a literature review of empirical studies on gamification.* Paper presented at the 47th Hawaii International Conference on System Sciences (HICSS).

Jennett, C., Kloetzer, L., Schneider, D., Iacovides, I., Cox, A., Gold, M., . . . Ajani, Z. (2016). Motivations, learning and creativity in online citizen science. *Journal of Science Communication, 15*(3), A05.

Lieberoth, A. (2015). Shallow Gamification: Testing Psychological Effects of Framing an Activity as a Game. *Games and Culture, 10*(3), 229-248. doi:10.1177/1555412014559978

Liu, D., Li, X., & Santhanam, R. (Forthcoming). DIGITAL GAMES AND BEYOND: WHAT HAPPENS WHEN PLAYERS COMPETE. *MIS Quarterly*.

Lu, A. S. (2015). Narrative in Exergames: Thoughts on Procedure, Mechanism, and Others. *Games For Health Journal, 4*(1), 19-24. doi:10.1089/g4h.2014.0090

Mehrabian, A., & Russell, J. A. (1974). *An approach to environmental psychology*. Cambridge, MA: MIT Press.

Oliver, M. B., & Bartsch, A. (2010). Appreciation as Audience Response: Exploring Entertainment Gratifications Beyond Hedonism. *Human Communication Research, 36*(1), 53-81. doi:10.1111/j.1468-2958.2009.01368.x

Oliver, M. B., Bowman, N. D., Woolley, J. K., Rogers, R., Sherrick, B. I., & Chung, M.-Y. (2015). Video Games as Meaningful Entertainment Experiences. *Psychology of Popular Media Culture*.

Oliver, M. B., & Raney, A. A. (2011). Entertainment as Pleasurable and Meaningful: Identifying Hedonic and Eudaimonic Motivations for Entertainment Consumption. *Journal of Communication, 61*(5), 984-1004. doi:10.1111/j.1460-2466.2011.01585.x

Preece, J. (2016). Citizen Science: New Research Challenges for Human–Computer Interaction. *International Journal of Human–Computer Interaction, 32*(8), 585-612. doi:10.1080/10447318.2016.1194153

Prestopnik, N. R., & Crowston, K. (2011). *Gaming for (Citizen) Science: Exploring Motivation and Data Quality in the Context of Crowdsourced Science Through the Design and Evaluation of a Social-Computational System*. Paper presented at the The 7th IEEE International Conference on e-Science, Stockholm, Sweden.

Prestopnik, N. R., & Tang, J. (2015). Points, stories, worlds, and diegesis: Comparing player experiences in two citizen science games. *Computers in Human Behavior, 52*, 492-506.

Rigby, S., & Ryan, R. M. (2011). *Glued to games: How video games draw us in and hold us spellbound: How video games draw us in and hold us spellbound*. Sanata Barbara, CA: Praeger.

Rotman, D. (2013). *Collaborative Science across the Globe: The Influence of Motivation and Culture on Volunteers in the United States, India, and Costa Rica.*

Rotman, D., Preece, J., Hammock, J., Procita, K., Hansen, D., Parr, C., . . . Jacobs, D. (2012). *Dynamic changes in motivation in collaborative citizen-science projects.* Paper presented at the Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work(CSCW).

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American psychologist, 55*(1), 68-78.

Ryan, R. M., Rigby, S. C., & Przybylski, A. (2006). The motivational pull of video games: A self-determination theory approach. *Motivation and emotion, 30*(4), 344-360.

Sauermann, H., & Franzoni, C. (2015). Crowd science user contribution patterns and their implications. *Proceedings of the National Academy of Sciences, 112*(3), 679-684.

Schell, J. (2008). *The Art of Game Design: A Book of Lenses*. Burlington, MA: Elsevier, Inc.

Schlagenhaufer, C., & Amberg, M. (2015). *A Descriptive Literature Review and Classification Framework for Gamification in Information Systems.* Paper presented at the Twenty-Third European Conference on Information Systems (ECIS), Münster, Germany.

Sicart, M. (2008). Defining game mechanics. *Game Studies, 8*(2), 1-14.

Suh, A., Wagner, C., & Lili, L. (2015, 5-8 Jan. 2015). *The Effects of Game Dynamics on User Engagement in Gamified Systems.* Paper presented at the System Sciences (HICSS), 2015 48th Hawaii International Conference on.

Tamborini, R., Bowman, N. D., Eden, A., Grizzard, M., & Organ, A. (2010). Defining media enjoyment as the satisfaction of intrinsic needs. *Journal of Communication, 60*(4), 758-777.

Tang, J., & Prestopnik, N. R. (2016). *Toward an understanding of the influences of meaningful framing on user participation in a gamified information system*. Paper presented at the European Conference on Information Systems, Istanbul, Turkey.