Investigating user-centered human computation games : the roles of perceived enjoyment and its antecedents

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**INVESTIGATING USER-CENTERED HUMAN
COMPUTATION GAMES: THE ROLES OF PERCEIVED
ENJOYMENT AND ITS ANTECEDENTS**

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2016

**Investigating User-Centered Human Computation Games:
The Roles of Perceived Enjoyment and Its Antecedents**

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ABSTRACT

The popularity of games has motivated their adoption for pursuits beyond entertainment. An emerging strategy is the Human Computation Game (HCG), the phenomenon of harnessing human intelligence through enjoyable gameplay to address computational problems that are beyond the power of computer programs but trivial for humans. As such, HCGs should be enjoyable for individuals so that their intention to play is enhanced, thereby increasing the generation of useful outputs. With the increased use of HCGs in various human computation contexts, different genres of HCG have emerged. Yet, there is a dearth of research examining the multidimensional aspect of players' perceived enjoyment and its antecedents across HCG genres.

Driven by these research gaps, two main research questions are identified: 1) what factors drive the perceived enjoyment of HCGs, and 2) how the influences of these driving factors differ across HCG genres. To address the research questions, the entire research is divided into two interrelated studies. In Study I, the first research question is addressed. Based on a review of the extant literature on both entertainment- and task-oriented contexts, this study proposed a conceptual model, which suggests that personality traits and perceived output quality are influential factors driving the perceived enjoyment of HCGs. Utilizing a custom-developed mobile content-sharing HCG named SPLASH, the proposed conceptual model was tested empirically by analyzing self-reported survey data gathered from 205 participants. The results demonstrated that perceived output relevancy had a stronger influence on perceived affective enjoyment, followed by personality traits of extraversion and openness, as well as perceived output accuracy. Furthermore, perceived output relevancy had the strongest impact on perceived cognitive enjoyment, followed by perceived timeliness of output and the neuroticism trait. The variables found to predict behavioral enjoyment were perceived relevancy and the openness trait.

In Study II, the second research question is addressed. Three variants of mobile content-sharing applications were developed: a collaborative HCG (Collabo), a competitive HCG (Clash), and a non-gaming application (Share). A mixed-design experiment using a total of 160 participants was conducted, with the application types as a within-subjects factor and personality traits as a between-subjects factor. Participants used all three applications on an Android-based mobile phone, and they then completed questionnaires on the respective applications. This study established that the collaborative

HCG was effective in promoting the perceived enjoyment of players who scored high on the traits of extraversion, agreeableness, and openness, whereas the competitive HCG was effective for those who scored low on these traits. Moreover, individuals perceived that the output of the competitive HCG was more accurate than that of the collaborative HCG. Most importantly, the output generated by the non-gaming application was perceived to have a higher level of accuracy, completeness and relevancy compared to both HCG genres.

By combining Study I and II, this research highlights the joint contribution of personality traits and game genres to explaining players' perceived enjoyment in HCGs. In addition, this research provides evidence about the effects of HCG genres on perceived output quality. Therefore, game designers should place high priority on creating personality-targeted HCG designs, and develop quality control mechanisms or game features that could enhance players' perceptions of output quality.

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CHAPTER 1

INTRODUCTION

1.1 Background

Human computation (HC) harnesses human intelligence to address computational problems that are beyond the power of computer programs but trivial for humans (Quinn & Bederson, 2009; von Ahn & Dabbish, 2008). One example of HC can be found in the area of image searching (e.g., Google Images) which requires the availability of a large number of well-annotated images to achieve efficient image retrieval. Although automatic image tagging could be used to generate annotations for images, this approach only works well within a controlled set of images and cannot be scaled to the amount of real-world data (Pavlidis, 2009). Here, human tagging presents an alternative and preferred approach, as humans can, with very little effort, describe the purposes and meanings of objects depicted in a given image. Traditionally, human computation systems (HCSs) employ paid human experts or volunteers to generate labels or annotations for images. However, hiring such experts is costly and volunteerism is dependent on individuals' willingness to devote their time and effort to such a project (Yuen, Chen, & King, 2009).

Meanwhile, coupled with advancements in interactive technology, computers and video games are becoming increasingly sophisticated and they provide a broad and diverse set of entertainment experiences for players. According to the latest statistics reported by the Entertainment Software Association (ESA, 2015), 59% of Americans have played computer or video games. Furthermore, the Casual Games Association (CGA, 2007) reported that there were more than 200 million online gamers worldwide, and this number is believed to be increasing. These statistics imply that games can attract the attention of a vast number of people around the world and that gaming has possibly reached a critical mass of users. Therefore, utilizing games could be a promising way of motivating people to participate in HC. Consequently, a novel paradigm called Human Computation Games (HCGs) has emerged, where players can contribute their computational intelligence to a given endeavor through enjoyable gameplay (Goh & Lee, 2011).

In essence, HCGs are built upon the desire of individuals to be entertained while generating useful computations as byproducts of gameplay (von Ahn & Dabbish, 2004).

Due to this entertainment-output generation duality, HCGs have also been termed ‘games with a purpose’ (von Ahn & Dabbish, 2008) and ‘computainment’ (Goh, Ang, Lee, & Chua, 2011). As HCGs depend on the voluntary effort of online game players, they are also referred to as crowdsourcing games (Doan, Ramakrishnan, & Halevy, 2011). More recently, the use of game elements has become prevalent in non-gaming contexts to increase user participation, and this phenomenon is termed ‘gamification’ (Deterding, Dixon, Khaled, & Nacke, 2011). In this regard, HCGs can be considered as a genre of gamified applications.

Primarily, HCGs harness human intelligence through the use of games to tackle computational problems that are beyond the power of computer programs but performed well by humans (von Ahn & Dabbish, 2008; Reeves & Sherwood, 2010). Thus, a HCG serves a dual purpose: providing entertainment while generating useful computations (Goh & Lee, 2011). The *ESP Game* (see Figure 1.1) is one of the earlier examples of HCGs that aimed to address the image-labeling problem (von Ahn & Dabbish, 2004). In this game, two unrelated players are tasked with creating matching labels for randomly-presented images within a given time limit. The labels that players agree upon are considered meaningful and thus used to improve online image searching. To increase the quality of labels generated as well as player engagement, the game forbids players from entering certain taboo words. These taboo words are used to make the game harder because they are typically words that players use to describe the given image. Every time two players agree on an image label, they will earn a certain amount of points. It was found that players would spend several hours on the *ESP Game*, creating millions of image tags or labels (Law & von Ahn, 2011).

Since the first wave of applications, various types of HCGs have been developed in different problem-solving contexts, including those requiring common-sense facts (Kuo et al., 2009; Vannella et al., 2014), text descriptions (Poesio et al., 2013; Siu, Zook, & Riedl, 2014), multimedia descriptions (Barrington, O’Malley, Turnbull, & Lanckriet, 2009; Dulačka, Šimko, & Bieliková, 2012), protein structures in biological science (Cooper et al., 2010), circuit paths for semiconductor devices (Mehta et al., 2013; Terry et al., 2009), and even location-based content (Celino et al., 2012; Lee, Kim, & Lee, 2014; Procyk & Neustaedter, 2014).

Figure 1.1. The *ESP Game* players try to guess what their partner is typing on for the given image (von Ahn & Dabbish, 2008, p. 65).

Given that the primary purpose of HCGs is to produce useful computations, prior studies have paid much attention to the quantity and quality of the output generated. In particular, studies have examined various design strategies in terms of output quality (Bell et al., 2009), the differences in quality between the output generated and gold standards (Casey et al., 2007), as well as the differences in players' perceptions and the quality of output across HCG genres (Goh et al., 2011). However, despite the amount of research conducted into HCGs, the aspect of enjoyment has been largely overlooked. This area demands research attention, as enjoyment has been regarded as the focal aspect of entertainment media (Vorderer, Klimmt, & Ritterfeld, 2004). This notion receives support from prior research suggesting that individuals' enjoyment has a profound impact on their attitudes toward, and behavioral intention to use, of hedonic applications such as games (Hsu & Lu, 2007; Wu, Wang, & Tsai, 2010). Therefore, HCGs should be enjoyable for individuals so that their intention to play is enhanced, thereby increasing useful output.

Furthermore, recent studies which survey existing HCGs and related systems suggest that HCGs can be classified into either collaborative or competitive genres (Pe-Than et al., 2013; Quinn & Bederson, 2011). The former allows players to work together as a team and leads to shared outcomes, while the latter enables them to play against each other and only one player can achieve the winning condition at any time (Waddell &

Peng, 2014). Meanwhile, prior research on entertainment-oriented games have implied that each game genre evokes specific gameplay experiences, which in turn makes players distinguish between games by their genres (Johnson, Wyeth, Sweetser, & Gardner, 2012). Similarly, genres may also have an effect on players' enjoyment of HCGs. However, as mentioned above, little work to date has examined HCG players' enjoyment in depth. This study is thus timely because it seeks to investigate what drives individuals' enjoyment of HCGs and how the impacts of these driving factors differ across HCG genres.

1.2 The Role of Perceived Enjoyment

From a motivational perspective, enjoyment is often used to indicate intrinsic motivation which drives an individual to engage in an activity for its own sake (Deci & Ryan, 2000). Vorderer et al. (2004) contend that enjoyment is at the core of media entertainment consumption and that any entertainment media must afford enjoyment to retain their audiences' attention. Similarly, enjoyment is believed to play a significant role in the use of hedonic applications such as games (Mekler, Bopp, Tuch, & Opwis, 2014; Wu et al., 2010). Research into technology acceptance suggests that perceived hedonic value can explain why individuals use certain information systems, implying that people hold an expectation of experiencing enjoyment through using such systems (e.g., Bargas-Avila & Hornbæk, 2012; Reinecke et al., 2012).

Perceived enjoyment has received considerable research attention in recent years. In an entertainment-oriented context, multiple studies have identified the profound impact of perceived enjoyment on the attitudes and behaviors of individuals toward games for pure entertainment (e.g., Boyle, Connolly, Hainey, & Boyle, 2012; Fang & Zhao, 2010). Although the intention of individuals to play games may involve several factors such as socializing, combating boredom or overcoming challenges, prior studies suggest that experiencing enjoyment is the most fundamental aim for most individuals (e.g., Davis, Bagozzi, & Warshaw, 1992; Jin, 2012). In a task-oriented context such as online information sharing or content creation, enjoyment is also considered to be a critical factor. In particular, prior studies suggest that enjoyable tasks are more likely to increase the satisfaction of users and encourage continued use (e.g., Ahn, Ryu, & Han, 2007; Chen, Shang, & Li, 2014). Altogether, perceived enjoyment is significant in both

entertainment- and task-oriented contexts where it determines the attitudes and behaviors of individuals.

Although the importance of enjoyment is widely appreciated, most studies to date have treated enjoyment as a single dimensional construct, assessed only through affective states such as fun, pleasure and excitement (Lin, Gregor, & Ewing, 2008; Wu et al., 2010). However, there is increasing support for the notion that enjoyment is not a monolithic process but rather a complex construct comprising multiple factors (Mekler et al., 2014; Vorderer, et al., 2004). Specifically, Nabi and Krcmar (2004) view enjoyment as an attitude that consists of three dimensions which may mutually influence one another: affective—emotional experiences derived from media consumption; cognitive—thoughts evoked by the media; and behavioral—behavior resulting from being deeply involved in the media.

Following up on this notion, studies have utilized multiple dimensions to investigate the individuals' enjoyment of pleasure-oriented applications including games and interactive web-based applications (e.g., Fang & Zaho, 2010; Lin et al., 2008; Oliver & Raney, 2011). The findings of these studies suggest that enjoyment can be seen not only in positive affect, but also through positive thoughts and behavioral signs of deep engagement in such applications. As HCGs blend computation with gameplay, the enjoyment experienced by players may involve more than just affect or emotion, and may possibly consist of other aspects of the experience such as cognition. For instance, as players need to generate useful computations to be successful in a HCG, they are more likely to judge whether the game performs well in helping them to achieve the intended task outcome. In this case, cognitive enjoyment is obtained when players derive a favorable experience from the HCG. Hence, various enjoyment dimensions should be investigated in order to gain a better understanding of a player's entertainment experience in the context of HCGs.

1.3 Potential Driving Factors of Perceived Enjoyment

1.3.1 Personality

Prior research on social and entertainment media regards psychological factors such as personality as potential driving forces behind user involvement in such media (e.g., Chorley, Whitaker, & Allen, 2015; Johnson et al., 2012), and HCGs are no

exception. In fact, personality is known as the experiential aspect of an individual which drives the way he or she thinks, behaves and approaches a particular situation (John, Naumann, & Soto, 2008). Hence, understanding how personality correlates with behavior in a particular context may provide insight into users—especially when looking at who does what and why. Several means of categorizing personality influences have been proposed, and one prominent approach is to apply the Big Five model. This model divides personality into a series of five dimensional traits, namely extraversion, agreeableness, conscientiousness, neuroticism and openness (John et al., 2008).

The Big Five personality traits are often used to examine the relationship between an individual's personality and the way he or she behaves in both traditional and new media contexts. In traditional media contexts such as television, studies have shown that the personalities of audience members determine their choice of programs, viewing patterns and enjoyment (e.g., Finn, 1997; Krcmar & Kean, 2005). In online and social media contexts, a growing body of evidence suggests that personality differences are influential drivers of behavior (e.g., Hughes, Rowe, Batey, & Lee 2011; Ross et al., 2009; Shen, Brdiczka, & Liu, 2015). In particular, Ross et al. (2009) suggest that personality can explain the significant amounts of variance in social media usage in terms of people's preferences for communicative features and the nature of their postings. Furthermore, Hughes et al. (2011) found personality to be correlated with online social activity, as well as information sharing and seeking.

Moreover, the Big Five personality traits have been found to be associated with players' experiences and behaviors in the context of games played for pure entertainment. Specifically, Johnson et al. (2012) found that individuals' personalities determine their online gameplay experiences in terms of annoyance, competence and immersion. Similarly, personality was discovered to be a significant predictor of players' motivations to engage in gameplay, including achievement, competition and socialization (Graham & Gosling, 2013). Furthermore, Johnson and Gardner (2010) revealed that players who score high for emotional stability tend to prefer fast-paced and adventurous games, implying that personality is related to players' preferences for game genres. Hence, understanding the role of personality in gameplay could help to create user-centered designs suitable for individuals with different personality orientations, thereby maximizing gameplay benefits such as learnability and enjoyment.

Personality has been a focus of design-related studies (e.g., Farzan, Dabbish, Kraut, & Postmes, 2011) due to its ability to inform the design choices of individuals. In an experimental study on the impact of user interface (UI) design features, Nov, Arazy, Lopez, and Brusilovsky (2013) found that extraverted users respond to the UI indicator of audience size, which in turn influences their participation in the online context. This finding implies that responsiveness of individuals to certain design interventions may moderate the relationship between their personalities and online experiences and behavior.

Although a substantial amount of research has examined the relationships between individuals' personalities and their experiences in both social media and gaming contexts, the findings are not conclusive. For instance, although Moore and McElroy (2012) found that extraverts have more friends on social media, their finding is contrary to that of Ross et al. (2009), who concluded no link between extraversion and a person's number of social media friends. Furthermore, Wang, Lin, and Liao (2012) could find no significant relationship between openness and the use of online information-sharing services such as blogs, which is inconsistent with the finding of Guadagno, Okdie, and Eno (2008) where the relationship between openness and blogging is significant. More importantly, Hughes et al. (2012) asserted that the effects of personality in social media are not as influential and consistent as in other online communication settings, hence the need for further investigation.

With regard to HCGs in particular, prior studies suggest that players with different motivations may hold a preference for different game genres (e.g., Goh et al., 2011; Goh & Lee, 2011). Indeed, player motivations were found to be influenced by personality traits in the context of games for pure entertainment (Johnson et al., 2012). One explanation could be that each game genre comprises a set of particular game elements that provide a distinct gameplay experience, thereby appealing to certain motivations (Rollings & Adams, 2003). Depending on the levels of personality traits they possess, individuals may be motivated to play particular HCG genres. Hence, research should examine whether individuals with particular personality traits enjoy certain HCG genres.

1.3.2 Perceived Output Quality

One important factor that determines the success of information-oriented systems is the perceived output quality (DeLone & McLean, 1992; Kim & Han, 2009). Output quality refers to the quality of information that is produced by the system (Chen, Meservy, & Gillenson, 2012). As quality is the most striking attribute of every informational output (Coşkunçay, 2013; Lee, Park, & Widdows, 2009), it is reasonable to assume that systems yielding better quality output are more likely to be perceived positively by users. In fact, prior studies on both traditional and online information-oriented systems referred to the crucial role of perceived output quality in dictating individuals' enjoyment and intention to use (e.g., Ahn et al., 2007; Ho, Kuo, & Lin, 2012).

Recently, scholarly interest in the quality of user-generated content (UGC) has increased as the popularity of applications with UGC grows among users. Such applications serve as a new outlet for content creation, sharing and consumption (Nov, 2007); consequently, the quality of UGC has become a significant issue. The importance of this concern has been underlined by recent studies (e.g., Kim & Han, 2009; Tsai & Men, 2013) suggesting that perceived output quality influences the behavior and attitudes of individuals toward online services such as social media and community-based knowledge sharing. Furthermore, perceived output quality has been identified as an influential factor in the flow experience of users in information-oriented mobile applications (Chen et al., 2012; Zhou, Li, & Liu, 2010). Perceived output quality, therefore, seems to play a significant role in applications that yield UGC, with a possible bearing on the experiences and behaviors of users.

Prior research into information quality assessment suggests that output quality is a multifaceted construct, hence necessitating the use of multiple quality dimensions to capture its various aspects (Wang & Strong, 1996; Zheng, Zhao, & Stylianou, 2013). Furthermore, due to the subjective and contextual nature of output quality, a number of quality dimensions relevant to the context of interest have been proposed (Rieh, 2012). Specifically, Alkhatabi, Neagu, and Cullen (2010) found that accuracy, completeness, relevancy and timeliness are the most frequently-assessed quality aspects of online content. Previous studies also suggest that output quality tends to differ across online applications (e.g., Fichman, 2011; Rosenbaum & Shachaf, 2010) and that these differences can be attributed to the structural characteristics possessed by each

application, such as the degree of collaboration afforded (Gazan, 2010). Collectively, the above studies indicate that the quality of output will differ depending on the features supported by each online application. Accordingly, these variances may influence individuals' perceptions and experiences of these applications.

HCG play requires participants to complete a number of challenges that primarily revolve around generating useful output or computations in a given task. Put differently, the quality and quantity of output created by players determine their success in HCGs. As with other information-oriented applications, it is probable that players' perceptions of the quality of output produced by the HCGs may influence their enjoyment of these games. Furthermore, the specific gameplay elements afforded by each HCG genre may affect the quality of output generated. Hence, there may be differences in perceived output quality and enjoyment across HCG genres—an area that should be researched further.

1.4 Research Gaps

The gaps that warrant this present research are twofold and are presented in the following sections.

1.4.1 Lack of Conceptual Clarity Regarding HCG Enjoyment

In recent years, there has been an increased focus on the construction of HCGs and the humanistic aspects of HCGs. Much of the prior research has centered on the former, with studies examining the design, implementation and output quality of HCGs (e.g., Goh et al., 2011; Siu, Zook, & Riedl, 2014). However, relatively little research has been conducted into the humanistic aspects of HCGs, including the perceptions of players and their experiences (e.g., Goh & Lee, 2011; Lee, Goh, Chua, & Ang, 2010). In particular, very few studies have evaluated players' perceived enjoyment of HCGs, although such enjoyment is known to be a long-standing success factor in hedonic applications (Sweetser & Wyeth, 2005).

Of the studies into HCG enjoyment, none has provided a careful delineation of user enjoyment and its distinction from other related concepts. Instead, previous studies have used words such as 'appeal', 'fun', 'liking' and 'pleasure' interchangeably to refer to the same phenomenon of enjoyment (e.g., Barrington et al., 2009; Siorpaes & Hepp,

2008). Furthermore, these studies treat HCG enjoyment as a single dimensional construct that is primarily assessed via affective experiences. The lack of a complete understanding of enjoyment hinders the effort to predict the role of enjoyment in HCG play (Nabi & Krcmar, 2004; Tamborini, Bowman, Eden, Grizzard, & Organ, 2010).

More importantly, the conceptualization of HCG enjoyment has not been built upon the notion of enjoyment from media entertainment theories. Numerous scholars in the field of media entertainment have asserted that enjoyment is a multifaceted construct and that various dimensions are required to capture the experience of enjoyment (e.g., Fang, Chan, Brzezinski, & Nair, 2010; Sherry, 2004). In their systematic review of the quantitative studies on entertainment-oriented games, Mekler et al. (2014) suggest that gameplay enjoyment is a dynamic and complex process which involves a positive affective and cognitive appraisal of the game experience. Since HCGs harness games to reinforce users' participation in output generation, perceived enjoyment may arguably be driven by multiple sources of experiences. In the context of games for pure entertainment, a small number of studies have evaluated the enjoyment of these games with multiple dimensions (e.g., Fang & Zhao, 2010; Jin, 2012; Weibel & Wissmath, 2011). However, due to the existing differences between HCGs and such a type of games, those findings may not be readily applicable to the HCG context.

More specifically, the entertainment-output generation duality of HCGs (Goh et al., 2011) implies that HCG gameplay is largely centered on a specified computational task and tightly aligned to it. While HCGs aim to yield useful outputs by injecting fun into the computational task, games for pure entertainment primarily aim to maximize the enjoyment by players by adjusting the difficulty level of the game task that is supposed to be fun by itself (Koivisto & Hamari, 2014). Hence, the uniqueness of HCGs makes them a genre of their own (Krause & Smeddinck, 2011), which may engender enjoyment from other sources, possibly not important for entertainment-oriented games. Thus, evaluating the multidimensional aspect of HCG enjoyment is novel and requires not only a deeper understanding of the players, but also the implementation of more enjoyable HCG features.

1.4.2 Inadequate Understanding of the Factors Driving HCG Enjoyment

In addition to the lack of proper conceptualization of HCG enjoyment, a review of the literature reveals a dearth of empirical studies examining the antecedents of perceived HCG enjoyment. Instead, studies have largely suggested the approach of adopting design elements from games for pure entertainment in order to enhance players' enjoyment of HCGs (e.g., Krause, Takhtamysheva, Wittstock, & Malaka, 2010; von Ahn and Dabbish, 2008). However, as research suggests that gameplay experiences are influenced by psychological factors such as personality and motivation, the shortcoming of this approach is that the developed HCGs would not appeal to a larger user base.

Indeed, personality effects have been an active area of research in both hedonic and task-oriented contexts (e.g., Johnson et al., 2012; Wang et al., 2012). In particular, prior studies have suggested that personality is an antecedent to the experiences and behaviors of individuals in the use of social media and online games (Amichai-Hamburger & Vinitzky, 2010; Graham & Gosling, 2013). More generally, it shapes the beliefs of users about information technology (Agarwal & Karahanna, 2010).

Besides personality factors, outcome-related attributes such as output quality were found to play a significant role in influencing individuals' experiences of information-oriented services (e.g., Chen et al., 2012; Kim & Han, 2009). However, to the best of knowledge, no study has focused specifically on this relationship in the HCG context. The current study argues that research into the antecedents to perceived HCG enjoyment is necessary for two reasons. Firstly, understanding this relationship will not only help researchers comprehend the role of enjoyment in the acceptance of HCGs, but it will also inform designers of the development features that could enhance players' engagement, thereby offering more enjoyable experiences (Johnson & Gardner, 2010). Secondly, although similar in nature, HCGs differ from typical applications found in purely hedonic or task-oriented contexts because they blend both instrumental and entertainment value in gameplay. Stated differently, HCGs assist players in generating useful output and provide fun at the same time. Therefore, without empirical investigation, it cannot be stated for certain that the drivers of perceived enjoyment found in other contexts are valid in the HCG context. Nonetheless, previous studies in other contexts provide a valuable set of factors that can be explored and compared to the HCG environment.

1.5 Research Objectives

The main objective of this research is to investigate the factors underlying the perceived enjoyment of HCGs, and how the influence of these factors differs across HCG genres. The focus of this research lies in the domain of location-based information sharing. Driven by the research gaps presented in Section 1.4, this study will address the following research questions:

1. What are the underlying factors that drive perceived enjoyment of HCGs?
 - 1.1. What is the relationship between personality and perceived enjoyment of HCGs?
 - 1.2. What is the relationship between perceived output quality and perceived enjoyment of HCGs?
2. How do the influences of these driving factors differ across HCG genres?
 - 2.1. Are there any differences in the influence of personality on perceived enjoyment across HCG genres?
 - 2.2. Are there any differences in perceived output quality across HCG genres?

The research questions will be answered by meeting the following research objectives:

1. Investigate the influence of personality and perceived output quality on perceived enjoyment across HCG genres.
2. Investigate the differences in perceived output quality across HCG genres.

To achieve the objectives presented above, the research is divided into two interrelated studies. In Study I, the first research question and part of the first research objective are addressed. Specifically, this study includes a review of the extant literature on both entertainment- and task-oriented contexts to identify factors that may be important in the HCG context. The study then proposes a conceptual model to understand players' perceived enjoyment of HCGs. This model suggests that personality and perceived output quality are influential factors driving perceived enjoyment of HCGs. A custom-developed mobile content-sharing HCG named *SPLASH* is used, which adopts a virtual pet game genre whereby players contribute information by means of feeding pets. The proposed conceptual model is then tested empirically by analyzing the self-reported survey data gathered from 205 participants after *SPLASH* play.

In Study II, the second research question and the remaining part of the second research objective and third research objective are addressed. As part of Study II, three

variants of mobile content-sharing applications have been developed, namely, *Collabo* or a collaborative HCG, *Clash* or competitive HCG, and *Share* or a non-gaming application. A mixed-design experiment including a total of 160 participants is conducted, with the HCG genre as a within-subjects factor and personality as a between-subjects factor. Participants play all three HCG genres on an Android-based mobile phone, each game spaced one day apart, and they then complete questionnaires on the respective games. The aim of Study II is not only to validate the findings of Study I, but also to examine whether individuals with varying levels of personality traits display a preference for certain HCG genres, and whether their perceptions of output quality differ across genres.

1.6 Research Contributions

The present research is notable in several aspects. Firstly, this is one of the first studies attempting to examine the multidimensionality of perceived enjoyment and the factors driving it in the context of HCGs. In particular, this research explains how players derive enjoyment through the lens of personality and perceived output quality. In other words, the impacts of players' personalities and their perceptions of the output quality on their perceived HCG enjoyment are investigated, with the goal of overcoming the challenges encountered in achieving player engagement. Based on the findings of this study, in which perceived enjoyment appears to be more than an emotional experience and also includes players' thoughts and the behaviors evoked by HCG play, the notion of the multidimensional nature of enjoyment is acknowledged and supported.

Secondly, the findings of this research may prove helpful for HCG designers in implementing features that will augment the entertainment experience of players and thus encourage sustained participation. From the perspective of the interactionist approach to human-computer interaction design (Nov et al., 2013; Swann & Seyle, 2005), the findings of this study explain the effectiveness of game design features that target individuals' personality orientations. In particular, this study contributes knowledge supporting personality-targeted HCG design by explaining why certain game genres (e.g., collaborative or competitive) are more suitable for individuals with certain levels of personality traits (e.g., low or high levels of extraversion). In addition, given the significant influence of perceived output quality on enjoyment, this study suggests that features that facilitate output quality assessment, as well as those that afford personalized

content presentation, are essential. Overall, the model proposed in this research suggests that players' perceived enjoyment of HCG genres is moderated by their personality trait levels. This model can thus serve as the groundwork upon which game designers can create user-centered HCGs catering to the needs of individual players, enhancing the output quality of such games at the same time.

1.7 Thesis Outline

This thesis is organized into six chapters followed by references and supporting documents. Chapter 1 provides the background for the present study, the research gaps, objectives and questions, and it explains how this research contributes to the literature. Chapter 2 provides a critical review of the literature. The chapter begins with an introduction to HC followed by a discussion of HCGs. It also presents research related to perceived enjoyment and the influential factors driving it: personality traits and perceived output quality. Chapter 3 elaborates on the conceptual model developed in this research to investigate perceived enjoyment and the driving forces behind it in the HCG context, and several hypotheses are proposed. The model draws upon the literature on human behavior in games for pure entertainment, information systems, social media and UGC applications.

Chapter 4 presents Study I that investigated the antecedents of perceived enjoyment of HCGs using *SPLASH*, a custom-developed HCG for mobile content-sharing. Firstly, both gaming and information sharing features of *SPLASH* are presented, followed by hypotheses to be addressed in the study. The profile of the participants, the method used, and the summary of the results and findings are subsequently discussed. In Chapter 5, Study II is presented. The chapter begins with an introduction to two HCG genres that are commonly used in the current literature, followed by the research questions and hypotheses to be addressed. The study design, participants' profiles, data collection procedure, results, and discussion of the findings are then presented. Finally, Chapter 6 concludes the thesis by discussing the implications for the research field as well as for game design and implementation, followed by a consideration of the limitations of the research and recommendations for future work.

CHAPTER 2

LITERATURE REVIEW

This chapter reviews the literature concerning human computation (HC) and its related concepts, followed by a description of human computation games (HCGs) which forms the context of this research. The similarities and differences between HCGs and other types of games are then presented to provide clarity in identifying HCGs. This is followed by a review of the literature concerning the important variables used in assessing individuals' perceptions in contexts similar to HCGs, such as games for pure entertainment, as well as traditional and social media applications.

2.1 Human Computation

The concept of utilizing humans as a computational element is not a new practice and has been suggested in early computer science literature (e.g., Licklider, 1960; Turing, 1950). In essence, human computation (HC) seems to be envisioned in Licklider's (1960) work of 'Man-computer symbiosis' where he anticipated that advances in computational intelligence will be made through an intimate association between men and computers. One such example can be seen in the work of Dawkins (1986) in which a human experimenter was employed as a function of an interactive evolutionary program so that the program could utilize his/her visual perception and aesthetic judgment. However, the more recent usage of HC seems to be inspired by the research of von Ahn (2005) where online users contribute their computational capabilities toward problems that computers cannot solve alone.

As its name suggests, human computation (HC) refers to the computation carried out by humans (Gershenson, 2013; Michelucci, 2013). More generally, computation can be regarded as "the process of mapping of some input representation to some output representation using an explicit, finite set of instructions" (Law & von Ahn, 2011, p. 3). Similarly, humans can be considered to be performing computation when they process inputs and generate outputs following given instructions. In this regard, computational contributions made by humans include, but is not limited to, tags or labels for images and

videos, relationships between words and phrases, object locations in images, common sense facts, and geospatial information (Krause & Smeddinck, 2011).

In essence, HC is regarded as a paradigm of harnessing humans' computational abilities to tackle problems that are beyond the power of computer programs but are trivial for humans (Bozzon, Fraternali, Galli, & Karam, 2014; von Ahn & Dabbish, 2004). Accordingly, human computation systems (HCSs) explicitly organize human efforts to perform the process of computation in order to generate useful output for pre-specified computational problems (Law & von Ahn, 2011). HCSs possess an enormous potential to address such problems through collaboration between humans and computers (Quinn & Bederson, 2011; Savage, 2012). Examples of problems include, but are not limited to, natural language processing, contextual reasoning and understanding real-world problems.

Due to the popularity of social computing, people are now generating a wealth of information as a byproduct of online activities, exemplified by popular user-generated content (UGC) sites such as Wikipedia, *Facebook* and *Yahoo! Answers*. This phenomenon perhaps highlights how intelligence could emerge through either collaboration or competition among a group of people and it is broadly termed 'collective intelligence' (Malone, Laubacher, & Dellarocas, 2009). Consequently, HCSs enlist a crowd of Internet users to tackle specified problems, and these systems are often termed 'crowdsourcing systems' (Doan et al., 2011; Lukyanenko, Parsons, & Wiersma, 2014).

In general, HCSs can be classified into three types by the motivations of participants—volunteerism or altruism, monetary incentives, and enjoyment or entertainment (Chamberlain, Fort, Kruschwitz, Lafourcade, & Poesio, 2013). The first type of HCS relies on volunteerism or users who are inherently interested in making contributions. Here, *Galaxy Zoo* (see Figure 2.1) is a well-known example where online users contribute their intelligence to scientific research. This project has attracted more than 200,000 online users to classify images of galaxies in terms of shape and rotation (Raddick et al., 2010) and their contributions are beneficial to astronomers. The results of this project are encouraging and has yielded more than 100 million classifications of galaxies over the course of its two-year launch. Due to the pure reliance on volunteerism, one potential problem with this type of HCS might be that tasks need to be interesting enough for users to encourage participation.

Figure 2.1. The *Galaxy Zoo* players classify the shape of given galaxy (Raddick et al., 2010, p. 2).

Therefore, another type of HCS has been used where participants are paid money in return for performing given tasks. For instance, Deng et al. (2009) gathered tags for 1.2 million images from workers of a crowdsourcing platform, *Amazon's Mechanical Turk* (AMT). Figure 2.2 shows the AMT's interface in which workers select images associated with a given word or phrase. However, this approach limits HC projects to those backed with adequate funding (Yuen et al., 2009), and the appropriate amount to incentivize participation has yet to be agreed upon among researchers (Kittur et al., 2013; Ipeirotis & Paritosh, 2011).

Due to the abovementioned limitations of HCSs with volunteers and paid humans, another type of HCS has been introduced to motivate individuals with enjoyment or entertainment. The basic idea involves the integration of computational tasks into games so that players perform computations as a side effect of enjoyable gameplay (von Ahn & Dabbish, 2004). The emergence of this type of HCS is motivated by the fact that games attract a large user base and encourage replayability (Grace & Jamieson, 2014; Seaborn, & Fels, 2015). In addition, HC projects such as *reCAPTCHA* (see Figure 2.3) highlights that piggybacking human computational tasks into activities that users are already interested in has great potential for reaching large segments of the population. A typical *CAPTCHAs* (an acronym for **C**ompletely **A**utomated **P**ublic **T**uring test to tell **C**omputers

and **H**umans Apart) is a distorted character string that users type in when they are attempting to perform certain activities on the Internet such as opening an email account (von Ahn, Maurer, McMillen, Abraham, & Blum, 2008). In *reCAPTCHA*, distorted character strings are taken from scanned texts so that the recognized strings can be used for the digitization process. The results are encouraging in that over 200 million *CAPTCHAs* have been generated via users' everyday activities on the Internet (Law & von Ahn, 2011).

Figure 2.2. The workers of *AMT*'s select images associated with the word “delta” (Fei-Fei, 2010, p. 24).

Figure 2.3. The *reCAPTCHA* system displays the word, “morning”, from scanned text which was not recognized by OCR to online users (Law & von Ahn, 2011, p. 48).

Recently, the idea of turning tasks into games has been increasingly applied to influence human behavior in various domains, including learning and training, employee engagement and healthier lifestyles. This concept has been labeled ‘gamification’, which is a term that originated in the digital media industry approximately in 2008 and was

possibly coined by the British game designer Nick Pelling (Deterding et al., 2011). Moreover, research into human-computer interaction has shown that incorporating gaming elements into user interfaces could increase enjoyment and engagement with the systems (Raftopoulos, 2014; Shneiderman, 2004), in turn possibly influencing usage intention. Hence, utilizing games could be a promising way of motivating people to participate in HC. However, as in HCSs with monetary incentives, injecting the element of fun into computation through games may counteract the objective of HC by producing low-quality output (Chamberlain et al., 2013; Huck, Kübler, & Weibull, 2012; Thomsen, 2013).

Furthermore, HCSs could raise a number of ethical concerns (Zittrain, 2008). In particular, players generate outputs as by-products of gameplay, and hence their work may not be appropriately recognized. Next, information privacy may be another concern of users, especially in mobile location-based HCGs that utilize players' current location as part of gameplay (Benford & Magerkurth, 2005). Despite these concerns, the power of HC is substantial to make advances in computing (Zittrain, 2008). Therefore, HC is not a phenomenon to be avoided but needs to be treated with caution.

In sum, each type has its pros and cons regarding recruitment, engagement, and retention. For instance, games may perform better than those relying on pure volunteerism, and monetary incentives for certain projects but the latter two may work better for projects dealing with cognitively demanding problems. Hence, it may be inappropriate to contend that one type of HCS is better than the other. The present research focuses on the type of HCS which attracts people to perform computations with games, which will be discussed further in Section 2.2.

2.1.1 Comparisons with Related Concepts: Crowdsourcing and Social Computing

It has been suggested that the notion of HC is related to, but not synonymous with, the terms often used to refer to the idea of the wisdom of crowds. This section will discuss the concepts of social computing and crowdsourcing to clearly understand the notion of HC. Firstly, social computing (SC) refers to the interplay between individuals' social behaviors and their interactions with computing technologies (Parameswaran & Whinston, 2007; Quinn & Bederson, 2011). Typically, SC applications facilitate the formation of collective action and social interaction among online users with an exchange

of text and multimedia information together with an evolution of aggregate UGC (Parameswaran, & Whinston, 2007). Examples include online encyclopedias, blogs, multimedia sharing and tagging, social bookmarking, and social networking. These applications focus on sharing as a communal activity performed by a multitude of users (Wang & Stefanone, 2013; Pandey & Nandi, 2014). On the other hand, SC can also be considered to be a general computing framework that supports computations carried out by groups of online users (Law & von Ahn, 2011).

The second term related to HC is ‘crowdsourcing’ (CS). CS is understood as the act of gathering a large group of people to address a particular task, traditionally executed by a designated person, through an open call for proposals via the Internet (Howe, 2006; Schneider, de Souza, & Lucas, 2014). In fact, CS makes it possible to mobilize the competence and expertise that are distributed among members of a crowd beyond the restrictions of time and space (Schenk & Guittard, 2011). Specifically, Doan et al. (2011) regard CS as an approach that solicits a crowd of online users to help address pre-defined problems. Typical examples include *InnoCentive* (innocentive.com), which broadcasts research and development challenges to its users and seeks solutions, and *Threadless* (threadless.com), which asks users to create T-shirt designs. Based on the notions of SC and CS presented above, it could be said that HCSs are built upon a social computing framework utilizing crowdsourcing as a means of getting online users involved in addressing computational problems that are trivial for humans yet challenging for computers to tackle alone.

2.2 Human Computation Games

Games are often regarded as the phenomenon of play and entertainment (Yee, 2006). The first modern computer game is known to be the *Spacewar* developed in 1961. It is a two-player game in which each player maneuvers his/her spaceships while trying to shoot the other’s (Aarseth, 2001; Kent, 2010). Next, the *ADVENT* developed in 1977 is known to be one of the earliest computer adventure games (Aarseth, 1997). The *ADVENT* then inspired the emergence of multiplayer role-playing games, with *Multi-User Dungeon* (*MUD*) being an earlier example.

Games reached the masses around 1977 with the development of home console systems, such as the Atari 2600, and home computers (Kent, 2010). Since then, games

have amassed millions of players worldwide. According to the latest statistics reported by the Entertainment Software Association (ESA, 2015), in the United States alone, there are 155 million video game players. Games have been extended to the mobile platform. This phenomenon is driven by the advent of hand-held game consoles, and mobile phones that allow online multiplayer gameplay (Hjorth & Richardson, 2014). The earlier mobile games were simple and single-player games, with *Tetris* being one example (Feijoo, Gómez-Barroso, Aguado, & Ramos, 2012). Mobile games have become increasingly sophisticated with advances in mobile computing and wireless communication together with GPS technology. Location-based games are an emerging new genre which utilize spatial information as part of gameplay, bringing the gaming experience out into the real world (Benford & Magerkurth, 2005). Earlier examples include *The Beast* by Microsoft (released in 2001) and *Mogi* (released in 2003).

Recently, games have been used to tackle problems that are usually trivial for humans, but difficult for computers. These games are termed as Human computation games (HCGs) (Chamberlain et al., 2013; von Ahn & Dabbish, 2004). One motivation behind the development of HCGs is that people enjoy playing games as evident by consumer demand and psychological studies (e.g., ESA, 2015; Ryan et al., 2006; Tamborini et al., 2010). Put succinctly, HCGs are dual-purpose artifacts which generate computation and offer entertainment at the same time, and hence can be called ‘games with a purpose’ (GWAPs), as defined by von Ahn and Dabbish (2004). They could also represent a genre of computainment, a portmanteau of computation and entertainment (Goh et al., 2011). As such, enjoyment and computation are the most striking features of HCGs. This characteristic indeed distinguishes HCGs from pure entertainment games in which enjoyment is considered to be the single most important goal (Mekler et al., 2014; Sweetser & Wyeth, 2005).

As HCGs enlist online players to help perform computation, they have also been called crowdsourcing games in recent literature (Doan et al., 2011; Guy, Hashavit, & Corem, 2015). Unlike other types of HCSs, HCGs incentivize players through fun in return for taking part in the HC. Therefore, HCGs adopt game design principles from games for pure entertainment to ensure that players experience enjoyment through HCG play. In recent literature, the use of gaming elements in a non-gaming context to increase the motivation and retention of users has been called gamification (Seaborn & Fels, 2015). Used in this context, HCGs are a type of gamified application with a focal purpose

of generating useful computations. Following the notion of HCGs proposed by von Ahn (2005), this thesis takes a view of HCGs that utilize games as a means of motivating people to perform computations. This proposition also reflects the primary intent of generating useful computations through gameplay that is conveyed in much of the HCG literature (e.g., Grace & Jamieson, 2014; Michelucci, 2013).

One well-known example of a HCG is the *ESP Game* (von Ahn & Dabbish, 2004) which has the purpose of image labeling that is considered difficult for computers to perform but easy for humans. The *ESP Game* embeds the task of image labeling into gameplay where two randomly-paired players are given the same image. The game rule is that a player has to guess the words that might be used by his/her partner to describe a given image and then enter their guesses in the form of labels, and both players will be rewarded when their labels match. While being entertained, players of the *ESP Game* produce labels as byproducts of gameplay that can later be used to improve web-based image search engines such as Google Images. The *ESP Game* has been tremendously successful; as of 2008, it has been played by over 200,000 people, allowing the collection of 50 million image labels (von Ahn & Dabbish, 2008).

Although HCGs are designed with the entertainment goal in mind, players may be motivated by different means. For instance, players may view HCGs as a medium to express values related to altruistic concerns (Chamberlain et al., 2013). In this regard, HCGs may be attractive to people who would like to help others for the greater good. Next, performing computation in HCGs may be seen a way of practicing their knowledge as well as learning skills (Law & von Ahn, 2011). Hence, HCG players may be motivated by learning or enhancement. Finally, HCGs may be able to fulfil people's desire to socialize as these games offer an opportunity for players to meet with like-minded others (Raddick et al., 2010).

More importantly, HCGs seem to have the potential to overcome the challenges of recruitment and retention in HCSs which do not rely on a gaming approach. Although the power of volunteerism cannot be underestimated, a non-gaming approach is largely dependent on the willingness of volunteers to spend their time and effort generating useful computations (Yuen et al., 2009). In contrast, HCGs capitalize on games, which in turn engender the implicit involvement of players in HC, thereby generating computations as a side effect. Stated differently, as HCGs are designed to motivate players intrinsically through the use of games, they will have a better opportunity of mitigating problems

inherited in HCSs with other extrinsic motivations, such as financial payments, that may discourage the participation of certain individuals (Massung, Coyle, Cater, Jay, & Preist, 2013). Furthermore, the success of online social games such as *Farmville*, with 21.5 million active players each month, highlights that the potential for mass participation is possible through games (Shaul, 2014). Hence, channeling humans' processing ability through games could be a viable alternative to leverage HC, potentially alleviating issues encountered in traditional HCSs.

Due to their potential, HCGs are found in numerous computational problem spaces including image recognition, music annotation, website indexing, natural language processing, ontology building, common-sense knowledge acquisition, protein folding in biological science, geospatial knowledge collection, and many others. Despite the diversity of their use in various areas, these games share an underlying commonality in that they serve as motivators for people to perform computations (Goh & Lee, 2011). Some examples of HCGs on both web-based and mobile environments are presented in Section 2.2.1 and 2.2.2 respectively.

2.2.1 HCGs in Web-Based Environments

HCGs initially emerged as web-based casual games. The *ESP Game* described above is a typical example of a web-based HCG. In contrast to the *ESP Game*, which requires collaboration between players to earn points, *KissKissBan* (Ho, Chang, Lee, Hsu, & Chen, 2009) approaches the image-labeling problem from a competitive perspective. Here, a player acts as a blocker and competes with a group of two players by following a rule that the blocker prevents others from reaching agreement (i.e., matching image labels). In particular, the blocker creates a list of tags for a given image before the group starts working together to achieve a matching label. The group wins the game if the players match a label that is not on the blocker's list; otherwise, the blocker wins. Next, *Tagatune* (Law et al., 2009) and *TAG4VD* (Pinto & Viana, 2013) are web-based HCGs that collect tags for sounds and music in order to improve audio searches. In this game, a pair of players is asked to generate tags for the soundtrack played by the game and to exchange their tags. Each player then decides whether the game has played the same song to them based on their partner's tags. Points are awarded for correct guesses.

In addition, web-based HCGs such as *Matchin* (Hacker & von Ahn, 2009) have been utilized to elicit user preferences for images, and the collected information is used to enhance the performance of an image search engine by ranking the appeal of images. Other HCGs involve the detection of the location of objects in images, and examples include *Peekaboom* (von Ahn, Liu, & Blum, 2006) and extended *PexAce* (Dulačka et al., 2012). Some of these HCGs also involve selecting appropriate key frames or video segments, such as in *Movie Recognizer* (Müller, Lux, & Böszörményi, 2012). They may also involve collecting common-sense facts to construct or verify the existing facts in a knowledge base such as in *Verbosity* (von Ahn, Kedia, & Blum, 2006), *Hourglass Game* (Cambria, Xia, & Hussain, 2012), and *HeartESP* (Hodhod, Huet, & Riedl, 2014). Then, there are such HCGs that harvest text annotation to improve natural language processing, including *Phrase Detectives* (Chamberlain et al., 2013), *Zombilingo* (Fort, Guillaume, & Chastant, 2014), and *Puzzle Racer* (Vannella, Jurgens, Scarfini, Toscani, & Navigli, 2014). Building ontologies is also employed in these HCGs, as observed in *BetterRelation* (Hees, Roth-Berghofer, Biedert, Adrian, & Dengel, 2011), *Little Search Game* (Šimko et al., 2013) and *OntoGalaxy* (Krause et al., 2010). A similar concept has been applied in an electronic engineering context through *Plummings* (Terry et al., 2009) and *Untangled* (Mehta et al., 2013), specifically to reduce the critical path of a digital circuit and to create efficient mappings of dataflow graphs that cannot be solved with reasonable computational cost. Other web-based HCGs such as *FoldIt* (Cooper et al., 2010) and *Phylo* (Waldispühl & Blanchette, 2014) help to yield the structure of proteins represented as 3D visual puzzles and the sequence of DNA represented as strings of colored blocks respectively.

With the unprecedented growth of social media, HCGs are not limited to stand-alone web-based games and they are now piggybacked in social media applications bearing much resemblance to social games. There are a number of HCGs deployed on *Facebook*; these can generate tags for music in the case of *Herd It* (Barrington et al., 2009), *Emotify* and *Hooked* (Aljanaki et al., 2014), evaluate positive and negative sentiments in sentences in the case of *Sentiment Quiz* (Rafelsberger & Scharl, 2009), and create ontological relations for climate change knowledge in the case of *Climate Quiz* (Scharl, Sabou, & Föls, 2012). The *Virtual Pet Game* (Kuo et al., 2009) is another example that is deployed on a text-based bulletin board system to gather common-sense knowledge from its users.

2.2.2 HCGs in Mobile Environments

Due to the mobility and accessibility afforded by mobile devices, they have become an integral part of everyday interactions and their usage has become pervasive. This phenomenon has changed the way that people perform computation from that of a traditional desktop environment to one of a mobile environment, which in turn has caused the emergence of mobile HCGs that allow players to perform computations pervasively (Ross, 2013). Location-based HCGs are typical examples of HCGs on mobile platforms that collect geospatial knowledge about real-world locations.

MobiMissions (Grant et al., 2007) is a location-based HCG in which missions are created, solved and reviewed by players. These missions are accomplished by means of creating a series of photographs and text annotations associated with specific locations. Similarly, the *Gopher Game* (Casey et al., 2007) facilitates geospatial content sharing through the performance of information-creation tasks conducted by a game agent called a gopher. Players can either create a new gopher and assign tasks, or pick one up as they move around their physical world and help the gopher to complete its mission by supplying situated photographic and textual content.

Eyespy (Bell et al., 2009) generates photos and texts of geographic locations that can be useful in supporting navigation or creating tourist maps. In this game, players take pictures of locations and share them with others who then have to determine where these pictures were taken. Points are awarded for both producing more recognizable images and for confirming the images of other players, so that players are more likely to create images of more popular and interesting locations. Next, *CityExplorer* (Matyas et al., 2008) is another example of a location-based HCG in which players conquer each city segment by placing the markers for their chosen categories, such as food, cafés and so on, within this segment. To place a marker, the player needs to provide the game with a photo of the location of interest and its name. Players who create the most markers will win the game.

Next, *Indagator* (Lee et al., 2010) incorporates gaming elements into content-sharing activities. Players can share and browse media-rich location-based information, and earn points by rating and creating content. Using these points, they can play mini-games, lay traps and obtain treasure. The design of *Indagator* can facilitate not only entertaining experiences but also information discovery. Using geospatial data from

OpenStreetMap, *Urbanopoly* (Celino et al., 2012) presents real-world venues as building icons on the map interface and challenges players to play mini-games in which information creation or verification tasks are embedded so they can conquer the venues and become rich landlords. As a side benefit of playing this game, players contribute geospatial data that is useful in other locative services. *Tidy City* (Wetzel, Blum, & Oppermann, 2012) is another example of a location-based HCG in which players pick up riddles that are shown on the map. Each riddle consists of a name, a difficulty level, a textual clue and image. The player's task is to figure out what real-world location the riddle describes and verifies it physically. After having found the correct spot, the players are rewarded with points depending on the difficulty of the riddle.

Next, *Hidden View Game* and *Drag&Drop Game* (Lee et al., 2014) have a similar design and purpose, which is to gather the latest information about a street map view to keep maps and street views up-to-date. Here, the players are shown a street view image and tasked with identifying whether the given labels exist in the latest street view. One label is displayed at a time and the player has a time limit to come to a decision. If the label exists, the player drags it to the appropriate place and confirms the chosen location. Otherwise, the player removes the label from the street view. Players earn points based on the accuracy of their contributions and how quickly they accomplish the task. Finally, *GEMS* or Geolocated Embedded Memory System (Procyk & Neustaedter, 2014) allows players to document location-based stories for personal reflection, and for future generations to find. During gameplay, players receive directives or short-term goals from the game character. Players can complete these directives by creating a memory record, which includes a combination of text, audio, photographs or video clips, to capture a particular experience and the place of origin. As players create records, they earn points and access tokens that can be used to unlock secret information about the game character.

It must be noted that some of the games reviewed in this research are no longer available to play. For instance, the *ESP Game* and *PhotoCity* were closed in 2011. However, this does not mean that HCGs are not sustainable in the long run. This is because most of the HCGs to date are primarily developed for research purposes with limited funding. Put differently, long term usage is not the main objective. Therefore, when the research goals have been achieved, the games are withdrawn. In some cases, they may become the foundation for larger research endeavors. One example is *GiveALink Slider* (Weng & Menczer, 2012) where players construct a chain of web

resources by tagging and selecting web pages. The data collected from this game has been an integral part of the project (www.givealink.org) which broadly examines several aspects of social tagging to foster the construction of a socially driven semantic annotation network. Similarly, the *FACTory* game was used to validate the knowledge structure of common sense facts, and the collected data was utilized in the construction of Cyc's database (www.cyc.com) (Siorpaes & Hepp, 2008). Nevertheless, there are HCGs that are backed with adequate funding and continue to attract participation across time. These include *Urbanopoly* (Celino et al., 2012) in which players validate and update information about real-world locations and *Phrase Detectives* (Chamberlain et al., 2013) in which players indicate the relationships between words and phrases to create rich linguistic information.

In summary, the review of the existing literature suggests that HCGs are versatile and have the potential to address computation problems in various domains. Although the initial appearance of HCGs employed the web platform, more sophisticated forms of HCGs have begun to emerge on mobile platforms as mobile computing technology advances. The proliferation of HCGs across multiple domains and platforms highlights the capability of these games in harnessing the participation of game players in problem-solving. The summary of HCGs and other HCSs reviewed in this research are summarized in Table 2.1.

Table 2.1
A Brief Survey of HCGs and Computations generated

Game	Reference	Platform	Computations
ESP Game	von Ahn & Dabbish, 2004	Web	Image annotations
KissKissBan	Ho et al., 2009		
<i>Tagatune</i>	Law et al., 2009	Web	Music annotations
<i>TAG4VD</i>	Pinto & Viana, 2013		
<i>Herd It</i>	Barrington et al., 2009	Social	
<i>Emotify and Hooked</i>	Aljanaki et al., 2014	media	
<i>Phrase Detectives</i>	Chamberlain et al., 2013	Web	Text annotations
<i>Zombilingo</i>	Fort et al., 2014		
<i>Puzzle Racer</i>	Vannella et al., 2014		
<i>Verbosity</i>	von Ahn et al., 2006	Web	Common-sense facts
<i>Hourglass Game</i>	Cambria, Xia, & Hussain, 2012		
<i>HeartESP</i>	Hodhod et al., 2014		
<i>Virtual Pet Game</i>	Kuo et al., 2009	Social media	
Peekaboom	von Ahn et al., 2006	Web	Object locations in images
PexAce	Dulačka et al., 2012		
<i>Matchin</i>	Hacker & von Ahn, 2009	Web	Image preference
<i>Movie Recognizer</i>	Müller et al., 2012	Web	Key frames or video segments
<i>Sentiment Quiz</i>	Rafelsberger & Scharl, 2009	Social media	Positive/negative sentiment
<i>BetterRelation</i>	Hees et al., 2011	Web	Relationships among words
<i>Little Search Game</i>	Šimko et al., 2013		
<i>OntoGalaxy</i>	Krause et al., 2010		
<i>Climate Quiz</i>	Scharl et al., 2012	Mobile	
<i>MobiMissions</i>	Grant et al., 2007	Mobile	Location-based text and multimedia information
<i>Gopher Game</i>	Casey et al., 2007		
<i>CityExplorer</i>	Matyas et al., 2008		
<i>Indagator</i>	Lee et al., 2010		
<i>Urbanopoly</i>	Celino et al., 2012		
<i>GEMS</i> or Geolocated Embedded Memory System	Procyk & Neustaedter, 2014		

2.2.3 Comparisons with Related Concepts: Gamification and Serious Games

Fundamentally, gamification refers to the process of utilizing game elements in non-gaming contexts with the aim of increasing user engagement (Deterding et al., 2011; Richter, Raban, & Rafaeli, 2015). This goal is typically pursued by providing affordances of gameful design such as points, leaderboards and levels, thereby making the activity more engaging (Zichermann & Cunningham, 2011). The gamification approach has wide applicability to a diversity of problems, such as increasing brand awareness, helping users to improve their health, and encouraging users to participate in activities that are otherwise mundane or boring to perform (Huotari & Hamari, 2012; Seaborn & Fels, 2015). In this regard, HCGs could be a type of gamified application deployed in the context of HC with the aim of addressing computational problems that cannot be addressed by either humans or computers alone.

Serious games can be defined as interactive game-based applications that have been developed with the intention of being more than entertainment (Connolly, Boyle, MacArthur, Hainey, & Boyle, 2012; Ritterfeld, Cody, & Vorderer, 2009). Therefore, the distinction between serious games and HCGs is fuzzy as they are developed not just to entertain, but also to garner computational contributions. In particular, serious games attempt to convey ideas and values, modify a behavior, or teach a skill in the course of gameplay, wherein entertainment value is secondary (Connolly et al., 2012; Mitgutsch & Alvarado, 2012). It can be said that they are designed primarily to facilitate educational purposes. Stated differently, serious games embed real-world problems into games to make them easier to understand, thereby improving learnability (Mayer et al., 2014). Examples of application areas include defense, education, emergency management and city planning (Richter et al., 2015). In contrast, the primary purpose of HCGs is to collect useful computational contributions as byproducts of enjoyable gameplay, rather than to explicitly make players engage in a learning process.

2.3 Perceived Enjoyment

From the perspective of users, enjoyment refers to the extent to which an activity is perceived as pleasurable in its own right, aside from performance consequences (Chang, Liu, & Chen, 2014; Davis et al., 1992). It is often described as an individual's positive responses to media technology and its content. The concept has become a central

component of the media entertainment experience (Vorderer et al., 2004), as well as one of the most frequently assessed dimensions of user experience (Bargas-Avila & Hornbæk, 2012).

Research into enjoyment has been prominent in the context of hedonic or entertainment-oriented systems, which in general support non-instrumental needs and experiences. For instance, van der Heijden (2004) clarified how perceived enjoyment surpasses perceived usefulness in explaining users' behavioral intentions to use a hedonic system, underlining the essential role of enjoyment in the hedonistic context. As HCGs are based upon individuals' desire to be entertained, enjoyment is undoubtedly important in the success of these games. Accordingly, this study reviews previous research into the enjoyment of games for pure entertainment in order to underline its potential significance in the HCG context, and subsequently introduces a tripartite media enjoyment model that is used to evaluate individuals' HCG enjoyment in this study.

2.3.1 Perceived Enjoyment and Games

It has been generally acknowledged that enjoyment is a key component of a player's experience of digital entertainment games that typically hold high hedonic value. Although the notion of enjoyment may seem commonplace, the precise meaning of enjoyment has yet to be determined (Bartsch, 2012). Previous research into games for pure entertainment has approached player enjoyment from multiple perspectives. Firstly, a stream of research posits that enjoyment is a reflection of needs satisfaction, implying that the fulfillment of certain needs during gameplay gives rise to enjoyment (e.g., Przybylski, Rigby, & Ryan, 2010; Tamborin et al., 2010). These include not only needs derived from empirically-grounded data such as achievement, immersion, social acceptance and interaction (Yee, 2006), but also psychological needs such as autonomy, competence and relatedness (Reinecke et al., 2012; Tamborini et al., 2010). Several studies have confirmed this notion by relating enjoyment to the feeling of being in control (Schmierbach, Limperos, & Woolley, 2012), competence (Przybylski et al., 2009) and belongingness (Klimmt, Hartmann, & Frey, 2007).

A second stream of research has considered the experience of flow, characterized by Csikszentmihalyi (1990) as a contributor to enjoyment (e.g., Hsu & Lu, 2004; Kiili, Lainema, de Freitas, & Arnab, 2014). Most studies deemed flow to be an experience that

is attained when an individual's attention is completely focused on the task at hand and that nothing else seems to matter (e.g., Nacke, Grimshaw, Lindley, & More, 2010; Weber, Tamborini, & Westcott-Baker, 2009). It was found to be an influential factor in determining the attitudes and behaviors of individuals in both task-oriented (e.g., Agarwal & Karahanna, 2000; Gao & Bai, 2014) and entertainment-oriented environments (e.g., Sweetser & Wyeth, 2005; Weibel & Wissmath, 2011). That said, Jin (2012) suggests that flow is an intense form of enjoyment and that players may experience enjoyment independently of flow. Therefore, limiting player enjoyment to the experience of flow would fail to account for the variety of enjoyable experiences that games may offer (Mekler et al., 2014; Poels, de Kort, & Ijsselstein, 2007).

Thirdly, prior research has also assessed enjoyment as a form of affective experience. Indeed, studies in this line of research treated enjoyment as a unidimensional construct and examined whether individuals encounter affect or emotion during gameplay (Mekler et al., 2014). In particular, various types of emotional experience such as fun, pleasure, happiness and excitement were examined (e.g., Chumbley & Griffiths, 2006; Gollwitzer & Melzer, 2012; Lankoski, 2012). These emotional experiences were found to be related to the players' intention to play (Chang et al., 2014), their involvement (Poels, Hoogen, Ijsselstein, & de Kort, 2012) and their game genre preferences (Hsu & Lu, 2007).

In addition to affective experiences, some previous research regarded the positive cognitive appraisal of media as a form of enjoyment. In particular, Fang and Zhao (2010) found that players cognitively enjoyed simulation games (e.g., city-building games such as *CityVille*). As simulation games reflect real-world situations (Apperley, 2006), players may have tried to relate or compare themselves to game characters or actions during gameplay. In other words, these games facilitate players to practice their intellectual capabilities which, in turn, gives rise to cognitive enjoyment. Moreover, previous studies have assessed enjoyment as a form of playfulness that can be considered as a state of mind that represents affective or cognitive experiences felt by individuals (Moon & Kim, 2001; Shin & Shin, 2011; Wang & Wang, 2008). Bringing the aspect of cognition into the experience of enjoyment is in line with the conceptualization of enjoyment in the context of media psychology (Nabi & Krcmar, 2004; Vorderer et al., 2004).

Earlier studies have also considered immersion to be critical to the enjoyment that results from a good gaming experience (e.g., Christou, 2014; Jennett et al., 2008; Nacke

& Lindley, 2008; Weibel & Wissmath, 2011). In particular, presence and flow are regarded as immersive experiences (e.g., Weibel & Wissmath, 2011; Weibel, Wissmath, Habegger, Steiner, & Groner, 2008). Jennett et al. (2008) asserted in more detail that flow is an optimal experience or intense form of enjoyment. Hence, individuals in the state of flow will appear to be fully engaged in an activity and completely unaware of surroundings and time passage. In contrast, immersion occurs when individuals are highly engaged, but still maintain self-awareness, in an activity (Brown & Cairns, 2004). Indeed, the experience of immersion is noted as a precursor for flow (Jennett., et al., 2008).

Based on the analysis of data collected from 244 online game players, Jennett et al. (2008) characterized the experience of immersion as a mixture of factors including cognitive involvement, real-world dissociation and emotional involvement. Acknowledging the notion of enjoyment as a multifaceted construct, Fang and Zhao (2010) examined player enjoyment of several game genres with multiple dimensions. Their results revealed that players were highly involved in most genres of games for pure entertainment which is observed through their effortless and timeless behaviors, while the experience of cognition explains the enjoyment of family entertainment and simulation games. It therefore seems that player enjoyment extends beyond mere fun or pleasure, and encompasses multiple factors that may exert influence on one another (Boyle et al., 2012; Mekler et al., 2014).

Finally, some studies have indicated that enjoyment is positively related to a desire to remain engaged in the activity (e.g., Lyons et al., 2014). In particular, O'Brien and Toms (2008) argued that engagement could emerge from three different sources: (1) sensual, that pertains to the visual, auditory, and interactive components of the users' experiences with the application; (2) emotional, that pertains to the affective experiences and motivations; and (3) spatiotemporal, that pertains to the perceptions of time and external environments. The authors further stated enjoyment as a form of emotional engagement. However, based on their review of existing literature on engagement, Bouvier, Lavoué, and Sehaba (2014) proposed engagement as individuals' willingness to have emotions, affect, and thoughts directed toward and aroused by the mediated activity. Therefore, it can be argued that engagement and enjoyment are different but interrelated concepts, with the former possibly driving the latter (Boyle et al., 2012).

In summary, prior studies on games for pure entertainment have assessed player enjoyment with varying conceptualizations. While some studies have attempted to

approach enjoyment as a reflection of needs satisfaction, others have related it to the experiences of flow, affect or emotions, cognition and real-world dissociation. Player enjoyment has also been considered to be the experience of playfulness, which indeed represents a state of mind resulting from affective or cognitive responses to media content. Based on these previous studies, it is worth noting that the player enjoyment construct has yet to be thoughtfully defined, and apparently very few studies have attempted to investigate player enjoyment with multiple dimensions.

2.3.2 Tripartite Media Enjoyment Model

In order to investigate the complex phenomenon of enjoyment, Nabi and Krcmar (2004) proposed a tripartite model based on an analysis of various terms used to capture the notion of enjoyment in the previous literature. From the perspective of this model, enjoyment is understood to be an attitude and explained through positive reactions derived from media consumption, beyond mere fun or pleasure. As attitudes themselves are multidimensional features (Tsai & Bagozzi, 2014), this conceptualization allows the assessment of enjoyment experiences through three attitudinal components, namely affective, cognitive and behavioral.

The affective dimension focuses on the individuals' affective or emotional experiences in response to the media at hand, and it has been the most widely used construct to assess media enjoyment. Indeed, emotions are considered to be the fundamental element of the experience of both traditional and interactive entertainment media. Research has shown that the use of traditional media such as movies and books induces certain emotions such as sadness, frustration and empathy (e.g., Dai, Luo, Liao, & Cao, 2015; Oliver & Westbrook, 1993), and refers to those positive and negative moods that occurred during media consumption as a form of enjoyment. Similarly, interactive media, particularly games, has the potential to trigger certain emotions as players are keen to challenge their abilities by interacting with the game content (e.g., Cohen, 2014; Poels et al., 2012), which may ultimately lead to enjoyment. Stated differently, the more emotionally involved the user is in the media, which gives rise to the development of affective dispositions toward the media and its content such as liking and attraction, the higher the levels of enjoyment that will be experienced (Vorderer et al., 2004).

Next, the cognitive dimension centers on individuals' experiences gained through evaluative judgments in response to media content. The rationale is that enjoyment could also result from cognitive appraisals of media technology and its content, beyond merely affective responses (Jennett et al., 2008; Raney & Bryant, 2002; Reychav & Wu, 2015). This can be seen in the traditional entertainment media context where audiences are involved in actively thinking about the movie content, such as whether the actions of the characters are ethical or whether the quality of the storyline is interesting and well-written. The positive appraisal of such an experience gives rise to cognitive enjoyment of the media (Krakowiak & Oliver, 2012; Piselli, Claypool, & Doyle, 2009). Similarly, playing games demand players' intellectual capabilities which make them more interested and mentally involved in the gameplay. This, in turn, would give rise to cognitive enjoyment (Fang & Zhao, 2010; Johnson et al., 2012). Thus, the more favorable the appraisal, the more likely it is that the individual will enjoy media cognitively.

Finally, the behavioral dimension focuses on individuals' behaviors during media consumption (Nabi & Krcmar, 2004). In particular, individuals are considered to be behaviorally enjoying an activity when they are in a state of flow and immersion. In such a situation, individuals' attention would be fully focused on the task which, in turn, makes them perform actions effortlessly (Sherry, 2004; Weibel & Wissmath, 2011). Furthermore, individuals who are immersed in an activity will have a decreased sense of self-consciousness and distorted sense of time (Jennett et al., 2008). Individuals were found to project this type of behavior in the use of various interactive technologies such as surfing the Internet (Agarwal & Karahanna, 2000), playing digital games (Cairns, Cox, & Nordin, 2014; Weibel & Wissmath, 2011), and online task-oriented services such as shopping (Gao & Bai, 2014; Hsu, Chang, & Chen, 2012). To capture a holistic evaluation of media enjoyment, individuals' behaviors should also be assessed, along with experiences of affect and cognition.

In summary, the model proposed by Nabi and Krcmar (2004) could be suitable in investigating players' enjoyment of HCGs for the following reasons. Firstly, since an attitude is denoted as "a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor" (Eagly & Chaiken, 1993), this model allows one to assess the extent of players' evaluative responses to the media in terms of emotions or feelings, judgments and actions. Secondly, this model seems to cover most aspects of enjoyment discussed in the previous literature. In particular, its

affective dimension covers emotional or affective experiences mentioned in most entertainment literature, while the cognitive dimension takes account of the experiences derived from judgments of the media content. Moreover, the behavioral dimension assesses the experiences related to player involvement in the media, which closely resembles the notion of immersion. Finally, this model is conceptually sound and widely cited in media entertainment literature (e.g., Sweetser, & Wyeth, 2005; Tamborini et al., 2010). Further, it has recently been used to evaluate enjoyment in both interactive and traditional forms of entertainment (Fang & Zhao, 2010; Krcmar & Renfro, 2005). Therefore, in this PhD research, the tripartite media enjoyment model is employed and players' perceived enjoyment is regarded as the positive affective, cognitive and behavioral responses derived from HCG play (Nabi and Krcmar, 2004).

2.4 Personality

In this section, personality, and in particular the “Big Five” personality traits which have been used in this study to assess individuals' personality traits, are introduced. This is followed by a review of prior studies concerning personality in games for pure entertainment to highlight how personality plays an important role in the context of games. Due to the resemblance of HCGs to social media applications, this study reviews past studies concerning personality and the use of social media.

2.4.1 The Big Five Personality Traits

Personality is referred to as “the unique psychological qualities of an individual that influence a variety of characteristic behavior patterns, both overt and covert, across different situations and over time” (Gerrig & Zimbardo, 2009). In particular, the combination of traits, motives and needs determines individuals' behaviors, thoughts and feelings in certain circumstances. Therefore, personality has been an important topic in psychology research. Consequently, psychologists have developed several personality theories to explain the characteristics of individuals from different perspectives.

In this PhD research, trait theory is employed to approach personality as a set of traits to summarize, predict and explain an individual's behavior (Chorley et al., 2015). Fundamentally, trait theories are rooted in the statistical technique of factor analysis to determine the pattern of characteristics from which personality traits are identified. Thus,

individuals may be classified by means of trait theory. With an extensive body of research developed in the last few decades, it seems that a broad consensus has been achieved among researchers that individuals' personality traits can be captured by five major dimensions (John et al., 2008). The initial discovery of the Big Five dimensions was based on Cattell's 35 personality variables. In particular, Cattell (1945) utilized 4,500 trait terms constructed by Allport and Odbert (1936) in their lexical research and reduced these to 35 variables through a factor analysis of 171 scales developed. Cattell's work inspired many researchers to investigate the dimensional structure of trait ratings. Multiple researchers who utilized Cattell's variables as a starting point (e.g., Fiske, 1949; Norman, 1963) claimed that only five variables or factors proved to be replicable across samples and rotation methods. These five factors have become commonly known as the "Big Five"—a name coined by Goldberg (1981).

To test the generalizability of the Big Five dimensions, Goldberg (1990) constructed a set of trait adjectives from a comprehensive set of trait terms (i.e., 1,710 terms) and asked participants to rate their own personality. The Big Five dimensions were found to emerge across different methods of extraction and rotation. In addition, Goldberg (1990) found that the Big Five structures obtained from self- and peer-reported data were very similar to each other, and no additional factors were replicable beyond these five factors. Goldberg's findings were later supported by a study by Saucier (1997) which found no other replicable factors beyond the Big Five.

With the considerable support of empirical research about the comprehensiveness and applicability of these factors, it has now become a common taxonomy of personality traits (Bean & Groth-Marnat, 2014; Hughes et al., 2012). This model has been used in a number of domains including organizations, traditional media, social media and gaming (e.g., Finn, 1999; Graham & Gosling, 2010; Jadin, Gnams, & Batinic, 2013). In addition, the robustness of the Big Five dimensions has been demonstrated across cultures, ages and methods (e.g., Benet-Martinez & John, 1998; Goldberg, 1990; John et al., 2008; McCrae & Terracciano, 2005). Although there has been general agreement regarding the number of factors contained in the taxonomy of personality traits, it seems that there is less agreement with regard to labeling each trait. However, John et al. (2008) stated that the use of different labels does not necessarily indicate that they are referring to different traits. For instance, the openness personality trait is labeled as "openness" in the model of John et al. (2008), but "openness to experience" in the model of McCrae and

Costa (2003). Because this research will use the Big Five Inventory (BFI) scales set developed by John et al. (2008), this report follows their labeling scheme of the Big Five factors: extraversion, agreeableness, conscientiousness, neuroticism and openness, which are characterized as follows:

- ***Extraversion (E)***: This factor assesses an individual's energetic tendency toward the social world, and encompasses traits such as sociability, assertiveness, activity and positive emotionality (John et al., 2008; Hamburger & Ben-Artzi, 2000). Extraversion is the opposite of 'introversion', which is characterized by traits such as aloofness, quietness and unfriendliness (Goldberg, 1900). Individuals scoring high for extraversion tend to achieve social status in groups, actively engage with people, and express positive emotions toward others (John et al., 2008).
- ***Agreeableness (A)***: This factor addresses an individual's prosocial and communal tendency toward others, and includes traits such as altruism, cooperativeness, friendliness, trust and modesty, contrasting with traits such as selfishness, uncooperativeness and distrust (John et al., 2008; Worth & Book, 2014). People scoring high for agreeableness tend to be considerate of others, be helpful toward others, and are better when performing in group activities.
- ***Conscientiousness (C)***: This factor assesses an individual's capability of self-control, with considerations such as organization, thoroughness and self-discipline (Fayard, 2012; John et al., 2008). People with a high conscientiousness score tend to be well-organized and focused on the task at hand which makes them reliable and efficient, in contrast to those with low scores who are regarded as unreliable and inefficient.
- ***Neuroticism (N)***: This factor concerns an individual's emotional susceptibility, and it includes traits such as anxiety, nervousness, sadness and tension, in contrast to relaxedness (John et al., 2008; Shoss, Callison, & Witt, 2015). People who score high for neuroticism are regarded as reactive and thus are likely to experience more negative emotions in stressful situations than those with low scores who are regarded as relaxed or resilient (Howard & Howard, 1995).
- ***Openness (O)***: This factor refers to the extent of an individual's tendency toward openness to experience, and it includes traits such as curiosity, imaginativeness and originality (John et al., 2008; Özgüven & Mucan, 2013). People scoring high for openness tend to be imaginative and open-minded, and they explore new things,

generate new ideas and pay close attention to their emotions. In contrast, people who score low for openness tend to be traditional, narrow-minded and practical, and they tend to prefer familiar situations and ignore emotions (Howard & Howard, 1995).

2.4.2 Personality and Media Use

The Big Five personality traits have been widely used in media research, demonstrating a significant influence on the media use and preference of individuals. However, their utilization is not yet apparent in the context of HCGs. In particular, it is generally acknowledged that no prior work has investigated the role of personality in the HCG context. Thus, the present study examines the literature concerning personality in media research. It is noted that traditional and new media are different in terms of participation (i.e., passive or active), but they have similar aspects in motivation, such as relaxation and escapism (Bostan, 2009). Additionally, social media encourages users to collaborate in knowledge-sharing processes, facilitating interactions among users (Fraternali, Castelletti, Soncini-Sessa, Vaca Ruiz, & Rizzoli, 2012). In this respect, HCGs share some commonalities with social media because they serve as a channel for harnessing collective information through collaborative or competitive social interactions among players. However, social interaction among players is restricted in most HCGs, which is not true for social media, specifically social networking sites. Nonetheless, findings from prior media research may shed some light on understanding the effects of personality in the HCG context.

In traditional media research, Finn (1997) investigated the impact of the Big Five personality traits on traditional media use. The analysis revealed that individuals who scored high for openness were more likely to use print media for pleasure reading and to attend movies, but less likely to use television. Results also indicated that the diverse and rich mediated experiences offered by movies and obtained by reading could satisfy the needs of open people. Further, extraversion and agreeableness were negatively associated with television viewing and pleasure reading.

Besides studies that focused on different types of media, Krcmar and Kean (2005) studied the influence of personality on enjoyment or liking of violent media content. Results revealed that individuals who rated high for the excitement-seeking factor, a sub-factor of extraversion, enjoyed watching violent media. Furthermore, openness to

esthetics was associated with enjoyment of violent media, whereas modest people were less likely to enjoy such media. In addition, Kraaykamp and Van Eijck (2005) found a relationship between personality traits and media genre preferences. Results indicated that open individuals preferred to watch informative programs, but they did not enjoy watching soap operas which were found to be preferred by emotionally unstable individuals. In summary, these studies indicated that personality traits have an influence on individuals' media enjoyment as well as genre preferences.

With the growth of the Internet, people tend to rely on online facilities to communicate, interact and gather information. Personality, which has a significant role in exploring traditional media use, has hence been utilized to explore its influences on the motives for Internet usage. Amiel and Sargent (2004) attempted to understand individual differences in these motives using three personality traits: psychoticism, extraversion and neuroticism. Their results revealed that people who scored high for neuroticism used the Internet to feel a sense of belongingness, while extraverts used it with more goal-directed objectives rather than for its communal aspects. In their study of a large sample of 6,900 adults, Mark & Ganzach (2014) found that the personality trait of extraversion is related to the use of the Internet including academic, communication and leisure activities, whereas agreeableness is associated with none of these.

In the context of social media in particular, Rosen and Kluemper (2008) investigated the impact of individuals' personality traits on their acceptance of social networking sites (SNSs). Their results revealed that the personality traits of extraversion, agreeableness and openness exerted an influence on the perceived usefulness of SNSs, and conscientious, neurotic and extraverted individuals perceived SNSs as being easy to use. Next, Correa, Hinsley, and De Zúñiga (2010) demonstrated how individuals' personality traits of extraversion, openness and emotional stability exert an influence on the generic use of social media. In particular, they found that people with high extraversion and openness scores were more likely to use social media, whereas emotionally stable people were less likely to use it. Furthermore, their results indicated that gender and age differences in personality traits had an impact on individuals' media use. For instance, men with greater degrees of emotional instability were found to be regular social media users, and young adults with a high level of extraversion were more likely to use social media than mature adults.

Some studies have also examined the impact of personality traits on the use of specific communicative features of certain social media platforms. Ross et al. (2009) suggested that personality traits were associated with the use of certain *Facebook* features. In their research, extraverted individuals were members of more online groups than those who scored lower for this personality trait. However, contrary to their expectation, extraversion was unrelated to the frequency of using *Facebook* or to the number of friends. The authors further explained that individuals high on extraversion may have utilized *Facebook* as a social tool, but they did not perceive it to be a substitute for offline social activities. Neurotic people showed a preference for the wall feature, whereas non-neurotic people preferred to post photos on their profile pages. Extraverted and unconscientious individuals used *Facebook* more often, and they were prone to being addicted. In contrast, agreeableness was unrelated to using *Facebook*. Some studies (e.g., Lee, Ahn, & Kim, 2014; Ryan & Xenos, 2011) highlighted that people high on extraversion preferred to use all the communicative features of *Facebook* such as chat, messages and comments, while people high on neuroticism preferred to use its wall feature only. In terms of time spent, neurotic individuals were found to spend more time on *Facebook* whereas conscientious individuals were less frequent visitors.

Moore and McElroy (2012) asserted that personality traits could explain significant amounts of variance over and above gender and *Facebook* experience in terms of the nature of their wall postings and their level of regret for inappropriate postings. Results revealed that people high on agreeableness were more likely to post messages about themselves on the *Facebook* wall, whereas conscientious people were less likely to do so. Individuals who are more agreeable, more conscientious, more emotionally stable, but less extraverted reported a greater level of regret for their inappropriate postings. Another study (Eftekhar, Fullwood, & Morris, 2014) found that personality traits were influential in determining photo-related activity on social media. Specifically, those with high extraversion and neuroticism scorers were likely to upload more photos, but those who received a higher number of likes and comments on their profile pictures were found to be high in agreeableness.

The study by Hughes et al. (2012) investigated the relationship between personality traits and the use of social media for social and informational purposes by utilizing two popular social networking sites, *Twitter* and *Facebook*. With regard to social use, conscientiousness was found to be positively associated but openness was negatively

associated with the social use of *Twitter*, whereas neuroticism was positively related to the social use of *Facebook*. Neurotic and extraverted people were less likely to use *Twitter* for informational purposes, while conscientious people were more likely to use it. Agreeableness was unrelated to the informational use of *Facebook*. Another study (Kim, Sin, & Tsai, 2014) found that there were significant differences in the use of social media for information seeking among individuals with certain levels of the Big Five personality traits. People with high levels of openness and those with low levels of agreeableness were found to use blogs and online reviews more frequently than their counterparts. Extraverted people tended to use social networking sites (SNSs) to obtain updates and news more frequently than introverted people did.

Studies have also examined the motives behind the use of social media. In a study by Seidman (2013), high agreeableness scorers were found to use social media to seek acceptance from and maintain connections with other people. Results also showed that high neuroticism scorers tended to use social media for communication and information-seeking purposes. Moreover, neuroticism was positively related to the disclosure of both personal information and emotions, and hence the social media use of high neuroticism scorers seemed to be largely due to their self-presentational needs. In contrast, conscientiousness was negatively associated with posting personal information (e.g., photographs) on social media. In another study (Orchard, Fullwood, Galbraith, & Morris, 2014), individuals who scored high for extraversion were motivated to make new friends through social media and to seek fun and excitement through its use, whereas those who scored high for neuroticism reported being more likely to use it for escapism.

Research has also examined the relationship between personality and the use of location-based social network features. Wang and Stefanone (2013) investigated how the personality traits of extraversion and narcissism influence one's intensity of check-in on social media. Results revealed an indirect effect of personality traits on the intensity of *Facebook*'s check-in. In particular, extraversion was positively related to the intensity of *Facebook*'s check-in through self-disclosure. Next, in their study of anonymous users who had collectively checked in 487,396 times at 119,746 venues via *Foursquare*, Chorley et al. (2015) found that individuals who scored high for openness were more likely to check-in to sociable and popular venues than those who scored lower for this trait. Further, openness was positively related to the total number of check-ins. However, negative associations were found between neuroticism and the total number of check-ins

to sociable venues. In contrast, high conscientiousness scorers were likely to contribute more check-ins than low scorers of this trait.

Based on the studies discussed earlier, the applicability of the Big Five personality traits in various contexts, including traditional and social media, is demonstrated. Specifically, past research has indicated that personality exerts influence not only on the acceptance of social media, but also on the motivations and usage of its various features. As discussed earlier, considering the entertainment nature of HCGs and their resemblance to social media in certain aspects, it could be possible that personality will also have an impact on individuals' enjoyment of HCGs.

2.4.3 Personality and Games

Although earlier game research mainly focused on examining how gameplay exerts a positive or negative influence on individuals in certain circumstances, most recent work has centered on investigating possible precursors that underlie these influences (Przybylski, Rigby, & Ryan, 2010; Seok & DaCosta, 2015). In this regard, personality can provide a greater insight into, and understanding of, players' behaviors as it represents the experiential aspect of an individual that drives the way he or she behaves, thinks and approaches a particular situation (McCrae & Costa, 2003; Worth & Book, 2014). Therefore, incorporating personality variables into game research allows for an understanding of how to minimize the negative effects of playing games, such as aggression, and how to maximize the benefits of playing games, such as learnability, engagement, and wellness (Johnson & Gardner, 2010). For instance, neurotic individuals are known to be prone to aggressive behaviors and hence exposing them to violent games may increase their aggressive tendencies (Barlett & Anderson, 2012; Markey & Markey, 2010). This potential effect may be minimized by presenting neurotic players with non-violent games such as simulation and puzzle games. Therefore, comprehending how individual differences in personality exert an influence on game preferences and gameplay behavior will assist in the creation of effective game designs for individuals and groups, identifying possible game features that appeal to different people.

Most psychological research into games for pure entertainment has focused on examining the role of personality from the perspective of susceptibility to playing violent games. Markey and Markey (2010) have examined how players' personality traits

moderate the aggressive behavior resulting from playing violent video games. Their results revealed that a combination of neuroticism, agreeableness and conscientiousness traits were more powerful moderators of violent gameplay effects than any single trait. Another study conducted by Collins, Freeman, and Chamarro-Premuzic (2012) examined the association between personality traits and gameplay (classified as normal and problematic). Through a survey of 225 online game players, this study highlighted that players who scored low for agreeableness and self-regulation traits were more likely to be problematic game players.

Another stream of research explored personality as a means of gaining a better understanding of players' behaviors in order to leverage the engagement of games. Of these studies, some investigated differences in personality between game players and non-players. Douse and McManus (1993) investigated personality differences in players of fantasy role-playing games, comparing them to those who do not play such games. Based on the analysis of survey data, players were more significantly introverted than those who do not play such games, although there was no significant difference found in the neuroticism or social acquiescence personality traits. Another study (Teng, 2008) attempted to reveal the differences in personality traits, such as openness, conscientiousness and extraversion, between online game players and non-players using a matched sample of 130 pairs of Taiwanese students. The results showed that players scored higher for openness, conscientiousness and extraversion than non-players, whereas no significant difference was found in the agreeableness and neuroticism traits.

Others studies aimed to profile game players according to their personality types. Bateman and Boon (2006) identified four different gameplay styles based on Myers-Briggs' personality traits and gameplay habits. These playing styles were: (1) conqueror, which relates to the thinking and judging personality traits and involves players who prefer winning or beating other players; (2) wanderer, which relates to feeling and perceiving personality traits and involves players who are seeking fun or enjoyment; (3) manager, which relates to thinking and perceiving personality traits and involves players who prefer learning and optimizing their skills through strategic and tactical challenges; and (4) participant, which relates to feeling and judging personality traits and involves players who have a preference for emotional or story-oriented contexts.

Another study (McMahon, Wyeth, & Johnson, 2012) further investigated the link between the abovementioned playing styles and the Big Five personality traits. In this

study, high conscientiousness scorers were likely to prefer the conqueror and manager playing styles. Furthermore, those who scored high for openness were likely to be attracted to the participant style whereas those who scored lower for this trait seemed to prefer the manager playing style. In a study conducted by van Meurs (2007), the relationships between Big Five personality traits and four player types defined by Bartle (1996) were investigated. These player types are: (1) achievers, who identify goals in the games and set out to achieve them; (2) explorers, who try to discover new areas and hidden places; (3) socializers, who utilize the game's communitive facilities to interactive with the fellow players; and (4) killers or grievors, who play the game to distress other players. The results revealed that role players were found to score high for the personality traits of neuroticism and openness while achievers, grievors and explorers were found to be associated with all Big Five personality traits except openness, conscientiousness and extraversion, respectively. Surprisingly, socializers were associated with all Big Five personality traits, which could be partly because social interaction has become an integral part of most online games (Shin & Shin, 2011).

A further line of research has also investigated the relationships between players' personality traits and their experiences and motivations for playing online games. Johnson et al. (2012) found that people with high levels of agreeableness were more likely to feel competent but less likely to get annoyed during gameplay, while those with high levels of openness tended to become immersed in the game. Another study (Graham, & Gosling, 2013) found that people playing in order to socialize tended to be high in extraversion, agreeableness and openness, whereas those playing to gain a sense of achievement tended to be low in agreeableness and conscientiousness. In their recent study, Seok and DaCosta (2015) investigated whether the Big Five personality traits could be used to explain mobile gameplay. Their findings revealed that the personality traits of agreeableness and openness were related to the frequency and time spent on mobile games, and high openness scorers even reported that they would recommend the mobile games they played to others.

In addition, using the participation of 30 students playing the game for approximately 10 hours over a six-week period, Griebel (2006) attempted to examine the association between the Big Five dimensions of players' personality characteristics and their gameplay behavior in *The Sims 2* (e.g., how players managed their game characters [Sims]). Results indicated that the personality traits of neuroticism, openness and

conscientiousness had a significant influence on their in-game behavior. For instance, neurotic players were less likely to accomplish their Sims' goals, whereas players with high openness were more likely to achieve these goals, allowing them to lead exciting lives. Additionally, players who rated high for conscientiousness were more likely to perceive that they were in control of their Sims.

Numerous studies have examined the relationships between personality traits and the behavior of players in multiplayer role-playing games, and in particular *World of Warcraft* (WoW). The study conducted by Mosley (2010) was one of the first to examine the relationship between players' personality characteristics and their cooperative and competitive behavior in WoW, employing the Big Five personality traits. Results revealed that all of the personality traits except neuroticism were correlated to cooperative and/or competitive gameplay behavior. Next, from behavioral data collected from 1,040 WoW players, Yee, Ducheneaut, Nelson, and Likarish (2011) identified various features of WoW that appealed to players with certain personality traits. For instance, players with high levels of extraversion tended to prefer group-oriented activities, while those with low levels of agreeableness seemed to enjoy non-combat activities.

Based on survey data collected from 509 participants, Peever, Johnson, and Gardner (2012) reported that the personality trait of extraversion is negatively related to solo gameplay, whereas conscientiousness is positively associated with the preference for games, such as racing and flight simulation games that are largely task- or goal-oriented. In their study, Fang, Zhu, and Chan (2014) found that players who scored high for extraversion were more likely to prefer games that offer intensive social interactions. Similarly, another study (Worth & Book, 2014) found that highly extraverted players were attracted to social gameplay settings whose emphasis is on cooperation and interaction among players, whereas highly conscientious players were fascinated by the accumulation of in-game items and achievements. Consistent with expectations, openness was positively related to behaviors that could induce players to immerse themselves in the game world, such as role-playing and acquiring unusual in-game items.

In a study of 1,210 WoW players, Bean and Groth-Marnat (2014) examined how players' personality traits influence their choice of three gameplay styles: player versus player (PVP), player versus environment (PVE) and role-playing (RP). PVP centers on the destruction of other players in the game; PVE focuses on environmental gameplay, questing and defeating various virtual monsters located within the virtual realm; and RP

focuses on the development of the personality of the player's character and partaking in in-game events for pleasure. Results revealed that participants who chose to play the PVP style were more extroverted, less neurotic and had a lower tendency for openness when compared to participants who selected the PVE and RP styles. Those who chose to play the PVE style were less agreeable, less open to experience and less conscientious, but role players were higher in agreeableness, neuroticism and openness.

To date, the majority of the extant studies have examined how personality influences players' in-game behaviors and their gameplay motivations. However, it is generally acknowledged that very little research has investigated the relationship between personality and enjoyment across entertainment-oriented game genres, and importantly, no prior work has examined the HCG context in particular. This understanding is essential to enhance gameplay enjoyment, which is believed to be a consequence of the appropriate fit between a player's personality and game genres (Fang & Zhao, 2010). Nonetheless, based on the findings of prior studies, it can be said that players may experience greater enjoyment while playing their preferred game genres or activities (Johnson et al., 2012).

Although the findings of research into games for pure entertainment are valuable, they may not be readily applicable to the HCG context because of the uniqueness of HCGs that blends games and computations together, which marks them as a genre of their own (Krause & Smeddinck, 2011). In particular, findings of personality traits in the contexts of social and entertainment media often contradict with those in the context of task-oriented information systems. For instance, conscientiousness is regarded as an important factor driving the use of task-oriented information systems such as web-based classrooms (e.g., Barnett, Pearson, Pearson, & Kellermanns, 2014), whereas prior studies on social and entertainment media found either negative or non-significant relationship between conscientiousness and usage (e.g., Wang et al., 2012). Given that HCG intertwines with gaming and task-oriented activity, it would be useful to investigate how an individual's personality influences his or her perceived HCG enjoyment. Here, the Big Five personality traits could be suitable in the HCG context as those traits are the most recognized in users of social media as well as players of games for pure entertainment.

2.5 Perceived Output Quality

Another concept critical to the HCG context is a player's perception of output quality. As players need to contribute useful computations in order to succeed in HCGs, their enjoyment may be influenced by their perceptions of how much these games support them in generating high-quality output. Especially for systems that provide utilitarian values either directly or indirectly, one important perception that influences individuals' usage and behaviors is output quality (Dai et al., 2015). According to Davis et al. (1992), output quality is regarded as a judgment made "by observing intermediate or end products of using the system". Indeed, perceived output quality is considered to be an important factor determining the success of information systems (Coşkunçay, 2013; DeLone & McLean, 1992). Furthermore, it is also regarded as one of the key predictors influencing individuals' behaviors and attitudes toward the use of traditional information systems (Etezadi-Amoli & Farhoomand, 1996), as well as systems with user-generated content (Kim & Han, 2009; Lee et al., 2009).

However, very few studies have addressed the influence of output quality on players' behavior in the context of HCGs. Due to the entertainment-output generation duality of HCGs (Goh & Lee, 2011), perceived output quality may be a factor influencing players' enjoyment of these games. For instance, if a player perceives that HCGs do not help them to produce useful output, it is very likely that their interest in such games will decline. In a study comparing two HCGs for image tagging, Goh et al. (2011) reported that players of both collaborative and competitive HCGs perceived that such games were more useful for generating tags than non-game applications, indicating the players' concerns for the quality of generated output. This leads to an interesting area of research investigating the relationship between perceived output quality and enjoyment of HCGs.

2.5.1 Perceived Output Quality and Related Studies

A number of studies have investigated the influence of perceived output quality on users' attitudes and behaviors in online task-oriented systems. Indeed, DeLone and McLean (1992) have stated that quality of output had a significant impact on users' satisfaction and continued usage of information systems. As such, the role of output quality has become significant in information-oriented systems that essentially produce information output. This assertion receives support from recent studies in the mobile

context (e.g., Chen, Meservy, & Gillenson, 2012; Zhou et al., 2010) which found a positive relationship between users' perceived output quality and their experience in the use of information-oriented mobile applications such as usefulness and enjoyment. Within the online context, perceived output quality was also found to be associated with perceived ease of use, usefulness, as well as the playfulness of the information-oriented online applications (Ahn et al., 2007; Chen et al., 2012; Zheng et al., 2013). Using survey data collected from 856 Internet users, Ho et al. (2012) suggest that users' perceived quality of information presented by websites has a positive impact on their Internet searching behavior.

The above studies examined output quality as a one-dimensional construct although the extant literature on data quality suggests that output quality is a multidimensional construct (Lee, Strong, Kahn, & Wang, 2002; Lukyanenko et al., 2014). Hence, evaluating output quality through a single dimension may not capture all the possible characteristics of output that might be important for the given context. This may in turn impede the understanding of its impact on users' attitudes toward information-oriented applications (Kim & Han, 2011). Accordingly, a number of studies have proposed various output quality dimensions. Firstly, Wang and Strong (1996) attempted to identify all possible output quality dimensions that are used by consumers and to ascertain their importance. From survey data of 355 participants, the authors proposed a total of 15 dimensions including accuracy, believability, completeness, relevancy, timeliness and availability, and these were later categorized into four groups: intrinsic, contextual, representational and accessibility.

Similarly, Lee et al. (2002) proposed four aspects of output quality and their respective dimensions to be considered in improving the quality of information systems in general. These included free-of-error and completeness for the *sound* aspect, timeliness and security for the *dependable* aspect, appropriate amount and relevancy for the *useful* aspect, and believability and accessibility for the *usable* aspect. These dimensions were later validated using survey data collected from 261 participants in five organizations. In addition, Nelson, Todd, and Wixom (2005) identified accuracy, completeness, timeliness and format as the key quality dimensions that affected users' satisfaction with the output of a data warehouse. The authors further suggested that currency would be a more appropriate dimension to assess output quality in real-time and online environments.

As the popularity of online applications that empower users to create and share content with others has increased, output quality has gained vital importance for user-generated content. Accordingly, the extant studies have focused on identifying relevant quality criteria for such content. Firstly, Klein (2001) identified five quality dimensions with which users could detect output quality problems in online information systems, including accuracy, completeness, relevance, timeliness and the amount of data. In essence, this is an indication of the areas to which online information-oriented systems should pay attention with regard to the quality of their output. Using a meta-analysis of quality frameworks, Alkhatabi et al. (2010) revealed accuracy and timeliness as the most frequently appearing dimensions in these frameworks, followed by completeness and relevancy. Through an experiment with 15 participants who were asked to perform four information-searching tasks and explain their reasons for choosing particular searches, Savolainen (2011) proposed five quality factors employed by online users in judging online content, namely, goodness, accuracy, currency, usefulness and importance.

In a comparative study, Fichman (2011) found that the importance of certain output quality aspects such as accuracy, completeness and verifiability differed across online question-answering applications. For instance, *Askville* was found to provide more complete information than *Yahoo! Answers*. *Wikipedia Reference Desk* provided the most verifiable answers, whereas *WikiAnswers* provided the least verifiable information. The author further explained that these differences could be attributable to the structural characteristics of each application which may appeal to individuals with different motivations (Harper, Raban, Rafaeli, & Konstan, 2008). Next, based on prior literature as well as on grounded research into the 16 most popular user-generated content sites, Schaal, Smyth, Mueller, and MacLean (2014) proposed a number of quality dimensions relevant to online social content, some of which include consistency, relevancy, timeliness, accuracy, reliability and efficiency.

Acknowledging the multidimensional nature of output quality, Kim and Han (2009) examined whether certain output quality dimensions impact the attitudes and usage intention of individuals toward community-based knowledge-sharing applications. The authors then suggested that the lack of output quality with regard to believability, objectivity and completeness affected users' perception of trust in such applications. In the context of seeking online health-related information, studies (e.g., Lee et al., 2009; Mun, Yoon, Davis, & Lee, 2013) found that users' perceptions of the relevancy and

timeliness of output were crucial in them feeling satisfied with and being motivated to continue using the service. Furthermore, Zheng et al., (2013) investigated whether users' perceived output quality is influential in determining their experiences in information-oriented virtual communities such as online forums and news groups. In their study, perceived output quality was assessed through five dimensions, namely, reliability, objectivity, value-added, timeliness and richness, and the findings revealed that these quality dimensions affected users' perceived satisfaction and benefit of exchanging information in virtual communities. Recently, Chen, Shang, and Li (2014) examined which characteristics of travel blogs attract users' attention and influence their behavioral intention. Among the four content quality dimensions examined, namely, novelty, reliability, understandability and interestingness, users' perceived content novelty and interestingness were significant in determining their enjoyment of using blogs that further influenced their intention to visit.

2.6 Summary

This chapter addresses five issues. The first issue covers the notion of HC and its development over recent years. As HCSs are powered by the participation of online users, the review emphasizes how these systems encourage user participation. Employing a crowdsourcing approach, traditional HCSs typically utilized two incentive schemes, monetary incentive and voluntary participation, to attract online users. However, these incentive schemes suffer from two major drawbacks: costliness and dependence on the willingness of volunteers. The second issue concerns how games can overcome the drawbacks of traditional HCSs and it presents the novel paradigm called HCGs. Although HCGs were initially developed on web-based platforms, the growing numbers of HCGs on mobile platforms can be viewed as a consequence of the advances in mobile and pervasive computing.

The third issue involves how the aspect of enjoyment is crucial to entertainment-oriented applications, including games for pure entertainment. Specifically, the review emphasizes how prior studies have assessed enjoyment to conceptualize the notion of enjoyment in the context of entertainment media. While much research treated enjoyment as a simple or one-dimensional construct, the complex nature of enjoyment is introduced in other studies, which could be used to capture a more holistic entertainment experience.

The fourth issue covers the psychological determinant of enjoyment, personality in particular, which shows influential effects on enjoyment in multiple contexts including games for pure entertainment, traditional and social media. Finally, the fifth issue covers the importance of perceived output quality in applications that directly, or by implication, generates output. The quality of output has been an important issue, especially for UGC, and prior studies have examined various aspects of output quality that might be of importance in that context. Those findings not only shed light on the imperative for quality UGC, but they also inform various quality dimensions that might be of relevance to HCGs.

CHAPTER 3

CONCEPTUAL MODEL

This chapter proposes the conceptual model applied in this research to understand the influence of personality traits and perceived output quality on perceived enjoyment of HCGs. The following sections elaborate on the constructs that comprise the model and propose their relationships with perceived enjoyment.

3.1 Perceived Enjoyment

According to motivation theorists, motivations can be differentiated into two types: intrinsic and extrinsic (Przybylski et al., 2010). Intrinsic motivation emphasizes the pleasure and satisfaction derived from performing an activity, whereas extrinsic motivation refers to performing an activity in order to achieve specific goals or rewards. Intrinsic motivators are believed to play an important role in the use of entertainment media. Numerous studies have suggested that enjoyment is one such significant motivator that contributes to the success of any application that intends to attract users through their need for entertainment (e.g., Bargas-Avila & Hornbæk, 2012; Boyle et al., 2012; Vorderer et al., 2004).

In most prior studies, perceived enjoyment was assessed primarily through individual affective experiences such as preferences or emotions (e.g., Chumbley & Griffiths, 2006; Gollwitzer & Melzer, 2012). Meanwhile, other studies suggested that enjoyment is also attributable to favorable thoughts derived from cognitive media appraisals, as well as spontaneous behavior generated by the use of such media (Mekler et al., 2014; Raney & Bryant, 2002). Acknowledging these differences, Nabi and Krcmar (2004) proposed a tripartite model of media enjoyment. In this model, enjoyment is treated as attitude comprised of three related but distinct components, namely, affective, cognitive and behavioral. Stated differently, individual enjoyment is assessed through the individual's positive reaction toward media and their content in terms of affection, cognition and behavior, each of which is discussed in detail below.

Firstly, the affective component is concerned with the emotional experiences evoked by media including pleasure, happiness and excitement (Nabi & Krcmar, 2004). Indeed, affective or emotional states are known to be the most common experiences induced (Fang & Zhao, 2010; Poels et al., 2012). Depending on the extent that an

individual experiences an affective or emotional state, he/she is considered to affectively or emotionally enjoy media. Secondly, the cognitive component focuses on experiences emerging from the evaluative judgment about media and its content. In other words, individuals are considered to enjoy media cognitively when they engage in rational thinking about it and its content, which is often induced by utilitarianism (Reychav & Wu, 2015). Therefore, the ability of media to trigger intellectual capabilities of individuals seems to be important to induce cognitive enjoyment. Finally, behavioral dimension is concerned enjoyment derived from being in a state of flow or immersion (Nabi & Krcmar, 2004). Hence, individuals are likely to be spontaneous and less aware of time passage and surrounding areas when they are enjoying an activity behaviorally.

Meanwhile, existing literature suggests that both external and internal stimuli such as system characteristics and personality can influence individual beliefs in hedonic and information-oriented systems (e.g., Johnson et al., 2012; Wang & Wang, 2008). Thus, it is thought that such stimuli might influence an individual's perceived enjoyment in the use of entertainment media (Agarwal & Karahanna, 2000). More specifically, in the context of online information-oriented applications, the internal factors of individuals such as personality, as well as context-specific factors such as output quality, are known to be important stimuli that influence beliefs regarding the use of such applications (e.g., Chen et al., 2012; Kim & Han, 2009). Prior research in the hedonic context supports the notion that individual differences can significantly influence three different dimensions of perceived enjoyment. In particular, studies found that there are differences between individuals in terms of their emotions and preferences for entertainment-oriented game genres and social media features (e.g., Moore & McElroy, 2012), perceived appreciation of games and social media (e.g., Fang & Zhao, 2010), and perceived immersive experience derived from gameplay and the use of social media (e.g., Graham & Gosling, 2013).

In addition, previous studies indicate that an individual's perception of output quality can influence not only his/her satisfaction, but also his/her cognitive appraisal of, and immersive tendency for, information-oriented applications (e.g., Kim & Han, 2009; Zhou et al., 2010). Given the entertainment-output generation duality of HCGs, player personality and perceived output quality are also expected to have an effect on the perceived affective, cognitive and behavioral enjoyment of these games. Accordingly, this research proposes two categories of driving factors for perceived enjoyment: the Big Five personality traits and perceived output quality. The Big Five personality traits are

extraversion, agreeableness, conscientiousness, neuroticism and openness, and perceived output quality consists accuracy, completeness, relevancy and timeliness. The relationships between these driving factors and the three dimensions of perceived enjoyment are presented in Figure 3.1 and these are explained in detail in the following sections.

Figure 3.1. Conceptual Model of Understanding Players' Perceived Enjoyment of HCGs and its Antecedents.

3.2 The Big Five Personality Traits

Trait theorists approach personality as a set of traits, and believe that such traits induce consistent behavior across situations (John et al., 2008). The Big Five personality traits are widely accepted in personality research, and numerous scholars have asserted that the majority of individual differences in personality can be classified into five major traits (e.g., Goldberg, 1990; John et al., 2008; McCrae & Costa, 1997; Saucier, 1994). Previous research has provided evidence of the ability of such traits to predict important user behavior in various contexts, including organizations, traditional and social media, and digital games (e.g., Correa et al., 2010; Erdheim, Wang, & Zickar, 2006; Griebel, 2006; Panaccio & Vandenberghe, 2012; Yee et al., 2011). The Big Five personality traits comprise of extraversion, agreeableness, conscientiousness, neuroticism and openness.

Firstly, extraversion refers to an individual's level of comfort with interpersonal relationships and it is characterized by sociability, assertiveness, activity and positive emotionality. Secondly, agreeableness refers to an individual's ability to have a harmonious relationship with others, and it is associated with altruism, cooperativeness, friendliness and modesty. Thirdly, conscientiousness refers to an individual's tendency to be self-disciplined, well organized, thorough and careful, as well as their inclination for focusing on relatively few goals. Fourthly, neuroticism refers to an individual's susceptibility to negative emotional states such as anxiety, nervousness, sadness and tension. Finally, openness refers to an individual's receptivity to new ideas and experiences, and it is characterized by curiosity, originality and imaginativeness. This research extends exploration of the influence of the Big Five personality traits on perceived affective, cognitive and behavioral enjoyment to the context of HCGs. In the following sections, the proposed relationship between each trait and the three perceived enjoyment dimensions is described.

3.2.1 Perceived Affective Enjoyment and the Big Five Personality Traits

Firstly, the personality trait of extraversion relates to sociability and positive emotionality (John et al., 2008; Wang et al., 2012). As such, high scorers are more likely to be responsive to media that fulfill their need for sociability in an emotional fashion compared to low scorers who tend to conceal their emotions (Kokkonen & Pulkkinen, 2001; Shen et al., 2015). Prior studies suggested that activities that offer social interaction among participants can attract individuals who score high for extraversion (e.g., Tobin, Graziano, Vanman, & Tassinari, 2000). In the online context, extraverted people are

attracted to various social activities, including visiting chat rooms and discussion forums (e.g., Ryan & Xenos, 2011), and playing multiplayer games (e.g., Mosley, 2010). In addition, individuals who are highly extravert were identified as active content creators of social media (e.g., Correa et al, 2010). This is because content creation on social media occurs as a form of social communication that extraverts are fond of participating in (Yoo & Gretzel, 2011), and as a result, extraverts are likely to develop positive emotions in such activities. In the case of HCGs, the social need of extraverted players may be satisfied either by collaborating with or by competing against other players, thus resulting in a positive emotional state. Therefore, the following hypothesis is posited:

Hypothesis 1A: Extraversion is *positively* related to perceived affective enjoyment of HCGs.

Secondly, agreeableness refers to an individual's ability to get along with others, and it is characterized by a tendency to be altruistic, gentle and understanding (Wang et al., 2012). Tobin et al. (2000) suggested that agreeable people tend to harness emotions in order to maintain a positive relationship with others. Stated differently, people who score high for agreeableness can easily connect with others on an emotional level (Panaccio & Vandenberghe, 2012). This assertion is supported by previous media research in which agreeable individuals were found to exhibit empathetic feelings toward movie characters (e.g., Kraaykamp & Van Eijck, 2005), and give out positive emotions while playing multiplayer online games (e.g., Yee et al., 2011). Furthermore, agreeableness was found to determine individuals' tendency to share knowledge with others online (e.g., Matzler, Renzl, Müller, Herting, & Mooradian, 2008; Wang et al., 2012). More importantly, agreeable people were found to share content that others could benefit from (Jadin et al., 2013), and consequently, they were likely be perceived as supportive (Park, Song, & Teng, 2011). Such perceptions may help them develop positive emotions. Since HCGs can be regarded as a genre of online application for output creation, players with high levels of agreeableness may play these games as they do other online applications, thereby increasing their experience of positive emotions. Hence, the following hypothesis is proposed:

Hypothesis 1B: Agreeableness is *positively* related to perceived affective enjoyment of HCGs.

Thirdly, conscientiousness refers to an individual's tendency to be thorough, responsible and systematic, instead of being careless, irresponsible and disorganized (John et al., 2008). It is believed that conscientious people have a strong need for achievement, and hence they tend to be goal-oriented when performing an activity (Griebel, 2006). Furthermore, as conscientious people are disciplined, they are more likely to be in control of given situations which helps them to improve their performance (Wong, Foo, Wang, & Wong, 2007). Congruent with this assertion, prior studies (e.g., Amichai-Hamburger & Vinitzky, 2010; Teng, 2008) have found that individuals high in conscientiousness were more capable of achieving their intended goals than those low in this trait, and this may further induce them to experience positive emotions in their in-game performance (Fayard, 2012). Furthermore, high-conscientious individuals were found to spend more time on task-oriented online activities (e.g., using information-sharing websites) than their low-conscientious counterparts (Landers & Lounsbury, 2006). Since conscientious individuals tend to plan and organize their activities in advance and are more likely to be competent and efficient when performing tasks (Shoss et al., 2015), thereby giving rise to positive emotions. As HCGs are task-focused in nature, that is players perform computational tasks during HCG play, it is expected that the more conscientious the player is, the more likely he/she will succeed at generating computations that may, in turn, increase the likelihood of engaging in positive emotions. This leads to the following hypothesis:

Hypothesis 1C: Conscientiousness is *positively* related to perceived affective enjoyment of HCGs.

Fourthly, neuroticism represents an individual's tendency to be worried, temperamental and stressful, contrary to its countermeasure of emotional stability which implies a tendency to be calm and relaxed (Judge, Heller, & Mount, 2002). Due to the inclination to interpret experiences in a negative light, individuals who score high for neuroticism should be less likely to develop positive attitudes toward their behavior (Apandi, Omar, & Abdullah, 2015; Watson & Clark, 1997; Weaver, 2003). In particular, previous research into technology acceptance suggested that, compared to their emotionally stable counterparts, people with high levels of neuroticism tend to be frustrated and nervous when interacting with computers (e.g., Woszczynski, Roth, & Segars, 2002). Similarly, neurotic players were found to be less competent when performing activities in multiplayer online games (Griebel, 2006; Yee et al., 2011).

Furthermore, a number of previous studies (e.g., Matzler et al., 2008; Wang & Yang, 2007) found a negative linkage between neuroticism and knowledge-sharing intention. This could be because neurotic individuals are worried that the information they shared would be misused. In turn, this concern caused them to contribute less on the Internet (Shen et al., 2015) which prevented them from experiencing positive emotions. Hence, this study argues that individuals who score high for neuroticism are less likely to experience positive emotions while generating computational output during HCG play, and it posits the following hypothesis:

Hypothesis 1D: Neuroticism is *negatively* related to perceived affective enjoyment of HCGs.

Finally, openness refers to an individual's receptivity to new ideas and experiences, and their tendency to value emotions (John et al., 2008; McMahon et al., 2012). Individuals who score high for openness are willing to seek novel and innovative ideas, whereas those who score low for openness tend to prefer routines (Guadagno et al., 2008). Meanwhile, Erdheim et al. (2006) suggested that individuals who exhibit higher levels of openness tend to be more emotionally committed to an activity than those with lower levels of this trait. Prior studies found that people high in openness are more likely to use applications with user-generated content such as social media, compared to those who are low in openness (Błachnio, Przepiórka, & Rudnicka, 2013; Krcmar & Kean, 2005). This could be because such applications offer a new approach to sharing and seeking information online (Nov, 2007) which seems to fulfill the need for novelty in people with high levels of openness, thereby giving rise to their emotions. While playing multiplayer online games, people who score high for openness tend to explore the game world with the aim of discovering new and interesting things (Graham & Gosling, 2013; Jeng & Teng, 2008), which implies that online games that facilitate exploration and discovery are more likely to appeal to the emotions of players with high levels of openness. Not only do HCGs offer a new form of gameplay experience that blends games with computations, but they also facilitate the process of information discovery (Lee et al., 2011); thus, it is reasonable to assume that HCGs can induce emotional experiences in people with high levels of openness. This leads to the following hypothesis:

Hypothesis 1E: Openness is *positively* related to perceived affective enjoyment of HCGs.

3.2.2 Perceived Cognitive Enjoyment and the Big Five Personality Traits

Firstly, prior research suggested that individuals who score high for extraversion seem to approach the Internet and social media from a more utilitarian-oriented perspective that engages them in the process of value judgment. For instance, Hughes et al. (2012) argued that extraversion is positively related to informational use of *Facebook*, which implies that the extraversion trait was instrumental in seeking and sharing information on social media. In particular, prior studies found that extraversion is positively related to the use of online discussion forums and blogs whereby individuals share their personal experiences with others (Ryan & Xenos, 2011; Wang et al., 2012). In fact, content creation in such online media happens largely as a form of social communication (Yoo & Gretzel, 2011). Due to the outgoing and sociable nature of extraverts, barriers to creating content in multi-user online environments are lowered, which may induce them to judge such activities more favorably than introverts (Moore & McElroy, 2012). Thus, compared to introverts, extraverts' evaluations of online content creation tasks are more likely to be positive, thereby giving rise to cognitive enjoyment. As social media and HCGs are similar in terms of yielding information through multi-user environments, these games may elicit more favorable thoughts from extraverts than introverts, triggering an experience of cognitive enjoyment. Accordingly, the following hypothesis is posited:

Hypothesis 2A: Extraversion is *positively* related to perceived cognitive enjoyment of HCGs.

Secondly, compared to the personality trait of extraversion, much less research has been conducted relative to agreeableness and the use of social media, and the findings are not unanimous. Whereas some prior studies (e.g., Correa et al., 2010; Ross et al., 2009) found no relationship between agreeableness and the generic use of social media, Swickert, Hittner, Harris, and Herring (2002) found a significant positive relationship between agreeableness and the use of specific online pleasure-oriented activities such as instant messaging and online games. These findings may imply that individuals high in agreeableness are attracted to the more hedonistic aspect of social media. In the hedonic context, individual involvement with an activity is more likely to be driven by emotions rather than by the perceived utilitarian value stemming from the logical evaluation of the activity (Reychav & Wu, 2015), and hence, cognitive enjoyment is less likely to be attained. Based on the findings of the aforementioned studies, it is probable that

individuals with high levels of agreeableness are more attracted to the hedonic aspect of HCG than its utility in helping them to generate useful computations, and hence, they are less likely to experience cognitive enjoyment. Thus, the following hypothesis is proposed: **Hypothesis 2B:** Agreeableness is *negatively* related to perceived cognitive enjoyment of HCGs.

Thirdly, individuals with high levels of conscientiousness enjoy planning and seeking achievements, whereas those with a low level of this trait are placid and spontaneous (Blachnio et al., 2013). While playing games, individuals high in conscientiousness tend to thoroughly plan gameplay activities in order to maximize their in-game achievement (Griebel, 2006; Yee et al., 2011). Indeed, planning involves the process of thinking and organizing activities in such a way as to yield the intended outcome (McGhee, Ehrler, Buckhalt, & Phillips, 2012). Therefore, the gameplay enjoyment of conscientious people is more likely to be driven by cognitive experiences compared to their non-conscientious counterparts. In the social media context, conscientious people were also found to be involved in cognitive endeavors, such as seeking and spreading information, rather than in using social media simply as a form of entertainment (Hughes et al., 2012; Özgüven & Mucan, 2013). Since HCGs engage players in problem solving, it is expected that conscientious people are more likely to be involved in a careful decision-making process during HCG play in order to maximize their in-game achievement, which may, in turn, evoke their cognitive enjoyment. Thus, this study offers the following hypothesis:

Hypothesis 2C: Conscientiousness is *positively* related to perceived cognitive enjoyment of HCGs.

Fourthly, individuals who score high for neuroticism tend to be nervous when interacting with others, and hence, are less likely to communicate with them in face-to-face settings (Rosen & Kluemper, 2008). However, neuroticism is significantly and positively associated with the use of the Internet for social activities, including chat and discussion forums (e.g., Amiel & Sargent, 2004; Ryan & Xenos, 2011). This was further supported by prior studies (e.g., Celli & Rossi, 2012; Hughes et al., 2012) which found that neurotics contributed more information and established a longer chain of interaction in social media than their emotionally stable counterparts. Compared to face-to-face communication, online settings not only support anonymity but also enable individuals to

have more time for the preparation of their messages. Besides, being cautious about what they share, neurotic individuals are likely to benefit from sharing information with others in online settings, which may, in turn, elicit more favorable thoughts about such activity (Shen et al., 2015). Stated differently, the use of social media by neurotic individuals seems to be driven by their perceived utility of such media in terms of supporting them to share information with others more comfortably than the face-to-face setting does, which may, in turn, induce cognitive enjoyment in them. As HCGs are a way of creating computations that facilitate social interaction by means of either collaboration or competition online, the enjoyment of players who score high for neuroticism is expected to stem from recognizing the merit of interaction afforded by such games. This leads to the following hypothesis:

Hypothesis 2D: Neuroticism is *positively* related to perceived cognitive enjoyment of HCGs.

Finally, people who score high for openness tend to appreciate new and innovative ideas more than those who score low for this trait (Moore & McElroy, 2012). During online gameplay, players with high levels of openness show a preference for games that engage them in exploratory activities (Jeng & Teng, 2008; Yee et al., 2011). This finding implies that due to their need for exploration, players with high levels of openness seem to judge explorative gameplay positively, which can lead to cognitive enjoyment. Furthermore, people who score high for openness show interest in various online features, including instant messaging (Özgüven & Mucan, 2013), blogs (Wang et al., 2012) and social media, for social and informational purposes (Błachnio et al., 2013). Perhaps the curiosity of people with high levels of openness is aroused because of the novelty and uniqueness of the Internet and social media, which in turn leads to being cognitively involved in such media. Because HCGs promote a novel approach for contributing computations, players who are open to experience are more likely to judge gameplay favorably due to an appreciation of the novelty of such games, thereby giving rise to cognitive enjoyment. Thus, the following hypothesis is proposed:

Hypothesis 2E: Openness is *positively* related to perceived cognitive enjoyment of HCGs.

3.2.3 Perceived Behavioral Enjoyment and the Big Five Personality Traits

Firstly, it has been suggested that individuals with low levels of extraversion have a narrower focus of attention compared to those high in this trait (Jurnet, Beciu, & Maldonado, 2005; Thornson, Goldiez, & Le, 2009). Furthermore, this reflective nature and narrow range of attention leads to less extensive processing of stimuli not related to the primary task, and hence irrelevant or distracting matters should easily be ignored (Alsina-Jurnet & Gutiérrez-Maldonado, 2010). Therefore, it is not surprising that individuals low in extraversion obtained a higher proportion of their gratification from being absorbed in entertainment-oriented online activities such as games (e.g., Graham & Gosling, 2013; Weibel, Wissmath, & Mast, 2010). Similarly, introverted individuals are expected to gain greater focus during HCG play, which may further motivate them to immerse themselves in the gameplay, ultimately enhancing the likelihood of enjoying these games behaviorally. Thus, this study proposes the following hypothesis:

Hypothesis 3A: Extraversion is *negatively* related to perceived behavioral enjoyment of HCGs.

Secondly, agreeableness represents an individual's favorability toward social interaction with others (Błachnio et al., 2015). In general, people with high levels of agreeableness tend to avoid conflict that could have a negative impact on their relationships with others. Therefore, it is not surprising that players who score high for agreeableness were found to enjoy group-based activities while playing online games (Mosley, 2010; Yee et al., 2011). However, the findings with regard to agreeableness and media absorption are not unanimous. For instance, Graham and Gosling (2013) found that players motivated to immerse themselves in a multiplayer online game, *World of Warcraft* (WoW), are high in agreeableness. Yet in other studies (e.g., Johnson et al., 2012; Weibel et al., 2010), agreeableness was not identified as a significant determinant of individuals' level of engagement with both traditional and interactive media, such as reading books, watching movies and playing online games in general. Similarly, Bassi, Steca, Monzani, Greco, and Delle Fave (2014) found that agreeableness did not determine whether an individual experienced flow in his/her everyday life activities. Perhaps as agreeableness is a tendency to be pleasant and accommodating in social relations (John et al., 2008), it may influence individuals' preferences for activities (e.g., based on the level of collaboration supported), but it is not necessarily a determinant of their engrossment in

such activities. Accordingly, behavioral enjoyment of HCGs may not be driven by players' levels of agreeableness, and hence, the following hypothesis is proposed:

Hypothesis 3B: Agreeableness is *not* related to perceived behavioral enjoyment of HCGs.

Thirdly, it is believed that conscientious individuals are capable of performing assigned tasks systematically and efficiently due to their innate nature of being organized, self-disciplined and dutiful (Teng, 2008). Individuals high in conscientiousness were found to be more competent in performing online social and entertainment activities than their non-conscientious counterparts (e.g., Amichai-Hamburger & Vinitzky, 2010; Johnson et al., 2012; Ryan & Xenos, 2011). In fact, Bassi et al. (2014) suggest that being self-disciplined could favor individuals' concentration and absorption in the activity at hand, which could give rise to behavioral enjoyment. Previous studies (e.g., Jadin et al., 2013; Matzler et al., 2008) found that conscientious individuals are more likely to involve in online content creation, and hence they are more likely to enjoy such activity behaviorally. However, Graham and Gosling (2014) pointed out that conscientious individuals are less likely to be attracted to entertainment-oriented games, which in turn hinders them from becoming absorbed in these activities and hence behavioral enjoyment may be diminished. As HCGs are the games that blend gaming and output creation tasks, they might be perceived differently from activities that focus primarily on entertainment. Considering the differences between HCGs and entertainment-oriented games, this study argues that highly conscientious people might be competent in HCG play, and this may in turn encourage them to spend more time on generating output, which ultimately increases the tendency to experience behavioral enjoyment. This leads to the following hypothesis:

Hypothesis 3C: Conscientiousness is *positively* related to perceived behavioral enjoyment of HCGs.

Fourthly, it has been suggested that neurotic people are inefficient in coping with their emotions, and they are more likely to be obsessed with an activity compared to their emotionally stable counterparts (Johnson et al., 2012; Weibel et al., 2010). This assertion is supported by the findings of prior studies which suggested that neuroticism is positively related to the excessive amount of time spent on sharing information with others on social media (Moore & McElroy, 2012), as well as the addiction to multiplayer online games (Huh & Bowman, 2008). In fact, individuals who are addicted to an activity are more likely to become absorbed in such activity (Cairns et al., 2014), which may

further drive them to behave more spontaneously and effortlessly, thereby triggering behavioral enjoyment. Hence, neurotics are more likely to experience behavioral enjoyment while playing games or creating content online through social interactions. As HCGs possess both gaming and content-creation features, this study argues that players high in neuroticism are more likely to immerse themselves in HCG play which, in turn, leads to their behavioral enjoyment and the following hypothesis:

Hypothesis 3D: Neuroticism is *positively* related to perceived behavioral enjoyment of HCGs.

Finally, it has been suggested that individuals who score high for openness have a greater desire for artistic experience and intellectual stimuli than those who score low for this trait (Thornson et al., 2009; Yee et al., 2011). As such, high scorers are more likely to become absorbed in media that induces creative imagination, such as reading books and watching movies (Finn, 1997; Sas, O'Hare, & Reilly, 2004), which can lead to their behavioral enjoyment through experiencing spontaneous actions in the use of such media. Prior studies have also found a significant positive relationship between individuals' level of openness and their tendency to become absorbed not only in the generic use of technology but also in other specific technology use, such as playing games (e.g., Graham & Gosling, 2013; Woszczyński et al., 2002). More specifically, Weibel et al. (2013) asserted that gameplay that places high cognitive demands on players seemed to be more appealing to those with high levels of openness. Here, HCG play requires players to apply their cognitive abilities to tackling given computational problems, and hence, players high in openness are more likely to become intently involved in these games, thereby reinforcing their behavioral enjoyment. Thus, the following hypothesis is posited:

Hypothesis 3E: Openness is *positively* related to perceived behavioral enjoyment of HCGs.

3.3 Perceived Output Quality

In most online contexts, perceived output quality has been found to be shaped by four dimensions: perceived accuracy, which represents the extent to which output is perceived to be correct by users; perceived completeness, which represents the degree to which output is perceived to contain all necessary information; perceived relevancy, which represents the extent to which output is perceived to be applicable, useful and helpful to users; and perceived timeliness, which represents the degree to which output is

perceived to be current and up-to-date (Alkhatabi et al., 2010; Nelson et al., 2005; Schaal et al., 2014; Wang & Strong, 1996)

Furthermore, user perception of output quality has been shown to greatly impact user experience in the use of both traditional and interactive information-oriented applications (Coşkunçay, 2013; DeLone & McLean, 1992; Kim & Han, 2009). As mentioned previously, HCGs are applications that inject the element of fun in generating output, and hence a player's enjoyment experience may be influenced by the perceived output quality produced by these games. Based on the review of existing literature, this study proposes a potential relationship between the four dimensions of perceived output quality and the three aspects of perceived enjoyment, as discussed in detail in the following sections.

3.3.1 Perceived Affective Enjoyment and Perceived Output Quality

As with entertainment-oriented media, earlier studies in the context of information-oriented applications highlighted that users' affective states or emotions influence online behavior. For instance, prior studies (e.g., Dai et al., 2015; Éthier, Hadaya, Talbot, & Cadieux, 2006) found that users experience positive emotions such as pleasure and joy in the utilization of task-oriented online applications such as shopping. In addition, Lin et al. (2008) contended that game-based online applications are perceived to be more interactive and hence more likely to trigger emotional experience in users. Here, HCGs utilize game features to make the process of computation fun, and consequently, they have a higher tendency to engender emotions in players. Meanwhile, studies suggest that user experiences that arise from the utilization of online information-oriented applications are driven by the perceived outcome quality afforded by these applications (e.g., Chen et al., 2012; Ho et al., 2012).

Although a significant amount of research has been conducted into users' perceived output quality and their experience in the use of online applications, few studies have examined the influence of various quality dimensions. Among such sparse research, Gohmann, Barker, Faulds, & Guan (2005) found that users who believe in the accuracy of the output offered by information-oriented systems are more likely to have positive feelings, such as satisfaction with the use of these systems. In addition to output accuracy, Wixom and Todd (2005) advocated perceived completeness and timeliness as significant factors that contribute to the satisfaction of users with online applications. Lee et al., (2009) also suggested perceived output relevancy as the strongest predictor of user

satisfaction with online health searches. Indeed, recognizing the relevancy of online content can facilitate a serendipitous information discovery that may induce certain types of emotions in users, such as surprise and delight (Joranson, VanTuyl, & Clements, 2014). Based on the findings of the aforementioned studies, players who believe that the output provided by HCGs is accurate, complete, relevant and timely are expected to have positive feelings, and hence, are more likely to enjoy these games affectively. Accordingly, the following hypothesis is proposed:

Hypothesis 4: Perceived output **A)** accuracy, **B)** completeness, **C)** relevancy and **D)** timeliness are *positively* related to perceived affective enjoyment of HCGs.

3.3.2 Perceived Cognitive Enjoyment and Perceived Output Quality

In addition to emotional experiences, the existing literature on information systems suggested that the output quality as perceived by users exerts influence on their thoughts or judgments about such systems (Wells, Valacich, & Hess, 2011; Wixom & Todd, 2005). In particular, prior studies in the online context identified a significant positive relationship between users' perceived output quality and their perceived value of mobile and online information-oriented applications (e.g., Barnes & Vidgen, 2002; Chen et al., 2012; Zheng et al., 2013). For instance, Zheng et al. (2013) found that users who observed high-quality user-generated content in virtual communities, such as online discussion forums, were more likely to perceive a greater value in these communications. In addition, Chen et al. (2012) suggested that the output quality afforded by mobile social media affects users' judgment on whether they should believe in these media.

Furthermore, Kim and Han (2009) found that users exhibited a higher level of trustworthiness toward online knowledge-sharing applications when the content produced by such applications is perceived to be believable, objective and complete. Because accuracy and completeness represent the reliability of a given output, the positive perception of such quality aspects influences user evaluation of online information-oriented applications (Fichman, 2011). In addition, Lee et al. (2009) found a positive relationship between relevancy, timeliness and user judgment regarding online e-health information seeking. According to Nabi and Krcmar (2004), users who exhibit favorable thoughts regarding such media are considered to enjoy the media cognitively. Therefore, if HCG output is evaluated to be accurate, complete, relevant and timely, players will then be more likely to have positive thoughts regarding these games, thereby increasing

the likelihood of enjoying these games cognitively. Hence, this study forwards the following hypothesis:

Hypothesis 5: Perceived output **A)** accuracy, **B)** completeness, **C)** relevancy and **D)** timeliness are *positively* related to perceived cognitive enjoyment of HCGs.

3.3.3 Perceived Behavioral Enjoyment and Perceived Output Quality

Although not specifically labeled as behavioral enjoyment, past research in the context of technology use investigated similar concepts, such as flow states (Hsu et al., 2012), playfulness (Moon & Kim, 2001) and immersion (Graham & Gosling, 2013). In fact, flow experience has been suggested as being composed of multiple factors including attention focus, immersion and control (Agarwal & Karahanna, 2000; Koufaris, 2002; Mekler et al., 2014). As such, during the flow state, individuals are completely engrossed or absorbed in an activity and in timelessness (Chen, Wigand, & Nilan, 1999). Similar to flow experience, behavioral enjoyment refers to the actions of individuals which emerge when they are deeply absorbed in an activity (Nabi & Krcmar, 2004; Weibel & Wissmath, 2011), and hence such enjoyment may be related to their perception of the output quality of mobile social applications. Although prior studies did not examine the specific relationships between different quality dimensions and constructs, such as playfulness and flow, the measurement used to assess output quality typically implies these four quality aspects (e.g., Ahn et al., 2007; Lin et al., 2008).

Previous studies in the mobile context (e.g., Gao & Bai, 2014; Zhou et al., 2010) have found that output quality significantly and positively affects users' perceived flow experience in the use of mobile social networking. Ahn et al. (2007) found that perceived output quality determines the tendency of individuals to experience a sense of playfulness in the use of online retailing applications. Similar to the flow experience, people in the state of playfulness find the current activity intrinsically appealing and they become deeply involved in it (Moon & Kim, 2001). Therefore, these findings may imply that a perceived higher output quality drives users to engage deeply in the application in use, thereby initiating them to behave in a way in which they are unaware of time passing and forgetful of their surroundings which are the indicators of behavioral enjoyment (Fang & Zhao, 2010). Akin to other online applications, HCGs perceived to have more accurate, complete, relevant and timely output are more likely to maintain players' attention, which, in turn, makes them enjoy these games behaviorally. Thus, the following hypothesis is posited:

Hypothesis 6: Perceived output **A)** accuracy, **B)** completeness, **C)** relevancy and **D)** timeliness are *positively* related to perceived behavioral enjoyment of HCGs.

3.4 Summary

This chapter presented the development of a conceptual model aimed at understanding how the Big Five personality traits and individual perceptions of the four quality aspects of output influence individual perception of the three enjoyment dimensions. In order to achieve this objective, this research relied on the literature on traditional and social media, games for pure entertainment, traditional information systems, and user-generated online content. The conceptual model and proposed hypotheses were presented in Figure 3.1 where five dimensions of personality traits and four dimensions of perceived output quality serve as antecedents of three dimensions of perceived enjoyment.

With regard to the Big Five personality traits antecedent, this research argued that individual personality traits can be an influential factor in determining the extent to which individuals experience different types of enjoyment. Firstly, the personality research suggested that people who score high for extraversion, agreeableness and openness are more receptive to emotions than those who score low for these traits. Accordingly, prior studies into the Internet and entertainment media found that individuals who exhibited a higher level of these personality traits are more likely to reveal their emotions in response to various types of media, including online social games, social media and other types of Internet applications, and they may have a higher tendency to experience affective enjoyment accordingly. Next, highly conscientious people tend to plan and organize their actions in order to achieve the intended outcomes, and such behavior drives them to engage more cognitively with media. Finally, the literature suggested that neurotics can easily become addicted to social media and online social games. This implied that people who are high in neuroticism are more inclined to become absorbed in these types of media, thereby having a high propensity for enjoying media behaviorally.

With reference to the output quality antecedents, the literature review suggested that users' perceived output accuracy, completeness, relevancy and timeliness are factors that influence their experience and behavior toward both traditional and online information-oriented applications. In particular, it was found that individuals who perceive a higher level of output quality are more likely to exhibit positive feelings (e.g., satisfaction) through the use of online information-oriented applications. Furthermore,

studies on technology acceptance have revealed that users' perception of output quality induces their appraisal of online applications in terms of usefulness, helpfulness and more. In addition, users are more likely to become absorbed in the use of online information-oriented applications perceived to have better quality information. Hence, this research contends that users' perceived output quality generated by HCGs may influence their perception of the affective, cognitive and behavioral enjoyment dimensions.

CHAPTER 4

STUDY I – INVESTIGATING THE ANTECEDENTS OF PERCEIVED ENJOYMENT

This chapter will start by describing the HCG used in Study I. It will then introduce the research methods and procedures, an assessment of reliability and validity of measures, and elaborate on the statistical methods for testing the model and hypotheses proposed in Chapter 3. The results of the analyses and findings are subsequently discussed. The findings from Study I then guide the conduct of Study II, which is presented in the following chapter.

4.1 Introducing *SPLASH*: The Mobile HCG Used for the Study

SPLASH (Seek, **PL**ay, **SH**are) is a mobile content-sharing HCG that runs on the Android mobile platform. As a type of HCG, *SPLASH* achieves the entertainment-output generation duality by providing a game layer over the top of the normal activity of sharing information about real-world locations. In other words, *SPLASH* blends information sharing activity with gaming, to not only to create an enticing content-sharing experience but also to yield quality information. As a result of playing *SPLASH* on their mobile phones, players generate geo-referenced information as byproducts, that could be used in other locative applications and receive entertainment value in return. In this section, the type of output produced by *SPLASH* is highlighted first, followed by the gameplay of *SPLASH* along with its features. The design decisions incorporated into *SPLASH* are then discussed.

4.1.1 Primary Features of *SPLASH*

In this section, the type of output produced by *SPLASH* is highlighted first, followed by the gameplay of *SPLASH* along with its features

Output of *SPLASH*. The output generated by *SPLASH* is location-based information known as “comments”, comprising the title, tags, descriptions, media elements (e.g. photos) and ratings. The comments are open-ended and players can freely

contribute their opinions about real-world locations. *SPLASH* organizes user-generated information on two levels: “places” and “units”. “Places” represent arbitrary geographic areas such as schools, parks and points of interest, and each of these can be further divided into more specific “units” which hold associated comments. For instance, if a school can be considered as a place, the library inside will be one of its units which attracts comments. Figure 4.1 highlights an example of *SPLASH*’s comments.

***SPLASH*’s Gameplay.** *SPLASH* adopts a virtual pet game genre which requires players to keep a pet alive and to “feed” it so it grows and develops. Based on the common knowledge that pets need appropriate food for their growth and development, *SPLASH* builds a content-sharing task around a feeding activity, aiming not only to encourage sharing but also to yield quality information. The virtual pets in *SPLASH* are labeled “Globs” and their food is the location-based information or comments. Globbs are community-owned pets which players encounter as they explore the world of *SPLASH* and they are obliged to feed them with comments. *SPLASH*’s world is the virtual representation of a real-world environment, supported by a map-based interface in which real-world places are overlaid with “mushroom houses” as depicted in Figure 4.2. As players move around their physical surroundings, *SPLASH* identifies places within their vicinity, and displays them as mushroom houses on the map. If the a player moves to a particular place that has been marked by a mushroom house, the player can enter by tapping on the respective mushroom house. Once tapped, *SPLASH* retrieves the corresponding Globbs or virtual pets, enabling the player to select the Glob that he/she wants to interact with. Here, the mushroom houses and Globbs reflect the two levels of information organization in *SPLASH*, which are places and units respectively.

Once selected, a player can interact with the Glob by means of feeding and exploring its comments fed by other players as a form of food. Feeding the Glob can be accomplished by creating textual and/or multimedia information relevant to the location of the Glob. Furthermore, players can peruse the comments (see Figure 4.3) and rate them according to their perceived quality. Players will earn points for every interaction with the Glob. These points also act as in-game currency and they can be invested so players can participate in other *SPLASH* activities such as decorating virtual rooms, playing mini-games or customizing avatars.

Figure 4.1. A comment in *SPLASH*.

Figure 4.2. *SPLASH*'s Map View.

Figure 4.3. A Virtual Pet (Glob) in *SPLASH*.

To signify the impact of players' actions, *SPLASH* provides immediate feedback by way of changing the appearance of the Glob and the mushroom house based on four different attributes of information: quality, quantity, recency and sentiment. Specifically, the appearances of the Glob or the mushroom house are subjected to these four attributes of information associated with this Glob or house. In particular, a Glob's (pet's) size

varies according to the amount of content it is fed while content quality, as measured by ratings, affects its color. Next, new content would make the pets look younger while a lack would cause them to age. Finally, pets are happier if they are fed with content that is generally positive in sentiment while those fed with content that is negative will appear to be sadder. It is possible that this feature may encourage players to create more positive information. However, in user-generated content contexts such as *SPLASH*, information quality is crucial as poor quality information (e.g., incomplete and outdated) may be misleading. *SPLASH*, therefore, includes ratings features to ensure information quality in which players rate each other's comments on a five-star scale. As sentiment and quality are two different concepts, comments that are poor in quality are likely to receive lower rating values regardless of their positive or negative sentiment.

Similar to Globs, the different parts of mushroom houses including size, wall color, roof color and weather are influenced by amount, ratings, recency and sentiment respectively. In addition to facilitating information discovery, the change in pet appearance serves as a way of providing immediate feedback which could make *SPLASH* more interactive, thereby inducing emotional or affective experiences in its players. Figures 4.4 and 4.5 illustrate the different appearances of the pets and mushroom houses respectively.

Figure 4.4. Different appearances of a Glob.

Figure 4.5. Different styles of a mushroom house.

4.1.2 Additional Features of *SPLASH*

In addition to primary gameplay, *SPLASH* includes additional features to enhance the value of enjoyment as well as the quality of output as discussed below.

Customization. To allow for players to experience deeper levels of emotional attachment, *SPLASH* includes the feature of avatar customization and personalization. Each player will have to maintain his/her own avatar and they are allowed to choose hairstyles, hair color, clothes and other accessories. While the basic items are available at

no cost, more advanced items have to be purchased using the in-game currency acquired by interacting with the Globs. Players can show off their avatars by putting them on their profile page, as well as visiting virtual rooms which display the avatars of current visitors. Figure 6 presents a customized avatar on a player's profile.

Virtual Rooms. To promote socialization, *SPLASH* provides virtual rooms (Glob's Homes), where each of these represents a pet's apartment (see Figure 7). Players can represent themselves with their own avatars in virtual rooms and they are allowed to decorate these rooms with items purchased from the in-game store. One such item is a game arcade machine that operates different types of mini-games which are casual in nature. These mini-games include those for pure entertainment such as puzzles and shooting, for information that harness the surrounding content to provide an awareness of one's vicinity, and mini-HCGs for players to perform useful computations. Others include utility items such as chairs, tables, musical instruments, wallpapers and so on. Decorating virtual rooms requires various amounts of in-game currency depending on the type of item. As such, *SPLASH* randomly sets certain items at the beginning of gameplay so as not to diminish the entertainment value of these rooms. Another element which advances the social aspect of a virtual room is the comment board through which players can broadcast messages to other players who are visiting this room. Figure 7 shows a virtual room with decorated items, where a player's avatar appears in the center and the avatars of other visitors are displayed in the bottom left-hand corner.

Reward System. To publicize the players' accomplishments, *SPLASH* offers a reward system that dictates their performance through in-game currency ("gold"), awards or badges, and leaderboards. Players can earn gold by interacting with Globs in terms of viewing, creating and rating comments, and by playing the mini-games inside virtual rooms. Gold can then be spent on purchasing items in order to decorate avatars and rooms. Awards or badges can be won by completing specified missions (e.g. creating a certain number of comments). Leaderboards show the game's top players, such as those with the most gold and most rated comments, or those who have contributed the most number of comments.

Figure 4.6. Avatar personalization page.

Figure 4.7. Glob's Home or Virtual room.

4.1.3 Design Decisions of *SPLASH*

The design decisions incorporated into *SPLASH* are primarily focused on motivating players to create and share location-based information while being entertained at the same time. The following design guidelines are adopted, culled from literature on motivation, media psychology and design principles for games for pure entertainment and HCGs.

Motivations. In order to drive player engagement, games need to tap into certain basic human motivations (Przybylski et al., 2010). One overreaching motivational appeal of *SPLASH* is the fulfillment of an individual's desire to raise their own offspring as postulated by Reiss (2004), which is achieved by allowing players to grow Globbs or virtual pets by feeding them with location-based information. In addition, *SPLASH* includes a number of features which aim to appeal to three components of motivation for playing social games as suggested by Yee (2006): achievement, socialization and immersion. Firstly, *SPLASH* facilitates players' need for achievement in two ways: amassing in-game wealth and status and competing with other players. In the former scenario, players receive in-game currency as an immediate reward for feeding the Globbs with comments, rating other players' comments, and playing mini-games, and they can also accumulate awards or badges by completing specified tasks. In the latter scenario,

SPLASH introduces a light competitive element in the form of leaderboards through which players can compare their standings in the game against others. In fact, competition is known to be one of the fundamental reasons for playing games (Vorderer et al., 2004) and hence *SPLASH*'s leaderboards may appeal to a larger number of players.

Secondly, *SPLASH* creates an opportunity for social interaction through a Glob's Home or a virtual room that serves as a social community, allowing players to represent themselves with their own customized avatars and interact with others via the comment board. Finally, *SPLASH* supports two features for customization which enables players to immerse themselves in the game (Cheung, 2011; Teng, 2010). One feature involves virtual rooms in which players can tailor the appearance of the rooms with various decorative items bought from the in-game store. The other involves avatars as players can customize their own avatars with different styles of clothing, facial features, preset haircuts, skin tones, as well as many other characteristics.

Multiple Components of Enjoyment. Research into media psychology suggested that enjoyment was more than emotions or affect evoked by the media; it also comprised cognitive appraisals and behaviors that emerged when individuals lost self-consciousness (Agarwal & Karahanna, 2000; Nabi & Krcmar, 2004). *SPLASH* addresses each of these enjoyment components, and the features that support the respective enjoyment components are described in Table 4.1.

Firstly, *SPLASH* integrates a visualization feature into its gameplay to facilitate the affective enjoyment of its players. Through this feature, players realize the changes in the appearances of *SPLASH*'s Globbs and mushroom houses with respect to size, color, age and moods. In this regard, the Globbs and mushroom houses resemble embodied agents equipped with an ability to express emotions (Slater, Moreton, Burkley, & Bridges, 2008), allowing players to establish empathic feelings toward these agents which give rise to affective enjoyment.

Secondly, *SPLASH* facilitates the cognitive assessment of its gameplay and features that might lead to cognitive enjoyment. In particular, *SPLASH* creates a content-sharing task as a form of "Feeding the Glob", and the appearances of Glob and mushroom houses are reflected by the quantity and quality of information fed. Next, *SPLASH*'s comments are organized into two levels, places and units, which may increase the chance of encountering comments that are more relevant to the player's location of interest.

These interactive visualization and comment organization features help players recognize the utilitarian value of *SPLASH* for information sharing, which could trigger cognitive enjoyment. Moreover, *SPLASH*'s rating feature gets players involved in judging the quality of the comments which increases the likelihood of them recognizing the value of this game, potentially giving rise to cognitive enjoyment.

Table 4.1

Summary of the Affective-, Cognitive- and Behavioral-Enjoyment-Supportive Features of SPLASH

Features	Description	Supported Enjoyment Dimension
Changing the appearance of Globbs and mushroom houses	- Visualizes the size, color, age and mood/weather with quantity, quality (ratings), recency and sentiment of comments fed to the Glob	Affective Cognitive
Feeding the Glob	- Engages players in a content-sharing task in a curious and problem-solving way	Cognitive
Rating comments	- Gets players involved in personal judgments about the quality of comments	Cognitive
Comment organization	- Increases the chance of encountering more relevant content respective to players' current location	Cognitive
Browsing comments	- Facilitates information discovery, empowering players to explore and peruse comments	Cognitive Behavioral
Customizing avatars	- Facilitates emotional attachment to the avatars through an individual experience derived from changing the appearance of avatars by way of hairstyles, clothes etc. - Provides an opportunity for players to represent themselves with unique features that they could not possess in the real world	Affective Behavioral
Virtual rooms	- Serves as an environment for various player-defined purposes such as social interaction and communication where players are represented by their own avatars - Creates a more personalized environment as players can decorate the rooms with pieces of furniture and other items bought from the in-game store	Behavioral Affective

Finally, *SPLASH* affords the opportunity for players to enjoy the game behaviorally through virtual rooms, avatar customization and content browsing features. For one, the Glob's Home or virtual room serves as an imaginary world in which players can represent themselves through their customized avatars and engage in imaginative social interactions and communication with other players (Mäntymäki & Riemer, 2014). Secondly, *SPLASH*'s avatar customization permits players to make unique changes to their avatars, which not only creates individual user experiences but also allows them to imagine themselves as characters they could not be in the real world (Dunn & Guadagno, 2012). Thirdly, *SPLASH*'s browsing feature facilitates information discovery by empowering players to peruse and judge the quality of its contributed content. These features of *SPLASH* are expected to engender a sense of imagination and exploration, which in turn elicit the experience of immersion, thereby giving rise to behavioral enjoyment.

Quality Control. In order to yield useful information as byproducts of gameplay, *SPLASH* adopts a social verification mechanism which is commonly applied to most applications dealing with user-generated information (Casey et al., 2007; Poesio et al., 2013). Here, players evaluate the quality of comments and give ratings on a five-star scale. As such, comments with higher rating values are considered to possess more quality than those with lower rating values. To encourage the creation of good quality comments, extra points are allotted to players based on the amount of ratings received on their comments. Assigning points in this way aims not only to attract good quality comments, but also to minimize cheating which is a concern for HCGs.

4.1.4 Implementation of *SPLASH*

SPLASH adopts a client-server architecture. The mobile client is implemented in Adobe Flash and ActionScript v3.0 while the application server runs on PHP v5.3.6 combined with a MySQL database. The Google Maps API v3 is integrated into *SPLASH* to display its map view in which places are overlaid with mushroom houses. The location data is obtained through the device's built-in geo-location function. Each Glob's Home and mini-games are developed as an SWF file which acts as a container for animation and interaction. A further SWF serves as an entry point and main control which instantiates

all levels, loads Glob's Homes and mini-games when needed, provides necessary communication with the application server, and stores user data.

There were a number of reasons for using *SPLASH* in this study as opposed to the other content-sharing HCGs currently available. Firstly, it was chosen for its notable design features as described above, and it has been relatively well-received by users in previous work (Goh, Lee, Chua, Razikin, & Tan, 2011). Secondly, developing a customized game provides a better control over its look and feel that ensures a more consistent user experience during the study. Finally, the content created by users of *SPLASH* could be easily accessed for analysis.

4.2 Method

4.2.1 Sampling

The present study adopted a non-probability sampling method called convenience sampling. In convenience sampling, researchers recruit individuals who are available and willing to participate in a study (Hocking & Stacks, 2003). Hence, the sample is easy to obtain, and the cost of obtaining them is relative low (Stangor, 2014). However, the downside is that the results of studies using convenience sampling are not very generalizable to other settings, as a convenience sample does not reflect the entire population (Salkind, 2010). Despite this shortcoming, convenience sampling enables researchers to obtain their required sample size in a relatively fast and inexpensive way. In addition, this approach allows researchers to focus more on other important aspects of the study such as the development of measurement instruments and usage scenarios instead of calculating the best way to obtain a population sample (Stangor, 2014).

More importantly, prior studies also suggest that university students can effectively make up an important age demographic of not only online game players (Kirriemuir, 2005; Sigurdsson, Gudjonsson, Bragason, Kristjansdottir, & Sigfusdottir, 2006; Wu & Liu, 2007), but also mobile Internet users (Zhou et al., 2010). Therefore, university students were chosen in this study, and they were recruited from two local universities. The participants were either undergraduate or graduate students, and the age range was 21 to 35. According to the latest statistics reported by the Entertainment Software Association (ESA, 2015), a large group of online game players are aged 18 to

35. Therefore, this study contends that a sample consisting of undergraduate and graduate students with this age range is suitable for exploring the player enjoyment of HCGs.

4.2.2 Survey Design

The research method used for this study is the survey, specifically a cross-sectional survey design which involves collecting quantifiable data from a group of people at a given time. A questionnaire was developed to collect the three key constructs used in this study, and included question items concerning the Big Five personality traits, perceived output quality, as well as perceived enjoyment of HCGs. In addition, this questionnaire collected participants' demographic data, mobile phone usage as well as gaming experience. All questions items were formulated based on existing literature and modified to suit the HCG context (Lee et al., 2002; Nelson et al., 2005; John et al., 2008; Fang et al., 2010).

A pilot study was carried out with five graduate students prior to conducting the actual study to uncover deficiencies in the developed questionnaire and study procedure. Generally, the entire questionnaire was found to be clear and comprehensive, but some question items were modified based on the feedback of participants. Minor changes such as wording and survey format were made until the participants felt comfortable with the questionnaire, and this questionnaire was then used in the actual study. The survey questionnaire was approved by the NTU Institutional Review Board, and a copy of it can be found in Appendix A.

4.2.3 Procedure and Data Collection

The data was collected between February and June 2012. The study was conducted on the university campus and participants were recruited through invitations using emails, pamphlets, posters around the university, and advertisements in school classes. Participation was voluntary and anonymous, and participants were paid a modest incentive of \$5 for their efforts. The study was carried out according to the following procedure.

Firstly, participants were introduced to *SPLASH* and its features including browsing the map, feeding the pet, rating comments, visiting virtual rooms and

customizing avatars. Secondly, participants were each provided with an HTC Desire mobile phone with *SPLASH* installed and they were asked to familiarize themselves with the application. In order to minimize any bias which may occur by using different devices, this study employed a target mobile device. The actual study then began and participants performed a series of tasks designed to cover all the features of *SPLASH*. These included (a) finding places on the map, (b) feeding pets and creating content, (c) rating comments, (d) visiting virtual rooms, (e) customizing avatars, and (f) viewing the leaderboard.

Finally, the paper-based survey was administered. Participants were also requested to provide qualitative comments about what they liked and disliked about *SPLASH* and its features. The entire study took approximately 40 minutes to complete. The study employed a total of 209 participants. However, four participants did not complete the entire survey and thus they were removed from the study, resulting in a final sample of 205 participants. The demographics of the sample are presented in Table 4.2 and examples of comments created by participants are shown in Table 4.3.

Table 4.2

Sample Demographics (N = 205)

Demographic variable	Count	%
Gender		
Male	86	42.0
Female	119	58.0
Age		
21-25	110	53.7
26-30	63	30.7
31-35	32	15.6
Educational background		
Computer Science or IT-related	100	48.8
Arts, humanities, and social science	40	19.5
Engineering	40	19.5
Business and related disciplines	25	12.2

Table 4.3

Example of Comments Contributed by Participants in SPLASH

Description	Tags
This is where all the university's convocation is held.	NTU, auditorium
The center is the former Administration building of Nanyang University.	Ntu, Chinese Heritage Centre, historical site
Tablet was put up to commemorate the completion of the first phase of Nanyang university in 1958.	Ntu, history
This center has a running track, swimming pool and gym.	Ntu, leisure, sports
Only one theatre of SCI	Lee foundation theatre, sci, wkwsci, theatre, ntu
Good coffee shop near nanyang auditorium.	Cafe, coffee shop
A lot of special events are held in it.	Auditorium, ntu, theatre
Beautiful, Nice and clean place.	School, biological science, sbc, ntu
Canteen layout is nice. All Food are halal.	Canteen, cafe
Information counter for foreign students.	Isc, foreign student help desk, information counter, enquiry
Good school for computer engineering and computer science students.	Sce, ntu, school,
There is one atm, one cash-in and one internet machine.	Ocbc bank, bank, atm
Popular and biggest library at ntu.	Lee wee nam library, library, ntu
Fishball noodle stall, the most popular noodle stall at ntu	Fishball noodle, canteen a, foodcourt
another cat was spotted and fed with cat food	cat, NTU
SCE offers Bachelor degree of Computer Engineering and Computer Science.	School of Computer Engineering
Its enrollment cut-off point is the highest amongst all the engineering faculties in NTU.	School of Chemical and Biomedical Engineering
SAC is a place in NTU Campus that provides K box and BBQ service for NTU staff	Stuff Activity Center
ADM Library is a newly built Library with a lot of high tech elements. It is a good place for study and watching videos	ADM Library
The only super market inside NTU campus, selling daily life goods for NTU students.	Super Market

4.2.4 Measures

A total of 56 question items were used to assess the independent variables (i.e., personality traits and perceived output quality), and all question items were adapted from prior research (Fang et al., 2010; John et al., 2008). In particular, perceived output quality was measured with 12-item scales and the 44-item Big Five Inventory (BFI) (John et al., 2008) was utilized to assess personality traits. Additionally, 12-item scales were used to measure the dependent variable (i.e., perceived enjoyment). All questions were measured on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Prior to analyzing the data to test the study's hypotheses, principal component factor analysis with varimax rotation was used to test the validity of all the constructs in the conceptual model. Varimax rotation was used as potential factors were expected to be orthogonal (Abdi, 2003). The decision about the number of factors to be retained was based on the widely used Kaiser's criterion (Girden, 2001). This criterion suggests to retain factors with eigenvalues (i.e., the variances extracted by the factors) equal or higher than 1. This is because factors with eigenvalues less than 1 are not considered to be stable, and they account for less variability than one original variable (Girden, 2001). Besides, the conceptual clarity, interpretability and theoretical salience of the rotated factors were also considered in identifying factors. When loadings less than 0.50 were excluded, the analysis yielded 12 factors with a simple structure (factor loadings ≥ 0.50).

As the study's constructs were measured with multiple items, the score for each construct was computed by averaging item scores, which is typically used for multi-item scales to form an overall scale (Whitley, Kite, & Adams, 2012). Reliability analyses using Cronbach's alpha were then carried to ensure that all the items representing a particular construct measure the same construct (Cohen, Cohen, West, & Aiken, 2013). The results exhibited acceptable alpha values (i.e., ranged from 0.78 to 1.00) for the given sample size. These values exceeded 0.70 which is considered acceptable in most social science research, presenting good internal consistency (Tabachnick & Fidell, 2007). The loading factors for all the constructs and associated Cronbach's alpha values are presented in Table 4.4 to 4.6.

Perceived Enjoyment

In line with the present study, the dependent variable was perceived enjoyment derived from playing HCGs. Based on Nabi and Krcmar's (2004) tripartite media enjoyment model, perceived enjoyment is assessed in three dimensions. Twelve items were utilized to measure the perceived enjoyment of HCGs and these items were formulated on the basis of prior studies and then adapted to suit the current context (Fang et al., 2010; Fang & Zhao, 2010). As expected, three factors emerged from the factor analysis performed on the perceived enjoyment construct, including affective, cognitive and behavioral dimensions. The results of the factor analysis are presented in Table 4.4 and described below

- **Affective:** measures the extent to which a player perceives emotional experiences during gameplay. There were four items to measure perceived affective enjoyment and they were averaged to yield the overall perceived affective enjoyment score. The mean index was 2.90 ($SD = 0.83$, Cronbach $\alpha = 0.93$). Higher scores indicate that the player perceives strong emotional influences during gameplay.
- **Cognitive:** measures the extent to which a player perceives favorable thoughts and beliefs about HCGs. Specifically, it concerns the player's judgment as to whether HCGs are worthy, good, effective and interesting. A four-item measurement was utilized to assess the perceived cognitive enjoyment of HCGs and it had a mean value of 3.57 ($SD = 0.70$, Cronbach $\alpha = 0.91$).
- **Behavioral:** measures the extent to which a player perceives deep involvement in HCGs. Again, four items were utilized to measure the perceived behavioral enjoyment. Based on the player's evaluation, the mean index was 3.01 ($SD = 0.90$, Cronbach $\alpha = 0.93$).

Table 4.4

Measurement and Factor Analysis of Perceived Enjoyment (N = 205)

Scale items	Factor loadings			<i>M</i>	<i>SD</i>	α
	1	2	3			
1. Affective						0.93
I felt emotionally involved in this application (or feature).	0.85	0.15	0.17	2.87	0.91	
I felt emotionally attached to this application (or feature).	0.84	0.15	0.19	2.75	0.89	
I felt emotionally affected while using this application (or feature).	0.83	0.26	0.19	2.82	0.94	
I felt attracted to this application (or feature).	0.79	0.28	0.21	3.08	0.91	
2. Cognitive						0.91
I think this application (or feature) is a good way of sharing information.	0.16	0.81	0.18	3.68	0.79	
I think this application (or feature) is an effective way of sharing information.	0.24	0.80	0.23	3.55	0.79	
I think this application (or feature) is an interesting way of sharing information.	0.23	0.77	0.26	3.59	0.80	
I think it is worthwhile to use this application (or feature).	0.21	0.75	0.15	3.47	0.78	
3. Behavioral						0.93
I became less aware of my surroundings because I was engrossed in using this application (or feature).	0.15	0.11	0.75	2.91	0.96	
I lost track of time while using this application (or feature).	0.19	0.22	0.71	2.91	0.99	
I was able to easily use the application (or feature) to accomplish my designated tasks.	0.27	0.25	0.56	3.11	1.03	
I was able to quickly choose appropriate actions for my designated tasks in this application (or feature).	0.23	0.27	0.52	3.14	0.98	
Variance explained (%)	3.94	2.32	1.71			
Eigenvalue	5.79	3.41	2.52			

Personality Traits

As described earlier, the Big Five personality traits of extraversion, agreeableness, conscientiousness, neuroticism and openness were assessed using the 44-item BFI (John et al., 2008). The BFI was chosen for this study because it could capture the core attributes of the Big Five traits (John et al., 2008) and the scale has been shown to have strong psychometric properties. Specifically, the BFI has a clear factor structure, adequate internal consistency and retest reliability (Srivastava, 2012). Additionally, the BFI has previously demonstrated considerable convergent and discriminant validity with other longer versions of Big Five measurements (John et al., 2008). Recently, a BFI has been applied successfully in the social media context to assess users' personality traits (e.g., Hughes et al., 2012; Ryan & Xenos, 2011; Wang et al., 2012).

In particular, the BFI contains eight items for extraversion, nine items for agreeableness, nine items for conscientiousness, nine items for neuroticism and ten items for openness. Each item consists of a short statement and items are measured on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). This study was able to extract clear Big Five factor structures. The factor analysis results of these personality traits are shown in Table 4.5 and described below.

- **Extraversion:** measures an individual's tendency to be sociable, outgoing, active, assertive and enthusiastic (John et al., 2008). There were eight items used to measure the extraversion trait and they are summed and averaged to represent its value. The mean of the index was 3.45 ($SD = 0.70$, Cronbach $\alpha = 0.92$). Higher scores indicate that the player exhibits high levels of extraversion.
- **Agreeableness:** measures an individual's tendency to be altruistic, friendly, cooperative, straightforward, modest and trustworthy (John et al., 2008). Nine items were used to assess the agreeableness trait and it had a mean value of 3.86 ($SD = 0.42$, Cronbach $\alpha = 0.78$).
- **Conscientiousness:** measures an individual's tendency to be careful, efficient, responsible, self-disciplined, thorough and has a high will to achieve (John et al., 2008; Finn, 1997). This trait was assessed with nine items and the mean index was 3.33 ($SD = 0.55$, Cronbach $\alpha = 0.82$).
- **Neuroticism:** measures an individual's tendency to experience anxiety, sadness, nervousness and embarrassment (John et al., 2008). Eight items were utilized to

measure the neurotic tendency of individuals. The mean of neuroticism was 3.01 ($SD = 0.58$, Cronbach $\alpha = 0.81$).

- **Openness:** measures an individual's tendency to be curious, imaginative, ingenious, artistic (McCrae & Costa, 2003; John et al., 2008). Ten items were employed to measure the tendency to be open to experience. The mean of the index was 3.53 ($SD = 0.52$, Cronbach $\alpha = 0.85$).

Table 4.5

Measurement and Factor Analysis of Personality Traits (N = 205)

I am someone who ...	Factor loadings					M	SD	α
	1	2	3	4	5			
1. Extraversion								0.92
tends to be quiet	0.82	0.08	0.04	-0.11	0.01	3.33	0.97	
is talkative	0.80	0.16	0.02	-0.07	0.09	3.43	0.90	
has an assertive personality	0.79	0.17	0.13	-0.02	0.01	3.47	0.82	
is sometimes shy, inhibited	0.78	0.22	-0.04	-0.05	0.11	3.34	0.94	
generates a lot of enthusiasm	0.77	-0.02	0.03	-0.12	0.08	3.56	0.82	
is reserved	0.76	0.21	0.11	-0.04	0.04	3.33	0.88	
is full of energy	0.72	0.26	0.10	-0.09	0.04	3.56	0.83	
is outgoing, sociable	0.70	0.33	0.16	-0.05	-0.02	3.60	0.84	
2. Openness								0.85
values artistic, aesthetic experiences	0.16	0.69	-0.05	0.04	0.05	3.71	0.81	
has an active imagination	0.08	0.69	0.01	0.02	-0.02	3.68	0.79	
likes to reflect, play with ideas	0.10	0.69	0.03	0.11	0.02	3.70	0.74	
is curious about many different things	0.28	0.64	0.15	0.02	0.10	3.80	0.81	
is original, comes up with new ideas	0.24	0.63	0.12	0.04	0.22	3.41	0.79	
is ingenious, a deep thinker	0.12	0.62	0.19	0.02	0.03	3.70	0.73	
is inventive	0.31	0.62	0.05	0.01	-0.07	3.27	0.73	
is sophisticated in art, music, or literature	0.12	0.60	-0.04	0.11	0.05	3.37	0.89	
prefers work that is routine	-0.02	0.54	0.03	0.15	0.16	3.37	0.85	
has few artistic interests	0.14	0.51	0.07	0.08	-0.10	3.34	0.81	

Table 4.5 (Continued)

Measurement and Factor Analysis of Personality Traits (N = 205)

3. Conscientiousness							0.82
tends to be disorganized	0.03	-0.01	0.70	-0.13	0.17	3.34	0.96
is a reliable worker	0.08	0.14	0.67	0.02	0.16	3.80	0.77
tends to be lazy	0.07	-0.08	0.62	-0.01	0.07	3.09	0.93
can be somewhat careless	0.01	0.23	0.61	-0.04	0.19	3.00	0.91
is easily distracted	0.08	0.22	0.61	-0.12	0.12	3.04	0.85
makes plans and follows through with them	0.09	-0.15	0.60	0.13	0.14	3.43	0.76
perseveres until the task is finished	0.02	-0.04	0.59	-0.16	0.10	3.53	0.81
does things efficiently	0.10	0.17	0.54	-0.24	0.16	3.56	0.85
does a thorough job	0.19	0.18	0.53	0.01	0.20	3.22	0.89
4. Neuroticism							0.81
remains calm in tense situations	-0.03	-0.08	-0.09	0.72	-0.14	2.82	0.85
is relaxed, handles stress well	-0.10	0.20	-0.08	0.72	0.00	2.82	0.91
worries a lot	-0.11	-0.13	-0.03	0.71	-0.04	3.24	0.95
is emotionally stable, not easily upset	-0.07	0.11	0.02	0.64	-0.05	2.71	0.85
can be moody	-0.05	-0.01	-0.12	0.63	-0.08	3.26	0.93
is depressed, blue	-0.14	0.20	-0.23	0.55	-0.06	3.02	0.93
gets nervous easily	-0.12	0.13	-0.04	0.53	0.10	3.00	0.83
can be tense	0.03	0.23	0.12	0.53	-0.04	3.21	0.81
5. Agreeableness							0.78
is helpful and unselfish with others	0.12	0.05	0.16	0.00	0.64	3.90	0.66
starts quarrels with others	0.13	0.15	0.11	-0.06	0.62	3.95	0.81
is sometimes rude to others	-0.11	-0.11	0.07	0.10	0.61	3.85	0.75
is considerate and kind to almost everyone	0.01	0.08	0.11	-0.16	0.58	3.88	0.65
is generally trusting	0.04	0.16	0.27	0.03	0.58	3.99	0.66
can be cold and aloof	-0.01	-0.08	0.13	-0.01	0.58	3.70	0.76
has a forgiving nature	0.22	0.15	-0.02	0.16	0.56	3.86	0.68
tends to find fault with others	-0.11	-0.13	0.14	-0.05	0.53	3.67	0.69
likes to cooperate with others	0.12	0.10	0.21	-0.08	0.52	3.90	0.56
Variance explained (%)	10.49	7.97	4.89	3.31	2.15		
Eigenvalue	15.42	11.72	7.19	4.86	3.16		

Perceived Output Quality

As discussed in Section 3.4, output quality is operationalized as information quality in this study since mobile content-sharing HCGs generate information output. It was assessed with twelve items that were drawn from previous studies (Lee et al., 2002; Nelson et al., 2005) and then modified to suit the current context. Four factors described below were extracted from the factor analysis performed on the output quality construct: accuracy, completeness, relevancy and timeliness. The results are presented in Table 4.6.

- **Accuracy:** assesses the extent to which information generated by HCGs is correct, reliable and accurate. There were three items used to measure information accuracy and they were summed and averaged in order to represent the construct. The mean index was 3.40 (SD = 0.77, Cronbach α = 0.96). Higher scores mean that a player perceives information generated by HCGs to be accurate.
- **Completeness:** assesses the extent to which information generated by HCGs contains sufficient details for one's needs. Again, three items were utilized to measure a player's perception of the completeness of information produced by HCGs, and they have with a mean value of 3.22 (SD = 0.78, Cronbach α = 0.96).
- **Relevancy:** assesses the extent to which information generated by HCGs is appropriate, relevant and useful for one's needs. Three items were used to assess the perceived information relevancy. Based on player evaluation, the mean of information relevancy in HCGs was 3.30 (SD = 0.75, Cronbach α = 0.91).
- **Timeliness:** assesses the extent to which information generated by HCGs is current, timely and up-to-date for one's needs. The perceived timeliness of information was measured with three items and had a mean value of 3.55 (SD = 0.81, Cronbach α = 1.00).

Table 4.6

Measurement and Factor Analysis of Perceived Output Quality (N = 205)

Scale items	Factor loadings				<i>M</i>	<i>SD</i>	α
	1	2	3	4			
1. Accuracy							0.96
This application provides accurate information.	0.89	0.07	0.15	0.11	3.38	0.81	
This application provides correct information.	0.89	0.14	0.11	0.14	3.44	0.81	
This application provides reliable information.	0.87	0.14	0.14	0.12	3.37	0.79	
2. Completeness							0.96
This application provides information that covers sufficient breadth and depth for my needs.	0.14	0.88	0.17	0.13	3.22	0.82	
This application provides information that includes all necessary details.	0.13	0.88	0.19	0.11	3.21	0.80	
This application provides information that is sufficiently complete for my needs.	0.11	0.87	0.21	0.16	3.23	0.83	
3. Relevancy							0.91
This application provides information that is relevant to my needs.	0.20	0.27	0.82	0.08	3.29	0.81	
This application provides information that is appropriate for my needs.	0.16	0.23	0.81	0.11	3.28	0.80	
This application provides information that is useful for my needs.	0.22	0.25	0.78	0.12	3.32	0.84	
4. Timeliness							1.00
This application provides information that is sufficiently up-to-date.	0.39	0.34	0.18	0.68	3.54	0.81	
This application provides information that is sufficiently current for my needs.	0.40	0.33	0.19	0.69	3.55	0.81	
This application provides information I need in time.	0.41	0.33	0.18	0.69	3.56	0.81	
Variance explained (%)	1.95	1.81	1.58	1.35			
Eigenvalue	2.87	2.67	2.33	1.98			

4.3 Results

4.3.1 Description of Sample

The total sample of 205 participants comprised 58% (N = 119) females and 42% (N = 86) males. Their ages ranged from 19 to 41 with an average of 26.40 years. The majority of participants (67.3%, N = 138) indicated that they were online gamers. The participants also described the different types of games that they had played more than once a month. From the sample, participants had experience of social games (45.4%, N = 93), puzzle games (42.9%, N = 88), strategy games (38.55 %, N = 79), adventure games (35.6 %, N = 73) and simulation games (25.4 %, N = 52). Additionally, 51.7% (N = 106) of the participants indicated that they played games on social networking sites such as *Facebook*.

In addition to gaming experience, participants were asked to indicate their prior mobile phone usage and information-sharing experiences. With regard to mobile phone usage, 89.8% (N = 184) of participants used mobile phones to take pictures and videos. Of the total sample, 82.9% (N = 170) of participants surfed the Internet via their mobile phones while 80.5% (N = 165) used them for map navigation. The results also highlighted that 73.7% (N = 151) of participants shared pictures, videos, music and other media via mobile phones. Next, 50.7% (N = 104) of participants indicated that they used the location check-in feature of social networking applications such as *Facebook* and *FourSquare* on their mobile phones. In addition, 42.4% (N = 87) of participants shared information about locations on social networking applications via mobile phones.

4.3.2 Hypotheses Testing

The hypotheses developed in Chapter 3 are shown in Table 4.7. Before conducting the regression analyses, the multicollinearity among the independent variables (IVs) was examined. The analysis of the correlation matrix of IVs (see Table 4.8) revealed that there were no high correlations (0.60 or above). Multicollinearity is considered serious if the sample correlation exceeds 0.70 (Cohen et al., 2013) and hence this may not be an issue in the study. However, as correlation coefficients only measure pairwise dependencies, substantial multicollinearity may still exist. Hence, the variance inflation factor (VIF) was used to assess how much the variance of an estimated regression coefficient increases if the IVs are correlated. The results revealed that the VIF values, which ranged from 1.16

to 2.04, did not exceed the recommended cut-off value of 10 (Cohen et al., 2013) and hence multicollinearity may not be a substantial problem in the study's data analysis.

Table 4.7

Summary of Proposed Hypotheses

Hypothesis	
Big Five Personality Traits	
Hypothesis 1A:	Extraversion is <i>positively</i> related to perceived affective enjoyment of HCGs.
Hypothesis 1B:	Agreeableness is <i>positively</i> related to perceived affective enjoyment of HCGs.
Hypothesis 1C:	Conscientiousness is <i>positively</i> related to perceived affective enjoyment of HCGs.
Hypothesis 1D:	Neuroticism is <i>negatively</i> related to perceived affective enjoyment of HCGs.
Hypothesis 1E:	Openness is <i>positively</i> related to perceived affective enjoyment of HCGs.
Hypothesis 2A:	Extraversion is <i>positively</i> related to perceived cognitive enjoyment of HCGs.
Hypothesis 2B:	Agreeableness is <i>negatively</i> related to perceived cognitive enjoyment of HCGs.
Hypothesis 2C:	Conscientiousness is <i>positively</i> related to perceived cognitive enjoyment of HCGs.
Hypothesis 2D:	Neuroticism is <i>positively</i> related to perceived cognitive enjoyment of HCGs.
Hypothesis 2E:	Openness is <i>positively</i> related to perceived cognitive enjoyment of HCGs.
Hypothesis 3A:	Extraversion is <i>negatively</i> related to perceived behavioral enjoyment of HCGs.
Hypothesis 3B:	Agreeableness is <i>not</i> related to perceived behavioral enjoyment of HCGs.
Hypothesis 3C:	Conscientiousness is <i>positively</i> related to perceived behavioral enjoyment of HCGs.
Hypothesis 3D:	Neuroticism is <i>positively</i> related to perceived behavioral enjoyment of HCGs.
Hypothesis 3E:	Openness is <i>positively</i> related to perceived behavioral enjoyment of HCGs.

Table 4.7 (Continued)

Summary of Proposed Hypotheses

Perceived Output Quality	
Hypothesis 4:	Perceived output A) accuracy, B) completeness, C) relevancy, and D) timeliness are <i>positively</i> related to perceived affective enjoyment of HCGs.
Hypothesis 5:	Perceived output A) accuracy, B) completeness, C) relevancy, and D) timeliness are <i>positively</i> related to perceived cognitive enjoyment of HCGs.
Hypothesis 6:	Perceived output A) accuracy, B) completeness, C) relevancy, and D) timeliness are <i>positively</i> related to perceived behavioral enjoyment of HCGs.

Table 4.8

Correlations among Independent Variables (Pearson)

	1	2	3	4	5	6	7	8	9
1. Extraversion	1								
2. Agreeableness	0.15*	1							
3. Conscientiousness	0.24**	0.41**	1						
4. Neuroticism	-0.16*	-0.12	-0.18**	1					
5. Openness	0.40**	0.16*	0.19**	0.13	1				
6. Accuracy	0.05	0.01	0.01	0.07	-0.03	1			
7. Completeness	-0.04	-0.04	0.05	-0.01	-0.08	0.50**	1		
8. Relevancy	0.01	0.23**	0.12	-0.04	0.01	0.44**	0.59**	1	
9. Timeliness	0.12	0.06	0.05	0.04	0.05	0.53**	0.55**	0.56**	1

Note. *Correlation is significant at the 0.05 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).

Thereafter, a series of multiple linear regression analyses were carried out to examine which factors were significantly associated with the perceived enjoyment of HCGs. As perceived enjoyment was assessed in three dimensions (affective, cognitive, behavioral), the summed scores of each enjoyment dimension were regressed in all independent variables in the conceptual model. For instance, in the affective enjoyment model, five personality traits and four perceived information quality dimensions were entered as independent variables, while affective enjoyment was treated as a dependent variable. This was repeated for the other enjoyment dimensions. Statistical significance for all tests was set at a .05 level. The results of the analyses are described below.

Regarding perceived affective enjoyment, the model, which is a linear combination of five personality factors and four output quality factors, was found to be statistically significant (Adjusted $R^2 = 0.24$, $F(9, 195) = 7.96$, $p < 0.001$) and accounted for 24% of variability in the perceived affective enjoyment of HCGs. Perceived output relevancy demonstrated a stronger influence, followed by personality traits of extraversion and openness and perceived output accuracy. The model for perceived cognitive enjoyment was also found to be statistically significant (Adjusted $R^2 = 0.33$, $F(9, 95) = 11.93$, $p < 0.001$) which accounted for 33% of variability in the perceived cognitive enjoyment of HCGs. The order of the strength of the predictors is perceived relevancy and timeliness, followed by neuroticism. In addition, the model for perceived behavioral enjoyment was found to be statistically significant (Adjusted $R^2 = 0.10$, $F(9, 95) = 3.57$, $p < 0.001$) which accounted for 10% of the perceived behavioral enjoyment of HCGs. The variables found to predict behavioral enjoyment were perceived relevancy and the openness personality trait. The results of the multiple linear regression analyses are presented in Table 4.9.

Influence of Personality Traits

In support of Hypothesis 1A, the results highlight that extraversion was positively associated with perceived affective enjoyment ($\beta = 0.22$, $p < 0.01$). This indicates that players who scored high for extraversion experienced positive emotions while playing *SPLASH*. One player who scored higher than the mean value of extraversion remarked, “*I like the way that SPLASH allows me to communicate with others while posting comments*”. Contrary to expectation, openness was significantly negatively associated with perceived affective enjoyment ($\beta = -0.20$, $p < 0.01$) and thus Hypothesis 1E was not supported. This means that *SPLASH* could not provide opportunities for individuals with high openness to express themselves openly in terms of emotional expressions. The qualitative feedback lends support to this finding. When asked about their impressions of *SPLASH*, many participants who scored high for openness reported that, compared to other popular social games such as *The Sims*, the functionality of *SPLASH*’s virtual rooms was “*not exciting enough*” and “*quite boring to use*”.

Hypothesis 1B, 1C and 1D were rejected because no association between the personality traits of agreeableness ($\beta = 0.02$, $p = 0.82$), conscientiousness ($\beta = -0.05$, $p =$

0.50), and neuroticism ($\beta = 0.11$, $p = 0.86$) and perceived affective enjoyment was found. This means that individuals who scored either high or low on the personality traits of agreeableness, conscientiousness and neuroticism did not feel emotions induced by *SPLASH*. The qualitative feedback seemed to provide some possible explanations. For instance, the majority of participants with either high or low levels of these traits referred to *SPLASH*'s graphics as “*not so attractive and intuitive enough*”, “*so confusing*” and they “*do not bring excitement*”. Perhaps the interaction with *SPLASH*'s graphical content could not evoke spontaneous feelings in the participants, which in turn hindered the development of affective enjoyment.

Hypothesis 2D predicted that neuroticism would exert a positive influence on perceived cognitive enjoyment. As observed in Table 4.9, the effect was significant ($\beta = 0.12$, $p < 0.05$), supporting Hypothesis 2D. In other words, individuals who are afraid to communicate with others in offline environments (i.e., neurotics) recognize the value of *SPLASH*, especially in communicating effectively with others. When participants were asked about what they liked about *SPLASH*, some of the often-used phrases of the neurotic participants included “*attracted to comment board*”, “*loved to have my comments rated*”, and “*liked comparing my standing against others*”. However, no associations between perceived cognitive enjoyment and extraversion ($\beta = 0.12$, $p = 0.06$), agreeableness ($\beta = 0.11$, $p = 0.09$), conscientiousness ($\beta = -0.04$, $p = 0.60$) and openness ($\beta = -0.01$, $p = 0.90$) were found, and thus Hypothesis 2A, 2B, 2C and 2E were rejected. Put differently, the participants' personality traits of extraversion, agreeableness, conscientiousness and openness did not influence their beliefs and thoughts about *SPLASH*. In the collected qualitative feedback, it was found that participants reported *SPLASH* to be “*an interesting concept but not effective enough*”, “*a useful way of sharing information*” and “*really innovative*”. However, there seemed to be no difference in the perceived value of *SPLASH* among participants with high or low levels of extraversion, agreeableness, conscientiousness and openness.

Contrary to the expectations of Hypothesis 3E, openness was significantly negatively associated with perceived behavioral enjoyment ($\beta = -0.17$, $p = 0.05$), indicating that participants who scored low on openness immersed themselves in HCG play. The qualitative feedback lends support to this finding. A participant scoring low on openness commented, “*I was so addicted to beating the top scorers that I kept playing the game until I defeated them*”. Meanwhile, a participant scoring high on openness reported,

“SPLASH doesn’t really bring me much excitement so I don’t really see a need to share that much information”. As expected, the results showed no relationship between agreeableness and perceived behavioral enjoyment ($\beta = 0.12, p = 0.13$) which supports Hypothesis 3B. Perhaps such a relationship may have been affected by individual preferences for different game genres or gameplay activities. This is supported by the qualitative feedback in which a participant with a low level of agreeableness reported, *“I would like to see more intense forms of player-versus-player activities, such as duels, in SPLASH”*.

However, Hypothesis 3A, 3C and 3D were rejected because the results showed that there were no significant associations between perceived behavioral enjoyment and extraversion ($\beta = 0.10, p = 0.22$), conscientiousness ($\beta = -0.06, p = 0.47$) and neuroticism ($\beta = 0.06, p = 0.39$). This suggests that the extent to which an individual was occupied by *SPLASH* was not determined by their levels of these personality traits. The non-significant effects of extraversion could be attributable to the limited social interaction afforded by *SPLASH*, hence participants who scored high on this trait were not completely involved in the gameplay which could have hindered them from enjoying the game behaviorally. This is supported by the qualitative feedback in which a participant with a high level of extraversion reported, *“I would suggest SPLASH to have more collective features such as groups/guilds in WoW so that I feel myself as part of the group feeding the pet with content”*.

Next, the non-significant effects of conscientiousness could be attributable to the uncomplicated nature of *SPLASH* play where players focus on creating and rating comments to score points, which may have enabled them to perform in-game tasks with minimal conscientious effort. As such, the ability of these individuals to be conscientious did not contribute to their HCG enjoyment behaviorally. A participant who scored low on conscientiousness stated, *“SPLASH play is challenging but still manageable enough to score points and win awards”*. Finally, the need for social support for participants with high levels of neuroticism seemed to be unfulfilled in *SPLASH* play which may have impeded their behavioral enjoyment. One comment from a participant who scored high on neuroticism lends support to this view, who shared, *“SPLASH should have a ‘like’ button so that I can see how much support I received from other players”*.

Influence of Perceived Output Quality

As predicted by Hypothesis 4A, the results demonstrated a significant positive association between perceived output accuracy and affective enjoyment ($\beta = 0.15, p < 0.05$), indicating that the players' perceived accuracy of output help determine whether they experience emotions while playing *SPLASH*. Similarly, the perceived relevancy of output was significantly positively associated with perceived affective enjoyment ($\beta = 0.29, p < 0.001$), supporting Hypothesis 4C. This means that the output of *SPLASH* was perceived to be relevant by participants, which in turn evoked positive emotions. A participant reported that she was “*satisfied*” with the overall experience of *SPLASH* because she found some “*useful and authentic*” comments. However, no significant relationships between perceived affective enjoyment and perceived completeness ($\beta = 0.08, p = 0.37$) and timeliness ($\beta = 0.04, p = 0.60$) were found, and hence Hypothesis 4B and 4D were not supported. In other words, these results indicate that complete and timely output could not engender emotions or affective experiences. Lending support to this view, one participant remarked, “*SPLASH is fun but I cannot take it seriously as an ample source of information*”.

With regard to perceived cognitive enjoyment, results revealed a significant positive effect of perceived output relevancy ($\beta = 0.30, p = 0.001$) and timeliness ($\beta = 0.19, p = 0.01$) on perceived cognitive enjoyment, supporting Hypothesis 5C and 5D. In other words, players were inclined to make favorable judgments about *SPLASH* when the output was perceived to be relevant and timely. The same observation was made by one participant who, when asked about her impression of *SPLASH*, said, “*Games like SPLASH mean a lot to me because I can easily get not only up-to-date but also relevant information about my current location in a fun way*”. However, perceived accuracy ($\beta = 0.05, p = 0.50$) and completeness ($\beta = 0.11, p = 0.16$) did not show a significant association with perceived cognitive enjoyment, and hence Hypothesis 5A and 5B were rejected. This implies that what players think and believe about *SPLASH* was not influenced by their perceptions about the accuracy and completeness of its output. Lending support to this view, one participant remarked, “*Overall, I think that SPLASH's features are interesting but some comments could be more detailed and truthful*”.

Table 4.9

Multiple Linear Regression Analyses (N = 205)

Independent Variables	Dependent variable = Perceived enjoyment					
	Affective		Cognitive		Behavioral	
	Standardized β	<i>t</i> -values	Standardized β	<i>t</i> -values	Standardized β	<i>t</i> -values
Personality Traits						
Extraversion	0.22	3.03**	0.12	1.86	0.10	1.22
Agreeableness	0.02	0.23	0.11	1.72	0.12	1.58
Conscientiousness	-0.05	-0.69	-0.04	-0.53	-0.06	-0.73
Neuroticism	0.11	1.73	0.12	2.00*	0.06	0.86
Openness	-0.20	-2.83**	-0.01	-0.16	-0.17	-2.30*
Perceived Output Quality						
Accuracy	0.15	1.96*	0.05	0.68	-0.02	-0.21
Completeness	0.08	0.89	0.11	1.42	0.14	1.50
Relevancy	0.29	3.38***	0.30	3.78***	0.19	2.07*
Timeliness	0.04	0.53	0.19	2.47**	0.05	0.50
Adjusted R^2	0.24***		0.33***		0.10***	

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

As for perceived behavioral enjoyment, the results showed a positive association between perceived output relevancy and perceived behavioral enjoyment ($\beta = 0.19, p < 0.05$), providing support for Hypothesis 6C. This indicates that players were more likely to be engrossed in *SPLASH* when its comments were perceived to be relevant to their needs. When asked about their experience of *SPLASH*, one participant commented, “*I spent more time on some Globbs than others depending on whether I found something useful inside*”. However, no significant relationships between perceived behavioral enjoyment and perceived accuracy ($\beta = -0.02, p = 0.83$), completeness ($\beta = 0.14, p = 0.14$) and timeliness ($\beta = 0.05, p = 0.62$) were identified. Hence, Hypothesis 6C, 6B and 6D were not supported. Compared to the relevancy judgment, assessing accuracy, completeness and timeliness of comments seemed to be more straightforward and less cognitively demanding because *SPLASH*’s features, such as ratings and time of posting, facilitated these assessments. Stated differently, participants do not need to get absorbed in recognizing such quality aspects thereby revealing no significant effect on their perceived behavioral enjoyment. A comment from one participant seems to support this view: “*The way that SPLASH displays comments together with ratings and time of posting improves reliability of information*”.

In summary, the results of the hypotheses are illustrated in Table 4.10.

Table 4.10

Results of Hypotheses

Hypothesis	Independent Variable	Dependent Variable	Result
Personality Traits			
Hypothesis 1A	Extraversion	Perceived affective enjoyment	Supported
Hypothesis 1B	Agreeableness		Not Supported
Hypothesis 1C	Conscientiousness		Not Supported
Hypothesis 1D	Neuroticism		Not Supported
Hypothesis 1E	Openness		Not Supported
Hypothesis 2A	Extraversion	Perceived cognitive enjoyment	Not Supported
Hypothesis 2B	Agreeableness		Not Supported
Hypothesis 2C	Conscientiousness		Not Supported
Hypothesis 2D	Neuroticism		Supported
Hypothesis 2E	Openness		Not Supported
Hypothesis 3A	Extraversion	Perceived behavioral enjoyment	Not Supported
Hypothesis 3B	Agreeableness		Supported
Hypothesis 3C	Conscientiousness		Not Supported
Hypothesis 3D	Neuroticism		Not Supported
Hypothesis 3E	Openness		Not Supported
Perceived Output Quality			
Hypothesis 4A	Accuracy	Perceived affective enjoyment	Supported
Hypothesis 4B	Completeness		Not Supported
Hypothesis 4C	Relevancy		Supported
Hypothesis 4D	Timeliness		Not Supported
Hypothesis 5A	Accuracy	Perceived cognitive enjoyment	Not Supported
Hypothesis 5B	Completeness		Not Supported
Hypothesis 5C	Relevancy		Supported
Hypothesis 5D	Timeliness		Supported
Hypothesis 6A	Accuracy	Perceived behavioral enjoyment	Not Supported
Hypothesis 6B	Completeness		Not Supported
Hypothesis 6C	Relevancy		Supported
Hypothesis 6D	Timeliness		Not Supported

4.4 Discussion

This section presents a discussion of the analyses obtained from Study I which examined the influence of the Big Five personality traits and the four dimensions of perceived output quality on players' enjoyment of HCGs in three dimensions. The results reveal the significant impact of the personality trait of extraversion on perceived affective enjoyment, neuroticism on perceived cognitive enjoyment, and openness on both perceived affective enjoyment and behavioral enjoyment. Furthermore, the significant influence of perceived output accuracy on perceived affective enjoyment, relevancy on perceived affective, cognitive and behavioral enjoyment, and timeliness on perceived cognitive enjoyment are identified.

4.4.1 Influence of Personality Traits

Extraversion. Firstly, Hypothesis 1A that suggests extraverted people would be more likely to enjoy HCGs affectively than introverted people was supported. This indicates that HCGs could arouse feelings of pleasure and emotions in extraverted players. This finding corresponds with previous research by Ryan and Xenos (2011) and Orchard et al. (2014) which advocates that extraverts become involved in online community-based environments more than introverts do, and it further strengthens their argument that the experience of emotions is a central factor in extraverts enjoying such environments. One possible explanation for why extraverted participants enjoy HCGs could be derived from the work of Hughes et al. (2012) which suggests that extraverted people socialize by seeking and sharing information online, and their inherent tendency to experience positive emotions makes them emotionally involved when pursuing such activities. Although *SPLASH* does not explicitly support social interaction, players may try to achieve it by feeding Globs with query-based comments (i.e., posting questions) or by conversing through the comment board inside virtual rooms. Experiencing a sense of social interaction in *SPLASH* through these aforementioned means may have induced affective states or emotions in extraverted participants. One extraverted participant commented, "*Playing SPLASH is fun because I can ask others for what I want to know about places that I don't really know*".

However, the predictions made about the personality trait of extraversion and, perceived cognitive (Hypothesis 2A) and behavioral enjoyment (Hypothesis 3A) were not

supported. In particular, the non-significant effects observed between extraversion and perceived cognitive enjoyment might be that extraversion matters more for tasks with high levels of social interaction particularly in cultivating positive thoughts. As sociability is an aspect of extraversion (Weibel et al., 2010), activities that support extensive social interaction and the strong sense of community might be particularly relevant to individuals high in that trait. Thus, it is likely that such individuals feel rewarded for participating in a socially-oriented HCG, which may induce them to judge this game favorably, in turn giving rise to cognitive enjoyment. However, the limited nature of interaction afforded by a HCG like *SPLASH* was not able to satisfy the sociability of extraverted participants, and therefore resulted in no influence on their cognitive enjoyment. One participant who scored high on extraversion remarked, “*It would be better if I can share my comments in SPLASH with my social media friends*”.

Considering the non-significant relationship between extraversion and perceived behavioral enjoyment, the finding appears to contradict some previous research in which people low in extraversion were found to immerse themselves in playing an online multiplayer role-playing game, *WoW* (e.g., Graham & Gosling, 2013; Weibel & Wissmath, 2011). Perhaps it could be due to the differences in the support of social interaction between *WoW* and *SPLASH*. In the former, for instance, players can form guilds where like-minded players come together and help each other with certain game objectives, providing a deeper form of social interaction among players. Such gameplay encourages extraverted players, who possess a higher degree of social interaction to spend longer playing the game (Huh & Bowman, 2008), which in turn increases the likelihood to become engrossed in it, thereby triggering behavioral enjoyment. Therefore, the lack of explicit group formation or team play in *SPLASH* may possibly hinder extraverted players from being persistent in its play, resulting in no impact on behavioral enjoyment.

Neuroticism. Secondly, neuroticism was significantly positively associated with perceived cognitive HCG enjoyment, thus providing support for Hypothesis 2D advanced in this study. In other words, this finding suggests that the enjoyment of HCGs for people high in neuroticism stems mainly from having a favorable attitude toward these games. HCGs, in line with the majority of online applications that allow more preparatory time for constructing the solutions or output (Shen et al., 2015), seemed to be quite compatible with individuals high in neuroticism. In addition, the approach of anonymous HCG play seemed to provide an environment in which neurotic players feel secure enough to engage

in generating computations, which in turn induced favorable thoughts about these games. For example, *SPLASH* allows players to represent themselves with avatars, and the interaction that happens only by means of information sharing and direct communication among players is not instrumental in achieving the objective of feeding the Globs. This feature of *SPLASH* seemed to afford the appropriate amount of anonymity needed by people with a high level of neuroticism, which in turn affects what they think about HCGs, leading to cognitive enjoyment. A participant scoring high on neuroticism, lending support to this view, commented, “*SPLASH is important because it allows me to show real me*”.

Furthermore, this finding could be explained by the relationship between the trait of neuroticism and autonomic arousal, which suggests that the activation level of neurotic people decreases as the task difficulty increases (Eysenck, Derakshan, Santos, & Calvo, 2007). As such, people with high levels of neuroticism are less likely to achieve good performance in demanding and stressful tasks (Bishop, 2009). This is because, according to the attention allocation mechanism (Eysenck et al., 2007), people high in neuroticism narrow down the range of cue utilization in order to focus on what they are doing. However, in tasks requiring much skills and effort of players, being distracted from certain cues may result in lower processing efficiency, which negatively affects performance (Studer-Luethi, Jaeggi, Buschkuhl, & Perrig, 2012). The relatively simple and uncomplicated nature of *SPLASH* play may have perhaps enabled neurotic players to concentrate entirely on the task of location-based content creation, resulting in higher performance. Thus, participants who scored high on neuroticism are likely to hold an impression that a HCG such as *SPLASH* helps them perform better in output generation, which may lead them to judge the game more favorably than those who scored low on this trait, thereby experiencing enjoyment via the cognitive dimension.

Although it may seem logical that people high in neuroticism are less likely to enjoy HCGs affectively, the present study did not support this prediction and hence Hypothesis 1D was not confirmed. This finding contradicts much of prior research, which suggests that neuroticism is negatively associated with positive affect or emotions (e.g., Ng, 2009). One explanation for this finding might be that the relationship between neuroticism and positive emotions is moderated by the perception of the activity itself. As individuals high in neuroticism tend to react more strongly to negative stimuli than those low in this trait, neurotic people would feel less positive in activities that are perceived to

be unpleasant (Lü, Wang, Liu, & Zhang, 2014). Put differently, the strength of positive emotions encountered by high- and low-neurotic individuals may not significantly differ in pleasant activities. In the present study, neurotic players were found to exhibit favorable attitudes toward HCG play which is demonstrated by the significant positive relationship between neuroticism and perceived cognitive enjoyment (i.e., Hypothesis 2D), implying that such players may regard playing HCGs as a pleasant activity. Hence, this study found no association between neuroticism and perceived affective enjoyment of HCGs.

Similarly, this study found that the effect of neuroticism on perceived behavioral enjoyment was non-significant, providing no support for Hypothesis 3D. This finding is inconsistent with prior studies (e.g., Huh & Bowman, 2008; Weibel et al., 2010) which suggest that individuals high in neuroticism are more likely to be addicted to online hedonic applications than those low in this trait. Unlike purely hedonic applications, players of HCGs are required to generate output as part of gameplay. Due to the manifestation of negative emotionality in neuroticism, participants high on neuroticism may have attempted to overcome their negative emotions by focusing on the output-creation task rather than immersing themselves in the gameplay, which in turn diminishes behavioral enjoyment. One participant who scored high on neuroticism commented, *“I was aware that I would get higher scores when I created something useful, so I focused on this”*.

Openness. Thirdly, openness was observed to have significant negative influences on both perceived affective and behavioral enjoyment, which is contrary to Hypothesis 1E and 3E respectively. These findings contradict with those of previous studies in which openness was positively associated with emotional involvement and absorption in the use of social media and entertainment-oriented online games (e.g., Graham & Gosling, 2013; Weibel et al., 2010). As people who rate highly in openness have a wide variety of interests and a willingness to pursue those interests through innovative and unusual means (Hughes et al., 2012), addressing computational problems through games would seem to be a natural fit for those who are inherently curious. Thus, it is somewhat puzzling that high levels of openness were related to low levels of perceived affective and behavioral enjoyment. Perhaps this could be explained from the viewpoint of Ross et al. (2009), which suggests that people scoring high on openness seemed to have difficulty in communicating with others through online media because their interests do not translate

well. In other words, they require more descriptions to express their opinions (e.g., facial cues and other nonverbal signals) than those provided in an impoverished online medium (Ross et al., 2009).

Here, *SPLASH* is low in media richness compared to games such as *The Sims* where players can project various emotions in their in-game characters (Zammitto, 2010), and blogs where users can elaborate on their experiences in greater detail (Guadagno et al., 2008). One participant remarked, “*SPLASH’s virtual rooms are boring because they have very limited features to explore compared to other more advanced social games*”. Another participant commented, “*SPLASH should have a feature that allows players to share information in more detail*”. Although *SPLASH’s* pets present happy and sad emotions based on the positivity and negativity of comments, these emotional expressions seemed not to be sufficient enough for people with high levels of openness to express their interests, thereby decreasing the likelihood of being involved emotionally and behaviorally in the game.

Although Hypothesis 2E anticipated that individuals who score high on openness would have a greater level of cognitive enjoyment of HCGs, the results did not support this hypothesis. This is surprising because people who exhibit strong openness seem to appreciate the novelty value of new technologies such as the Internet and social media, as they display a greater tendency to use these technologies compared to their less open counterparts (e.g., Correa et al., 2010; Hughes et al., 2012). Due to the uniqueness of HCGs that blends gaming with output generation, individuals scoring high on openness were expected to feel curious about these games. Prior research suggests that curiosity determines the exploratory behaviors of individuals (Jeng & Teng, 2008). In this regard, one possible explanation for this non-significant outcome might be that high-openness participants expected to enjoy exploring a HCG such as *SPLASH* in terms of discovering new locations or interesting content and receiving rewards for their discoveries, as well as experiencing narratives in the game. However, *SPLASH* was not able to facilitate such kinds of exploration in its current form, and hence the need for curiosity required by participants who scored high on openness was not fulfilled, resulting in no influence on their cognitive enjoyment. Participants who scored high on openness remarked, “*SPLASH is certainly innovative, but its gameplay is a little bit boring and less exciting*” and “*It would be more fun if SPLASH let me create comments as a form of solving quests or act as guided by the storyline*”.

Agreeableness. Fourthly, contrary to expectations, agreeableness was found to be non-significant in influencing the perceived affective (Hypothesis 1B), cognitive (Hypothesis 2B), and behavioral (Hypothesis 3B) enjoyment, indicating that participants' tendency to be agreeable did not determine their enjoyment of HCGs. This finding concurs with much of the previous research which has found no relationship between agreeableness and the generic use of the Internet and social media (e.g., Amichai-Hamburger & Vinitzky, 2010; Ross et al., 2009). However, studies which examined the specific behaviors of online game players reported that people who scored high on agreeableness were more likely to participate in group-based gameplay, whereas those who score low for this trait seemed to prefer combat-oriented games (e.g., Mosley, 2010; Yee et al., 2011). Thus, this finding may be attributable to the differences in preference for particular gameplay styles or game genres. Peever et al. (2012) contend that individuals seem to hold a preference for certain game genres which may, in turn, affect how they respond to them. In this study, the current version of *SPLASH* does not offer any explicit forms of collaboration or competition among players in sharing location-based content. This may have caused no variation in the preference for the game among high- and low-agreeable participants resulting in no influence on their perceived enjoyment. This same observation was made by a participant who scored low on agreeableness, saying, "*Leaderboards could not attract me that much and I would prefer to pit myself against other players*". Thus, future research may discover whether individuals with varying levels of agreeableness exhibit different levels of enjoyment of a certain HCG genre.

Conscientiousness. Finally, conscientiousness was found to determine none of the dimensions of perceived enjoyment which rejected the hypotheses proposed—Hypothesis 1C for affective, 2C for cognitive, and 3C for behavioral enjoyment. Such a result is surprising. Since highly-conscientious people tend to be well organized and hardworking (Teng, 2008), they could yield better performance in tasks (Bakker, Demerouti, & Lieke, 2012). Such situations would drive them to experience positive emotions, positive assessment of, and engrossment in the tasks performed (Reinecke, Trepte, & Maass, 2011). Contrary to such previous research, the findings demonstrate how an individual's experience of HCG enjoyment is unaffected by his/her levels of conscientiousness. Perhaps the entertainment-output generation duality of HCGs may be a hindrance for conscientious individuals to experience enjoyment. For instance, since a

HCG incorporates gaming into the task of output creation, conscientious participants may still have perceived it as an entertainment game in which they put less interest in (Graham & Gosling, 2014), thereby impeding enjoyment. The qualitative feedback supported this, with one high-scoring participant feeling demotivated in the gameplay, reporting, “*SPLASH should tell me which level I am in now. Lack of this demotivated me as I did not feel like I was making progress in the game*”. Another explanation might be that game genres may have moderated the relationship between conscientiousness and perceived enjoyment. For instance, in competitive games, players need to work against each other (Peng & Hsieh, 2012), and hence their achievements in this game genre may be more significant for them. Given that people high in conscientiousness are achievement-oriented (McGhee et al., 2012), they are likely to be attracted to competitive games, and playing their preferred game genres increases the likelihood of experiencing enjoyment (Johnson et al., 2012). With an aim to attract a wider range of players, *SPLASH* adopts a simple and familiar game design that allows players to quickly reach proficiency and easily accomplish the designated goal (Kultima, 2009). Hence, the level of performance or achievement in *SPLASH* may not be significant enough for conscientious players, thereby diminishing their enjoyment. Future research should, therefore, empirically examine the potential mediating effects of game genres on the conscientiousness-enjoyment relationship in HCGs.

4.4.2 Influence of Perceived Output Quality

Accuracy. Perceived output accuracy was found to exert influence on perceived affective HCG enjoyment, supporting the Hypothesis 4A made in this study. Consistent with previous research (e.g., Kim & Han, 2009), this finding indicates that participants give importance to the accuracy of output generated by HCGs, as in other online user-generated content applications. This study further demonstrates that HCGs need to convey an impression that their output is accurate to make players enjoy the game affectively. In this regard, this study strengthens the argument of Éthier et al. (2004) in that the emotional experiences of individuals are central to the use of online information-oriented applications. One possible explanation might be that accurate outputs may have encouraged participants to feel satisfied with HCG play, which in turn triggers affective enjoyment. The qualitative feedback supported this, with one of the participants who scored high on perceived accuracy reporting, “*Some decent and highly-rated information*

made me feel satisfied with the game (SPLASH), otherwise I might stop playing it". In this study, *SPLASH* includes a rating mechanism whereby players judge the quality of each other's comments and this rating's value signifies their quality. In addition, *SPLASH* went a step further by visualizing these ratings values in the color of the Globbs. Perhaps the features of ratings and visualization paved the way for an accuracy assessment, contributing to the significant association between perceived accuracy and affective enjoyment.

However, the results did not provide support for Hypothesis 5A and 6A, each of which predicts the positive association between perceived accuracy and perceived cognitive and behavioral enjoyment respectively. One possible explanation might be that due to the integration of games with output generation in *SPLASH*, it was not able to instill a sense of worthiness in participants in terms of producing accurate output, which in turn thwarted the development of cognitive and behavioral enjoyment. The qualitative responses backed this up, with one of the participants reporting feeling discouraged by the quality of *SPLASH*'s outputs, saying, *"I didn't see any value in playing it (SPLASH) because I felt that people were not making enough effort to create quality content, but playing it for fun"*. In this regard, the impression that HCGs are effective in motivating players to behave in a way that is productive seems to influence their attitudes toward output quality, which may in turn determine whether they enjoy these games cognitively and behaviorally. For instance, people were found to achieve higher performance in group-based activities than in individual-based activities (Ladley et al., 2015). Here, *SPLASH* does not require players to depend on each other to earn points. Consequently, participants may have regarded *SPLASH* gameplay as a solo or individualistic activity, which in turn makes them impartial in assessing its effectiveness, resulting in this non-significant result. Clearly, the investigation of the potential difference in perceptions of quality across gameplay situations or genres is an area for future research.

Relevancy. A significant positive influence of perceived output relevancy on perceived affective, cognitive and behavioral enjoyment was observed, providing support for Hypothesis 4C, 5C and 6C respectively. These findings highlight the necessity to elicit the perceptions of players that the generated output is relevant to their needs to drive individuals' enjoyment of HCGs and similar applications that yield user-generated content affectively, cognitively, and behaviorally. One possible explanation might be that players actively seek location-relevant content to understand better about their

surrounding areas (Schaal et al., 2012), so the relevant content generated by *SPLASH* may have increased their satisfaction with and value of HCG play, in turn giving rise to affective and cognitive enjoyment. One participant who scored high on perceived output relevancy commented, *“I think the game (SPLASH) is fun and useful at the same time. Because I had stacked up many gold points while I was finding relevant location-based information”*. Furthermore, the impression that *SPLASH* offers relevant content may have encouraged participants to engage more with the game, which in turn triggers behavioral enjoyment. A comment made by one participant lends support to this view, stating, *“I feel engaged in SPLASH as it gives me a bunch of comments which are of my current interest”*. These findings, therefore, underline the importance of situations that facilitate the creation and discovery of relevant output in HCGs. Here, *SPLASH*’s content structure, where comments are organized with respect to the associated locations and units, enables players to bump into more relevant information about their location of interest.

Timeliness. Thirdly, the perceived timeliness of output was identified as a determinant of perceived cognitive enjoyment of HCGs, which supports Hypothesis 5D, indicating the importance of timely output in HCG context. This is consistent with the findings of prior studies (e.g., Kim, Oh, Shin, & Chae, 2009). However, this finding contradicts Kim and Han (2009) who found no relationship between timeliness and user beliefs about online questioning and answering. This difference could be attributable to the mobility of *SPLASH* where players give importance to information timeliness, as they need to make appropriate decisions at specific times and locations (Basole & Chao, 2004). The view that *SPLASH* generates timely output may have increased the usefulness of the game, which prompted participants to judge it more positively, leading to cognitive enjoyment. In particular, *SPLASH* changes the weather of the mushroom houses and the age of the Globs based on the recency value of comments. Perhaps this feature was able to signify the timeliness of its output, which further influenced the participants’ beliefs and attitudes toward the game. The results of this study, however, provide no support for Hypothesis 4D and 6D, which predicted a positive relation between perceived output timeliness and affective and behavioral enjoyment respectively. One possible explanation might be that timeliness contributes more to the utilitarian value of *SPLASH* as the timely information is needed to make appropriate decisions in the mobile context (Kim & Han, 2011). Put differently, timely output prompted participants to judge *SPLASH* more from a utilitarian perspective, rather than an emotional one, thereby having no influence on

affective and behavioral enjoyment. The qualitative feedback backed this up, with one of the participants who scored high on perceived output timeliness reporting the usefulness of *SPLASH* in delivering current information by saying, “*I find it (SPLASH) useful because I can find the information I want immediately*”.

Completeness. Finally, the non-significance of the perceived output completeness suggests that players are not concerned about this quality aspect while playing HCGs, indicating that having output with all the required details is not necessary for players to experience enjoyment of HCGs. This finding does not support Hypothesis 4B, 5B and 6B, and it is also not consistent with previous research into user-generated content applications which found that users who perceived a higher level of content completeness exhibited a greater level of trust in these applications (e.g., Kim & Han, 2009; Lee et al., 2009). This finding can be explained by the assertion of Rieh (2002) which suggests that there are differences in the importance of output quality dimensions across content types such as factual or social. Speculatively, *SPLASH* may attract more opinion and social content types in which the completeness quality aspect may not be so important (Fichman, 2011), thus diminishing the role played by output completeness on perceived enjoyment. One participant supported this view by stating that *SPLASH*’s comments offered more emotional content rather than in-depth and factual content.

4.5 Summary

Study I was conducted to address the first research question and objective. In particular, this study investigated the influential factors of the three dimensions of perceived HCG enjoyment using a lens of personality traits and perceived output quality. Utilizing *SPLASH*, a location-based content-sharing HCG as a context of study, players’ experiences were gathered in a cross-sectional survey. The results demonstrated that perceived output relevancy had a stronger influence on perceived affective enjoyment, followed by personality traits of extraversion and openness, and perceived output accuracy. Furthermore, perceived output relevancy had the strongest impact on perceived cognitive enjoyment followed by perceived timeliness of output and the neuroticism trait. The variables found to predict behavioral enjoyment were perceived relevancy and the openness trait. In sum, Study I provided evidence that not all personality traits and perceived output quality dimensions are significant in determining players’ enjoyment of

a HCG, *SPLASH*. This study, therefore, calls for a nuanced approach to research not only to explain these non-significant relationships but also to provide insights into the significant findings.

In particular, Study I is descriptive as it could only explain whether personality traits and perceived output quality have a positive or negative effect on players' perception of enjoyment. As such, the study was not meant to provide an explanation of the antecedents that contributed to its findings. One possibility might be that individuals with varying personality traits seek different motivational elements in games (Park et al., 2011). For instance, players scoring high on openness may be motivated to enjoy a HCG by exploring and discovering new things during its play. Similarly, as people who work hard on the tasks at hand tend to have a higher self-efficacy (Di Giunta et al., 2013), perceived self-efficacy could be another factor that may mediate the personality-enjoyment relationship in HCGs.

In addition, the non-significant findings may suggest that the effects of genres might exist in the context of HCGs. Prior research on media psychology suggests that individuals seem to have a preference for certain media content or genres depending on the personality traits they possessed (Kraaykamp & Van Eijck, 2005). In games, mechanics are the fundamental element that drives the way that players behave in the game (Siu et al., 2014). Hence, games can be classified by different genres, depending on the type of mechanics used (Waddell & Peng, 2014; Zagal, Rick, & Hsi, 2006). For instance, a HCG could be classified as a collaborative genre if its gameplay allows players to work together to reach the victory conditions, whereas a HCG that allows players to compete against each other can be named as a competitive genre. Due to the use of different game mechanics, the experience derived from a collaborative HCG could be different from those which arise from competing with others. Since personality drives the way an individual thinks, behaves and approaches a particular situation (John et al., 2010), it may be a determinant of individual preference for HCG genres. Indeed, findings from prior research on entertainment-oriented games (e.g., Park et al., 2011; Yee et al., 2011) have found that personality determines how players behave during gameplay, suggesting a possible relationship between personality and game genre preference. It is thus worthwhile to expand the scope of Study I by investigating how the influences of driving factors of perceived enjoyment (i.e., personality traits and perceived output quality) vary across HCG genres.

CHAPTER 5

STUDY II – INVESTIGATING PERSONALITY-TARGETED HCG GENRES

This chapter presents Study II which aims to address the second research question and objective. Study II involves investigating whether the influence of individual differences in personality on perceived enjoyment varies across HCG genres and whether perceived output quality differs across HCG genres. Based on the findings of Study I and the review of previous literature, this chapter postulates research questions and hypotheses for Study II and tests them using three developed types of applications for mobile content-sharing: *Collabo*, which employs a collaborative gameplay style enabling players to work together while contributing location-based content; *Clash*, which employs a competitive gameplay style allowing players to compete against each other while contributing location-based content; and *Share*, which is a control application with no gaming features included. The development of the research questions and hypotheses, the descriptions of the application types used, the study design, the data collection approach, the results and a discussion are then presented in this chapter.

5.1 Introduction

A large body of research on social and entertainment-oriented media is concerned with identifying effective ways of encouraging user enjoyment and participation (Johnson et al., 2012; Wang et al., 2012). In particular, a stream of research has focused on psychological factors, such as personality, as a primary predictor of the media usage behavior of individuals (e.g., Hughes et al., 2012; Ryan & Xenos, 2011). Another stream has emphasized the characteristics of the media, such as the types of social interaction and collaboration supported (Yee et al., 2011). However, research focusing on either psychological factors or media characteristics are descriptive as they could only explain the extent to which the media exerts a positive or negative influence in particular circumstances (Johnson & Gardner, 2010). Stated differently, these research findings could not provide insights into how to maximize individuals' motivation for media use by considering the aspects of the media that appeal to different individuals.

A further strand of research has tried to bridge these opposing views and highlight the joint contribution of personality and media characteristics to explaining the behaviors of individuals (e.g., Blau & Barak, 2012; Nov et al., 2013). In fact, each game genre has its own specific characteristics with the use of particular game mechanics and elements (Siu et al., 2014; Zagal et al., 2006) and hence, the game genre preference of players may correspond to their personality factors. Prior research on media psychology also suggests that the consideration of personality traits exhibited by an individual facilitates the prediction and explanation of media content or genre preferences (e.g., Johnson et al., 2012; Kraaykamp & Van Eijck, 2005). Therefore, depending on the personality trait possessed, players may be more attracted to certain HCG genres, which may in turn determine their levels of enjoyment. Furthermore, the non-significant findings of Study I may imply that individuals with varying levels of personality traits respond differently to HCG genres. Thus, it is important to investigate the effects of the interaction between players' personality traits and game genres on their enjoyment in HCGs.

Study II has been planned to examine the effects of personality traits on players' enjoyment across HCG genres. This study is also in line with recent studies drawing on the interactionist tradition in psychological research, which highlights how the interaction between individuals' personality and design features affects their experiences and behavior in the online context (e.g., Nov et al., 2013). In this regard, Study II will complement and extend Study I, furthering the understanding of players' enjoyment in HCGs by highlighting the interaction between personality traits and game genres.

5.1.1 Collaborative and Competitive Game Genres

According to prior research, games can be broadly classified into two genres, collaborative and competitive (Velez, Greitemeyer, Whitaker, Ewoldsen, & Bushman, 2014; Zagal et al., 2006). Moreover, according to a recent survey of HCGs and related systems (Pe-Than et al., 2013; Quinn & Bederson, 2011), most HCGs can be classified into either collaborative or competitive genres. This study therefore attempts to examine the interaction of personality traits with collaborative and competitive game genres as described below.

In collaborative games, players work together as a team and the outcomes are shared among team members (Cerny & Mannova, 2011; Waddell & Peng, 2014). In

particular, team members in a collaborative game have a common goal, and they work together to achieve this goal and share the rewards and punishments resulting from the gameplay. For instance, if the team wins or loses, everyone wins or loses. An example of a collaborative HCG is the *Gopher Game* (Casey et al., 2007) where, in order to score game points, two players need to work together as a team with one player creating a mission (i.e., asking textual and multimedia descriptions about a location) and the other taking on the mission and solving it (i.e., creating the information requested). After another player has reviewed the play and decided that the mission has been completed, both players earn points.

In contrast, players develop strategies to play against others in competitive HCGs, and only one player at a time can achieve the winning condition (Zagal et al., 2006; Cerny & Mannova, 2011). In particular, players play against each other to achieve the winning condition in competitive games. Many HCGs have utilized this type of gameplay (Waddell & Peng, 2014). One such example is *KissKissBan* (Ho et al., 2009), in which a pair of players need to produce matching image labels which are not included in a list of labels created by another player (called a blocker). With this game rule, *KissKissBan* creates a sense of competition between the pair of players and the blocker, and the image labels are the result of the competition between them.

5.2 Research Questions and Hypotheses Development

Scholars in the field of media psychology have consistently suggested that enjoyment is a complex construct comprising multiple dimensions (Tamborini et al., 2010; Vorderer et al., 2004). According to the model of media enjoyment proposed by Nabi and Krcmar (2004), perceived enjoyment includes three components— affective, cognitive and behavioral—which may mutually exert influence on each other. This multidimensional conceptualization of enjoyment has been empirically confirmed in Study I in the HCG context and will be employed in Study II,

Furthermore, the findings of Study I revealed that individuals' personalities exert influence on these dimensions of perceived enjoyment. In particular, the personality traits of extraversion and openness determined the tendency to experience emotions and affects in *SPLASH*. In addition, openness influenced the propensity to experience behavior that indicates total involvement with *SPLASH*. However, the personality traits of

agreeableness and conscientiousness were not found to influence any dimension of perceived enjoyment. One possible explanation for these non-significant relationships is that participants who have these personality traits do not respond well to *SPLASH* and its features. Stated differently, the design of *SPLASH* is not effective in evoking enjoyment in all participants. Hence, HCG genres that target participants with different personality orientations should be examined.

Meanwhile, prior research suggests that individuals with certain personality traits have a particular set of motivations for using social media and playing online games (e.g., Jeng & Teng, 2008; Johnson et al., 2012). It is therefore probable that the players' personalities will determine how they respond to a particular HCG genre which in turn affect their perceived enjoyment. This study argues that the interaction between players' personality trait levels (i.e., low or high scores) and HCG genres (i.e., collaborative and competitive) would influence the three dimensions of perceived enjoyment. Accordingly, the hypotheses to be investigated in Study II are formulated and presented in the following sections.

5.2.1 Perceived Enjoyment, Personality Traits and HCG Genres

Extraversion refers to the extent to which individuals are sociable, outgoing, active and enthusiastic (John et al., 2008). This personality trait is typically characterized as an individual's level of comfort in interpersonal relationships (Howard & Howard, 1995). As such, extraverts generally enjoy activities which offer interpersonal relationships among participants (Ross et al., 2009). Introverts, on the other hand, are reserved and distant toward other people and hence they are more likely to be involved in solo activities (Ryan & Xenos, 2011).

Extraverted individuals were found to use social media to maintain relationships with friends and family, and to meet new people online (Correa et al., 2010). The preference of extraverts for social activity is also reflected in their use of social media for sharing and seeking information. For instance, extraverts preferred *Facebook* to *Twitter* to share and seek information because the former affords a richer form of social interaction in performing such activities (Hughes et al., 2012). Extraverts were also found to encounter a lower number of conflicts with their friends in social media environments (Quercia, Lambiotte, Stillwell, Kosinski, & Crowcroft, 2012). Furthermore, while being

involved in the social settings of an organization, extraverts were found more likely than introverts to be attracted by a team culture (Judge & Cable, 1997). Similarly, while playing traditional games for pure entertainment, players who score high on extraversion were more likely to participate in group activities where they cooperate with other players to accomplish the challenging tasks (e.g., Jeng & Teng, 2008; Mosley, 2010). Thus, extraverts may experience a greater level of enjoyment than introverts in collaborative HCGs.

On the other hand, introverted individuals were found to be involved in more solo gameplay activities and they had more duel-winning statuses than extraverted individuals when playing online games (e.g., Mosley, 2010; Yee et al., 2011). This finding may suggest that introverts would prefer to compete with other players as long as they are allowed to carry out the given tasks or challenges alone. It is therefore likely that introverts will experience a higher level of enjoyment of competitive HCGs than extraverts. Based on the findings presented above, this study proposes the following hypotheses:

Hypothesis 1A: Players who score high on extraversion will experience *a higher level* of perceived affective, cognitive, and behavioral enjoyment of *collaborative HCGs*.

Hypothesis 1B: Players who score low on extraversion will experience *a higher level* of perceived affective, cognitive, and behavioral enjoyment of *competitive HCGs*.

Agreeableness represents the extent to which individuals are friendly, cooperative, modest and trustworthy (John et al., 2008). It is also characterized as the level of an individual's ability to get along with other people (Korukonda, 2007). As such, individuals who score high on agreeableness would perform better in group settings as they are more likely to adapt to group norms and collaborate with group members (Howard & Howard, 1995). In contrast, people who score low on agreeableness tend to be unfriendly, hard-hearted, quarrelsome and competitive (Tobin et al., 2000).

In the workplace environment, agreeable people were found to prefer working together with others which may suggest that they possess a higher tendency to be involved in group-based activities (Judge & Cable, 1997). This may be because people who score high on agreeableness are more likely to succeed in maintaining positive relationships with other team members than those who score low for this trait due to their

empathetic and cooperative nature (John et al., 2008). Furthermore, prior studies suggest that agreeableness seems to influence players' in-game behavior. For instance, when playing multiplayer online games for pure entertainment, people who scored high on agreeableness were more likely to take part in group challenges and non-combat activities whereas those who scored low for this trait were more likely to enjoy killing their opponents and challenging them to a duel (Mosley, 2010; Yee et al., 2011). Hence, it is probable that individuals who score high on agreeableness are more likely to experience a higher level of enjoyment when playing collaborative HCGs than those who score low for this personality trait. Similarly, individuals who score low on agreeableness are more likely to experience a higher level of enjoyment when playing competitive HCGs than those who score high for this personality trait. Hence, the following hypotheses are proposed:

Hypothesis 2A: Players who score high on agreeableness will experience *a higher level* of perceived affective, cognitive, and behavioral enjoyment of *collaborative HCGs*.

Hypothesis 2B: Players who score low on agreeableness will experience *a higher level* of perceived affective, cognitive, and behavioral enjoyment of *competitive HCGs*.

Conscientiousness reflects the degree to which individuals are ambitious, resourceful, persistent and efficient (John et al., 2008). Therefore, conscientious people are more likely to be organized, self-disciplined, responsible and thorough at performing tasks, whereas people low on conscientiousness tend to be disorganized, spontaneous, self-indulgent, irresponsible and careless.

Individuals who scored high on conscientiousness are regarded as achievement-oriented, and they were found to succeed in various task-oriented contexts such as job and education (e.g., Lin, Chiu, & Hsieh, 2001; Panaccio & Vandenberghe, 2008). Similarly, while playing multiplayer online games such as *The Sims 2*, highly-conscientious individuals were found to be able to accomplish in-game objectives by planning and organizing required activities thoroughly (Griebel, 2006). For instance, conscientious people were determined to ensure that their Sims live in clean houses, have interesting jobs and accomplish their goals. This could be because individuals who score high on conscientiousness tend to follow norms and rules, and they are able to plan and prioritize tasks effectively which, in turn, enables them to triumph in any undertaken activity (Teng,

2008). As such, they are more likely to succeed when working together with other players because tackling collaborative challenges in games includes adhering to the group norms and objectives and acting accordingly (Judge & Cable, 1997). Therefore, a collaborative HCG would be more important for conscientious people in order to experience a higher level of enjoyment.

In contrast, individuals who score low on conscientiousness are inclined to take part in activities which involve a higher level of risk (McGhee et al., 2012). Given this predisposition, it is not surprising that people who are less conscientious seem to enjoy the competitive-oriented aspect of gameplay which requires players to risk losing something that they have possessed during the game (Yee et al., 2011). Furthermore, competitive gameplay requires players to make decisions and change their actions promptly to respond to their opponents' moves (Zagal et al., 2006). Indeed, people who are less conscientious were found to be able to make more accurate decisions when unforeseen changes occurred (LePine, Colquitt, & Erez, 2000). Given this predisposition toward spontaneity and strong risk-taking tendency, players who are low on conscientiousness are more likely to succeed in adapting their actions, so as to increase their chances of winning which could subsequently lead to their enjoyment of competitive HCGs. Hence, this study advances the following hypotheses:

Hypothesis 3A: Players who score high on conscientiousness will experience *a higher level of perceived affective, cognitive, and behavioral enjoyment of collaborative HCGs*.

Hypothesis 3B: Players who score low on conscientiousness will experience *a higher level of perceived affective, cognitive, and behavioral enjoyment of competitive HCGs*.

Openness is a personality dimension that characterizes someone in terms of imagination, sensitivity, curiosity and thoughtfulness (McCrae & Costa, 2003). As such, people who score high on openness are more likely to be behaviorally flexible, give attention to others' opinions, seek new and innovative ideas, and have rich, complex and emotional lives (Krcmar & Kean, 2005). In contrast, people who score low on openness are considered to be conventional and traditional, and hence less receptive to others' perspectives (Park & Antonioni, 2007).

Due to their appreciation for variety and novelty, people who are open to experience were motivated to seek out diverse and varied experiences by exchanging

opinions with others on blogs and social media (Guadagno et al., 2008; Hughes et al., 2012). This finding may suggest that people with high openness are responsive to others' opinions, hence they may seek opportunities for collaboration rather than competing with others. This assertion received support from the findings of studies in the gaming context which suggests that players with high openness tend to spend a great deal of time on non-combat activities such as exploring the game world and collecting items (Peever et al., 2012), as well as group-based activities (van Meurs, 2007). Thus, players scoring high on openness are more likely to enjoy collaborative HCGs that provide opportunities for working together with others in generating output.

At the opposite end of the spectrum, people with low openness are considered to be less receptive to others' opinions (Wang et al., 2012). This predisposition may decrease their tendency to collaborate with others. In the organizational context, people scoring low on openness were found to attempt to achieve their goals at the expense of others (Park & Antonioni, 2007). While playing online social games such as *World of Warcraft*, they were found to enjoy combat-oriented activities such as dueling against either artificial or human players (Yee et al., 2011). Thus, players with low levels of openness are more likely to experience a greater level of enjoyment of competitive HCGs. Based on the findings presented above, the following hypotheses are proposed:

Hypothesis 4A: Players who score high on openness will experience *a higher level of perceived affective, cognitive, and behavioral enjoyment of collaborative HCGs.*

Hypothesis 4B: Players who score low on openness will experience *a higher level of perceived affective, cognitive, and behavioral enjoyment of competitive HCGs.*

5.2.2 Perceived Output Quality and HCG Genres

As discussed in Chapter 4, output quality has been an important issue in HCGs which are meant to harness players' problem-solving abilities to yield high-quality output for the intended purposes (Celino et al., 2012). Accordingly, researchers have identified and utilized various quality control mechanisms to ensure the quality of output generated (e.g., Quinn & Bederson, 2011; Yuen et al., 2009). For instance, earlier HCGs, including the *ESP Game*, utilized a social verification mechanism in which an output was considered to be valid when players agreed upon it (von Ahn & Dabbish, 2004). In other words, output generation is the result of collaboration among players. Although the output

of collaborative HCGs was found to have a high level of accuracy (i.e., a high rate of matching with ground truth data), other studies suggest that players seemed to take advantage of the game by collaborating with other players which could result in low-quality output (von Ahn et al., 2006). For example, players attempted to score points by entering irrelevant tags or very generic tags in image- and music-tagging games. To alleviate the problem of cheating, some HCGs have employed competitive gameplay styles and this type of HCG was found to yield more specific output compared to collaborative games (Goh et al., 2011; Ho et al., 2009). The findings from the above studies suggest that the type and quality of output seemed to differ based on the game genres employed.

In addition, the social psychological literature has supported well the notion that collaboration and competition have different effects on the performance of individuals and enjoyment (Peng & Hsieh, 2012; Waddell & Peng, 2014). In particular, multiple scholars argued that compared with competition, collaboration should increase positive behaviors among individuals, thereby facilitating performance (e.g., Ladley et al., 2015; Tauer & Harackiewicz, 2004). This assertion received support from previous studies in contexts of learning and multiplayer gaming, which found that individuals in collaborative situations exhibited more cooperative behaviors and trust in their partners that may, in turn, lead to higher levels of performance (e.g., Waddell & Peng, 2014). Similarly, Peng and Hsieh (2012) found that collaboration led to greater effort put into the multiplayer gameplay than competition. In contrast, there are studies suggesting that individual performance in the collaborative context is no different to that of in the competitive context, possibly indicating the mediating effects of the characteristics of tasks being performed (e.g., Tauer & Harackiewicz, 2004). Although inconsistent, findings from previous studies indicate the potential difference in the effects of collaboration and competition on individual performance. Similarly, player performance in generating output may differ on the basis of collaborative or competitive HCG play which may, in turn, influence their perceived quality of output generated.

Furthermore, studies in the context of mobile applications found that individuals who possess a higher tendency to seek entertainment tend to exhibit higher perceptions about the quality of content afforded by such applications (e.g., Kim & Han, 2011). In general, HCGs are designed such that players are gratified by entertainment in return for output creation. It is therefore probable that players who experience a greater level of

entertainment in HCG play are more likely to exhibit higher perceptions about the quality of output. However, previous research into games for pure entertainment suggests that different game genres tend to provide varying levels of entertainment experience (Johnson et al., 2012; Przybylski et al., 2010). In particular, Johnson et al. (2013) found that games involving adventure and exploration are more likely to induce a higher level of flow experience than combat-oriented games. One possible explanation for this finding is that each game genre comprises a set of game elements that may provide a particular gameplay experience (Rollings & Adams, 2003).

Therefore, the experience of enjoyment afforded by collaborative and competitive HCG genres may differ, thereby inducing varying levels of perceptions about the quality of their output. As discussed in Chapter 3, quality dimensions of accuracy, completeness, relevancy and timeliness can be used to characterize the quality of the output of HCGs. Furthermore, all quality dimensions except completeness were found to have an effect on players' enjoyment of *SPLASH* in Study I. Despite being non-significant, completeness has been known to be an influential quality dimension in assessing user-generated online content (e.g., Alkhatabi et al., 2010). However, to the best of knowledge, no prior research has investigated the differences in perceived output quality dimensions across genres in the HCG and its broader context such as user-generated content (UGC) applications. Due to insufficient evidence, this study is unable to make any prediction about potential links between HCG genres and perceived output quality dimensions. Instead, the following research question is proposed:

RQ1: How do players' perceptions of output vary across collaborative and competitive HCG genres in terms of **A)** accuracy, **B)** completeness, **C)** relevancy and **D)** timeliness?

5.3 Introducing *Share*, *Collabo*, and *Clash*: Three Applications Developed

To investigate the proposed hypotheses and research question, three mobile content-sharing applications were developed: *Share*, a non-game mobile content-sharing application (serving as a baseline for comparing results); *Collabo*, a collaborative HCG for mobile content-sharing, and *Clash*, a competitive HCG for mobile content-sharing.

Although each application involves different gameplay styles, they all share a common set of features. Like *SPLASH*, these applications enable players to create and consume information about the places in their vicinity. All three variants of HCGs take

advantage of the GPS feature of smartphones to detect the players' current locations. Utilizing Google Maps, these applications present players with a map interface where real-world places are overlaid with mushroom houses. Each house has a number of units and each unit holds a number of comments created inside. Among the actions that may be performed in these applications, players browse and rate comments generated by others, as well as create new comments. Players are also able to compare their status with other players through a ranking list or leaderboards and they can maintain their own customizable avatars. Based on these common features described above, three variants of HCGs are developed and each is described in detail below.

5.3.1 *Share*: Mobile Content-Sharing Application

This control version presents a player with a number of locations on the map which are near his/her current position. The locations are marked by mushroom houses and players can tap on a house to enter the associated location. Figure 5.1 shows a player's nearby locations which are overlaid with mushroom houses on the map. Once inside a location, units that exist in this location are displayed to the player. This feature allows players to filter information based on which unit of the location they wish to explore. A list of units in a location is illustrated in Figure 5.2.

When a unit is selected, the title bar displays the names of the unit and the parent building which the player is currently visiting. The number of comments, the aggregated ratings of comments, as well as the "Add Comment" button are shown in the top panel. In addition, a list of comments is shown in the bottom panel. Players can view and rate the details of each comment by tapping on it. They can also create new comments by tapping on the "Add Comment" button displayed in the top panel. Players are not awarded with any game points or rewards for their activities as it is desirable for this application to be as close as possible to a standard content-sharing application. Instead, players can view statistics such as how many comments they have contributed and rated through the use of this application on their profile page. *Share* therefore serves as a representative location-based content-sharing application through which to compare the enjoyment of HCGs.

Figure 5.1. Mushroom houses on the map.

Figure 5.2. A list of units.

5.3.2 *Collabo*: Collaborative HCG for Mobile Content-Sharing

Collabo is a collaborative HCG for mobile content-sharing and it has a similar design to *SPLASH*, which is a pet-based game genre. Instead of asking players to create comments about locations directly, players of *Collabo* develop virtual pets or Globs by feeding them with location-based content. In order to promote a sense of collaboration among players, this game presents a theme which asks them to search for starving Globs in their vicinity and to collaborate with other players to rescue these Globs. The gameplay of *Collabo* is described in detail below.

Once a player has logged in to the game, he/she will see a number of places which are represented as mushroom houses on the map. The Globs live inside these houses and they are given full strength at the start of the game (i.e., 100 points in *Collabo*). This strength decreases over time and the Globs will begin to starve if their strength is lower than the minimum required to be healthy (i.e., 40 points in *Collabo*). To rescue a Glob successfully, players need to replenish its strength to reach above the level required to be healthy within a 15-minute period. During gameplay, players need to visit each nearby location to search for a starving Glob. The starving Globs will appear to be sad and they have a darker skin color compared to healthier Globs. Figure 5.3 presents a list of Globs inside a location with a starving pet in the second row.

To rescue the starving Glob, the player needs to feed it with a comment(s) which includes the description and tags about where it is residing. The player can also attach multimedia content to the comment such as images and videos. Alternatively, players can rate the comments fed by other players on a five-star scale. As the player creates and rates the comments, the strength of the Glob increases. The Globs, which are currently being rescued, are highlighted by a star which signals to other players to join the rescue team. To accelerate the rescue process, the player can request help from other players who are currently visiting this unit by broadcasting a message that the Glob needs feeding. The “Activities Tab” (refer to Figure 5.4) highlights these broadcast messages as well as all other activities completed on the Glob, such as information regarding who joined the team, who fed and rated comments, and who rescued the Glob in order to increase a sense of collaboration.

Figure 5.3. A list of Globs residing in a location.

Figure 5.4. Activities of players performed on the Glob.

In general, each comment fed to the Glob increases its strength by five points. Bonus points are awarded to exemplify the value of collaboration, which is obtained by dividing the total number of comments fed by all team members with the total number of team members. Furthermore, the rating value (i.e., 1 to 5) given by each player is added to the strength. The Glob is successfully rescued once its strength has reached the specified level (i.e., 75% in *Collabo*) within a 15-minute period. Once the Glob has been

rescued, the game allocates an equal amount of game points to the members of the rescue team while the appearance of the Glob becomes healthier and a winning message is displayed at the end as a form of immediate feedback. Figure 5.5 illustrates a period in *Collabo* when the winning message is displayed after the Glob has been successfully rescued. The comment list is shown in the bottom panel and the number of ratings and comments are displayed in the top panel, while the energy of the Glob is shown in the top right-hand corner.

Figure 5.5. Notification that a Glob has been rescued.

5.3.3 *Clash*: Competitive HCG for Mobile Content-Sharing

Clash, a competitive HCG for location-based content sharing, presents players with another form of challenge which allows them to compete with others for Glob ownership. Like *Share* and *Collabo*, the locations in the players' vicinity are shown in the form of mushroom houses on the map. Once a player has entered a house, a list of Globs inside the location is presented together with the name of the current Glob owner on the nametag below. The player can challenge the owner of his/her chosen Glob to a duel, and he/she will win if the total of his/her strength and daily luck is greater than that of the challenged player.

In Figure 5.6, the current Glob owner is "gigo" as shown on the nametag. The strength of the current Glob owner is displayed as an energy bar in the top right-hand

corner under which the “Feed Glob” and “Duel” buttons are located. The strength of each player is based on the quantity and recency of comments fed by the player as well as the number of ratings received from others. Specifically, the strength is boosted by five for each comment fed and by the overall number of ratings. The recency value of each comment is set at 100 when it is created and this is reduced by 10% each day. Hence, the new value is computed daily and added to the strength. A player’s daily luck value, which is generated at the first login of each day, is also added to the strength. In this way, the strength decreases as the comments have become outdated and the overall ratings have become poorer. This mechanism ensures that the Glob is winnable, not only by existing players but also by newcomers.

Figure 5.6. A Glob owned by “gigo” whose strength is shown in the top right-hand corner.

Figure 5.7. A winning message.

If a player wants to maintain ownership status, he/she needs to frequently feed the Glob with quality content, which is determined by the number of ratings given to the content. Similarly, players who want to challenge the current Glob owner have to accumulate their strength by feeding the Glob with quality comments. Figure 5.7 shows the victory conditions for “Emma” who is now the owner of the Glob residing in the “Communication and Information Library”. The game allows owners to securely retain the ownership status for a 15–minute period during which other players cannot challenge them. This feature was included on the basis of the results of the pilot testing in which

players reported that it was very easy to lose Globbs. Indeed, this period serves as a preparation time for both owners and other players so they can replenish their strength before the next wave of competition commences. The features of three implemented HCG variants are summarized in Table 5.1.

Table 5.1

Summary of the Features of Share, Collabo, and Clash

Feature	Description
Content Sharing Features of <i>Share</i>	
Comment browsing, creating, and rating	<ul style="list-style-type: none"> - Represent basic features of content-sharing applications - Facilitate content discovery, creation, and making judgement about others' comments
Usage statistics	<ul style="list-style-type: none"> - Show statistics such as total numbers of comment created and rated by the user
Collaboration-Supportive Features of <i>Collabo</i>	
Globs anchored by a star	<ul style="list-style-type: none"> - Serves as a signal indicating that other players are currently rescuing this Glob - Increases the chance that players join the rescue team
The Activity tab	<ul style="list-style-type: none"> - Displays all activities done by players on the Glob at the visited location - Facilitates a sense that the player is rescuing the Glob together with other players at the same time
Group-based feedback	<ul style="list-style-type: none"> - Provides as a winning message with the names of all team members
Competition-Supportive Features of <i>Clash</i>	
Dueling with the Glob's owner	<ul style="list-style-type: none"> - Engages players in a situation that allows them to directly compete with another player
A Ranking list or Leaderboard	<ul style="list-style-type: none"> - Shows top 10 players ranked by the total numbers of Glob owned - Facilitates a sense of indirect competition among players as they can compare their in-game standings against others

5.4 Method

5.4.1 Sampling

Study II adopted a convenience sampling approach in which researchers recruit individuals who are available and willing to participate in a study. In the initial screening survey, a total of 235 students from two local universities participated, in which 130 were undergraduate and 105 were graduate students. Of these, 180 participants were invited for the experiment and 163 participants agreed to participate. Three participants were later removed from the sample because they failed to complete specified gameplay sessions. Of the 160 remaining participants, 55% were undergraduate and 45% were graduate students.

In fact, university students have been regarded as good proxies for general online game players in prior studies (e.g., Kirriemuir, 2005; Sigurdsson et al., 2006; Wu and Liu, 2007), as well as a large group of mobile Internet users (Zhou et al., 2010). As such, the university student group recruited in this study may reasonably represent the overall population that is involved in online games and mobile services, and hence may be suitable for exploring player enjoyment of HCGs.

5.4.2 Experimental Design

This study adopted a 2 (Personality trait scores: low scores vs. high scores) by 3 (Application types: *Collabo* vs. *Clash* vs. *Share*) mixed experimental design which seeks to examine how the interaction between these two factors affects participants' perceptions of enjoyment, as shown in Figure 5.8. In this experiment, the application type is regarded as a within-subjects factor while personality trait is treated as a between-subjects factor, meaning that all participants in this experiment played all three application types but they were part of either a low or high personality group. In particular, there were six groups or cells. Participants completed a screening questionnaire which determined their respective low and high personality traits, and this was used to assign them to the appropriate condition. This experiment also utilized a counterbalanced design to reduce the chances of the order of the application used affecting the results. Therefore, participants were divided into six groups and each followed one of these six possible orders of combinations: *Collabo*, *Clash*, *Share*; *Collabo*, *Share*, *Clash*; *Clash*, *Collabo*, *Share*; *Clash*, *Share*, *Collabo*; *Share*, *Collabo*, *Clash*; and *Share*, *Clash*, *Collabo*.

Personality trait scores	Application types		
	<i>Collabo</i>	<i>Clash</i>	<i>Share</i>
Low scores on personality trait	N = 80	N = 80	N = 80
High scores on personality trait	N = 80	N = 80	N = 80

Figure 5.8. Experimental Design.

In addition, each HCG play is spaced one day apart (e.g., play *Collabo*, wait a day, play *Clash*, wait a day, use *Share*) to minimize carryover effects. This method is adopted from a prior study in the context of games for pure entertainment in which three gameplay sections were spaced 1–2 days apart so as to wear off the effect of the earlier gameplay (Ryan, Rigby, & Przybylski, 2006). After each HCG play, a questionnaire containing the measures of perceived enjoyment and perceived output quality was administered. The questionnaire is a revised version of the one developed in Study I in which two items used to measure the perceived behavioral enjoyment were modified due to low factor loadings (< 0.50). The revised questionnaire and the usage scenarios were approved by NTU-IRB and can be found in Appendix B.

Before the actual experiment commenced, a pilot study was carried out with 24 graduate students to uncover deficiencies in the questionnaire and study protocol, as well as to check whether the two experimental conditions (i.e., collaboration and competition) differ significantly. Participants were divided into two groups, and randomly assigned to play either *Collabo* or *Clash*. All participants reported that the entire questionnaire was clear and comprehensive. However, two of them reported that they became frustrated with *Clash* as it was difficult to maintain Glob ownership. The game was therefore revised and included a feature which allows owners to have their Globbs protected for a 15-minute period as described earlier in Section 5.3.3. The revised version of *Clash* is used in the actual experiment. At the end of the pilot study, participants were asked to what extent they agreed with the two statements: “I felt that I was collaborating with other players in *Collabo*”, and “I felt that I was competing with other players in *Clash*”. Responses ranged between 1 (strongly disagree) to 5 (strongly agree) using a Likert scale. A t-test was used to compare the means, and difference between collaborative ($M = 2.64$) and competitive ($M = 3.80$) HCGs was found to be significant ($p < 0.01$). The results

supported the assumption that *Collabo* and *Clash* represent collaboration and competition in HCGs.

5.4.3 Procedure and Data Collection

Participants were recruited through the following means: email and pamphlet invitations, the placement of posters around the university campus, and advertising in school classes. Participation in this experiment was voluntary and participants were assured that their information would be kept confidential. The study was conducted according to the following procedure.

Firstly, a screening questionnaire was distributed to potential participants from the two local universities through the abovementioned means two weeks prior to the experiment. This questionnaire comprised a total of 62 items measuring personality traits, gaming experience, mobile phone usage and other demographic items. Secondly, the participants' personality traits were analyzed to select those who could represent each trait on a first come, first served basis. In particular, participants were selected on the basis of their scores their personality traits until all allocated slots for the corresponding personality had been filled. That is, a participant was not invited to the experiment after the required numbers for each experimental group had been filled regardless of his/her personality. Therefore, participants who did not meet the screening criteria were then reported as withdrawals from the study.

Finally, the experiment was conducted across separate sessions with each session having a minimum of three and a maximum of nine participants. This was to ensure that every participant had a chance to either collaborate or compete with other participants during HCG play. Before the experiment began, participants were invited to a briefing session in which they were given instructions on how to play HCGs together with a short 15-minute practice session. All the participants were advised that they had to play all three HCGs on Android-based mobile phones on three different days, each spaced one day apart. They could either use their own mobile phones or borrow ones from the researcher and they were asked to follow the assigned gameplay order.

On each scheduled day, participants played the assigned HCG for two specified gameplay sessions, each of which took place at 12:30pm and 6:30pm lasting approximately 30 minutes. Participants were advised to follow the provided scenario of

gameplay which can be found in Appendix B. They were also informed that they could play the game at any other time where convenient. Their gameplay data was recorded for further analysis. After two gameplay sessions, the participants completed a web-based questionnaire which contained 47 question items measuring perceived enjoyment and perceived output quality. After they had played all the HCGs and completed the questionnaires for the respective games, they were paid the promised modest incentive of \$20. Additionally, an extra cash incentive of \$10 was given to those participants who used their own mobile phones with the purpose of widening the number of participants performing the study at the same time, as well as to compensate for overhead costs such as installation and Internet data service. At the end of the experiment, the top three players were selected and each was awarded a pair of movie tickets worth \$44. This incentive scheme was intended to motivate players to spend more time playing the HCGs so that they could gather enough experience before completing their perceptions about the games.

Of the 235 participants who completed the screening questionnaire, 180 were selected as the representatives of the low and high dimensions of extraversion, agreeableness, conscientiousness and openness. Of these, 163 participants (73 male, 90 female) agreed to participate in the experiment. All participants joined the experiment for three days, playing a different HCG on each day, except for 3 participants who only briefly played each HCG. Thus, they were removed from the sample, resulting in a final sample of 160 participants. The demographics of the sample are shown in Table 5.2.

Table 5.2

Sample Demographics (N=160)

Demographic variable	Count	%
Gender		
Male	71	44.40
Female	89	55.60
Age		
21-25	133	83.13
26-30	16	10.00
31-35	11	6.89
Educational background		
Computer Science or IT-related	21	13.10
Arts, humanities, and social science	46	28.80
Engineering	37	23.10
Business and related disciplines	13	8.10
Life sciences	16	10.00
Others	25	15.60

5.4.4 Measures and Statistical Analysis

Study II utilized the instrument developed in Study I which comprises personality traits, perceived enjoyment and perceived output quality, with minor revision of the perceived behavioral enjoyment construct. All question items were adapted from prior research (Lee et al., 2002; Nelson et al., 2005; Fang et al., 2010; John et al., 2008) and measured on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Prior to addressing the major aim of the study, a principal component factor analysis with varimax rotation and reliability analyses were conducted separately for each HCG. Cronbach's alpha values of the four personality traits (extraversion, agreeableness, conscientiousness, openness), the three dimensions of perceived enjoyment (affective, cognitive, behavioral), and the four dimensions of output quality (accuracy, completeness, relevancy, timeliness) range from .93 to .97, surpassing the recommended threshold of 0.70 (Tabachnick & Fidell, 2007). Table 5.3 presents the summary table of the reliability and factor analyses.

Table 5.3

Summary Table of Factor and Reliability Analyses

Construct	Eigenvalue	Variance explained (%)	α
<i>Personality Traits</i>			
Extraversion	6.32	14.37	0.96
Agreeableness	5.70	12.95	0.93
Conscientiousness	6.45	14.65	0.94
Openness	5.39	12.24	0.90
<i>Collabo</i>			
Perceived Enjoyment			
Perceived affective enjoyment	3.57	29.76	0.97
Perceived cognitive enjoyment	3.51	29.26	0.95
Perceived behavioral enjoyment	3.72	30.99	0.96
Perceived Output Quality			
Perceived accuracy	3.04	25.30	0.96
Perceived completeness	2.52	20.03	0.94
Perceived relevancy	2.48	20.64	0.95
Perceived timeliness	3.00	24.86	0.95
<i>Clash</i>			
Perceived Enjoyment			
Perceived affective enjoyment	3.55	29.54	0.97
Perceived cognitive enjoyment	3.85	32.07	0.97
Perceived behavioral enjoyment	3.54	29.50	0.96
Perceived Output Quality			
Perceived accuracy	3.18	26.46	0.97
Perceived completeness	2.20	18.39	0.94
Perceived relevancy	2.94	24.51	0.96
Perceived timeliness	2.82	23.53	0.93
<i>Share</i>			
Perceived Enjoyment			
Perceived affective enjoyment	3.48	29.02	0.97
Perceived cognitive enjoyment	3.65	30.39	0.95
Perceived behavioral enjoyment	3.62	30.21	0.96

Table 5.3 (*Continued*)*Summary Table of Factor and Reliability Analyses*

Perceived Output Quality			
Perceived accuracy	3.25	27.04	0.97
Perceived completeness	2.09	17.42	0.92
Perceived relevancy	2.68	22.26	0.93
Perceived timeliness	3.08	25.67	0.94

For statistical analysis, this study firstly distinguished between low and high scores of each personality trait—extraversion, agreeableness, conscientiousness and openness—by performing a median split. For example, participants whose extraversion scores were above the sample median extraversion score were classified as high-extraversion participants and those below the medium as low-extraversion participants. Dividing participants into groups using the median scale score has been widely used in prior personality research with similar sample sizes to this study (e.g., Blau & Barak, 2012; Nov et al., 2013).

Secondly, for each personality trait, three two-way analyses of variance (two-way ANOVAs) were conducted to evaluate the interaction effects of three HCG genres (*Collabo* vs. *Clash* vs. *Share*) and two personality trait levels (low vs. high) on perceived affective, cognitive and behavioral enjoyment dimensions. The follow-up tests were also conducted on all significant interactions. Thirdly, four one-way analyses of variance (ANOVAs) were conducted on perceived accuracy, completeness, relevancy and timeliness in order to investigate whether these perceptions differ across HCG genres.

5.5 Results

This section describes the findings of the profile of the sample and the results of the ANOVA analyses in accordance with the proposed research hypotheses and questions.

5.5.1 Description of Sample

Overall, 160 participants took part in this study of which 71 (44.4 %) were male and 89 (55.6 %) were female. The average age was 23.20 ($SD = 3.77$). The majority of the participants (81.3%, $N = 130$) indicated that they were online gamers. In terms of gaming experience, 78.8% ($N = 126$), 79.4% ($N = 127$), 76.9% ($N = 123$), 77.5% ($N = 124$) and 76.9% ($N = 123$) had experience playing social games, puzzle games, strategy games, adventure games and simulation games respectively. Furthermore, of the 126 participants who played social games, 14 (11.1%) did not play them very often, 21 (16.7%) played once a month, 23 (18.3%) played every other week, 42 (33.3%) played every week and 26 (20.6%) played them every day. In addition, 73.75% ($N = 118$) of participants indicated that they played games on social networking sites such as *Facebook*.

In addition to gaming experience, participants were asked to indicate their prior mobile phone usage and information-sharing experience. Of the total sample, 88.1% ($N = 141$) of the participants surfed the web via their mobile phones while 80.6% ($N = 129$) used them for map navigation. The results also revealed that 72.5% ($N = 116$) of participants shared pictures, videos, music and other media via their mobile phones. Next, 52.5% ($N = 84$) of participants indicated that they used the location check-in feature of social networking applications such as *Facebook* and *FourSquare* on their mobile phones. Furthermore, 59.4% ($N = 97$) of participants shared information about locations on social networking applications via their mobile phones.

5.5.2 Influence of Personality Traits and HCG Type on Perceived Enjoyment

Influence of the level of extraversion and HCG genres on perceived enjoyment

Hypothesis 1A and 1B suggest that perceived affective, cognitive and behavioral enjoyment will increase when participants who scored low for the trait of extraversion are exposed to competitive HCGs and those who scored high for this trait are exposed to collaborative HCGs. Table 5.4 shows the means and standard deviations of the three perceived enjoyment dimensions through the extraversion level and the application types.

Table 5.4

Means and Standard Deviations of Perceived Enjoyment Variables Measured by Extraversion Level and Application types

Low/high personality trait	Application types	Variable	<i>M</i>	<i>SD</i>
Low extraversion	<i>Collabo</i> (N = 80)	AFF	2.82	0.56
		COG	2.78	0.48
		BEH	2.71	0.57
	<i>Clash</i> (N = 80)	AFF	3.11	0.53
		COG	3.14	0.59
		BEH	3.09	0.59
	<i>Share</i> (N = 80)	AFF	2.61	0.64
		COG	2.55	0.46
		BEH	2.44	0.55
High extraversion	<i>Collabo</i> (N = 80)	AFF	3.18	0.49
		COG	3.33	0.62
		BEH	3.12	0.84
	<i>Clash</i> (N = 80)	AFF	2.88	0.57
		COG	2.93	0.57
		BEH	2.82	0.67
	<i>Share</i> (N = 80)	AFF	2.52	0.63
		COG	2.70	0.50
		BEH	2.56	0.59

Note. AFF = Perceived affective enjoyment, COG = Perceived cognitive enjoyment, BEH = Perceived behavioral enjoyment.

The results of the two-way ANOVAs indicated a significant interaction between the level of extraversion and the HCG genre with respect to affective enjoyment, $F(2,474) = 11.77$, $p < .001$, cognitive enjoyment, $F(2,474) = 19.59$, $p < .001$, and behavioral enjoyment, $F(2,474) = 11.43$, $p < .001$). The interaction comparisons using a tetrad contrast test were performed. The order of values treated to the test were the difference in mean scores of perceived enjoyment between *Collabo* and *Clash* for participants who scored *low* on extraversion, followed by that of participants who scored *high* on extraversion. Note that the same order was used in the tetrad contrast test performed for

other personality traits. This test yielded a contrast estimate of $-.59$, $F(1,474) = 21.82$, $p < .001$ for affective, $-.75$, $F(1,474) = 39.16$, $p < .001$ for cognitive, and $-.68$, $F(1,474) = 22.70$, $p < .01$) for behavioral enjoyment. This indicated that participants who scored low on extraversion enjoyed *Clash* more than those who scored high. In contrast, participants who scored high on extraversion perceived a higher level of enjoyment of *Collabo*, consistent with Hypothesis 1A and 1B.

Figure 5.9 provides graphical evidence that the mean scores on three perceived enjoyment dimensions significantly differ among HCG genres by the level of extraversion.

Figure 5.9. Influence of HCG genres on Extraversion.

Influence of the level of agreeableness and HCG genres on perceived enjoyment

Table 5.5 presents the means and standard deviations for the three perceived enjoyment dimensions measured by the level of agreeableness and the application types.

Table 5.5

Means and Standard Deviations of Perceived Enjoyment Variables Measured by Agreeableness Level and Application Types

Low/high personality trait	Application types	Variable	<i>M</i>	<i>SD</i>
Low agreeableness	<i>Collabo</i> (N=80)	AFF	2.89	0.64
		COG	2.88	0.56
		BEH	2.74	0.70
	<i>Clash</i> (N=80)	AFF	3.10	0.55
		COG	3.12	0.62
		BEH	3.04	0.65
	<i>Share</i> (N=80)	AFF	2.59	0.70
		COG	2.60	0.47
		BEH	2.48	0.56
High agreeableness	<i>Collabo</i> (N=80)	AFF	3.12	0.44
		COG	3.23	0.62
		BEH	3.09	0.75
	<i>Clash</i> (N=80)	AFF	2.89	0.55
		COG	2.96	0.53
		BEH	2.86	0.62
	<i>Share</i> (N=80)	AFF	2.54	0.57
		COG	2.65	0.50
		BEH	2.52	0.58

Note. AFF = Perceived affective enjoyment, COG = Perceived cognitive enjoyment, BEH = Perceived behavioral enjoyment.

Three 2×3 ANOVAs were conducted and the results yielded significant interactions between the level of agreeableness and HCG genre: $F(2,474) = 5.98, p < .01$ for affective, $F(2,474) = 8.31, p < .001$ for cognitive, and $F(2,474) = 6.87, p < .01$ for behavioral enjoyment. The follow-up tetrad contrast test confirmed that the difference in means of perceived enjoyment between *Collabo* and *Clash* for the low-agreeableness

group significantly differed from that of the high-agreeableness group: $-.44$, $F(1,474) = 11.65$, $p < .001$ for affective enjoyment, $-.50$, $F(1,474) = 16.46$, $p < .001$ for cognitive enjoyment, and $-.53$, $F(1,474) = 13.56$, $p < .001$ for behavioral enjoyment. In other words, the results suggest that the perceived enjoyment of *Clash* was higher in participants who rated low on agreeableness, while that of *Collabo* was higher in participants who rated high on agreeableness, consistent with Hypothesis 2A and 2B respectively.

The effects of the interaction between the level of agreeableness and the HCG genres are illustrated in Figure 5.10.

Figure 5.10. Influence of HCG genres on Agreeableness.

Influence of the level of conscientiousness and HCG genres on perceived enjoyment

The means and standard deviations of the three dimensions of enjoyment in terms of the level of conscientiousness and the application types are presented in Table 5.6.

Table 5.6

Means and Standard Deviations of Perceived Enjoyment Variables Measured by Conscientiousness Level and Application Types

Low/high personality trait	Application types	Variable	<i>M</i>	<i>SD</i>
Low conscientiousness	<i>Collabo</i> (N=80)	AFF	2.86	0.60
		COG	2.92	0.53
		BEH	2.80	0.64
	<i>Clash</i> (N=80)	AFF	3.00	0.56
		COG	3.03	0.62
		BEH	3.00	0.67
	<i>Share</i> (N=80)	AFF	2.54	0.68
		COG	2.55	0.46
		BEH	2.42	0.51
High conscientiousness	<i>Collabo</i> (N=80)	AFF	3.15	0.47
		COG	3.19	0.66
		BEH	3.03	0.83
	<i>Clash</i> (N=80)	AFF	2.99	0.56
		COG	3.05	0.55
		BEH	2.91	0.62
	<i>Share</i> (N=80)	AFF	2.58	0.60
		COG	2.71	0.50
		BEH	2.58	0.62

Note. AFF = Perceived affective enjoyment, COG = Perceived cognitive enjoyment, BEH = Perceived behavioral enjoyment.

The significant interaction between the level of conscientiousness and HCG genre was found for perceived affective enjoyment, $F(2,474) = 3.16, p < .05$, but no significant interaction effects were identified for perceived cognitive and behavioral enjoyment. Thus the follow-up test was performed on perceived affective enjoyment which uncovered that participants who scored low on conscientiousness felt that both *Collabo*

($M_{aff} = 2.86$) and *Clash* ($M_{aff} = 3.00$) induced a higher level of affective experience than *Share* ($M_{aff} = 2.54$), $F(2,474) = 12.75$, $p < .001$. Similarly, participants who rated high on conscientiousness reported a higher level of perceived affective enjoyment in both *Collabo* ($M_{aff} = 3.15$) and *Clash* ($M_{aff} = 2.99$) than *Share* ($M_{aff} = 2.58$), $F(2,474) = 20.05$, $p < .001$. However, the differences in perceived affective enjoyment between *Collabo* and *Clash* at each level of conscientiousness were not statistically significant, -305 , $F(1,417) = 5.52$, $p = .019$ and hence Hypothesis 3A and 3B were not supported.

Figure 5.11 illustrates the graphical evidence of the non-significant interaction between the level of conscientiousness and HCG genres.

Figure 5.11. Influence of HCG genres on Conscientiousness.

Effects of the level of openness and HCG genres on perceived enjoyment

Table 5.7 shows the means and standard deviations of the three perceived enjoyment dimensions by the level of openness and the application types.

Table 5.7

Means and Standard Deviations of Perceived Enjoyment Variables Measured by Openness Level and Application Types

Low/high Personality trait	Application types	Variable	<i>M</i>	<i>SD</i>
Low openness	<i>Collabo</i> (N=80)	AFF	2.89	0.55
		COG	2.90	0.43
		BEH	2.74	0.54
	<i>Clash</i> (N=80)	AFF	3.15	0.46
		COG	3.12	0.62
		BEH	3.13	0.63
	<i>Share</i> (N=80)	AFF	2.60	0.64
		COG	2.58	0.50
		BEH	2.48	0.52
High openness	<i>Collabo</i> (N=80)	AFF	3.12	0.55
		COG	3.21	0.73
		BEH	3.08	0.87
	<i>Clash</i> (N=80)	AFF	2.83	0.61
		COG	2.95	0.53
		BEH	2.76	0.61
	<i>Share</i> (N=80)	AFF	2.53	0.64
		COG	2.67	0.46
		BEH	2.52	0.62

Note. AFF = Perceived affective enjoyment, COG = Perceived cognitive enjoyment, BEH = Perceived behavioral enjoyment.

To test Hypothesis 4A and 4B, three 2×3 ANOVAs were conducted. The results showed that there was a significant interaction between the level of openness and HCG genre: $F(2,474) = 8.96, p < .001$ for affective, $F(2,474) = 7.82, p < .001$ for cognitive, $F(2,474) = 11.84, p < .001$ for behavioral enjoyment. The interaction comparisons using the tetrad contrast test yielded the contrast estimate of $-.55$ ($F(1,474) = 17.88, p < .001$)

for affective, $-.49$ ($F(1,474) = 15.61, p < .001$) for cognitive, and $-.70$ ($F(1,474) = 23.46, p < .001$) for behavioral enjoyment. The results indicated that participants who rated low on openness exhibited a higher level of perceived enjoyment of *Clash*, while those who rated high on openness showed a greater level of perceived enjoyment of *Collabo*. Thus, Hypothesis 4A and 4B were supported.

The effects of the interaction between the level of openness and the HCG genre are shown in Figure 5.12.

Figure 5.12. Influence of HCG genres on Openness.

5.5.3 Influence of HCG Genres on Perceived Output Quality

Table 5.8 shows the means and standard deviations for participants' perceptions of the output quality of the application they used.

Table 5.8

Means and Standard Deviations for Participants' Perceptions Of Output Quality

Perceived Output Quality Variables	Application types					
	<i>Collabo</i>		<i>Clash</i>		<i>Share</i>	
	(N = 160)		(N = 160)		(N = 160)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Perceived accuracy	2.89	0.91	3.13	0.98	3.43	0.75
Perceived completeness	2.88	0.83	2.80	0.83	3.36	0.97
Perceived relevancy	3.02	0.85	2.86	1.00	3.36	1.08
Perceived timeliness	3.01	0.82	2.98	0.93	3.09	0.93

The results of the ANOVAs indicated that there were significant differences with respect to three dependent variables: perceived accuracy, $F(2,477) = 15.08$, $p < .001$, completeness, $F(2,477) = 19.95$, $p < .001$, and relevancy, $F(2,477) = 10.86$, $p < .001$. There was, however, no statistically significant difference among the three HCG genres for perceived timeliness $F(2,477) = 0.52$, $p = .54$. Post-hoc comparisons using Tukey's test were then conducted (see Table 5.9) revealing the following results:

- **Perceived accuracy.** Participants felt that the output from *Share* was more accurate ($M = 3.43$) than from *Collabo* ($M = 2.89$) and *Clash* ($M = 3.13$). Furthermore, participants recognized a higher level of accuracy in *Clash* than in *Collabo*. Therefore, in order of perceived accuracy, *Share* ranked first, followed by *Clash* and *Collabo*.
- **Perceived completeness.** In terms of completeness of output, *Share* ($M = 3.36$) was again perceived to generate more complete output than *Collabo* ($M = 2.88$) and *Clash* ($M = 2.80$). This time, there was no significant difference in ratings between *Collabo* and *Clash*.
- **Perceived relevancy.** Similar to completeness, participants felt that the output from *Share* ($M = 3.36$) was more relevant than from *Collabo* ($M = 3.02$) and *Clash* ($M = 2.86$), suggesting that *Share* would be better at generating more relevant output for

them. However, the difference in the participants' perception of relevancy between both HCGs was not significant.

- **Perceived timeliness.** There were no statistical differences between the pairwise comparisons among the three applications. Put differently, the participants' perception of the timeliness of output was comparable across *Share*, *Collabo*, and *Clash*.

Table 5.9

Comparison between Means of Participants' Perception of Output Quality Variables

Variable	Genre (1)	Genre (2)	Mean Difference (1)–(2)
Perceived accuracy	<i>Share</i>	<i>Collabo</i>	0.54*
	<i>Share</i>	<i>Clash</i>	0.29*
	<i>Collabo</i>	<i>Clash</i>	–0.24*
Perceived completeness	<i>Share</i>	<i>Collabo</i>	0.50*
	<i>Share</i>	<i>Clash</i>	0.57*
	<i>Collabo</i>	<i>Clash</i>	0.07
Perceived relevancy	<i>Share</i>	<i>Collabo</i>	0.34*
	<i>Share</i>	<i>Clash</i>	0.50*
	<i>Collabo</i>	<i>Clash</i>	0.16
Perceived timeliness	<i>Share</i>	<i>Collabo</i>	0.06
	<i>Share</i>	<i>Clash</i>	0.10
	<i>Collabo</i>	<i>Clash</i>	0.04

Note. * $p < 0.025$. Genre (1) and Genre (2) refer to HCG genre being compared.

In summary, the results of the hypotheses are illustrated in Table 5.10.

Table 5.10

Results of Hypotheses and Research Question

Hypothesis and Research Question	Path			Result
Hypothesis 1	Low-Extraversion	→	Competitive HCG	Supported
	High-Extraversion	→	Collaborative HCG	
Hypothesis 2	Low-Agreeableness	→	Competitive HCG	Supported
	High-Agreeableness	→	Collaborative HCG	
Hypothesis 3	Low-Conscientiousness	→	Competitive HCG	Not supported
	High-Conscientiousness	→	Collaborative HCG	
Hypothesis 4	Low-Openness	→	Competitive HCG	Supported
	High-Openness	→	Collaborative HCG	
RQ1A	Accuracy	→	Collaborative HCG/ Competitive HCG	Competitive HCG
RQ1B	Completeness	→	Collaborative HCG/ Competitive HCG	No difference
RQ1C	Relevancy	→	Collaborative HCG/ Competitive HCG	No difference
RQ1D	Timeliness	→	Collaborative HCG/ Competitive HCG	No difference

5.6 Discussion

This section presents a discussion of the analyses from Study II which examined how the interaction between the personality trait level and the HCG genre influences participants' perceptions of three enjoyment dimensions: affective, cognitive and behavioral. The results revealed that the personality traits of extraversion, agreeableness, conscientiousness and openness determined the perceived enjoyment of particular HCG genres. As HCG enjoyment was found to be influenced by players' perceived quality of output generated in Study I, this study further seeks to examine whether participants' perceptions of four output quality dimensions (accuracy, completeness, relevancy and timeliness) vary across HCGs with different gameplay styles. The results demonstrated that collaborative and competitive HCGs differ in terms of perceived accuracy while the variations in perceived completeness and relevancy were not significant between these two HCGs. The findings are discussed in detail in the following subsections.

5.6.1 Influence of Personality Traits and HCG Genres on Perceived Enjoyment

The findings of Study II call into question the effectiveness of a common practice in the design of HCGs that is simply adopting game design elements of entertainment-oriented games without considering human factors, and highlight the potential effectiveness of a more nuanced interactionist approach to HCG design. Firstly, in assessing the interaction effects between extraversion and HCG genre, the results showed that both groups of participants who scored low and high on extraversion enjoyed both HCG genres emotionally, cognitively and behaviorally, as opposed to the non-game application represented by *Share* in this study. This finding suggests that HCGs were able to elicit a greater level of positive emotional experiences, favorable thoughts and player attention than the non-gaming location-based content-sharing application.

Specifically, with regard to the competitive HCG, the mean values of perceived affective, cognitive and behavioral enjoyment of the low-extraverted participants were significantly higher than for those of the high-extraverted participants. The findings suggested that participants who scored low on extraversion tended to experience emotions resulting from favorable appraisals of, and being immersed in, the competitive HCG. This concurs with the findings of Yee et al. (2011) and McGhee et al. (2012) which suggest that low-extraverted players tend to enjoy using the combat-oriented aspects of the *World of Warcraft*. One possible explanation might be that the impression that the competitive HCG allows players to defeat their opponents may have encouraged introverted participants to become more involved with output creation, which in turn give rise to enjoyment. Here, *Clash* creates such a situation, enabling players to challenge a Glob's owner when they may either lose their strength or win the Glob as a result of the challenge. This feature of *Clash* therefore seemed to be appropriate for low-extraverted participants which, in turn, influenced their perceptions toward emotions, thoughts and immersive experiences evoked by the game.

In contrast, participants high in extraversion exhibited a higher degree of enjoyment through affective, cognitive and behavioral dimensions in the collaborative HCG or *Collabo*. Put differently, this finding suggests that the extraverted participants perceived the collaborative HCG in a more favorable light than the competitive game, and that they experienced positive emotions, more favorable thoughts of appraisals, and became involved on a very deep level in the game. Considering that people who scored high on extraversion are able to establish effective communication with others in social

settings (John et al., 2008), they may be more motivated to be part of a team in creating output in HCGs. Here, the ability to use *Collabo*'s features such as sharing information as a form of collaboration seemed to be a natural fit for extraverted participants, which in turn leads to a higher state of perceived enjoyment. In particular, the challenge presented by *Collabo*, which requires players to form a group to rescue the starving Globbs, was able to facilitate a team-oriented environment favored by the extraverts (van Meurs, 2007). Thus, this finding suggests that player collaboration in HCGs ought to be enhanced in order to attract people high in extraversion.

Secondly, the interaction effects of agreeableness and HCG genre showed that there is a significant difference between perceived enjoyment of the collaborative and competitive HCGs among participants with low and high levels of agreeableness. As expected, a lower level of agreeableness was associated with a greater tendency to enjoy the competitive HCG emotionally, cognitively and behaviorally. One possible explanation is that because people low in agreeableness are less sympathetic toward others (Tobin et al., 2000), they may be willing to generate more outputs in the competitive HCG with an aim to outperform their opponents. In doing so, participants scored low on agreeableness are likely to succeed in *Clash*, which further induces a greater sense of pleasure. As in other competitive games that require players to devise strategies that would allow them to outplay their opponents (Velez et al., 2014), *Clash* encourages players to think not only about how to defeat a current Glob owner but also how to maintain the ownership status for as long as possible. As such, the interests of people who had a low level of agreeableness seemed to be compatible with *Clash*, thereby inducing more favorable thoughts and immersive experiences.

On the other hand, participants who scored high on agreeableness experienced higher levels of affective, cognitive and behavioral enjoyment in playing the collaborative HCG. This result is not surprising given that agreeable people were found to be attracted to team-oriented cultures in organizational and online game settings due to their tendency of being nice and supportive (van Meurs, 2007). It therefore seems that the collaborative HCG that enables players to work together with others in creating outputs was perceived positively by agreeable participants, in turn giving rise to their enjoyment. Here, *Collabo* emphasizes collaboration among players by asking them to help each other in rescuing the Globbs, and this game feature seemed to be a natural fit for those who are inherently empathic and cooperative (John et al., 2008) which in turn induced positive emotions and

thoughts as well as increased the level of engagement. Put together, this finding underlines how collaborative activities could increase HCG enjoyment for people high in agreeableness, whereas competitive or hostile activities could hinder their enjoyment.

Thirdly, a non-significant interaction between conscientiousness and the HCG genre suggests that regardless of the level of conscientiousness, participants found HCGs to be more enjoyable than the control application with respect to affective, cognitive and behavioral dimensions. This finding receives support from previous studies, which suggest that games serve as motivators for people to perform computations (e.g., Goh et al., 2012; von Ahn & Dabbish, 2008). In other words, this finding suggests that participants regarded performing computations as an enjoyable activity as long as HCGs support interaction among players by means of either collaboration or competition. One possible explanation for this is that because of the high need for achievement (Ross et al., 2009), conscientious people seemed to place weight on accomplishing the game objectives irrespective of the gameplay elements. In turn, no difference in gameplay experiences in terms of affect, cognition and behavior was induced. Therefore, either game genre could be used to enhance players' enjoyment in the HCG context.

Finally, the interaction between the personality trait of openness and the HCG genre was found to be significant. In particular, the competitive HCG or *Clash* evoked a higher level of emotional experiences and engagement in participants who scored low on openness. This finding may be attributable to the individualistic nature of *Clash* play in which players are not required to dynamically team up with other players to make progress in the game. In fact, *Clash* can be treated as solo play until players decide to challenge the Glob's owner, which seems to be quite compatible with players who are less receptive to the behaviors of others (Park & Antonioni, 2007). For example, players of *Clash* do not need to adjust their gameplay in accordance with the actions of other players as much as they do in *Collabo*. This gameplay approach in *Clash* therefore favors participants who rated low on openness because they are known to be more comfortable in performing activities in familiar situations (McMahon et al., 2012), in turn triggering their enjoyment.

However, participants who scored high on openness perceived the collaborative HCG more favorably than those who scored low on this trait, demonstrated by a significantly higher level of perceived affective, cognitive and behavioral enjoyment of *Collabo* than of *Clash*. This finding contradicts prior studies which found no relationship

between openness and individuals' preference for team-oriented cultures in task-oriented environments (e.g., Judge & Cable, 1997). Perhaps due to the entertainment-output generation duality of HCGs, participants who scored high on openness perceived the novelty of being entertained while working together with others for output creation as supported by the collaborative HCG. Such experience may have prompted them to become more involved in the game, which in turn evokes enjoyment. Here, the gameplay of *Collabo*, in which players rescue a Glob by being part of a team that feed it with content, seemed to be suited to participants who scored high on openness, thereby increasing their tendency to experience positive emotions and favorable thoughts as well as their propensity for being absorbed in the game.

5.6.2 Influence of HCG Genres on Perceived Output Quality

Another area of research involves the investigation of the differences in participants' perceptions of output quality across HCG genres. Firstly, the results revealed that participants perceived a higher level of output accuracy, completeness and relevancy in the non-gaming content-sharing application (*Share*) when compared to the collaborative HCG (*Collabo*) and competitive HCG (*Clash*). Perhaps participants felt that being able to focus solely on output generation in *Share* had resulted in higher output quality. In contrast, both HCGs required players to perform gaming activities or consider strategies, and such extra work could have been perceived to be deviating from output generation, leading to a lack of confidence in quality. In this regard, this finding receives support from the research by Goh et al. (2012) where players were found to yield better performance in a non-gaming application than in gaming applications. The authors further contend that while HCGs encourage usage, the gameplay mechanisms may impede the generation of accurate outputs. It is probable participants may hold the view that HCGs drive individuals to focus more on gaming aspect rather than putting enough effort in assuring the quality of generated outputs. Consequently, participants felt that the accuracy of the output produced by HCGs was not comparable to that of non-gaming applications. Stated differently, participants may have found HCGs to be lacking in quality assurance, implying that they were less trusting of the accuracy, completeness, and relevancy of outputs generated by these games.

Secondly and interestingly, the results revealed that the perceived timeliness of output did not significantly differ across applications, suggesting that the outputs generated by *Collabo* and *Clash* were perceived as timely as that of *Share*. This finding may be attributable to the mobility of location-based applications where immediate content delivery is believed to be the most striking feature of such applications (Kim & Han, 2009). Put differently, in the mobile context, content about current events would get noticed by other users easily, which in turn increases the likelihood of receiving higher ratings. Due to the importance of current information in the location-based context, participants may have contributed timely output regardless of the application type (gaming or non-gaming). A possible concern when designing HCGs might be that players would be too engaged and distracted by gaming elements, therefore providing low-quality outputs. The results of this study underline that games do not always hinder all aspects of quality. In fact, players of HCGs seem to give more importance to certain context-specific quality aspects (e.g., timeliness in this study) than to other aspects.

Thirdly, the output of the competitive HCG was perceived to be higher in accuracy than that of the collaborative HCG. This finding, therefore, highlights the importance of competitive game elements in the HCG context, since such elements could induce players' perceptions of output accuracy, which may impact their perceived trust toward these games. One possible explanation might be that the competitive HCG that drives players to strive for victory (Waddell & Peng, 2014) stands out as more engaging than the collaborative version, which in turn conveys an impression that more accurate output would be generated. Perhaps in *Clash*, participants were aware that they need to continually improve their strength either to win or retain the Glob because other participants are also in the race for Glob ownership. Since accuracy is commonly believed to be the most fundamental aspect of output quality (Nelson et al., 2005), participants may have contributed outputs that are more accurate with an aim to achieve higher strength within a shorter period, in turn inducing a sense that the output of *Clash* is more accurate than that of *Collabo*. Another possible explanation might be that the relationship among team members may have contributed to the lower accuracy of output in *Collabo*. In particular, prior studies suggest that playing with friends increased engagement and commitment compared to playing with strangers (Peng & Hsieh, 2012). The lack of a feature that allows players to invite their social media friends in *Collabo* may have been a hindrance to commit themselves into the gameplay, resulting in producing outputs that

are lower in accuracy. Clearly, investigating the potential effects of relationship types (friend versus stranger) on players' engagement in collaborative HCGs is an area for future research.

Finally, there was no difference in perceived completeness and relevancy of output between *Collabo* and *Clash*, suggesting that participants felt that the output of both HCGs was complete and relevant to a similar degree. In other words, neither collaborative nor competitive HCG outperformed one another in terms of yielding output that is complete and relevant, suggesting that both game genres need to improve on these quality aspects. One possible explanation might be that due to the inclusion of gaming elements in HCGs, participants felt that players of these games were more concerned about earning points or winning the game. As a result, they tried to generate more outputs with little or no thought given to the probability that their generated output might be accurate but not applicable to others. Hence, outputs of HCGs were perceived to be less complete and relevant regardless of genres compared with a non-gaming application.

In summary, the results showed that neither HCG outperformed the non-game application in influencing perceptions of most of the output quality dimensions. Hence, there is a need to employ effective quality control mechanisms to assure the quality of HCG output. For example, the mechanisms proposed in previous work (e.g., Pe-Than et al., 2013; Quinn & Bederson, 2011), such as an expert review where the quality of output is skimmed or cross-checked by trusted experts, or a reputation scoring system where users are assigned reputation points based on how good the quality of their output can be utilized. Failure to do so may result in dissatisfaction with the use of HCGs, thereby discouraging enjoyment and usage intention.

5.7 Summary

A total number of eight hypotheses and four research questions were developed in Study II to investigate whether the influence of individuals' personality traits on three dimensions of perceived enjoyment (affective, cognitive and behavioral) vary across HCG genres. This study evaluated the four personality traits of extraversion, agreeableness, conscientiousness and openness across three HCG genres: collaborative, competitive and control. The study established that Hypothesis 1, 2 and 4 were supported and that Hypothesis 3 was rejected. The results revealed that individuals who scored low

for the personality traits of extraversion, agreeableness and openness experienced a greater level of enjoyment in the competitive HCG, whereas those who scored high for these traits felt a greater sense of enjoyment in the collaborative HCG. However, there was no significant difference between the perceived enjoyment of the collaborative and competitive HCGs among individuals with low and high levels of conscientiousness.

In addition, this study examined whether individuals' perceived quality of output (accuracy, completeness, relevancy and timeliness) differs across three different location-based content sharing applications. The results showed that output generated by the non-gaming application was perceived to have a higher level of accuracy, completeness and relevancy compared to both the collaborative and competitive HCGs. Furthermore, individuals perceived that the output from the competitive HCG was more accurate than that of the collaborative HCG. However, the three applications do not significantly differ in terms of perceived timeliness of output. Implications of the HCG design based on the findings of Study II will be discussed in Chapter 6.

CHAPTER 6

CONCLUSION

This chapter concludes the dissertation with a discussion on the implications of this study for research and practice, its limitations, and recommendations for future research. For this purpose, the chapter is divided into four sections. The first section presents a review of this PhD research, while the implications for research and HCG design are discussed in the second section. The limitations of the research are then presented, and in the final section, possible future research directions are recommended.

6.1 Review of PhD Research

The popularity of online games has inspired the emergence of HCGs that allow players to contribute computations while being entertained. In recent years, there has been an increase in the development of such games in various domains, and the usefulness of these games has been well-documented in past studies. Despite the potential of HCGs, players' perceived enjoyment of such games has not yet been well-explored. In fact, perceived enjoyment has been regarded as the focal point of playing games that provide entertainment to players (Sweetser & Wyeth, 2005; Vorderer et al., 2004). The lack of understanding of how individuals derive enjoyment from HCGs may hinder the further investigation of the beneficial effects of playing such games. It may also neglect the design aspects of HCGs that could foster the enjoyment of individuals with different personality characteristics, hence promoting sustained usage.

Driven by these motivations, this research sought to investigate the factors underlying the perceived enjoyment of HCGs and how the influence of these factors differs across HCG genres. By reviewing past literature, this PhD research posits that personality traits and perceived output quality are potential factors influencing perceived enjoyment of HCGs. To achieve its goal, the entire research project was guided by the following questions:

1. What are the underlying factors that drive perceived enjoyment of HCGs?
 - 1.1. What is the relationship between personality and perceived enjoyment of HCGs?

- 1.2. What is the relationship between perceived output quality and perceived enjoyment of HCGs?
2. How do the influences of these driving factors differ across HCG genres?
 - 2.1. Are there any differences in the influence of personality on perceived enjoyment across HCG genres?
 - 2.2. Are there any differences in players' perceptions of output quality across HCG genres?

The research questions were answered by pursuing the following objectives:

1. Investigate the influence of personality and perceived output quality on perceived enjoyment across HCG genres.
2. Investigate the differences in perceived output quality across HCG genres.

To achieve the objectives presented above, this PhD research was divided into two interrelated studies: Study I and Study II. The aim of Study I was to investigate the factors that underlie the perceived enjoyment of a HCG through the lenses of personality and perceived output quality. Specifically, based on a review of extant literature concerning both entertainment- and task-oriented contexts, Study I proposed a conceptual model to understand players' perceived enjoyment of HCGs. This model suggested that the personality traits of extraversion, agreeableness, conscientiousness, neuroticism, and openness, as well as perceived output accuracy, completeness, relevancy, and timeliness, were influential factors driving perceived affective, cognitive, and behavioral enjoyment of HCGs. Utilizing a custom-developed mobile content-sharing HCG named *SPLASH*, the proposed model was tested empirically by analyzing self-reported, cross-sectional survey data gathered from 205 participants. The findings of Study I addressed the first research question and objective, indicating a significant influence of the personality trait of extraversion on perceived affective enjoyment, neuroticism on perceived cognitive enjoyment, and openness on perceived affective and behavioral enjoyment. Furthermore, perceived output relevancy was found to determine perceived cognitive and behavioral enjoyment, whereas perceived accuracy and timeliness influenced perceived affective and cognitive enjoyment respectively.

Study II aimed to investigate whether there were any differences in the influence of personality and perceived output quality across HCG genres. Based on the review of existing HCGs, this study identified two commonly used game genres—collaborative and

competitive—and accordingly developed two HCG genres for mobile content sharing, namely *Collabo* and *Clash*. In addition, a non-gaming location-based content sharing, which served as the baseline, was developed and named as *Share*. Thereafter, a 2 (Personality trait levels: low vs. high) by 3 (Application types: *Collabo* vs. *Clash* vs. *Share*) mixed-design experiment was conducted in which personality levels and application types were treated as a between-subjects factor and a within-subjects factor respectively. In accordance with the first part of the second research question, the experimental data was analyzed to examine how the interaction between these two factors influenced participants' perceptions of enjoyment. The results revealed that participants who scored high on extraversion, agreeableness, and openness enjoyed the collaborative HCG more affectively, cognitively, and behaviorally than the competitive HCG. However, there was no significant difference in perceived enjoyment of collaborative and competitive HCGs between participants with high and low levels of conscientiousness. With the aim of addressing the second part of the second research question, Study II also examined whether participants' perceptions of output quality differed across HCG genres. The findings indicated that participants perceived output of the non-gaming location-based content-sharing application as more accurate, complete, and relevant than that of the collaborative and competitive HCGs, while there was no significant difference in perceived output timeliness among the three application genres. Overall, the findings of Study II not only validated the findings of Study I, but they also revealed how the interaction between personality trait levels and HCG genres determines players' perceived enjoyment, as well as how players' perceived quality of output differs across HCG genres.

In the light of the findings of Study I and II, three journal papers and eight conference papers have been published to date and these are listed in Appendix C.

6.2 Implications

This study has yielded several contributions to research and practice in the fields of HCGs and players' behavior in games that are more than pure entertainment, as detailed in the following sections.

6.2.1 Implications for Research

The findings of this research have several theoretical implications. Firstly, the model in the present study posited the multidimensionality of enjoyment instead of a traditional approach to recognizing enjoyment as a unidimensional construct (e.g., Lin et al., 2008; Wu et al., 2010). Therefore, researchers investigating gameplay enjoyment should no longer be content with the conceptualization of enjoyment as a single dimension, regarding enjoyment as simply fun or pleasure. Rather, it should be acknowledged that enjoyment comprises affective, cognitive and behavioral dimensions that may exert mutual influence on one another. Failing to recognize these dimensions of enjoyment might result in an incomplete understanding of the consequences of enjoyment in the HCG and other similar contexts. Stated differently, treating enjoyment as unidimensional may overlook the importance of specific dimensions that are related to the phenomenon of interest (Whitley et al., 2012). For instance, due to the duality between entertainment and output generation (Goh & Lee, 2011), players may exhibit not only experiential but also utilitarian or mixed behaviors in HCG play. In other words, individuals may play HCGs for entertainment, and may have a purpose or goal in mind at the same time, such as producing useful outputs. Although experiential behavior enhances affective experiences (Koo, 2009), such influences in HCGs may not be as prominent as that of in entertainment-oriented games which are regarded as an autotelic activity (Mekler et al., 2014). Instead, the cognitive reaction toward HCG play, such as being perceived as effective in helping players to generate useful outputs, may serve as an influential antecedent of enjoyment. The lack of such understanding may impede integrating effective interventions in order to enhance the experience of enjoyment in HCGs. The perceived enjoyment scale developed in this study has a good reliability value and is reusable to evaluate HCGs employed in other problem spaces as well as similar games whose purpose is beyond pure entertainment.

Secondly, the findings of Study I revealed that not all personality traits have a direct impact on players' perceived enjoyment of HCGs, suggesting that other factors may contribute to the relationship between personality and enjoyment. This argument was evident in Study II which found that players with certain personality trait levels experienced a higher level of enjoyment in the collaborative HCG genre in comparison to the competitive HCG genre and vice versa. These findings inform researchers about the effects of genres on the relationship between personality and enjoyment of HCGs. Stated

differently, research investigating players' experiences and behaviors in HCGs and similar games may benefit from combining personality factors with game genre preference.

Thirdly, the findings of Study I initially demonstrate that players' perceived quality of HCG output determines their perceived enjoyment. These findings underscore the importance of output quality to enhancing entertainment in HCG play, in turn explaining why HCGs are different from games that are intended for pure entertainment. Study II further demonstrates that players' perceived output accuracy differs between collaborative and competitive HCG genres. Therefore, researchers investigating the enjoyment of HCGs should thus pay attention to the characteristics of each game genre that might have an influence on the quality of output generated by its gameplay. Furthermore, the results of Study I offer some evidence that different perceived output quality dimensions have varying effects on perceived enjoyment. Stated differently, output quality of HCGs appears to be multi-faceted, and hence the multidimensional output quality construct developed by this research serves as groundwork for providing fundamental knowledge of the quality of HCG output. Since output quality is known to be context-dependent (Kim & Han, 2009), this finding informs HCG researchers of the need to validate such quality dimensions across human computation domains.

In addition, this research found that the non-game application was perceived to have better quality output than HCGs but participants enjoyed the latter more. This finding indicates that a gulf between gaming and output quality might exist. Speculatively, this could be due to the differences in motivations afforded by HCGs and non-game applications. For instance, participants may be motivated by entertainment in HCGs, whereas they may be more willing to express their altruistic concerns in other HCSs (Chamberlain et al., 2013). Consequently, people with entertainment needs may treat HCGs as more of a playful activity and hence may not be particularly concerned with the usefulness of contributions for the greater good. This calls for future research to examine motivational differences across different types of HCSs and their influence on output quality.

Taking Study I and II together, it could be concluded that HCG enjoyment is not a simple phenomenon. Rather, it is the consequence of the interaction between players' personality factors and their game genre preferences. This is made particularly evident in the case of the agreeableness trait, which showed no influence on perceived enjoyment in

Study I. However, high and low scorers on agreeableness seemed to exhibit a different preference for collaborative and competitive HCG genres in Study II. This research therefore informs researchers about the differences in the effectiveness of HCG genres in terms of influencing the enjoyment of players with different personality orientations. Consequently, a closer look at the interaction between personality factors and game genres is necessary to reveal a more holistic understanding of enjoyment in HCGs. In addition, the relationship between perceived output quality and game genre appears to influence players' perceptions of HCG enjoyment. Therefore, research investigating players' experiences and behaviors in HCGs should pay attention not only to personality and output quality factors, but also to the relationships that these constructs may have with HCG genres.

6.2.2 Implications for Practice

In terms of contributions to practice, there are important implications in the findings for HCG designers. In particular, this research offers guidelines about how to enhance players' enjoyment in HCGs. HCG developers should take notice of the role of individuals' personalities and preferences for HCG genres, as well as perceived quality of output generated. In fact, this research highlights that a more nuanced, personality-targeted approach to HCG design is required to attract players with varying personality orientations. Moreover, this research also underlines the need to incorporate effective output quality control mechanisms into HCG designs, which may improve players' perceptions of output quality. Therefore, organizations that wish to turn their activities into games need to understand the personalities of customers or employees who will be playing the developed games, and relate personality factors to the games. The detailed design guidelines for HCGs, as well as for games that are designed not just for pure entertainment are discussed below.

Firstly, according to the findings of this research, participants who scored low on extraversion, agreeableness, and openness enjoyed the competitive HCG. These findings imply that designers should create competitive HCG play to heighten the enjoyment of individuals scoring low on these personality traits. In fact, competition can be either team-based or individual-based. As individuals with above-mentioned personality traits are known to be less sociable, agreeable, and receptive to others' ideas (John et al., 2008),

a team-based competition which could involve a high level of communication among members might not be suitable for them. Instead, solo competitive play would be better suited to players who scored low on those traits (Peever et al., 2012). Solo HCG play can be created by allowing players to perform given computation tasks by themselves or with minimal interaction with other players, and thereafter provide feedback on their in-game standings against others. One approach to inject competition into solo HCG play is the use of leaderboards through which players can compete with other players in the game without having to deal with them directly.

However, indirectly competing with other players in solo HCG play might not be sufficient to attract individuals who score low on agreeableness, as they tend to be antagonistic to others (Yee et al., 2011). Hence, competitive social situations or direct competition that enables players to play against an opponent(s) would be suitable for increasing the enjoyment of these individuals. Typically, these game situations are created by engaging players in player versus player activities, such as head-to-head contests or duels that deliver an explicit and visible result: either player can win or lose the competition (Vorderer, Hartmann, & Klimmt, 2003). HCGs could create such competitive situations by enabling players to compete with others for in-game resources (e.g., disputing a territory) that would be captured by the player who generated the most computations within a specified time limit. Similarly, matchmaking players who generated a similar number of computations and asking them to defeat each other's record could be a way of evoking a sense of direct competition between HCG players.

In addition, since individuals with low levels of openness are considered to be conventional, they might seem to enjoy performing routine and familiar activities (Peever et al., 2012). Hence, designers should introduce competitive gameplay that could retain similar tactics across gameplay levels or stages to trigger enjoyment in such individuals. Here, progressive gameplay such as linear or level-based game designs may be used (Zammitto, 2010). This could be achieved in solo competitive HCG play by arranging computational tasks based on difficulty level and presenting them sequentially so that changes in the gameplay are subtle, which in turn enables players to perform in-game activities in a similar fashion.

Secondly, the findings point to the fact that individuals who score high on extraversion, agreeableness, and openness prefer to collaborate with others in the course of HCG play. As in traditional multiplayer online games such as World of Warcraft,

collaboration in HCGs is possible in the form of group-based challenges by dividing the computational task into sub-tasks and assigning them to individual group members (Wendel, Gutjahr, Gobel, & Steinmetz, 2012). Rauterberg (2003) suggested that communication is vital for effective collaboration, hence games should provide ways for players to communicate (e.g., text and/or voice chat). The collaborative HCG with communication features would be suitable for enhancing extraverted individuals' enjoyment. However, von Ahn and Dabbish (2008) discouraged explicit communication or social interaction in HCG design because of the potential for cheating. Therefore, consideration is required to determine how to design effective collaboration in HCGs without diminishing the quality of output. One possibility is to integrate either a manual or automatic quality control mechanism into collaborative HCG play. Examples of these include assigning expert(s) to review the output generated at regular and specific intervals, and running an automatic quality checker that verifies the accuracy of the output with a predefined list (Quinn & Bederson, 2011).

In addition, the collaborative HCG play can be complemented by promotive interaction mechanisms, whereby players support each other's success by helping, encouraging, and praising each other (Zea, Sánchez, Gutiérrez, Cabrera, & Paderewski, 2009). One way to achieve this in HCGs is including features such as liking and rating the output generated by the group members. Such features can be more implicit, as a form of exchanging virtual gifts where a player asks for the opinions about his/her generated output or tips for the computational task to be performed as a gift, and offers kudos to those for sending it. Such mechanisms would possibly fuel the enjoyment of agreeable individuals because they are more likely to receive positive feedback from others for being nice and helpful due to their altruism (John et al., 2008). For instance, organizations may leverage such promotive interaction mechanisms and develop an office-themed social game, in which players organize their own workplace and perform all necessary interactions with their colleagues such as task sharing and information exchange. By this way, the organization gets to learn about their employees' behaviors through gameplay while employees become acquainted with the organization.

Furthermore, the collaborative HCG can be designed such that its gameplay is connected with the specified computational task embedded in the narrative. In fact, a game narrative can not only encourage exploration but also evoke intellectual curiosity (Moser & Fang, 2015), and hence be suitable for players with high levels of openness. In

an example where players are to complete the challenges of constructing pathways to reach the final solution, players may take roles as game characters, such as a problem solver, mentor, guide, or one who needs assistance. While creating such roles, designers can inject collaboration into HCGs by means of forming groups, such as parties and raids as in *World of Warcraft*. Players accomplish in-game goals such as generating computations within a specified time limit, and rewards are shared among group members.

Thirdly, in order to increase player enjoyment, HCGs should provide features which will ensure output quality. The findings suggest that players are concerned about the accuracy, relevancy, and timeliness of output while playing HCGs, and satisfaction with these quality aspects will drive enjoyment. Thus, the inclusion of features that ensure these quality aspects of output is important in HCG design. Examples include adopting a supplementary output quality management system that monitors the quality of output generated by HCG play, using paid specialists and an automatic program (Schwagereit, Scherp, & Staab, 2011). As in many other user-generated content applications, content assessment features such as ratings, text reviews, bookmarks, and abuse reports can be used. Besides, reward and punishment strategies can be employed (Christou, 2011) to offer extra game points for high quality output, but deduct some points for output whose quality is lower than the minimum threshold. In addition to quality assessment, content presentation seems to have a positive influence on users. Therefore, designers should consider ranking content based on its popularity value, and utilizing personalization mechanisms to display content that is more likely to be of interest to players. Here, either the content-based or collaborative filtering method that provides personalized recommendations based on a player's profile or browsing history can be applied (Jafarkarimi, Sim, & Saadatdoost, 2012). These strategies help to ease players' apprehension regarding the quality of HCG output.

Fourthly, the findings of this research highlight the need to explore personalized HCG design to tailor the optimal game experience to each individual (Bakkes, Tan, & Pisan, 2012). Personalized HCG design is important because a mismatch between personality and game genre could undermine players' perceptions of enjoyment and output quality. Consequently, the automatic detection of players' personality characteristics is essential. Personality can be identified explicitly through a survey-based assessment as part of their joining the game or a game-like activity. However, this

approach may place a burden of answering long personality questionnaire on players, and may not be able to capture personalities accurately due to their inclination toward socially desirable behavior (Van Lankveld, Schreurs, & Spronck, 2009). Alternatively, designers can consider less intrusive or implicit approaches for automatically detecting aspects of players' personalities. Examples of this may include an automatic recognition of personality based on their profile information (Schiaffino & Amandi, 2009), communication and application logs collected by a software running on the phones of players (Chittaranjan, Blom, & Gatica-Perez, 2013), and data collected via multimodal sensing interfaces that capture prosodic speech features, proximity, and colocation with other people and face-to-face interactions (Kalimeri, Lepri, & Pianesi, 2013). Here, privacy may be an issue of concern for players as they may not be aware that their personality is being assessed and captured. Accordingly, developers need to draw proper privacy guidelines for their games, as well as give players control over their privacy settings.

Furthermore, findings of this research are beneficial to HCGs that wish to implement adaptive gameplay features. Here, adaptive gameplay refers to the ability of the games to make appropriate responses to players' needs and behaviors (Charles, 2005). In particular, findings of this research can be used to adapt gameplay based on personality profiles of players to increase their enjoyment. More specifically, HCGs could include two generic play styles (i.e., collaboration and competition). The game then considers exposing players' to either the collaborative or competitive conditions depending on their in-game performance. If a given adaptation is not effective, re-profiling or introducing new gameplay styles is needed. By doing so, a more comprehensive player model could be developed.

Although this research found that games can attract individuals to partake in human computation, practitioners should be aware of the potential issues of these games. One potential issue could be the lack of awareness of players that they are generating computations as part of HCG play (Tuite, 2016). Here, making the purpose of the HCG explicit provides an opportunity for players to decide whether they want to participate, and to be intrinsically motivated by their attachment to this purpose. Further, the lack such awareness implies that information privacy may be an issue as players may not be noticed that their contributions will be used in a particular human computation project. Therefore, HCGs should implement proper guidelines for ethical use of information such

as how players' contributions will be used and who can access such information. Put differently, players should be well-informed that information collected will not be used for others purposes without their consent. The next issue could be related to the type of incentive used by HCGs for motivating players. Although computational tasks embedded in HCGs are simple and trivial for humans (von Ahn & Dabbish, 2008), people would be willing to perform similar tasks with an exchange of money. It is, therefore, important to inform players that playing HCGs is completely voluntary and that no financial incentive is provided.

In sum, this research informs the HCG community that a proper fit between personality and game genre can raise players' enjoyment and possibly their work-based productivity. Stated differently, this research highlights the importance of personalized gaming in the context of HCGs, consequently indicating the need to investigate how to detect players' personalities automatically. Together with the importance of how personality can be inferred from behavioral data, the formation of adaptive HCG play can be facilitated. Furthermore, this research sheds light on the importance of maintaining the quality of HCG output, because perception of it not only has an impact on players' enjoyment but also varies across game genres. Therefore, developers need to be aware of the potential impacts of game mechanics applied in each HCG genre on its output generation process, and consider how to effectively incorporate quality control mechanisms into its gameplay. In this regard, understanding the essential quality dimensions of HCG output is an important first step toward determining what types of modification could be done to enhance output quality, thereby heightening enjoyment.

6.3 Limitations

Although this research has yielded valuable insights, there are several limitations which give rise to possible new directions for future research. Firstly, this research employed a cross-sectional survey methodology, and players' perceptions were collected after they had played *SPLASH* for about 40 minutes in Study I, and *Collabo*, *Clash*, and *Share* for about 60 minutes each according to the given scenario in Study II. Hence, the tasks performed were somewhat directed by the scenario and participants may have different perceptions if they were to play HCGs without such restrictions. Furthermore, *SPLASH*'s features and enjoyment dimensions were matched conceptually in this research

with the support of extant literature. Hence, participants' perceptions were limited to the extent to which these features were supportive of the enjoyment dimensions. In addition, the short gameplay session may have exposed the participants' unfamiliarity with the game, which may result in biased findings. However, the effect of unfamiliarity may have been minimized in this study given that the majority of participants (67.3%) in Study I and (81.3%) in Study II had previous experiences of playing online games. On the other hand, participants' prior experience in games and location-based applications may bias their perceptions of HCGs in a manner that is either favorable or unfavorable. In any case, conducting a longitudinal study with repeated use, as well as observing players' behavior in an actual context of use would be beneficial in validating the findings of this research.

Secondly, the way by which personality traits are measured in this research introduces another limitation. This study measured personality traits at a single point in time and used only self-reported data, which may suffer from participants stating socially desirable effects and responses may not accurately reflect how participants actually think or behave (Van Lankveld et al., 2009). Therefore, future research may validate the findings of this study by collecting personality data using multiple methods to obtain a more balanced and complete depiction of individuals' personalities. Such methods may include a classification of personality from multimodal behavioral clues and a measurement of invariable traits such as profile information (Kalimeri et al., 2013). Nonetheless, given the practicality and efficiency challenges in obtaining self-reported data from a large number of participants and the acceptable reliability value of each personality trait (i.e., Cronbach's alpha ranges from 0.78 to 0.92), this study drew insights for design practitioners in conceptualizing HCG features that appeal to individuals with varying personality orientations.

Thirdly, although this research found a significant influence of personality traits on enjoyment, it is possible that other individual difference variables including demographics such as gender and socioeconomic status, as well as motivations such as altruism and community, may also impact the relationships identified. The inclusion of these control variables may either strengthen or weaken the personality-enjoyment relationships in HCGs. Future research will, therefore, be necessary to investigate what potential intervening variables are and how they mediate the relationships identified by this research. Furthermore, this is an exploratory study that focused on only the interaction effects of personality traits and genres. In particular, this study examined

whether players' perceptions of enjoyment differ as a function of their personality trait score (low vs. high) and HCG genre (collaborative vs. competitive). Put differently, the effect of personality on each genre of HCG was not investigated. As such, genre is not treated as an independent variable in the proposed model. This limitation calls for future research to examine how personality and perceived output quality influence perceived enjoyment after controlling for the effect of game genre.

Fourthly, this research collected data from just one human computation domain—information sharing. It is unclear whether the extent of computation performed by players can be generalized to other similar human computation contexts. In fact, different human computation tasks may demand varying levels of individuals' cognitive abilities (Quinn & Bederson, 2011), which may in turn have an impact on their perceptions of HCGs. For better generalizability, it would therefore be instructive to conduct investigations into different human computation domains using different HCG genres. Nevertheless, our findings hint at the crucial role played by individuals' personality traits and design interventions in the context of HCGs. Furthermore, this study is dependent on the extent to which the two HCG genres used were supportive of collaborative and competitive gameplay styles. In other words, different types of collaborative and competitive games can be developed using specific game elements and mechanics. Here, HCGs used in this research are a virtual pet simulation game genre. It would therefore be instructive to investigate whether collaboration and competition afforded by other types of simulation games such as construction and management games (e.g., *CityVille*) as well as other genres such as board games (e.g., *Monopoly*) may yield different results.

Finally, the characteristics of the sample pose further limitations. Participants in this study were primarily undergraduate and graduate students who share common demographics and similar educational backgrounds and they were self-selected. This may affect the external (population) validity and generalizability of the study. It would therefore be constructive to replicate the study with people from diverse occupational and educational backgrounds to reveal whether findings of the present research are confirmed. Nonetheless, this research contributes to the understanding of HCG players' behaviors given that university students are regarded to be representative of a major group of online game players in prior studies (Sigurdsson et al., 2006; Wu & Liu, 2007).

6.4 Recommendations for Future Research

Three areas of important future study that emerged from the findings of this research are related to the following aspects: personalized HCG design, the relevancy of individual difference factors for HCG enjoyment, and the generalizability of the research findings.

One future research direction is the development of psychologically-verified player models, also known as player profiling, that are integral to a personalized HCG design which tailors the game experience to the individual player (Karpinskyj, Zambetta, & Cavedon, 2014). In particular, this study highlights how a player's perceived enjoyment of collaboration and competition in HCGs correlates to the Big Five personality model. This information is beneficial to the development of a personality-based player model. Future work should therefore attempt to investigate other possible game mechanics in the context of HCGs, and correlate them with the Big Five personality traits. Employing such player models would provide a more comprehensive means for game developers to tailor the gameplay experience to individual players.

Another recommendation for future research is to consider a wider range of variables and examine their influences on perceived HCG enjoyment. In particular, previous studies on hedonic and task-oriented contexts have identified several factors that might influence individuals' attitudes and behavior, such as personal innovation, attractiveness, and self-efficacy (e.g., Jeong & Kim, 2011; Wang & Wang, 2008). In addition, individuals may have different motivations for playing HCGs, such as altruism, community, and learning. These motivational factors may influence individuals' enjoyment through their satisfaction with making contributions in HCGs. The study of a wider range of variables may improve the understanding of players' perceptions of enjoyment in HCGs, and more generally games that are not just for pure entertainment.

In addition, one research area that needs to be investigated is the negative consequences of playing HCGs. For instance, players may try to cheat the game by producing outputs that are not meaningful. This is evident in prior research in which participants were found to create nonsense comments, such as "tg", "abc", and "fgo", as a quick way to earn virtual credits (e.g., Goh, Lee, & Low, 2011). Next, players may feel pressured if they were forced to create information against time. Hence, imposing time limits in HCGs may evoke negative experiences in players.

Another future research area is to improve the generalizability of this research. First, participants' perceptions may be somewhat limited to the extent to which the game features were supportive of enjoyment dimensions used in this research. In Study I, the features of *SPLASH* and the enjoyment constructs were conceptually matched, and hence they need to be empirically validated by future research. Nonetheless, the speculative explanations offered by this research could serve as a springboard for further studies that wish to examine the affective-, cognitive- and behavioral-supportive features of HCGs.

Similarly, Study II relied on only two HCG genres (i.e., collaborative and competitive), and a single human computation domain (i.e., location-based content sharing). In particular, this research demonstrated only one way to create collaboration and competition in HCGs through forming temporary groups and one-to-one engagements/duels respectively. There may be other ways to implement collaborative and competitive mechanics in HCGs. Therefore, a possible next step would be to investigate other types of mechanics in order to determine their effects on the personality-enjoyment relationship in the HCG context. In addition to classifying games as collaborative and competitive genres, prior games studies research has suggested that games can also be categorized by their use of gameplay styles and elements such as adventure and simulation genres (Apperley, 2006; Rollings & Adams, 2003). Hence, it would be worthwhile to extend this research by conducting studies using a larger number of HCG genres in a wider range of contexts. For instance, future research may replicate this study in other domains such as collecting common-sense facts and creating ontological relations for climate change knowledge to examine whether the collaborative and competitive HCGs project similar effects in such domains. Extending further, studies may compare the effectiveness of multiple HCG genres (e.g., adventure vs. action vs. simulation) across human computation domains.

Secondly, the study's participants are made up of undergraduate and graduate students from two local universities. Hence, a study using more representative samples with diverse age groups, educational attainments, and occupations must be conducted in order to validate the findings of this research. Thirdly, the research should go beyond collecting self-reported data on independent and dependent variables; it should collect objective measures of HCG enjoyment such as actual gameplay habits and physiological signals. Finally, collecting longitudinal data at different points in time, for example, every

one or three months over a one-year period, would be beneficial to test the stability of these findings.

6.5 Concluding Remarks

From the findings of Study I, it can be inferred that participants viewed HCGs as a computainment system that offers an entertainment experience to them while performing computations (Goh & Lee, 2011). Consequently, enhancing enjoyment has become an essential aspect of HCGs to maintain a long-term relationship with players. Study II further demonstrates how personality-targeted design approaches could serve as an effective way of increasing individuals' perceived enjoyment of HCGs. This, in turn, may have an influence on their participation in human computation. Goh et al. (2011) argued that HCG designers should be mindful that while it is important to foster enjoyment, their designs should not undermine the quality of generated output. Therefore, considering the interaction between personality traits and design interventions in the HCG design process could be beneficial, as individuals were found to not only experience a greater level of enjoyment but also produce a higher level of performance while using their preferred systems (Bakkes, Spronck, & Lankveld, 2012). Consequently, the HCG design process needs to consider minimally intrusive ways to detect players' personality attributes and their preferred game genres.

In conclusion, the two studies described here evaluated how individuals' personalities can inform HCG design decisions. In particular, while Study I revealed a significant influence of individuals' personality traits on their enjoyment of a mobile HCG for information sharing, Study II tested the effectiveness of a personality-targeted design approach in a HCG context. HCG designers and researchers should place high priority on individuals' characteristics and situational factors (i.e., personality traits and game genres) when designing games for a particular human computation task. Overall, the findings of this study have shed light on how personality characteristics of individuals and their game genres preference could be used in a novel way to improve perceptions of enjoyment and output quality in HCGs.

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Appendix A: Task Description and Questionnaire Used in Study I

Subject: Survey on Mobile Information Sharing Gaming Application

Dear Sir/Madam,

I am a PhD student at the Nanyang Technological University, Singapore, and my supervisor is A/P Dion Goh from the Wee Kim Wee School of Communication and Information, Nanyang Technological University, Singapore. I am conducting a survey on a mobile information sharing gaming application, and examining its relationship to user personality traits, motivation needs satisfaction, perceived enjoyment, and perceived quality of information.

In this survey, you will be required to perform a series of activities. Firstly, you will be given a mobile phone with a preloaded application and asked to perform a series of tasks involving information viewing, creating, and rating. Details of the tasks can be found on the next page. Thereafter, you will need to complete a survey form.

It will take 30-40 minutes to complete this study and you can leave the study at anytime if you do not want to participate further. You will be given S\$5 for your participation at the end of the study.

By participating in the study, you will be able to contribute to the development of future mobile information sharing games. Further, there are no anticipated risks, beyond those encountered in daily life, associated with participating in this study.

I assure you that the information provided by you would be treated with utmost confidence and no names of the participants will be revealed. I will use this data for research purposes, and only aggregated finding will be reported.

If you have any concerns about this study or your experience as a participant, please feel free to contact me at +65-91469221 or email at ei1@e.ntu.edu.sg.

Further, if you have questions or concern about the ethical use of human participants in this research, you may wish to contact NTU Institutional Review Board at irb@ntu.edu.sg.

Your inputs are critical to the success of this study. Thank you very much in advance.

Yours sincerely,

Ei Pa Pa Pe Than
PhD Candidate
Division of Information Studies
Wee Kim Wee School of Communication and Information

Your Consent

I have read and understood the above information and voluntarily consent to participate in this survey.

Name

Date

☐ I have not taken this survey before.

Task Description

The following are the **TWO** places and their globs that you need to visit during the use of the application.

- a. Wee Kim Wee School of Communication and Information: Acrc library
- b. Blk N2.1 NTU: Canteen A

I. Perform the following tasks on “Wee Kim Wee School of Communication and Information”:

1. Find the place on the Map
2. Enter the place
3. View a list of globs
4. Enter the Glob, “Acrc library”

Glob

5. Explore the Glob, such as its appearance, number of comments, and ratings
6. View comments
7. View details of one comment [at least]
8. Feed the Glob with one comment
9. Enter Glob’s Home

Glob’s Home

10. Explore Glob’s Home
11. Tap on the avatar icon to see room information and your aurum (Tap the icon again after viewing)
12. Ting in
13. View comment board
14. View details of one comment [at least]
15. Rate one comment
16. Play mini-HCG, “The Linker”
17. Tap on the avatar icon to check your aurum
18. View items in the game store
19. Ting out
20. Go back to the Glob
21. Go back to the Map

II. Perform the following tasks on “Blk N2.1 NTU”:

1. Find the place on the Map
2. Enter the place
3. View a list of globs
4. Enter the Glob, “Canteen A”

Glob

5. Explore the Glob, such as its appearance, number of comments, and ratings
6. View comments
7. View details of one comment [at least]

8. Rate one comment
9. Enter Glob's Home

Glob's Home

10. Explore Glob's Home
11. Tap on the avatar icon to see room information and your aurum
12. Ting in
13. View comment board
14. Post one comment
15. Play mini-Casual game, "Memorize"
16. Ting out
17. Go to your profile and check your aurum

III. Access your profile

Player's Profile

1. Personalize your avatar
2. Post a message on your own wall
3. Browse through awards
4. See friends list
5. Visit a friend's profile
6. Leave a message for him/her
7. See his/her awards
8. Go back to Main menu

IV. View leaderboards

Ranking

1. Go to the Ranking
2. Browse through the richest players list
3. Browse through the street smart players list
4. Browse through the popular players list

Post Questionnaire

Part I: Demographic Information

Login ID: _____

Instructions:

Answer the following questions about yourself.

1. Nationality: _____ 2. Age: _____

3. Gender: ☐ Male ☐ Female

4. What is your educational background?

- ☐ Computer sciences / IT ☐ Engineering ☐ Education ☐ Business
☐ Arts, humanities, social sciences ☐ Sports and leisure ☐ Architecture ☐ Law
☐ Life/health science/medicine ☐ Advertising, design and media
☐ Hospitality/tourism ☐ Others (Please Specify) _____

5. Which sector does your organization belong to?

- ☐ Computer sciences / IT ☐ Engineering ☐ Education ☐ Business
☐ Arts, humanities, social sciences ☐ Sports and leisure ☐ Architecture ☐ Law
☐ Life/health science/medicine ☐ Advertising, design and media
☐ Hospitality/tourism ☐ Others (Please Specify) _____

6. Do you play online games?

- ☐ Yes ☐ No → (If your answer is No, please skip to question no. 9)

7. If you play online games, how often do you do so?

- ☐ Less than once a month / never ☐ Once a month ☐ Every Other week ☐ Every week
☐ Everyday

8. If you play online games, please indicate usage frequencies for each type of game you play using a scale of 1 to 5

1 = Less than once a month / never	2 = Once a month	3 = Every Other week	4 = Every week	5 = Everyday
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Action	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐	Adventure	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
Fighting	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐	Simulation	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
Shooting	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐	Role-Playing (RPG)	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
Strategy	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐	Sports and Racing	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
Puzzle	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐	Others (Please Specify) _____	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
Social	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		

9. Answer the following questions on usage frequencies using a scale of 1 to 5.

1 = Less than once a month / never	2 = Once a month	3 = Every Other week	4 = Every week	5 = Everyday
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1	How often do you use your mobile phone to surf the Web?	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
2	How often do you use your mobile phone to take pictures or videos?	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
3	How often do you use your mobile phone to share pictures, videos, music, and other media with others?	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
4	How often do you use your mobile phone for map navigation or to obtain directions?	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
5	How often do you use your mobile phone to play games?	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
6	How often do you play games on desktop or other game consoles?	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
7	How often do you use your mobile phone to log into social networking applications?	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
8	How often do you play games on social networking applications using your mobile phone, e.g. Facebook, FourSquare, etc.?	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
9	How often do you check into a location using social networking applications with your mobile phone, e.g. Facebook, FourSquare, etc.?	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
10	How often do you share tips about a location on social networking applications using your mobile phone, e.g. Facebook, FourSquare, etc.?	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Part II: How Accurately Can You Describe Yourself?

Instructions:

Describe yourself as you generally are now, not as you wish to be in the future. Please indicate your level of agreement with the following statements on a scale of 1 to 5.

1 = Strongly disagree	2 = Disagree	3 = Neutral	4 = Agree	5 = Strongly agree
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I am someone who ...

1	is talkative	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
2	tends to find fault with others	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
3	I am usually among the first people to adopt new technologies and devices	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
4	I want to be among the first people to try out new mobile services	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
5	is original, comes up with new ideas	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

6	is reserved	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
7	is helpful and unselfish with others	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
8	can be somewhat careless	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
9	is relaxed, handles stress well	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
10	is curious about many different things	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
11	is full of energy	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
12	starts quarrels with others	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
13	is a reliable worker	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
14	can be tense	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
15	is ingenious, a deep thinker	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
16	generates a lot of enthusiasm	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
17	has a forgiving nature	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
18	tends to be disorganized	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
19	worries a lot	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
20	has an active imagination	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
21	tends to be quiet	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
22	is generally trusting	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
23	tends to be lazy	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
24	is emotionally stable, not easily upset	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
25	is inventive	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
26	has an assertive personality	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
27	can be cold and aloof	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
28	perseveres until the task is finished	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
29	can be moody	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
30	values artistic, aesthetic experiences	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
31	is sometimes shy, inhibited	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
32	is considerate and kind to almost everyone	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
33	does things efficiently	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
34	remains calm in tense situations	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
35	prefers work that is routine	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
36	is outgoing, sociable	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
37	is sometimes rude to others	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
38	makes plans and follows through with them	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
39	gets nervous easily	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
40	likes to reflect, play with ideas	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

41	has few artistic interests	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
42	likes to cooperate with others	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
43	is easily distracted	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
44	is sophisticated in art, music, or literature	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Part III: Your perceptions of information quality of the application

Instructions:

For each item below, please indicate your level of agreement on a scale of 1 to 5.

	1 = Strongly disagree	2 = Disagree	3 = Neutral	4 = Agree	5 = Strongly agree
1	This application provides correct information.				1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
2	This application provides accurate information.				1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
3	This application provides reliable information.				1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
4	This application provides information that includes all necessary details.				1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
5	This application provides information that is sufficiently complete for my needs.				1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
6	This application provides information that covers sufficient breadth and depth for my needs.				1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
7	This application provides information that is useful for my needs.				1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
8	This application provides information that is relevant to my needs.				1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
9	This application provides information that is appropriate for my needs.				1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
10	This application provides information that is sufficiently current for my needs.				1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
11	This application provides information that is sufficiently up-to-date.				1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
12	This application provides information I need in time.				1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
13	Overall, this application provides accurate information.				1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
14	Overall, this application provides up-to-date information.				1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
15	Overall, this application provides sufficient information for my needs.				1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
16	Overall, this application provides relevant information for my needs.				1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Part IV: Your perceptions of enjoyment in using the application and its individual features

Instructions:

Using the 1-5 scale below, please indicate your level of agreement with the following statements by placing the appropriate number in the boxes provided.

1 = Strongly disagree	2 = Disagree	3 = Neutral	4 = Agree	5 = Strongly agree
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* *SPLASH* refers to the entire application.

* Glob, Glob's Home, and Player's Profile are individual features of the application (*SPLASH*).

		<i>SPLASH</i>	Glob	Glob's Home	Player's Profile
1	I felt attracted to this application (or feature).				
2	I felt emotionally involved in this application (or feature).				
3	I felt emotionally attached to this application (or feature).				
4	I felt emotionally affected while using this application (or feature).				
5	I think it is worthwhile to use this application (or feature).				
6	I think this application (or feature) is a good way of sharing information.				
7	I think this application (or feature) is an effective way of sharing information.				
8	I think this application (or feature) is an interesting way of sharing information.				
9	I lost track of time while using this application (or feature).				
10	I became less aware of my surroundings because I was engrossed in using this application (or feature).				
11	I was able to easily use the application (or feature) to accomplish my designated tasks.				
12	I was able to quickly choose appropriate actions for my designated tasks in this application (or feature).				
13	Overall, I enjoyed using this application (or feature).				
14	Overall, using this application was fun (or feature).				
15	Overall, using this application was boring (or feature).				

What do you like about *SPLASH* and its features (Glob, Glob's Home, and Player's Profile)?

What do you dislike about *SPLASH* and its features (Glob, Glob's Home, and Player's Profile)?

How do you think *SPLASH* and its features (Glob, Glob's Home, and Player's Profile) can be improved?

Appendix B: Usage Scenarios and Revised Questionnaires Used in Study II

Subject: Experimental Study on Mobile Information Sharing Games

Dear Sir/Madam,

I am a PhD student at the Nanyang Technological University, Singapore, and my supervisor is A/P Dion Goh from the Wee Kim Wee School of Communication and Information, Nanyang Technological University, Singapore. I am conducting a study with mobile information sharing games, and examining their relationships to user personality traits, motivation needs satisfaction, perceived enjoyment, and perceived output quality.

If you choose to participate in my study, you will first be given a “screening” questionnaire to determine if you’re eligible to participate. We will select participants based on personality characteristics, and cap enrolment of sub-groups once they are filled. You will be informed of your eligibility by email in the next one or two weeks.

Eligible participants will be asked to visit Wee Kim Wee School of Communication and Information, Nanyang Technological University, Singapore, on three occasions, 2 to 7 days apart. In each visit, you will be required to play a different mobile information sharing game as per given scenario. Specifically, you will be given a mobile phone with a preloaded game and asked to perform a series of tasks involving information viewing, creating, and rating. Thereafter, you will need to complete a questionnaire. Each visit will take approximately 40-45 minutes and you can leave the study at anytime if you do not want to participate further. You will be given S\$20 for your participation at the end of the third visit. In next pages, you will find gameplay scenarios and a table of study visits and procedures. This will give you a better idea of the study requirements and the time commitment involved.

By participating in the study, you will be able to contribute to the development of future mobile information sharing games. Further, there are no anticipated risks, beyond those encountered in daily life, associated with participating in this study.

Participants in this study will be required to provide your name and a valid email address in order to facilitate communication with you throughout the study. No other identifying information will be requested, such as your address, or telephone number. I assure you that the information provided by you would be treated with utmost confidence and no names of the participants will be revealed. I will use this data for research purposes, and only aggregated finding will be reported.

If you have any concerns about this study or your experience as a participant, please feel free to contact me at +65-91469221 or email at ei1@e.ntu.edu.sg. Further, if you have questions or concern about the ethical use of human participants in this research, you may wish to contact NTU Institutional Review Board at irb@ntu.edu.sg.

Your inputs are critical to the success of this study. Thank you very much in advance.

Yours sincerely,

Ei Pa Pa Pe Than, PhD Candidate

Division of Information Studies, Wee Kim Wee School of Communication and Information

Your Consent

I have read and understood the above information and voluntarily consent to participate in this survey.

Name

Email address

Date

☐ I have not taken this survey before.

Usage Scenarios

I. *Collabo*

Task I: Visit Wee Kim Wee School of Communication and Information

- Observe if there are any starving pets which are being rescued by other players.
- If “YES”, join them to rescue the pet.
- Visit that location.
 - View 2 comments at least.
 - Go to ‘Activities tab’ and see who are trying to save the pet.
 - Feed the pet by creating comment(s) about this location.
 - 2 Feed the pet by rating comment(s).
 - Observe the change in pet’s strength after you have fed it.
 - You will see the pop-up message if you have rescued the pet.
 - Exit from the visited location.
- If “NO”, start rescuing a starving pet
- Visit a location.
 - View 2 comments at least.
 - Feed the pet by creating comment(s) about this location.
 - Feed the pet by rating comment(s).
 - Observe the change in pet’s strength after you have fed it.
 - Go to ‘Activities tab’. [You will see that you’ve published a message of inviting others to join you.]
 - Exit from the visited location.

Task II: Repeat Task I for BLK N2.1 NTU and Chinese Heritage Center.

Task III: Go back to all visited locations and check their ‘**Activities tab**’ to see who collaborated with you in rescuing the pets.

Task IV: Visit Your Profile

- View how many pets you have rescued during this gameplay session.

Task V: Visit Ranking Page.

- View a list of players who have rescued each pet.
- Your ID will be highlighted if you have rescued the pet.

** Even if there is no starving pet, you can still feed the pet to prevent them from being starved.

** You can always come back to this location and see whether the pet was rescued or not either by observing the appearance of the pet or viewing the activities list.

II. *Clash*

Task I: Visit Wee Kim Wee School of Communication and Information

- Visit a pet that you want to be its owner and duel the current owner.
 - View 2 comments at least.
 - Feed the pet by creating comment(s) about the current location.
 - Feed the pet by rating comment(s).
 - Check the current owner’s strength before dueling.
 - Duel the current owner.
 - If you win, you will see the winning message and your name underneath the pet.

- Exit from the visited location.

Task II: Repeat Task I for **BLK N2.1 NTU** and **Chinese Heritage Center**.

Task III: Visit **Your Profile**.

- View how many pets you have managed to win during this gameplay session.

Task IV: Visit **Ranking Page**.

- View your ranking in the game.

III. Share

Task I. Visit **Wee Kim Wee School of Communication and Information**

- View 2 comments at least.
- Create a comment(s) about this location.
- Rate a comment(s).
- Exit from the location.

Task II. Repeat Task I for **BLK N2.1 NTU** and **Chinese Heritage Center**.

Task III: Visit **Your Profile**.

- View how many comments you have contributed and rated during this gameplay session.

Screening Questionnaire

Part I: Demographic Information

Instructions:

Answer the following questions about yourself.

1. Nationality: _____ 2. Age: _____

3. Gender: ☐ Male ☐ Female

4. What is your educational background?

- ☐ Computer sciences / IT ☐ Engineering ☐ Education ☐ Business
☐ Arts, humanities, social sciences ☐ Sports and leisure ☐ Architecture ☐ Law
☐ Life/health science/medicine ☐ Advertising, design and media
☐ Hospitality/tourism ☐ Others (Please Specify) _____

5. Which sector does your organization belong to?

- ☐ Computer sciences / IT ☐ Engineering ☐ Education ☐ Business
☐ Arts, humanities, social sciences ☐ Sports and leisure ☐ Architecture ☐ Law
☐ Life/health science/medicine ☐ Advertising, design and media
☐ Hospitality/tourism ☐ Others (Please Specify) _____

6. If student, please indicate your enrollment status.

- ☐ Full-time ☐ Part-time

7. Do you play online games?

- ☐ Yes ☐ No → (If your answer is No, please skip to question no. 9)

8. If you play online games, how often do you do so?

- ☐ Less than once a month / never ☐ Once a month ☐ Every Other week ☐ Every week
☐ Everyday

9. If you play online games, please indicate usage frequencies for each type of game you play using a scale of 1 to 5

1 = Less than once a month / never	2 = Once a month	3 = Every Other week	4 = Every week	5 = Everyday
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Action	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐	Adventure	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
Fighting	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐	Simulation	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
Shooting	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐	Role-Playing (RPG)	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
Strategy	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐	Sports and Racing	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
Puzzle	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐	Others (Please	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Social	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐	Specify) _____	
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10. Answer the following questions on usage frequencies using a scale of 1 to 5.

1 = Less than once a month / never	2 = Once a month	3 = Every Other week	4 = Every week	5 = Everyday
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1	How often do you use your mobile phone to surf the Web?	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
2	How often do you use your mobile phone to take pictures or videos?	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
3	How often do you use your mobile phone to share pictures, videos, music, and other media with others?	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
4	How often do you use your mobile phone for map navigation or to obtain directions?	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
5	How often do you use your mobile phone to play games?	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
6	How often do you play games on desktop or other game consoles?	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
7	How often do you use your mobile phone to log into social networking applications?	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
8	How often do you play games on social networking applications using your mobile phone, e.g. Facebook, FourSquare, etc.?	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
9	How often do you check into a location using social networking applications with your mobile phone, e.g. Facebook, FourSquare, etc.?	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
10	How often do you share tips about a location on social networking applications using your mobile phone, e.g. Facebook, FourSquare, etc.?	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Part II: How Accurately Can You Describe Yourself?

Instructions:

Describe yourself as you generally are now, not as you wish to be in the future. Please indicate your level of agreement with the following statements on a scale of 1 to 5.

1 = Strongly disagree	2 = Disagree	3 = Neutral	4 = Agree	5 = Strongly agree
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I am someone who ...

1	is talkative	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
2	tends to find fault with others	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
3	I am usually among the first people to adopt new	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

	technologies and devices	
4	I want to be among the first people to try out new mobile services	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
5	is original, comes up with new ideas	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
6	is reserved	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
7	is helpful and unselfish with others	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
8	can be somewhat careless	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
9	is relaxed, handles stress well	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
10	is curious about many different things	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
11	is full of energy	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
12	starts quarrels with others	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
13	is a reliable worker	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
14	can be tense	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
15	is ingenious, a deep thinker	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
16	generates a lot of enthusiasm	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
17	has a forgiving nature	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
18	tends to be disorganized	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
19	worries a lot	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
20	has an active imagination	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
21	tends to be quiet	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
22	is generally trusting	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
23	tends to be lazy	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
24	is emotionally stable, not easily upset	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
25	is inventive	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
26	has an assertive personality	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
27	can be cold and aloof	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
28	perseveres until the task is finished	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
29	can be moody	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
30	values artistic, aesthetic experiences	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
31	is sometimes shy, inhibited	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
32	is considerate and kind to almost everyone	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
33	does things efficiently	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
34	remains calm in tense situations	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
35	prefers work that is routine	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
36	is outgoing, sociable	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

37	is sometimes rude to others	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
38	makes plans and follows through with them	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
39	gets nervous easily	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
40	likes to reflect, play with ideas	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
41	has few artistic interests	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
42	likes to cooperate with others	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
43	is easily distracted	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
44	is sophisticated in art, music, or literature	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Post Questionnaire

User ID: _____

Game genre: _____

Part I: Your perceptions information quality of the game or application

Instructions:

For each item below, please indicate your level of agreement on a scale of 1 to 5.

1 = Strongly disagree	2 = Disagree	3 = Neutral	4 = Agree	5 = Strongly agree
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1	This game or application provides correct information.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
2	This game or application provides accurate information.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
3	This game or application provides reliable information.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
4	This game or application provides information that includes all necessary details.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
5	This game or application provides information that is sufficiently complete for my needs.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
6	This game or application provides information that covers sufficient breadth and depth for my needs.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
7	This game or application provides information that is useful for my needs.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
8	This game or application provides information that is relevant to my needs.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
9	This game or application provides information that is appropriate for my needs.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
10	This game or application provides information that is sufficiently current for my needs.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
11	This game or application provides information that is sufficiently up-to-date.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

12	This game or application provides information I need in time.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
13	Overall, this game or application provides accurate information.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
14	Overall, this game or application provides up-to-date information.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
15	Overall, this game or application provides sufficient information for my needs.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
16	Overall, this game or application provides relevant information for my needs.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Part II: Your perceptions of enjoyment in using the game or application

Instructions:

For each item below, please indicate your level of agreement on a scale of 1 to 5.

1 = Strongly disagree	2 = Disagree	3 = Neutral	4 = Agree	5 = Strongly agree
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1	I felt attracted to this game or application.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
2	I felt emotionally involved in this game or application.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
3	I felt emotionally attached to this game or application.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
4	I felt emotionally affected while using this game or application.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
5	I think it is worthwhile to use this game or application.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
6	I think this game or application is a good way of sharing information.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
7	I think this game or application is an effective way of sharing information.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
8	I think this game or application is an interesting way of sharing information.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
9	I lost track of time while using this game or application.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
10	I became less aware of my surroundings because I was engrossed in using this game or application.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
11	I was absorbed intently while using this game or application.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
12	My attention was focused while using this game or application.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
13	Overall, I enjoyed using this game or application.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
14	Overall, using this game or application was fun.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
15	Overall, using this game or application was boring.	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

What do you like about the application and its features?

What do you dislike about the application and its features?

How do you think the application and its features can be improved?

Appendix C: A List of Publications

JOURNALS

- Pe-Than, E. P. P., Goh, D. H.-L., & Lee, C. S. (2015). Why do people play human computation games? Effects of perceived enjoyment and perceived output quality. *Aslib Journal of Information Management*, 67(5), 592-612.
- Pe-Than, E. P. P., Goh, D. H.-L., Lee, C.S. (2015). A typology of human computation games: An analysis and a review of current games. *Behaviour and Information Technology*, 34(8), 809-824.
- Pe-Than, E. P. P., Goh, D. H.-L., Lee, C. S. (2014). Making work fun: Investigating antecedents of perceived enjoyment in human computation games for information sharing. *Computers in Human Behavior*, 39(2014), 88-99.

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- Pe-Than, E. P. P., Goh, D. H. L., & Lee, C. S. (2016, June). Does it matter how you play? The effects of collaboration and competition among players of human computation games. Paper to be presented at 66th Annual Conference of the International Communication Association, ICA 2016, (June 9-13, Fukuoka, Japan).
- Pe-Than, E. P. P., Goh, D. H. L., & Lee, C. S. (2015). The effects of collaboration and competition on players' perceptions in human computation games. In R. B. Allen, J. Hunter, & M. L. Zeng, *Digital Libraries: Providing Quality Information* (pp. 246-251). Springer International Publishing.
- Goh, D. H. L., Pe-Than, E. P. P., & Lee, C. S. (2015). Investigating the antecedents of playing games for crowdsourcing location-based content. In R. B. Allen, J. Hunter, & M. L. Zeng (Eds.), *Digital Libraries: Providing Quality Information* (pp. 52-63). Springer International Publishing.
- Goh, D. H. L., Pe-Than, E. P. P., & Lee, C. S. (2015). An investigation of reward systems in human computation games. In M. Kurosu (Ed.), *Human-Computer Interaction: Interaction Technologies* (pp. 596-607). Springer International Publishing.
- Pe-Than, E. P. P., Goh, D. H.-L., & Lee, C. S. (2014, May). Why do people play human computation games? Effects of perceived enjoyment and perceived output quality. Paper presented at 64th Annual Conference of the International Communication Association, ICA 2014, (May 22-26, Seattle, USA).
- Pe-Than, E. P. P., Goh, D. H. L., & Lee, C. S. (2013). Playing human computation games for mobile information sharing: The influence of personality and perceived information quality. In S. R. Urs, J-C. Na & G. Buchanan (Eds.), *Digital Libraries:*

Social Media and Community Networks (pp. 147-156). Springer International Publishing.

- Pe-Than, E. P. P., Goh, D. H. L., & Lee, C. S. (2012). Enjoyment of a mobile information sharing game: Perspectives from needs satisfaction and information quality. In H-H. Chen & G. Chowdhury (Eds.), *The Outreach of Digital Libraries: A Globalized Resource Network* (pp. 126-135). Springer Berlin Heidelberg.
- Pe-Than, E. P. P., Goh, D. H. L., & Lee, C. S. (2012). A survey and typology of human computation games. In *Information Technology: New Generations (ITNG), 2012 Ninth International Conference on* (pp. 720-725). IEEE.