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Author(s)	Wang, Xiaohui; Goh, Dion Hoe-Lian; Lim, Ee-Peng; Vu, Adrian Wei Liang
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Aesthetic Experience and Acceptance of Human Computation Games

Xiaohui Wang[1], Dion Hoe-Lian Goh[1], Ee-Peng Lim[2], Adrian Wei Liang Vu[2]

[1] Wee Kim Wee School of Communication and Information,
Nanyang Technological University, Singapore
{Wang0870,ashlgoh}@ntu.edu.sg
[2] School of Information Systems,
Singapore Management University, Singapore
{eplim,adrianvu}@smu.edu.sg

Abstract. Human computation games (HCGs) are applications that leverage games to solve computational problems that are out reach of the capacity of computers. Game aesthetics are critical for HCG acceptance, and the game elements should motivate users to contribute time and effort. In this paper, we examine the effect of aesthetic experience on intention to use HCGs. A between-subjects experiment was conducted to compare a HCG and a human computation system (HCS). Results demonstrated that HCGs provided a greater sense of aesthetic experience and attracted more intentional usage than HCSs. Implications of this study are discussed.

Keywords: Human computation games; aesthetic experience; acceptance

1 Introduction

The paradigm of "human computation" seeks to harness human intelligence to solve large-scale problems that are out of reach of the capacity of computers [1].Humans act as processers in a distributed system and each performs a small part of a massive computation. Such systems are known as human computation systems (HCSs) [2].

In a parallel development, video games have experienced a rapid worldwide growth in recent years. As a consequence, a significant amount of research has been placed on the use of games to motivate individuals to perform computational tasks [3]. These are called Human Computation Games (HCGs) [4] where individuals perform computational tasks as by-products of gameplay [5]. Compared to HCSs which mainly rely on contributions from online volunteers or paying for human resources, HCGs have the potential to effectively access a large amount of voluntary participants by providing entertainment [1]. They have thus been widely employed to build online collections in digital libraries and other information systems, such as multimedia tagging, location annotation, and ontology construction [6].

One of the first attempts to use video games as a medium for computation was the ESP Game [7], designed to collect labels for images. Randomly paired players are

showed the same images and tasked to guess the keywords their partner would provide. Points are awarded for matches. The matched keywords then become labels for the corresponding images. The ESP game collected over 50 million labels contributed by 200,000 players within a two-year period. These labels can be used to improve Web-based image search. This demonstrates the potential of human computation games in establishing and improving digital libraries. Other attempts include *Moodswing*, a game to record labels of the time-varying mood in a music clip [8], and *Eyespy*, a content sharing game which allows players to tag geographic locations with photos or text [9].

Like any other information system, encouraging user participation in HCGs is critical for success and is a challenging task [10]. This calls for an understanding of the driving factors of HCG acceptance. In related literature, studies suggested that enjoyable game experience in HCGs was the primary determinant of behavioral intention [11]. However, past research generally focused on explaining the hardcore game experience which emphasized the role of challenge and social interaction (e.g., [12, 13]), while the casual game experience is seldom recognized. On the other hand, HCGs focus on solving computation problems that can be easily divided into bite-size subtasks. Thus, the casual game genre is an efficient approach to embed such computational tasks [4].

In this research, we employ the aesthetic experience to articulate the casual game experience in HCGs and examine its effect on HCG acceptance. Doing so will deepen the understanding of the HCG experience and provide guidelines for HCG evaluation. Furthermore, experimental studies that examine the causal effect of game aesthetics on user acceptance are lacking in the literature. This study thus fills this gap and investigates whether aesthetic experience in HCGs motivates intentional use by comparing the performance of a HCG with a HCS.

Our objectives are thus twofold. We develop a music video tagging game incorporating various aesthetic elements. Next, we conduct an experiment to uncover the role of aesthetic experience in determining the acceptance of HCGs. The remaining sections of this article are organized as follows. First we highlight the research related to user experience of HCGs. We then present the methodology used in this study, followed by the results and discussions. Finally, we conclude with implications of the findings and future work.

2 Theoretical Background

2.1 Acceptance Research

Acceptance research seeks to investigate the contributing factors of individuals' willingness to employ an information technology [10]. User acceptance is the primary measure of the success of any information system, including HCGs. Prior studies in HCGs examined some predictors of individual acceptance, such as usability factors, output quality, and enjoyable game experience (e.g., [14]). In particular, game enjoyment has been suggested as a pertinent factor in influencing user acceptance. For

instance, [11] conducted a survey to investigate the influence of aesthetic experience as well as perception of output quality on intention to use a HCG. They found that aesthetic experience was the primary predictor.

The literature is unequivocal on stating that HCGs perceived positively by players are more likely to attract intentional use [14]. Nevertheless, there has been lacking effort examining the causation effect of aesthetic experience on HCG acceptance with experimentation, which is a limitation of [8]. An experimental study can examine the causal effect with all the other confounding factors controlled, which provides more rigorous evidence for the role of game enjoyment on HCG adoption. Moreover, comparing individuals' perceptions and acceptance of the HCG with those of a HCS could help clarify the question of how game elements motivate human computation.

2.2 Aesthetic Experience - The Casual Game Experience

Game enjoyment is a vital determinant of acceptance in the hedonic context. However, most of the current game experience models, such as flow [15] and gratifications [16], emphasize a sense of challenge and fellowship and focus on explaining the experience of hardcore gameplay. The experience of casual gameplay, that is, the desire to seek for relaxation or killing time, is essential to game experience but rarely emphasized. Here, [17] proposed a categorization of game enjoyment, in which four types of fun are accounted: hard fun, easy fun, serious fun, and social fun. This categorization explains how each game category provides the necessary motivations for different gamers in each type of game. Hard fun refers to the expectation to be challenged, to compete with others, with a program, or even with one's own previous achievements (i.e., score). Social fun refers to the expectation to build social connections with other players. Easy fun refers to the inspired curiosity, feeling of relaxation, and killing time with less involvement. Serious fun refers to the improvement of a player's internal state or achievement of real-world benefit. Hard fun and social fun are probably the most important motives for hardcore gameplay [18]. However, for casual gameplay, the primary motives may be achieving a sense of easy fun. Previous work demonstrated that an easy form of fun, such as relaxing, passing time, and narrative (e.g., [19, 20]), were vital driving forces of players playing casual games.

In the light of this, the aesthetic experience is proposed to construct the casual game experience. Aesthetics in games is defined as the emotional responses that players feel as a result of interacting with a game [21]. Instead of emphasizing a flow experience, aesthetic experience covers the emotional elements among players during the interactions with the game. More importantly, [22] proposed a taxonomy of game aesthetics, which includes eight categories: sensation, narrative, fantasy, challenge, fellowship, discovery, expression, and submission. This taxonomy provides a concrete way of talking about game enjoyment. Besides, it emphasizes the role of visuals, narrative, relaxation, and passing time in the game experience. Comparing with previous game enjoyment models, the aesthetic experience articulates the components of game experience explicitly with an emphasis on easy fun. Thus, the taxonomy of aesthetic experience could be a more appropriate framework to describe

the casual game experience. Accordingly, this study adopts the taxonomy of aesthetic experiences to describe HCG game enjoyment. By doing so, researchers and designers could improve their knowledge about components of the casual game experience. The study could also provide guidance for developers of HCGs to design systems with high levels of enjoyment and improve acceptance.

3 Application Development

To accomplish this study, two versions of an application were developed: a HCG named Kpoprally, and a HCS version. Kpoprally is a HCG based on a guessing game genre for collecting tags of K-pop music videos (Figure 1a). We choose the K-pop music genre because of its large following in Asian countries. Players annotate music videos through contributing answers to questions. As incentives, they obtain points as well as ranking in the game. Questions in Kpoprally come in two categories. Objective questions, such as "*what is the name of the artist performing in the video*" and "*what is the title of the song*", are included to differentiate experienced players from novices. Next, subjective questions, such as "*what is the mood of the video*" and "*what is the color of the video*" (Figure 2b), are designed to collect subjective tags. Objective tags can be provided by music publishers and automatic annotation systems. However, annotating for music videos is particularly challenging when it comes to capturing highly subjective human perceptions [23]. Here, human computation can be applied to collect subjective tags for music videos. Such tags would enhance the description of music videos and allow for more accurate video search and recommendation.

Figure 1. Screenshots of Kpoprally. (a) Main Menu; (b) Gameplay Session

Kpoprally integrates a series of aesthetic elements to foster a positive game experience: sensation, narrative, challenge, fellowship, and submission. Specifically, sensation represents a sensory arousal among players. This is provided by an appealing visual design. Narrative refers to the sense of drama in the game, operationalized as an avatar presenting the backstory. Players are told that their mission is to help the virtual avatar achieve a good ranking in a K-pop music competition. Challenge means an appropriate level of difficulty matching players' skills. This is operationalized as questions of varying difficulty. Fellowship means fostering social connections in the game. In Kpoprally, players can invite their friends and share their in-game achievements on Facebook, creating a sense of community. Submission represents game as a tool for passing time. Here, Kpoprally keeps players

engaged with attractive tasks and multiple goals, such as such as earning more points for the avatar and fighting for higher rankings in the leaderboard.

Correspondingly, a HCS was developed to serve as a control group comparing against the performance of Kpoprally (Figure 2a). The HCS duplicated all the computational mechanisms of Kpoprally, but removed some game-based aesthetic elements. These included the storyline, avatar, ranking system, and achievement mechanism. The interface design of the HCS was changed to a non-game version (Figure 2b). Nevertheless, users of the HCS would still have an aesthetic experience through functions such as *Message Board* and *Invite Friends. Message Board* in the HCS acted as a communication channel for users to discuss K-pop topics and leave comments. *Invite Friends* allowed users to invite Facebook friends to use this system. These elements might arouse a sense of social interaction and thus an aesthetic experience.

Figure 2. Screenshots of the HCS (a) Main Menu; (b) Task session

4 Methodology

The research method used for this study was a between-subjects experiment. Participants were randomly assigned to two groups, each using the HCG or the HCS. The experiment was conducted in the form of small groups (3-6 participants), and each group was separated from others. This was to make sure that every participant clearly understood the concepts and procedures in the study, and each participant had the chance to ask the researcher if he or she had doubts. The study began with the researcher briefing on the concept of human computation and its potential for collecting useful data. Participants were also presented with the usage of their corresponding application. They were then asked to test the assigned application for about 15 minutes.

Once concluded, participants completed an online questionnaire that captured their aesthetic perception and acceptance of the assigned application. In particular, perceived aesthetic experience was measured to ascertain perceptions towards the HCG and the HCS. This was assessed with five constructs (sensation, narrative, challenge, fellowship, and submission) adopted from the taxonomy of aesthetic experiences. Player acceptance, our dependent variable, was operationalized as attitude, intention to use, and intention to recommend the Kpoprally. Questions were adopted from previous work [e.g., 5, 16] and were all rated on a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree). The reliability of the constructs was

assessed with Cronbach's alpha. Most of the scores were above the good level (that is, above 0.80), while challenge was in the acceptable level ($0.60 < \alpha < 0.80$) [24]. Participants were also asked to provide qualitative comments of what they like and dislike about the application.

A total of 95 participants were recruited from local universities. There were 60 males and 35 females, with ages ranging from 18 to 40, and an average age of 23.5 years. Participants were typical casual game players who played casual games once a month or more (82.1%). At the same time, 57.9% of the participants had experience playing hardcore games. Further, 39 participants (41.1%) listened to K-pop music once a month or more. Forty-eight participants were assigned to the HCS group and 47 to the HCG group.

5 Results

Table 1 shows the means and standard deviations of participants' perceptions of the aesthetic elements. Unsurprisingly, participants rated all constructs higher for the HCG than the HCS. To investigate which aesthetic elements were significantly different between the HCG and the HCS, t-tests were performed with groups as the independent variable and aesthetic elements as dependent variables. Results showed significant differences between the HCG and the HCS in terms of fantasy [$t(1, 93) = 8.31$, $p < .01$], narrative [$t(1, 93) = 10.34$, $p < .01$], and submission [$t(1, 93) = 4.66$, $p < .05$]. However, tests for sensation [$t(1, 93) = .78$, $p = .38$], challenge [$t(1, 93) = 3.55$, $p = .06$], and fellowship [$t(1, 93) = .65$, $p = .42$] were not significant.

Table 1. T-test Results for Perceptions of Aesthetic Elements.

	HCG Group (n = 47)		HCS Group (n = 48)	
Variables	Mean	SD	Mean	SD
Sensation	4.98	1.15	4.77	1.18
Fantasy**	4.90	0.98	4.23	1.23
Narrative**	4.74	1.16	3.89	1.38
Challenge	4.58	1.10	4.16	1.08
Fellowship	4.75	1.05	4.57	1.11
Submission*	4.63	1.19	4.09	1.29

Table 2 shows the means and standard deviations of participants' perceptions and acceptance of the applications. On the whole, participants rated all the constructs higher for the HCG than the HCS. A MANOVA was performed to examine the difference in the perception and acceptance variables. The independent variable was the group and the dependent variables were Perceived aesthetic experience (PAE), Attitude (ATT), Intention to use (USE), and Intention to Recommend (REC).

Results showed that there was a statistically significant difference between the HCG and the HCS groups [$F(1, 93) = 2.62$, $p < .05$; Wilk's $\Lambda = .82$, partial $\eta^2 = .17$]. The univariate F tests showed that PAE of the HCG was statistically higher than the HCS [$F(1, 93) = 5.41$, $p < .05$]. With regards to acceptance, results showed that the

HCG group was statistically higher than the HCS group in terms of USE [$F(1, 93) = 9.01$, $p < .05$], and REC [$F(1, 93) = 10.12$, $p < .05$]. The difference in ATT among the two applications was statistically non-significant [$F(1, 93) = 2.12$, $p = 0.22$].

Table 2. MANOVA Results for Acceptance.

	HCG Group (n = 47)		HCS Group (n = 48)	
Variables	Mean	SD	Mean	SD
Perceived Aesthetic Experience *	4.76	0.14	4.29	0.14
Attitude	4.89	0.18	4.58	0.17
Intention to use *	4.73	0.20	4.12	0.19
Intention to recommend *	4.83	0.18	4.18	0.19

6 Discussion

The present study adopted the aesthetic experience to measure players' casual game experience in HCGs and examined its effect on player acceptance. A between-subjects experiment was conducted with participants randomly allocated into two groups evaluating a HCG and a HCS. Analysis of the experimental data yielded the following findings. With regards to perceptions of the applications, participants found that the HCG provided a better aesthetic experience compared to the HCS. Put differently, participants appreciated the aesthetic features of the HCG and found it more enjoyable. Consequently, participants showed higher intention to use and intention to recommend the HCG than the HCS. However, no difference was found in attitude towards those two applications. These findings are discussed next.

As expected, the t-test results showed that participants perceived the HCS and the HCG as significantly different in terms of narrative, fantasy, and submission. Stated differently, the HCG provided a greater sense of aesthetic experience compared to the HCS. This demonstrates that the aesthetic elements in HCGs are able to influence perceptions of game enjoyment. Participants liked the narrative, fantasy, and submission elements in the HCG and found it leading to positive emotions. This finding is reflected in the qualitative feedback. Here, participants commented with "*imaginative*", "*relax and make me feel at ease*", and "*nice interface, color, and graphics*" when asked about their favorite game features.

Consequently, participants showed higher intention to use the HCG and intention to recommend it to others when compared with the HCS. This implies that aesthetic elements in terms of fantasy, narrative, and submission significantly affect individuals' adoption behavior. This study thus demonstrates that HCGs which provide a greater level of aesthetic experience can attract more intentional usage and recommendation from users.

Moreover, this study provides empirical evidence for the effect of easy fun on HCG acceptance. Kpoprally employed aesthetic elements such as a storyline, an avatar, and multiple tasks. These elements likely aroused a sense of curiosity, role play, and killing time, hence supporting easy fun [17]. Here, participants' feedback on the HCG focused on the visual design and storyline, such as "*catchy UI*", "(*interface) very pleasing to eyes*" and "*interactive story",* which are all easy fun elements.

Unsurprisingly, participants found that these aesthetic elements affected their adoption behavior hence demonstrating the effect of easy fun on HCG acceptance.

While the effect of aesthetic experience on behavioral intention was demonstrated, no significant difference was found in individuals' attitude towards the HCG and the HCS. One possible explanation could be that attitudes of these two systems were established by different antecedents. For attitude towards HCGs, the most dominant predictor may be aesthetic experience. However, for HCSs, the most dominant predictor could be utility factors instead of enjoyment [25]. Qualitative feedback from participants suggested that individuals' preference of the HCS may largely depend on the usability and functionality of the system. When asked about the favorite aspect of the HCS, most of the comments provided by participants focused on two aspects: interface usability and computation. Comments such as "*clear and straightforward interface*", "*simple instructions and easy to use*", "*Overall, it is easy to learn to use and effective*", "*creative and interesting idea (human computation)*", and "*the system can help me when I want to find some videos*" were mentioned as the preferred aspect of the HCS. It seems that, for utility-oriented systems, interface quality and functions of the system were the focus areas of participants' attention, and whether the system was enjoyable or not was not their primary concern.

7 Conclusion

HCGs that harness human power to perform computational tasks through an entertainment-oriented approach have experienced an increase in popularity in the past decade, and their usefulness has been documented in previous studies. This study examines the effect of aesthetic experience on acceptance of HCGs by comparing a HCG with a HCS. Results demonstrate that our HCG provided a higher level of aesthetic experience and attract more intentional usage than our HCS.

The following implications can be derived from our findings. First, our work contributes to the understanding of factors that influence the usage of entertainment-oriented information systems. Previous studies used sophisticated models to examine the association between game enjoyment and acceptance. Nevertheless, there has been a lack of work investigating the extent to which aesthetic experiences affect user acceptance with experimentation. This experimental study thus provides more rigorous evidence for the effect of aesthetic experience on adoption.

In addition, results of this study suggested that game elements such as fantasy, narrative, and submission could improve individuals' behavioral intention of HCGs. This study examines the effect of easy fun on HCG acceptance and details the understanding of components of HCG enjoyment. Future research in HCG enjoyment should thus include those elements.

Findings of this study also suggest a number of design implications for HCGs.

- First, fantasy is a vital aesthetic element that can be incorporated into HCGs. A major appeal of the HCG is an environment that evokes mental images which do not exist in real life. This could be achieved through an avatar representing the system or the user. For HCGs, avatars can be an interface element which players use to control the game, or an image that represents the player's identity.
- Next, appealing narrative should be considered. Developing HCGs with storylines can provide players with a sense of curiosity and thus attract them to linger. Besides, a storyline is also an appropriate approach to embed computational tasks.

HCG developers can transform computational goals into turn points in narratives. Driven by the curiosity of the uncharted plots, players may be highly motivated to finish the computational tasks.

- Finally, submission is a vital component of aesthetic experience and should be pursued in HCG development. People play casual games to kill time. HCGs can thus be designed as a tool to facilitate this and achieve easy fun. Developers can enhance the accessibility of HCGs to make it possible for people to play with time and attention limitations, such as enabling quick start and quit. On the other hand, HCGs should have complex features to keep players occupied with game activities. For instance, HCGs with the quiz genre should shorten the duration of each round of play but set interrelated and also progressive goals, so that players can play in short fragments of time but stay attracted by larger, overarching goals.

Although this study has yielded valuable findings, they are subjected to several limitations. First, this research conducted a cross-sectional study that only captured a single snapshot of users' perception and acceptance. It remains an open question as to what extent the effect of perceptions on acceptance differs across time. Thus, future research can be done to further the understanding of HCG acceptance by focusing on how aesthetic experience and its effect on acceptance change over time. Second, results were generated based on the evaluation of one type of game and one type of platform. It would be worthwhile to evaluate different HCG genres because game elements of different game genres are previously found to satisfy different aesthetic experiences, which may affect users' performance and preference of these games.

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