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Understanding the determinants of human computation game acceptance: The effects of aesthetic experience and output quality

Xiaohui Wang Dion Hoe-Lian Goh Ee-Peng Lim Adrian Wei Liang Vu

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Understanding the determinants of human computation game acceptance

The effects of aesthetic experience and output quality

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Xiaohui Wang and Dion Hoe-Lian Goh
WKW School of Communication and Information, Nanyang Technological University, Singapore, and
Ee-Peng Lim and Adrian Wei Liang Vu
School of Information Systems, Singapore Management University, Singapore

Abstract

Purpose – Human computation games (HCGs) that blend gaming with utilitarian purposes are a potentially effective channel for content creation. The purpose of this paper is to investigate the driving factors behind players' adoption of HCGs through a music video tagging game. The effects of perceived aesthetic experience (PAE) and perceived output quality (POQ) on HCG acceptance are empirically examined.

Design/methodology/approach – An integrative structural model is developed to explain how hedonic and utilitarian factors, including PAE and POQ, working with another salient factor – perceived usefulness (PU) – affect the acceptance of HCGs. The structural equation modeling method is used to verify the proposed model with data from 124 participants.

Findings – Results show that PAE is the strongest predictor of HCGs adoption. PU has a significant impact on individuals' attitude toward HCGs. POQ is a salient predictor of PU and PAE, and its indirect effect on attitude is significance.

Originality/value – From an academic point of view, this study provides a good understanding of the driving factors behind player acceptance of HCGs and adds new knowledge to games with utilitarian purposes. It is also one of the first to describe the components of game enjoyment with a taxonomy of aesthetic experiences. From the practical perspective, the investigation of the specific factors behind adoption of HCGs provides specific guidelines for their design and evaluation.

Keywords Acceptance, Perceived output quality, Human computation games, Perceived aesthetic experience

Paper type Research paper

1. Introduction

Assigning descriptive labels for multimedia resources such as images and videos is essential for their effective and timely retrieval (Dulačka and Bieliková, 2012). Traditional approaches to accomplish this include automatic classification and manually labeling by experts. However, there are shortcomings in both approaches. Automatic classification has a limitation in generating heterogeneous and accurate labels. For instance, in classifying and detecting the mood of music, the subjective nature of the content makes it difficult to use automated algorithms that rely on quantified and specified metadata (Kim *et al.*, 2008). For resources with video content, their automatic classification is even more difficult. At the same time, manual labeling by experts can be error prone and cost intensive (Von Ahn, 2006).

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In recent years, with video games undergoing rapid worldwide growth (Liu and Li, 2011), the game experience has been used as a means for improving motivation and participation in non-game contexts, such as health (Hamari and Koivisto, 2014), education (Ebner and Holzinger, 2007), and commerce (Cechanowicz *et al.*, 2013), to name but a few. At the same time, a significant amount of research attention has been placed on the use of video games to harnesses human intelligence to solve large-scale problems that are out of reach of the capacity of artificial intelligence (Von Ahn and Dabbish, 2008). These are called human computation games (HCGs). The central theme of such games is that users are motivated to perform computational tasks, such as content creation, in the process of gameplay (Goh *et al.*, 2011).

HCGs have been employed in areas such as multimedia tagging (e.g. Kisskissban, Ho *et al.*, 2009), location annotation (e.g. Eyespy, Bell *et al.*, 2009), and ontology construction (e.g. Onto Tube, Siorpaes and Simperl, 2010). One such example is Herd-it (Barrington *et al.*, 2009), which uses game elements to collect tags for music clips. Players of Herd-it listen to a music clip and are then asked to answer multiple-choice questions related to the music content. Points are earned based on the percentage of agreement between a player's choices with previous answers. These points are translated into players' ranking in the leaderboard. These gaming elements add a sense of achievement and hence motivation for players (Yee, 2006). Simultaneously, the short text-based user-generated answers describing aspects of the music clip can be collected and used to index it for future retrieval. Put differently, players have fun with the game while contributing music tags.

Player acceptance is the primary measure of the success of any information system (Dillon and Morris, 1996). Researchers have suggested that the quality of the outputs and an enjoyable game experience are possible predictors of intention to play HCGs (Goh *et al.*, 2012b). In particular, enjoyment is a vital predictor of player acceptance in gaming contexts (Lee, 2009). Previous research has investigated general perceptions of game enjoyment (e.g. Hsu and Lu, 2004; Shin and Shin, 2011), but empirical research delving into the components of game enjoyment and their impact on player acceptance has been lacking. Here, Hunicke *et al.* (2004) proposed the aesthetic experience, defined as the emotional responses evoked in players during gameplay, to explain game enjoyment. They specified a taxonomy of aesthetic elements, providing a concrete way of examining game enjoyment, thus facilitating the evaluation of game enjoyment (Aleven *et al.*, 2010). Yet the taxonomy of aesthetic experience has been overlooked in game acceptance research and has not been applied in HCGs, thus representing a research gap.

Moreover, output quality is also an important predictor of player acceptance, and has the potential to influence intention to play HCGs (Delone and Mclean, 2004; Goh and Lee, 2011). However, its effects have been found as marginal in previous studies (e.g. Goh *et al.*, 2012b; Pe-Than *et al.*, 2013). To address this issue, perceived usefulness (PU), referring to "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p. 320), has been suggested as a mediator between output quality and intention to use information systems (e.g. Saeed and Abdinnour-Helm, 2008). We propose that, instead of directly affecting players' attitude and intention to play HCGs, perceived output quality (POQ) determines player acceptance indirectly through PU and perceived aesthetic experience (PAE).

In sum, the present study investigates the antecedents of player acceptance of HCGs. In particular, we adopt the aesthetic game experience and output quality to explain users' acceptance of HCGs. The effects of players' perception of aesthetic

experience, output quality, and usefulness on acceptance are examined with a HCG for music video tagging, named Kpoprally. The findings of this empirical study are useful to researchers in developing and evaluation game with utility purposes.

2. Literature review and research hypotheses

2.1 HCGs and acceptance

A HCG is a type of game used to solve computation problems that are beyond the capacity of artificial intelligence but are trivial to humans (Von Ahn and Dabbish, 2008). Research efforts have been invested to solve many types of computational problems. The ESP game (Von Ahn and Dabbish, 2004) is one of the pioneering examples of HCGs for collecting labels of images. In the game, randomly paired players are showed the same images and tasked to guess the keywords their partner would provide. The matched keywords will become labels for the corresponding image. Points are awarded for matches. The ESP game collected over 50 million labels contributed by 200,000 players within a two-year period (Von Ahn and Dabbish, 2008). This shows the potential power of humans in completing computational tasks motivated by playing video games. Other examples of HCGs include OntoGalaxy for ontology creation (Krause *et al.*, 2010) and Moodswing for music tagging (Kim *et al.*, 2008).

Acceptance research seeks to investigate and examine the contributing factors of willingness to employ information technology for the task it is designed to support (Dillon and Morris, 1996). User acceptance has been viewed as the pivotal factor in determining the success of information system (Davis, 1993), including HCGs. Only when large numbers of players participate in the human computation process could large-scale problems be solved. This calls for an investigation of the driving factors underlying HCG acceptance.

2.2 PAE

In the context of hedonic-oriented systems, constructs may be those related to emotional/psychological experience of user, such as flow and enjoyment (e.g. Hsu and Lu, 2004; Van der Heijden, 2003). Perceived enjoyment, the extent to which using a system is perceived to be enjoyable in its own right (Venkatesh, 2000), has been demonstrated as a strong predictor of usage intention (e.g. Lee and Tsai, 2010). Since perceived enjoyment is such an important driver of hedonic system adoption, it is important to understand the components that lead to it (Wu *et al.*, 2008). Nevertheless, there are very few studies that model the components of perceived enjoyment. A better understanding of the components of perceived enjoyment would provide researchers guidance for system evaluation and enable practitioners to design better hedonic systems that would be widely accepted by users (Wu *et al.*, 2008).

Here, game aesthetics is one of the few terms adopted to characterize the components of the emotional experience of gameplay. One of the more specific definitions of game aesthetics comes from Hunicke and his colleagues. They proposed that aesthetics of a game captures the subjective experience evoked in players during the interaction process with the game mechanics (Hunicke *et al.*, 2004). This includes but is not limited to happiness, anxiety and relaxation (Calvillo-Gámez *et al.*, 2010). More importantly, they proposed a taxonomy of game aesthetics, which includes eight categories: sensation, fantasy, narrative, challenge, fellowship, discovery, expression, and submission. This taxonomy goes beyond obscure items such as "fun" and "game enjoyment" and provides designers and researchers with a concrete means to talk about the positive game experience (Hunicke *et al.*, 2004).

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Previous studies have confirmed the assumption that the aesthetics taxonomy can be applied to describe the emotional responses of a game and act as guidance for game design (e.g. Aleven *et al.*, 2010; Carranza and Krause, 2012). For example, Aleven *et al.* (2010) utilized the aesthetic experience to create a general framework for educational game design and evaluation. They illustrated with a running example that the aesthetic experience is not only a useful analytical framework for researchers, but can also help to enhance the performance of game developers. Wang *et al.* (2014) examined the associations between aesthetic elements and HCG acceptance. They found that visual aesthetics, narrative, and submission were significantly related to attitude toward and intention to play HCGs. However, these studies did not examine the relationship between players' perceptions of aesthetic experience and adoption of HCGs. We deem that the taxonomy of aesthetic experiences can be applied to analyze players' emotional responses during gameplay, and that their PAE may have a positive effect on acceptance of HCGs. Thus, we propose the following hypotheses (see Figure 1):

H1. PAE has a positive effect on (a) attitude toward and (b) intention to play HCGs.

HCGs are different from traditional video games because they can provide players with utilitarian value in addition to entertainment. For instance, some players choose to play HCGs for entertainment purposes; others recognize HCGs as tools for information contribution. Thus, utility and entertainment function are both important attributes of HCGs (Von Ahn and Dabbish, 2008; Goh *et al.*, 2012a). This study investigates both the hedonic and utilitarian motivations in the attempt to explain HCG use behavior. Within this dichotomy, PU is an example of utilitarian motivation, whereas PAE is an example of hedonic motivation (Yu *et al.*, 2013). In the context of HCGs, We define PU as the degree to which an individual believes that a video game is a powerful approach to solve computational problems. We deem that individuals' perception of usefulness contribute to their preferences and subsequence intention to use HCGs. In addition, we address the question that which aspect, PU or PAE, is more important in determining the HCG acceptance. Thus, we propose:

H2. PU has a positive effect on (a) attitude toward and (b) intention to play HCGs.

RQ1. Comparing PAE with PU, which one is more important in determining the attitude and intention to play HCGs?

2.3 POQ

A HCG is a type of information system. Output quality, referring to the rationale of the end products of using a system (Davis *et al.*, 1992), has always been considered as a

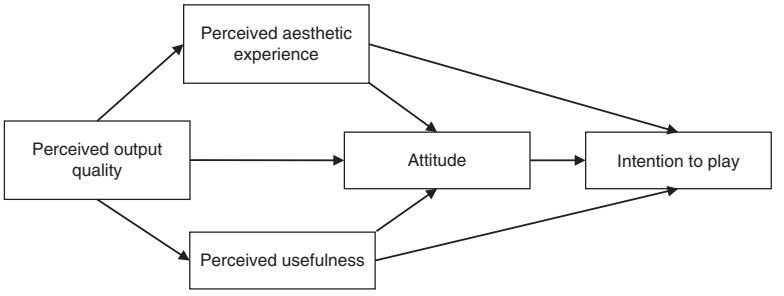

Figure 1.
Theoretical model

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vital factor for user acceptance of information systems (Lee *et al.*, 2002; Delone and Mclean, 2004). Individuals may be motivated to use a HCG because it provides meaningful information or is useful in generating the required outputs.

Research in HCGs showed that perceived quality of computational outputs was positively related with acceptance of HCGs (e.g. Goh *et al.*, 2012b), although the effect sizes are marginal. Specifically, in an experiment investigating players' perceptions of engagement and output quality and their effects on player's adoption of mobile HCGs, Goh *et al.* (2012b) found that quality of computational outputs significantly influenced the intention to use it. Pe-Than *et al.* (2013) confirmed this link. In a study with 205 participants, they demonstrated that output quality in terms of accuracy and relevancy were significant predictors of player's intention to play HCGs.

However, such research did not account for the mediation effect of PU and PAE between POQ and acceptance. Prior studies suggested that usefulness and enjoyment may mediate the effect on acceptance of POQ (Davis *et al.*, 1992). Davis *et al.* (1992) found that POQ was a strong predictor of PU, and its effect to behavioral intention was fully mediated by PU. Pe-Than *et al.* (2014) found that users' perceived quality of outputs has an effect on their enjoyment of information systems. It can be hypothesized that, all things being equal, the better the output quality provided by the HCGs, the more likely one would perceive the systems as useful and enjoyable. Enlightened by prior work, we believe that the association between POQ and acceptance should be mediated by PU and PAE. Thus, we propose:

H3. POQ has a positive effect on PU in HCGs.

H4. POQ has a positive effect on PAE in HCGs.

H5. POQ has a positive and indirect effect on attitude toward HCGs.

3. Kpoprally: the HCG used in this study

For the purpose of this study, we developed Kpoprally, a HCG based on a guessing game genre for collecting tags of music videos. Annotating music videos with tags (short text-based tokens describing certain aspect of the video) is the initial step that enables them to be retrieved. Studies show that music tags provided by tagging algorithms are insufficient, inaccurate, ambiguous, and overly personalized (Ballan *et al.*, 2010; Law *et al.*, 2009), and human intelligence is still needed to provide and/or verify tags. However, both the huge amount of music videos on the web and the large vocabulary of tags for music make the manual work tedious and time consuming (Barrington *et al.*, 2009).

Kpoprally focusses on collecting tags for K-pop music videos, a genre of popular music originating in Korea. We choose K-pop as our computational target because of its popularity in Asian countries. Players of Kpoprally annotate music videos through contributing answers for questions about the video content (Figure 2(a)). As incentives, they will obtain points as well as reputation in game. The questions in Kpoprally come in two categories: objective and subjective. Objective questions refer to those that have known, unambiguous answers, such as name of the artist performing in the video and title of the song. Subjective questions refer to those that have no fixed answers and may vary according to individual opinion such as the mood of the video, the color of the video, and the situation where this song is appropriate for playback. In both cases, the form of the questioning would be, for instance, "What genre does this song belongs to?" Points for objective questions are awarded based on accuracy. For subjective questions, points

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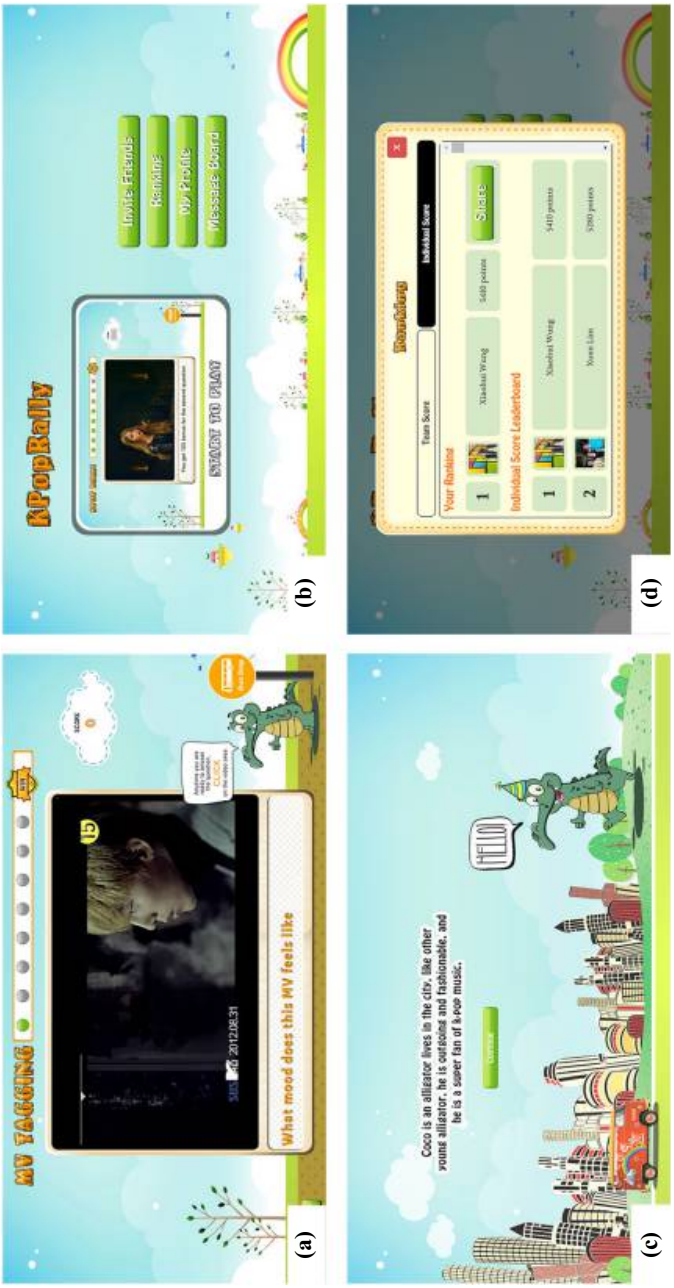

Figure 2.
Screen shots
of Kpoprally

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awarded equal to the percentage of other players in agreement. In this way, answers with the highest percentage agreement can be utilized as tags for the corresponding videos.

Kpoprally was developed based on the taxonomy of aesthetic experience. Aesthetic elements in regarding to sensation, narrative, challenge, fellowship and submission were accounted for. Sensation represents an arousal of sensory pleasure in players due to the audiovisual and tactile expressions of the game. This is provided by the visual aesthetical interface design in Kpoprally (Figure 2(b)). Narrative represents that games provide players with a sense of dramatics. This is operationalized as an avatar and a storyline that set the backstory and goals of the game (Figure 2(c)). Challenge means that levels of difficulty match players' skills (Sweetser and Wyeth, 2005). This achieved with subjective and objective questions of varying difficulty. Fellowship pertains to game support for social interaction. Kpoprally is embedded in Facebook and players can invite their friends and share their in game achievements through this platform, helping to create a sense of social connection. Submission refers to performing games as a tool for leisure and passing time. Players may feel detached from the real world and an altered sense of time during gameplay. Kpoprally involves players in the game activities with multiple tasks, such as earning more points for the avatar and fighting for higher rankings in the leaderboard (Figure 2(d)). Three categories of aesthetics (fantasy, discovery, and expression) are not included in this game. A more detailed description of Kpoprally can also be found in Wang (2015).

4. Methodology

4.1 Questionnaire development

A questionnaire was developed to investigate players' perception and acceptance of Kpoprally. Four constructs related to perception of Kpoprally, including PAE, perceived ease of use, POQ, and PU was accounted as predictors. Player acceptance, our dependent variable, was operationalized as attitude and intention to play Kpoprally. Taking into consideration that POQ, PAE are complex concepts and their measurement are expected to be multidimensional in nature (Aladwani and Palvia, 2002), we extended them with sub-constructs. Items were adapted from previous work (e.g. Sweetser and Wyeth, 2005; Carranza and Krause, 2012) and were all rated on a seven-point scale ranging from 1 (strongly disagree) to 7 (strongly agree).

PAE. This was assessed with five constructs (sensation, narrative, challenge, fellowship, and submission) from the aesthetic framework. Here, 14 items were adapted from past work on the evaluation of game aesthetics (Carranza and Krause, 2012; Fu *et al.*, 2009; Wu *et al.*, 2008). Scales of those constructs have been employed in various empirical studies to evaluate player perception of video games.

POQ. Research in information systems suggests that users POQ as a complex concept with multiple dimensions to assess the virtue of outputs (Alkhattabi *et al.*, 2010; Lee *et al.*, 2002). Accuracy, completeness, relevancy are quality dimensions frequently employed by prior studies (Alkhattabi *et al.*, 2010) and have been tested in HCG research (e.g. Pe-Than *et al.*, 2013). In the context of Kpoprally, accuracy refers to the correctness and reliability of the outputs; completeness means that the contributed outputs have sufficient detail; relevancy refers to the appropriateness of the outputs in relation to the computational purpose (Lee *et al.*, 2002). POQ was assessed by the three constructs and seven items adopted from prior work (Goh *et al.*, 2012b; Lee *et al.*, 2002).

PU. PU of Kpoprally refers to the degree to which an individual believes that video game is a powerful approach to solve computational problems. Three items were

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utilized to assess PU of HCGs adapted from prior acceptance studies (e.g. Hsu and Lu, 2004). These items have also been employed by studies in the HCG context (Goh and Lee, 2011).

Attitude and intention to play. Acceptance of Kpoprally was operationalized as attitude and intention to play. As indicated in prior work, attitude, representing the affective evaluation to a set of behaviors (Dillon and Morris, 1996), is a strong predictor of behavioral usage; intention to play reflects the players' satisfaction with the game and their willingness to play it (Hamari and Koivisto, 2013). These constructs were measured with six items adapted from previous studies (Goh and Lee, 2011; Hamari and Koivisto, 2013).

4.2 Procedure

The study began with a researcher introducing the concept of HCGs and their potential for collecting useful data. Participants were also presented with the purpose of Kpoprally and usage instructions. Next, each participant was handed out a card with gameplay instructions, ensuring that participants consistently experienced all elements of Kpoprally. The study then commenced with participants using Kpoprally for about 15 minutes. Participants were instructed to complete three tasks, including finishing at least one round of gameplay; try game mechanisms such as inviting friends, showing their rankings and profiles; browsing and leaving comments in the message board. Once concluded, participants completed the questionnaire that captured their perception and acceptance of Kpoprally, as well as demographic data. The entire study took about 30 minutes to complete. Participants were also paid a small incentive for their efforts.

5. Results

We recruited 124 participants from local universities, comprising undergraduate and graduate students. Of the valid respondents, 50 were male and 74 were female, with ages ranging from 18 to 41 and an average of 23.26 years. The majority of the participants (94/124) had a background in humanities and social science, computer science, or engineering, while the others came from disciplines such as arts and design, law, and business. In addition, 85 (66.1 percent) participants watched music videos online on a regular basis (more than once a month). Further, 65 (50.0 percent) participants played casual games frequently.

5.1 Scale reliability and validity

The constructs of PAE, perceived ease of use, and POQ in our questionnaire were operationalized with sub-constructs in our study. As discussed by Floyd and Widaman (1995), in data where factors are grouped under more general, higher order factors, hierarchical factor analysis is more appropriate. Hierarchical factor analysis is also an underused method in evaluating measurements in the social sciences because many constructs in social science are comprised of multiple, correlated facets. For this reason, confirmative factor analysis with three second-order factors was conducted using Lisrel 8.80 to test the factor structure stability and internal consistency. Error terms were not allowed to correlate. All fit indices of the measurement model were found to meet the requirements for good fit (Bagozzi and Yi, 1988), as shown in Table I. This indicated that the data in the survey were well represented by the measurement model. In addition, all items loaded significantly on the latent factors (ranging from 0.49 to 0.99).

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Further, composite reliability (CR) and average variance extracted (AVE) were assessed to ensure the convergent and discriminant validity of our measurements. As suggested by Fornell and Larcker (1981), the CR value should exceed 0.8, AVE value for each construct should exceed 0.5, and the square roots of the AVE of a construct should be greater than its correlation with other constructs. As can be seen from Table II, the CRs and AVEs of all the constructs satisfied the requirements. Therefore, convergent validity was met. Table II also lists the correlations among constructs, with the square root of the AVEs on the diagonal. All diagonal values exceed the inter-construct correlations. The results suggested an adequate discriminant validity of the measurements.

5.2 Hypothesis testing

Structural equation modeling was then conducted to test our hypotheses. The actual and recommended values of the model fit indices of our path model are listed in Table I. All the recommended model fit indices (including χ^2/df ratio, CFI, TLI, and RMSEA) in our estimated model were better than the recommended thresholds (Bagozzi and Yi, 1988). This demonstrated a good fit between the model and the data. Of a total of seven hypotheses, five were supported by the statistical results, as shown in Table III.

In particular, POQ had significant effects on PU ($\beta = 0.71$, $p < 0.001$) and PAE ($\beta = 0.64$, $p < 0.001$). PU ($\beta = 0.23$, $p < 0.05$) was found to positively and significantly affect attitude. PAE ($\beta = 0.77$, $p < 0.001$) significantly affect players' attitude toward HCGs, and PAE ($\beta = 0.21$, $p < 0.05$) together with attitude ($\beta = 0.75$, $p < 0.001$) in turn significantly influence intention to play. However, PU was neither a significant predictor of attitude nor of intention to play.

Fit index	χ^2(df)	CMIN/df	CFI	TLI	RMSEA
Recommended value		< 3	> 0.90	> 0.90	< 0.08
Measurement model	562.76(387)	1.13	0.93	0.93	0.070
Path model	167.9(111)	1.51	0.96	0.95	0.064

Notes: CMIN/df, the ratio between the χ^2 and the degrees of freedom; CFI, comparative fit index; TLI, Tucker-Lewis coefficient; RMSEA, root mean square error of approximation
Source: Bagozzi and Yi (1988)

Table I. The recommended and actual values of fit indices

Variables	CR	AVE	PAE	INT	ATT	POQ	PU
PAE	0.88	0.61	0.78				
INT	0.95	0.85	0.75	0.93			
ATT	0.94	0.83	0.78	0.87	0.92		
POQ	0.91	0.78	0.62	0.40	0.44	0.88	
PU	0.88	0.71	0.57	0.44	0.51	0.67	0.84

Notes: CR, composite reliability; AVE, average variance extracted; PAE, perceived aesthetic experience; INT, intention to play; ATT, attitude; POQ, perceived output quality; PU, perceived usefulness

Table II. Discriminant and convergent validity assessment

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Table III.
Path coefficients

Hypotheses	Path	Standardized coefficient	Supported or not
H1a	PAE → ATT	0.77***	Yes
H1b	PAE → INT	0.20*	Yes
H2a	PU → ATT	0.23*	Yes
H2b	PU → INT	−0.07	No
H3	POQ → PU	0.71***	Yes
H4	POQ → PAE	0.64***	Yes
H5	POQ → PU → ATT POQ → PAE → ATT	0.66***	Yes

Notes: *$p < 0.05$; ***$p < 0.001$

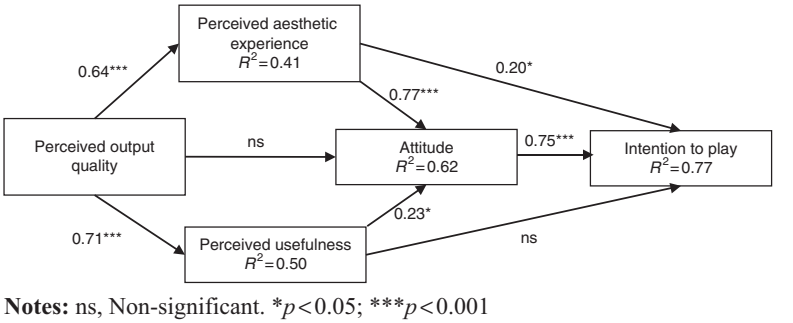
5.3 Total effect and indirect effect

The total effects of all constructs were evaluated in order to gain a more complete understanding of the prediction power of player acceptance. Results showed that PAE was the strongest predictor of attitude ($\beta = 0.77$, $p < 0.001$) as well as intention to play HCGs ($\beta = 0.78$, $p < 0.001$). PU also had a significant total effect on attitude ($\beta = 0.23$, $p < 0.01$) and intention to play ($\beta = 0.17$, $p < 0.05$). On the other hand, the indirect effects of POQ on attitude ($\beta = 0.66$, $p < 0.001$) was positive and significant, which indicates that the influence of POQ on HCG adoption is mediated by PU and PAE (Figure 3).

6. Discussion

The primary goal of employing a HCG is to solve computational problems in the form of gameplay. This goal cannot be achieved without the active participation and engagement of users. To understand the underlying drivers of player acceptance of HCGs, our research postulated PAE and POQ as key factors affecting player adoption. In particular, we examined the effect of PAE, POQ, and PU on player's attitude and behavioral intention with a HCG for music video tagging. This study is one of the few attempts to investigate player acceptance of HCGs and adds new understanding to this genre of games.

First, our results suggest that PAE is the most important element in influencing the acceptance of HCGs. This is consistent with the findings of Lee (2009). It shows that psychological rather than technical factors are more important for HCG players in predicting their preferences and intentions. HCGs can be seen as entertainment as well as information systems. Utility and hedonic functions have been suggested as important attributes of HCGs (e.g. Von Ahn and Dabbish, 2008). However, empirical studies comparing the effect size of those two aspects has been lacking. Results of this study



Notes: ns, Non-significant. *$p<0.05$; ***$p<0.001$

Figure 3.
Summary of hypothesis testing

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quantify the impact of acceptance predictors and imply that the most important aspect of HCG acceptance is providing aesthetic game experiences. The paradigm presented here does not rely on altruism or additional rewards to entice people to use; instead, it relies on the individual's desire to be entertained. Accordingly, it is valuable to account for the components of aesthetics when developing HCGs to attract users. Our model included five sub-constructs to measure PAE: sensation, narrative, challenge, fellowship, and submission. The high-factor loadings of our sub-constructs indicated that the taxonomy of aesthetic experience is valid to generalize the emotional response of players. Further, the taxonomy provides practical implications for HCG development.

While PAE directly affected both attitude and intention to play HCGs, PU only had a significant impact on individuals' attitude toward HCGs. This indicates that a sense of usefulness of HCGs can only induce a positive emotion in players, but fails to directly promote the behavioral intention to play it. The primary purpose of playing HCGs is to gain an enjoyable game experience rather than improve their performance; this may lead to the marginal effect of PU on player's behavioral intention. Nevertheless, our results are in contrast with prior claims that PU was no longer a significant predictor of individual's attitude and behavioral intention in the entertainment context (Hsu and Lu, 2004; Lee, 2009). In the HCG context, both utility factors and entertainment factors are drivers of players' acceptance.

Given that the purpose of HCGs is to generate useful outputs during gameplay, this study further investigated the influence of POQ on HCG adoption. Previous studies suggested a positive effect of output quality on acceptance of HCGs (e.g. Goh *et al.*, 2012b). We extend prior work by demonstrating that POQ did not directly affect players' attitude and intention to play HCGs, but instead, POQ influenced player acceptance indirectly through PU and PAE. This adds to our understanding of the under mechanisms between POQ and acceptance. The significance of the output quality factor indicates the need for assisting players to assess the quality of contributed contents in the computational tasks. The mediation effects of usefulness and aesthetic experience also indicate that usefulness and enjoyment are the common causal pathways through which many acceptance predictors achieve their influence.

7. Conclusion

7.1 Implications

The results of this study have several theoretical and practical implications for HCG researchers as well as designers. From an academic point of view, this study provides a good understanding of the driving factors behind player acceptance of HCGs. HCGs present researchers with opportunities to solve computational problems in an enjoyable way. At the same time, researchers in the field of information systems have shown increasing interest in predicting the user behavior regarding specific systems or technology (Park *et al.*, 2014). Investigating the predictors of individuals' adoption in different contexts would also improve existing acceptance frameworks. It is also one of the first to describe the components of game enjoyment with a taxonomy of aesthetic experiences. Instead of identifying player's general perception of game enjoyment, PAE was measured with five sub-constructs adopted from the aesthetic framework. This provides a more nuanced understanding of game enjoyment in the HCG context.

From the practical perspective, the investigation of the specific factors behind adoption of HCGs facilitates their design. Implications for HCG development drawn from the findings are summarized as below.

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Aesthetic experience. Aesthetic experience is the critical factor that affects user acceptance. HCG designers should thus put emphasis on creating activities and environments that induce the aesthetic experience, and incorporate aesthetic components in HCG design. For instance, submission is a vital component of the aesthetic experience. People tend to play casual games to kill time. Here, HCG developers can enhance the reach of the games to make it possible for people to play with time and attention limitations. Examples include enabling quick start and quit, or simplifying the interfaces to make it easier to get into the gaming process. On the other hand, HCGs should have a variety of features to keep players occupied with game activities.

Output quality. Ensuring that HCGs produce quality computational outcomes is essential to achieve information system success. For instance, HCGs providing accurate and completed answers is crucial to promote credibility and thus improve players' belief of the systems. As such, future HCG design could allow users to make judgments on contributions through mechanisms such as voting or liking. Through the voting results, players may be more convinced with the quality of the contributions. In addition, HCGs could encourage experienced players to participate in additional tasks. For example, involving such players in information management processes and allowing them to create new in game activities (e.g. questions for quizzes) for various rewards.

Utility. PU was found to significantly affect player's adoption of HCGs. Developers should ensure that HCGs also provide players with a sense of practicality. For instance, in terms of labeling music videos, developers can make the rationale for collecting labels explicit to players. If players are informed about how their answers are transformed into tags for the corresponding videos during the gameplay, they may have a more positive attitude toward the game and thus be motivated to provide more quality computations.

7.2 Limitations and future work

This study is subject to a number of limitations. First, the findings were generated from one study based on a single genre of HCG in the area of video tagging. Previous research suggested that game genre might affect players' perceptions (Goh *et al.*, 2011; Johnson and Gardner, 2010), and comparing the findings with different game genres and computation tasks would increase the generalizability of the results. Second, the majority of the respondents were university students. The similarity of their education level may bias their perceptions, which may also hinder the generalizability of the findings. Future research could replicate this study with more heterogeneous populations, such as including participants with different ages, occupations, and education backgrounds. Third, although we investigated aesthetic experience and output quality as determinants of player acceptance, other factors may also play an important role in its explanation. For instance, in future studies, moderators such as task type (Fang *et al.*, 2005) and previous exposure to technology (Holzinger *et al.*, 2011) could be considered in order to form a comprehensive understanding of acceptance. Moreover, age and gender difference are also suggested by previous studies as key influencers in system adoption (Ha *et al.*, 2007; Law *et al.*, 2009). It would add new knowledge to our understanding of acceptance by examining their effect in different contexts. Future work could thus investigate the individual differences and their influences on perceptions and acceptance of HCGs. Lastly, a cross-sectional study was conducted that only captured a single snapshot of the outcomes of the acceptance model. The effect size and individuals' perception of the

constructs in the model may vary across settings and times (Ajzen, 1991; Venkatesh and Davis, 2000). A longitudinal study to examine and compare perceptions toward HCGs and its effect on acceptance could be thus enlightening.

References

Ajzen, I. (1991), "The theory of planned behavior", *Organizational Behavior and Human Decision Processes*, Vol. 50 No. 2, pp. 179-211.

Aladwani, A.M. and Palvia, P.C. (2002), "Developing and validating an instrument for measuring user-perceived web quality", *Information & Management*, Vol. 39 No. 6, pp. 467-476.

Aleven, V., Myers, E., Easterday, M. and Ogan, A. (2010), "Toward a framework for the analysis and design of educational games", in Biswas, G., Carr, D., Chee, Y. and Hwang, W. (Eds), *Proceedings of the 3rd IEEE International Conference on Digital Game and Intelligent Toy Enhanced Learning*, IEEE Press, Washington, DC, pp. 69-76.

Alkhattabi, M., Neagu, D. and Cullen, A. (2010), "Information quality framework for e-learning systems", *Knowledge Management & E-Learning: An International Journal*, Vol. 2 No. 4, pp. 340-362.

Bagozzi, R.P. and Yi, Y. (1988), "On the evaluation of structural equation models", *Journal of the Academy of Marketing Science*, Vol. 16 No. 1, pp. 74-94.

Ballan, L., Bertini, M., Del Bimbo, A., Meoni, M. and Serra, G. (2010), "Tag suggestion and localization in user-generated videos based on social knowledge", in Boll, S., Hoi, S., Luo, J. and Zwol, R. (Eds), *Proceedings of Second ACM SIGMM Workshop on Social Media in Firenze*, ACM Press, New York, NY, pp. 3-8.

Barrington, L., O'Malley, D., Turnbull, D. and Lanckriet, G. (2009), "User-centered design of a social game to tag music", in Bennett, P., Chandrasekar, R., Chickering, M., Ipeirotis, P., Law, E., Mityagin, A., Provost, F. and von Ahn, L. (Eds), *Proceedings of the ACM SIGKDD Workshop on Human Computation in Paris*, ACM Press, New York, NY, pp. 7-10.

Bell, M., Reeves, S., Brown, B., Sherwood, S., MacMillan, D., Ferguson, J. and Chalmers, M. (2009), "EyeSpy: supporting navigation through play", in Olsen, D. and Arthur, R. (Eds), *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems in Boston, MA*, ACM Press, New York, NY, pp. 123-132.

Calvillo-Gámez, E.H., Cairns, P. and Cox, A.L. (2010), "Assessing the core elements of the gaming experience", in Bernhaupt, R., Ijsselsteijn, W., Mueller, F.F., Tscheligi, M. and Wixon, D. (Eds), *Evaluating User Experience in Games*, Springer, London, pp. 47-71.

Carranza, J. and Krause, M. (2012), "Evaluation of game designs for human computation", in Swanson, R. and Niehaus, J. (Eds), *AAAI Workshop on Human Computation in Digital Entertainment and Artificial Intelligence for Serious Games*, AAAI Press, Palo Alto, CA, pp. 9-15.

Cechanowicz, J., Gutwin, C., Brownell, B. and Goodfellow, L. (2013), "Effects of gamification on participation and data quality in a real-world market research domain", in Nacke, L., Harrigan, K. and Randall, N. (Eds), *Proceedings of the First International Conference on Gameful Design, Research, and Applications*, ACM Press, New York, NY, pp. 58-65.

Davis, F.D. (1989), "Perceived usefulness, perceived ease of use, and user acceptance of information technology", *MIS Quarterly*, Vol. 13 No. 3, pp. 319-340.

Davis, F.D. (1993), "User acceptance of information technology: system characteristics, user perceptions and behavioral impacts", *International Journal of Man-Machine Studies*, Vol. 38 No. 3, pp. 475-487.

Davis, F.D., Bagozzi, R.P. and Warshaw, P.R. (1992), "Extrinsic and intrinsic motivation to use computers in the workplace", *Journal of Applied Social Psychology*, Vol. 22 No. 14, pp. 1111-1132.

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Delone, W.H. and Mclean, E.R. (2004), "Measuring e-commerce success: applying the DeLone & McLean information systems success model", *International Journal of Electronic Commerce*, Vol. 9 No. 1, pp. 31-47.

Dillon, A. and Morris, M. (1996), "User acceptance of information technology: theories and models", *Annual Review of Information Science and Technology*, Vol. 14 No. 2, pp. 3-32.

Dulačka, P. and Bieliková, M. (2012), "Validation of music metadata via game with a purpose", in Sack, H. and Pellegrini, T. (Eds), *Proceedings of the 8th International Conference on Semantic Systems in Graz*, ACM Press, New York, NY, pp. 177-180.

Ebner, M. and Holzinger, A. (2007), "Successful implementation of user-centered game based learning in higher education: an example from civil engineering", *Computers & Education*, Vol. 49 No. 3, pp. 873-890.

Fang, X., Chan, S., Brzezinski, J. and Xu, S. (2005), "Moderating effects of task type on wireless technology acceptance", *Journal of Management Information Systems*, Vol. 22 No. 3, pp. 123-157.

Floyd, F.J. and Widaman, K.F. (1995), "Factor analysis in the development and refinement of clinical assessment instruments", *Psychological Assessment*, Vol. 7 No. 3, pp. 286-299.

Fornell, C. and Larcker, D.F. (1981), "Structural equation models with unobservable variables and measurement error: algebra and statistics", *Journal of Marketing Research*, Vol. 18 No. 3, pp. 382-388.

Fu, F., Su, R. and Yu, S. (2009), "EGameFlow: a scale to measure learners' enjoyment of e-learning games", *Computers & Education*, Vol. 52 No. 1, pp. 101-112.

Goh, D.H.-L. and Lee, C.S. (2011), "Perceptions, quality and motivational needs in image tagging human computation games", *Journal of Information Science*, Vol. 37 No. 5, pp. 515-531.

Goh, D.H.-L., Lee, C.S. and Low, G. (2012a), "'I played games as there was nothing else to do' understanding motivations for using mobile content sharing games", *Online Information Review*, Vol. 36 No. 6, pp. 784-806.

Goh, D.H.-L., Ang, R.P., Lee, C.S. and Chua, A.Y. (2011), "Fight or unite: investigating game genres for image tagging", *Journal of the American Society for Information Science and Technology*, Vol. 62 No. 7, pp. 1311-1324.

Goh, D.H.-L., Razikin, K., Lee, C.S. and Chua, A. (2012b), "Investigating user perceptions of engagement and information quality in mobile human computation games", in Boughida, K. and Howard, B. (Eds), *Proceedings of the 12th ACM/IEEE-CS Joint Conference on Digital Libraries*, ACM Press, New York, NY, pp. 391-392.

Ha, I., Yoon, Y. and Choi, M. (2007), "Determinants of adoption of mobile games under mobile broadband wireless access environment", *Information & Management*, Vol. 44 No. 3, pp. 276-286.

Hamari, J. and Koivisto, J. (2013), "Social motivations to use gamification: an empirical study of gamifying exercise", available at: http://aisel.aisnet.org/ecis2013_cr/105 (accessed December 20, 2014).

Hamari, J. and Koivisto, J. (2014), "Measuring flow in gamification: dispositional flow scale-2", *Computers in Human Behavior*, Vol. 40, November, pp. 133-143.

Ho, C.-J., Chang, T.-H., Lee, J.-C., Hsu, J.Y.-J. and Chen, K.-T. (2009), "KissKissBan: a competitive human computation game for image annotation", in Bennett, P., Chandrasekar, R., Chickering, M., Ipeirotis, P., Law, E., Mityagin, A., Provost, F. and von Ahn, L. (Eds), *Proceedings of the ACM SIGKDD Workshop on Human Computation in Paris*, ACM Press, New York, NY, pp. 11-14.

Holzinger, A., Searle, G. and Wernbacher, M. (2011), "The effect of previous exposure to technology on acceptance and its importance in usability and accessibility engineering", *Universal Access in the Information Society*, Vol. 10 No. 3, pp. 245-260.

Downloaded by TASHKENT UNIVERSITY OF INFORMATION TECHNOLOGIES At 22:59 15 November 2016 (PT)

Hsu, C. and Lu, H. (2004), "Why do people play on-line games? An extended TAM with social influences and flow experience", *Information & Management*, Vol. 41 No. 1, pp. 853-868.

Hunicke, R., Leblanc, M. and Zubek, R. (2004), "MDA: a formal approach to game design and game research", in Fu, D., Henke, S. and Orkin, J. (Eds), *AAAI Workshop on Challenges in Game Artificial Intelligence in San Jose, CA*, AAAI Press, Palo Alto, CA, available at: www.cs.northwestern.edu/~hunicke/MDA.pdf (accessed December 8, 2013).

Johnson, D. and Gardner, J. (2010), "Personality, motivation and video games", in Viller, S. and Kraal, B. (Eds), *Proceedings of the 22nd Conference of the Computer-Human Interaction Special Interest Group of Australia on Computer-Human Interaction*, ACM Press, New York, NY, pp. 276-279.

Kim, Y.E., Schmidt, E.M. and Emelle, L. (2008), "Moodswings: a collaborative game for music mood label collection", in Dixon, S., Bainbridge, D. and Typke, R. (Eds), *Proceedings of the 9th International Conference of Music Information Retrieval, Drexel University, Philadelphia, PA*, pp. 231-236.

Krause, M., Takhtamysheva, A., Wittstock, M. and Malaka, R. (2010), "Frontiers of a paradigm: exploring human computation with digital games", *Proceedings of the ACM SIGKDD Workshop on Human Computation*, ACM Press, New York, NY, pp. 22-25.

Law, E.L.-C., Gamble, T., Schwarz, D., Kickmeier-Rust, M.D. and Holzinger, A. (2009), "A mixed-method approach on digital educational games for K12: gender, attitudes and performance", in Holzinger, A. and Miesenberger, K. (Eds), *Lecture Notes in Computer Science, Volume 5889, Human-Computer Interaction and Usability for e-Inclusion*, Springer, Berlin and Heidelberg, pp. 42-54.

Lee, M. (2009), "Understanding the behavioural intention to play online games: an extension of the theory of planned behavior", *Online Information Review*, Vol. 33 No. 5, pp. 849-872.

Lee, M. and Tsai, T. (2010), "What drives people to continue to play online games? An extension of technology model and theory of planned behavior", *International Journal of Human-Computer Interaction*, Vol. 26 No. 6, pp. 601-620.

Lee, Y.W., Strong, D.M., Kahn, B.K. and Wang, R.Y. (2002), "AIMQ: a methodology for information quality assessment", *Information & Management*, Vol. 40 No. 2, pp. 133-146.

Liu, Y. and Li, H. (2011), "Exploring the impact of use context on mobile hedonic services adoption: an empirical study on mobile gaming in China", *Computers in Human Behavior*, Vol. 27 No. 2, pp. 890-898.

Park, E., Baek, S., Ohm, J. and Chang, H.J. (2014), "Determinants of player acceptance of mobile social network games: an application of extended technology acceptance model", *Telematics and Informatics*, Vol. 31 No. 1, pp. 3-15.

Pe-Than, E.P.P., Goh, D.H.-L. and Lee, C.S. (2013), "Playing human computation games for mobile information sharing: the influence of personality and perceived information quality", in Urs, S., Na, J.C. and Buchanan, G. (Eds), *Digital Libraries: Social Media and Community Networks*, Springer, Cham, pp. 147-156.

Pe-Than, E.P.P., Goh, D.H.-L. and Lee, C.S. (2014), "Making work fun: investigating antecedents of perceived enjoyment in human computation games for information sharing", *Computers in Human Behavior*, Vol. 39, October, pp. 88-99.

Saeed, K.A. and Abdinnour-Helm, S. (2008), "Examining the effects of information system characteristics and perceived usefulness on post adoption usage of information systems", *Information & Management*, Vol. 45 No. 6, pp. 376-386.

Shin, D.H. and Shin, Y.J. (2011), "Why do people play social network games?", *Computers in Human Behavior*, Vol. 27 No. 2, pp. 852-861.

Siorpaes, K. and Simperl, E. (2010), "Human intelligence in the process of semantic content creation", *World Wide Web*, Vol. 13 Nos 1-2, pp. 33-59.

Sweetser, P. and Wyeth, P. (2005), "GameFlow: a model for evaluating player enjoyment in games", *Computers in Entertainment*, Vol. 3 No. 3, available at: http://doi.acm.org/10.1145/1077246.1077253 (accessed August 8, 2013).

Van der Heijden, H. (2003), "Factors influencing the usage of websites: the case of a generic portal in the Netherlands", *Information & Management*, Vol. 40 No. 6, pp. 541-549.

Venkatesh, V. (2000), "Determinants of perceived ease of use: integrating control, intrinsic motivation, and emotion into the technology acceptance model", *Information Systems Research*, Vol. 11 No. 4, pp. 342-365.

Venkatesh, V. and Davis, F.D. (2000), "A theoretical extension of the technology acceptance model: four longitudinal field studies", *Management Science*, Vol. 46 No. 2, pp. 186-204.

Von Ahn, L. (2006), "Games with a purpose", *Computer*, Vol. 39 No. 6, pp. 92-94.

Von Ahn, L. and Dabbish, L. (2004), "Labeling images with a computer game", in Dykstra-Erickson, E. and Tscheligi, M. (Eds), *Proceedings of the SIGCHI conference on Human factors in computing systems in Vienna*, ACM Press, New York, NY, pp. 319-326.

Von Ahn, L. and Dabbish, L. (2008), "Designing games with a purpose", *Communications of the ACM*, Vol. 51 No. 8, pp. 58-67.

Wang, X. (2015), "Determinants of human computation game acceptance", in Bernhaupt, R. and Nacke, L. (Eds), *Proceedings of the 2015 Annual Symposium on Computer-Human Interaction in Play*, ACM Press, New York, NY, pp. 423-426.

Wang, X., Goh, D.H.L., Lim, E.P. and Vu, A.W.L. (2014), "Player acceptance of human computation games: an aesthetic perspective", in Tuamsuk, K., Jatowt, A. and Rasmussen, E. (Eds), *Lecture Notes in Computer Science, Volume 8839, the Emergence of Digital Libraries-Research and Practices*, Springer, pp. 233-242.

Wu, J., Li, P. and Rao, S. (2008), "Why they enjoy virtual game worlds? An empirical investigation", *Journal of Electronic Commerce Research*, Vol. 9 No. 3, pp. 219-230.

Yee, N. (2006), "Motivations for play in online games", *CyberPsychology & Behavior*, Vol. 9 No. 6, pp. 772-775.

Yu, J., Zo, H., Kee Choi, M. and Ciganek, A.P. (2013), "User acceptance of location-based social networking services: an extended perspective of perceived value", *Online Information Review*, Vol. 37 No. 5, pp. 711-730.

Corresponding author
Xiaohui Wang can be contacted at: wang0870@ntu.edu.sg

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