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The effects of human-game interaction, network externalities, and motivations on players' use of mobile casual games

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Abstract

Purpose – This paper empirically examines the factors that influence the acceptance and use of mobile casual games.

Methodology – A theoretical model is proposed based on the theory of reasonable action, the uses and gratifications theory, the network externalities paradigm and the human-computer interaction literature. An empirical study was conducted through an online survey of mobile casual gamers in Spain, using a convenience sample. The proposed model was tested by an analysis of the collected data through a structural equation model using the partial least squares (PLS) method.

Findings – The results indicate that human-mobile game interaction and network externalities have a significant indirect impact on intention to play, through utilitarian, hedonic and relational motivations. In addition, the full mediation effect of attitude was found between these constructs and intention to play, which is a very important determinant of actual use.

Originality/value – This study is among the few that focuses on users' acceptance of mobile games apps, the features of which differ significantly from personal computer and console games. It highlights the effects of human-game interaction and network externalities on the adoption of mobile casual games. Hence, the study contributes to the theoretical and practical understanding of the factors that lead users to adopt an entertainment mobile application.

Keywords: Mobile Game; Casual Game; Human-Game Interaction; Network Externalities; Motivations; Technology Adoption.

1. Introduction

Mobile app services have proliferated over the last few years, especially in the hedonic segment. It is known that the mobile game app industry is experiencing rapid growth (Park and Kim, 2013). Mobile gaming will reach 42% of the global gaming market ($46.1 billion) in 2017, with smartphone and tablet gaming having grown 19% in the last year; in contrast, the personal computer (PC) and console markets have decreased since 2015 and in 2017 will generate 27% and 31% of all global game

revenues, respectively (McDonald, 2017). Among the different categories of mobile games, some of the industry's biggest hits are casual games, like Candy Crush Saga®. Casual games are characterized by simple rules and uncomplicated game controls; they normally have short playing sessions and they do not require a high degree of player involvement (Kuittinen *et al.*, 2007).

Increasing competition is encouraging game suppliers to make great efforts to gain market share (Newzoo, 2016). Therefore, it would be very useful to know why people play mobile casual games and what are the main influencing factors. However, while the adoption of online games has inspired a number of studies in the area of PC games, little research has been done into the adoption of mobile games, according to the literature reviews conducted by Hamari *et al.* (2015) and Shaikh and Karjaluoto (2015). In comparison to other platforms, mobile games are more accessible and convenient (Hsiao and Chen, 2016). Furthermore, the specific features of mobile devices (screen size, visual effects, sound, connection quality, etc.) differ significantly from the same features on a PC or game console, which creates a different player experience (Liu and Li, 2011; Wei and Lu, 2014; Zhou, 2013) and, consequently, affect his or her adoption of the technology.

Researchers have divided the literature on online game adoption into two groups (Park and Kim, 2013): (a) one focused on the technical side (in terms of realism, animation, scenario, sound, visualization techniques, graphics, etc.); and (b) the other focused on the psychological perspective (the enjoyment of games, flow status, etc.). For instance, many researchers have built models based on the extended technology acceptance model (Davis et al., 1992), adapting the constructs and adding other variables such as flow experience and perceived attractiveness (Ha et al., 2007), perceived mobility, perceived control, perceived connectedness, satisfaction (Park et al.,

2014), economic cost and subjective norms (Jiang et al., 2015). Other researchers have included technological characteristics as important antecedents of intention to use, but they also exclude some important attitudinal and behavioral variables (e.g., Choe and Schumacher, 2015; Kim, Oh *et al.*, 2010). Nevertheless, although both the psychological and technical approaches suggested by Park and Kim (2013) have been found to influence the adoption of mobile casual games, there are few studies that make a joint analysis of both aspects.

In order to fill this gap in the literature, this research has three objectives: (a) to propose a model to help improve the understanding of the use of mobile casual games; (b) to explore whether human-mobile game interaction, network externalities, and hedonic, utilitarian and relational motivations have a significant impact on attitude and intention to play; and (c) to clearly establish the influence of each factor on the adoption of mobile casual games. The research model is based on the theory of reasonable action (TRA) (Fishbein and Ajzen, 1975), the uses and gratifications (U&G) theory, the network externalities paradigm (NE) (Witt, 1997) and the literature on human-computer interaction (Ghani and Deshpande, 1994).

2. Literature Review

2.1. Theoretical Background

Fishbein and Ajzen (1975) believed that the immediate predictor of behavior is behavioral intention, which is determined by attitude and social influence. According to the U&G theory, the satisfaction of an individual's expectations positively influences their attitude. The U&G theory originates in the field of research into mass media and tries to explain the selection and use of media. People actively select and use media to satisfy their needs or desires, influenced by social and psychological factors and, when

those needs or desires are satisfied, this generates gratification that shapes their perception of the medium and motivates the individual to use it again (Rubin, 2009). Therefore, if the motivational factors that explain how a person selects a medium are identified, their use could be inferred. That is, motivation is a key element because it influences the selection and active use of the medium, as well as the possible outcome. In recent years, studies into adoption of internet-based information systems / services have successfully applied the U&G theory by exploring user motivations. For example, attitude toward Internet use is positively related to social gratification, the passive social gratification deriving from Internet access and the active pursuit of interactions (Ji and Fu, 2013). Facebook use, meanwhile, is motivated by socializing, entertainment, and self-expression (Cho *et al.*, 2014).

This research posits that the U&G theory can be applied to the study of mobile gamers' motivations as antecedents of their attitude, because players choose a particular game motivated by needs or wishes influenced by social and psychological factors, and that after they play a game they will return to it or not based on the results. That is, in the mobile game context, gratification refers to the extent that the players' needs are satisfied, so we assume that the greater the degree of gratification, the greater will be the attitude and intention to play mobile casual games (Wei and Lu, 2014). In a prior study, Wu *et al.* (2010) classified online gamers' gratifications into three types: enjoyment, social interaction and achievement. Subsequently, Huang and Hsieh (2011), in regard to online games, and Wei and Lu (2014), in regard to mobile games, narrowed the classification down to the first two of these gratifications: enjoyment and social interaction. Recently, Liu (2016) demonstrated the influence of utilitarian and hedonic outcome expectations on intention to play online games. In regard to mobile games, Engl and Nacke (2013) found that only a few gamers were motivated by the mental

challenge of playing, while many more had a greater interest in entertainment. These findings suggest that achievement is not an important contributory factor in mobile game players' individual gratifications. This study therefore takes into account hedonic and relational motivations, in addition to utilitarian motivation, due to the increasing usefulness of games in aspects such as quality of life, learning, health, creativity enablers for children and performance at work (Cornejo *et al.*, 2015; Froschauer *et al.*, 2012; Xanthopoulou and Papagiannidis, 2012), among others. Consequently, this study will examine three types of gratification: utilitarian, hedonic and relational.

As to the models for adopting and using these technologies, gamers' motivations are influenced by external variables, such as technological features (Davis *et al.*, 1989) and their social environment (Venkatesh and Bala, 2008). Prior research has demonstrated the influence of the human-game interaction on intention to play or to continue to play online games (Chang, 2013) and mobile games (Choe and Schumacher, 2015; Ha *et al.*, 2007; Kim, Oh *et al.*, 2010). Moreover, it seems logical that gamers' motivations also depend on the social environment of the game, a perception formed according to the number of players in the game. The influence of network externalities has been identified as an important antecedent of intention to play mobile games (Wei and Lu, 2014) and online games (Hsu and Lu, 2004). In theory, one would expect that the more players there are (especially in one's immediate environment), the greater will be the possibilities of interaction and, consequently, enjoyment of the game, which would, in turn, have a positive effect on intention to play.

2.2. PC and mobile games adoption

The personal computer (PC) was one of the first devices used for video games. The rapid expansion of the Internet from the final years of the 20th

century increased the penetration of PC games, in parallel with the development of online games. Since then, there have been a significant number of studies into the factors that promote the adoption of video games. Most of them propose causal models based on the technology acceptance model (TAM) and / or theories such as the theory of reasoned action (TRA) and the theory of planned behavior (TPB) (Hamari *et al.*, 2015). Among the wide variety of independent variables used in the adaptation of these models to the context of PC games, researchers have frequently used constructs such as perceived enjoyment - including Davis *et al.* (1992), in the first extension of the TAM - and flow, among others. For example, Hsu and Lu (2004) incorporated the social influence and flow experience constructs into the TAM to predict users' acceptance of online games. Lee (2009), to explain behavioral intention to play online games, extended the TPB by adding flow experience, perceived enjoyment and interaction. Shin and Shin (2011) expand the TAM with perceived playfulness, perceived security and flow to explain intention to play social network games. Wang and Sun (2016) also extend the TAM to include game narrative, social interaction, physical condition and the moderating effects of gender, age and experience to explain intention to play online games. Despite the predominance of classic models of technology adoption, some researchers opt for other theoretical frameworks. For example, Davis *et al.* (2013) use the hedonic and utilitarian consumption values approach to explain the use of online games. And, more recently, Liu (2016) integrated a motivational perspective into social cognitive theory to predict a player's intention to play online games.

Since 2007, with the launch of the iPhone, video games have exhibited a rapid market penetration through mobile games. In this field, as for PC games, a

large part of the research into user acceptance has been conducted in the framework of the TRA and the models that stem from it, especially the TAM. For instance, Ha *et al.* (2007) extend the TAM and show that perceived ease of use, perceived enjoyment, flow experience and perceived attractiveness have an important influence on attitude toward mobile games. Liu and Li (2011) add to the TAM the cognitive concentration and use context variables. Later, Park *et al.* (2014) also extended the TAM by introducing variables such as perceived mobility, perceived control, perceived connectedness and satisfaction to explain acceptance of mobile social network games. Similarly, Jiang *et al.* (2015) adapted the TAM and showed that perceived entertainment, economic cost, and subject norm significantly affect the attitude toward use, while perceived ease of use has no significant effect. Choe and Schumacher (2015) show the effect of one specific mobile game technical characteristic (vibration) in three constructs of the TAM and in cognitive concentration. Few researchers have used theoretical frameworks other than these to explain the acceptance of mobile games. For example, Kim, Oh *et al.* (2010) studied how the attractive technical characteristics of a game influence perceived enjoyment and perceived copresence, and the effect of these on intention to play mobile games. Zhou (2013) draws on flow theory to show that perceived ease of use, connection quality, content quality, flow, social influence and playing cost determine mobile game usage intention. Wei and Lu (2014) show that network externalities, individual gratifications (i.e., interaction with others and enjoyment) and time flexibility significantly influence the intention to play social games on mobile devices. Therefore, previous studies provide some theoretical underpinnings explaining user adoption of mobile games, although few use a holistic approach to explore the effects of technical

characteristics, network externalities, and gratifications on attitudinal variables (i.e., attitude and intention to play).

2.3 Hypothesis Development

2.3.1 Effects of Human-Game Interaction

Venkatesh and Davis (2000) state, based on motivational theory and behavioral decision theory, that individuals form judgments on the perceived gratification of a system by cognitively assessing, based on its characteristics, what a system is capable of in terms of their needs and desires. Their evaluation of the system´s technical characteristics affects the user's cognitive service experience (Ding *et al.*, 2011). Individuals communicate with systems and experience their characteristics through interaction. This interaction with the system´s characteristics influences the user´s favorable (or unfavorable) perceptions regarding the gratification derived from using the system (Venkatesh and Bala, 2008).

In this study, human-game interaction (HGI) refers to a process by which human and game communicate and interact with each other through technology, thereby creating a personal experience. Based on Kim, Oh *et al.* (2010), HGI is modeled as a reflective second-order construct affecting three first-order dimensions, namely, (1) image characteristics (e.g., dynamic, levels, background story), (2) communication characteristics (e.g., sound, speed, anytime and anywhere access), and (3) attractive characteristics (e.g., information provided, options). An effective personal interaction with the game will positively influence whether the experience is optimal (i.e., interesting, enjoyable, funny, under control, etc.) (Choi and Kim, 2004). In particular, we postulate that effective interactions between the user and the game (HGI) will positively influence perceived convenience, effort expectancy, and hedonic motivations.

The effort expectancy (EE) of use refers to an individual's perception that using a certain system is easy (Venkatesh *et al.*, 2012). Perceived convenience (PC) is a function of EE and can be defined as a person's assessment of the extent to which using a given technology can help them achieve a goal (Jung *et al*., 2009). In contrast, hedonic motivation (HM) reflects the degree to which users experience fun or enjoyment when using an information system (Hsiao *et al.*, 2016).

Previous studies have shown that effective interactions between individuals and information systems directly and positively affect PC and EE (Davis *et al.*, 1989; Venkatesh and Bala, 2008). Particularly, in the mobile technologies field, it has emerged that certain characteristics of mobile payment systems (Kim, Mirusmonow *et al.*, 2010) and mobile games (Choe and Schumacher, 2015) significantly increase PC and EE. Also in mobile games, Ha *et al.* (2007) found that visual and acoustic characteristics had a positive impact on HM, and Kim, Oh *et al.* (2010) showed that characteristics such as image (graphics and scenario), communication (game speed, acessibility and sound) and attractiveness (goal setting and options), are also positively associated with HM. The characteristics of mobile casual games allow players to interact with the games using their natural communication skills, giving rise to interactive personal, emotional, meaningful, pleasant and effective experiences. Players access the games easily, anywhere, at any time, in simple and effective ways, to enjoy the characteristics of the images and the background stories, and can customize game options to maximize their usefulness, entertainment and fun. In accordance with the above discussion, we posit that HGI positively influences utilitarian and hedonic perceived gratifications of game use and, therefore, the following hypotheses are proposed:

Hypothesis 1. *Human-game interaction has a positive impact on the perceived convenience of mobile casual games*.

Hypothesis 2. *Human-game interaction has a positive impact on the effort expectancy of mobile casual games.*

Hypothesis 3. *Human-game interaction has a positive impact on the hedonic motivation of mobile casual games.*

2.3.2 Effects of Network Externalities

Network externalities (NE) influence EE, HM, and relational motivation (RM). The extent of a technology's NE has an impact on the word-of-mouth (WOM) communication in which potential adopters may engage regarding the technology. Information obtained through WOM can have a direct impact on EE by increasing the consumer´s knowledge of the technology's characteristics (Arndt, 1967). The extent of the NE can also affect the likelihood that consumers will obtain information about a technology's EE by observing prior adopters using the technology, or even by asking to borrow the technology from a prior adopter to try it themselves (Rogers, 2003). Moreover, the extent of the NE can affect EE due to the perception of the size of the users' network, which could prompt potential future users to decide to adopt the technology (Redmond, 1991). Therefore, it makes sense to assume that the larger is the perceived size of the network of mobile game players, the greater will be the EE.

NE have also been found to have a positive influence on the HM of interactive information technologies, such as instant messaging (Lin and Bhattacherjee, 2008), peer-to-peer (Song and Walden, 2007) and mobile social games (Wei and Lu, 2014). The greater the NE, the greater the HM because each player will have a larger group of people with whom to play and share experiences, which results in greater enjoyment of the game. In addition, Wei and Lu (2014) found that NE influence relational motivation

(RM) in mobile social games. RM refers to the use of mobile casual games to interact with other people. The RM of online gaming, such as cooperation and communication among players, is one of the most important motivators for playing (Frostling-Henningsson, 2009). Moreover, the online environment enables gamers to engage in social interactions with other gamers before, during and after the game (King *et al.*, 2010). In this regard, Hiltz and Turoff (1985) revealed that computer-mediated communication systems increase users' social interaction, which requires a minimum number of contributors; thus, NE positively influence RM. In light of these considerations, the following hypotheses are proposed:

Hypothesis 4. *Network externalities have a positive impact on the effort expectancy of mobile casual games.*

Hypothesis 5. *Network externalities have a positive impact on the hedonic motivation of mobile casual games.*

Hypothesis 6. *Network externalities have a positive impact on the relational motivation of mobile casual games.*

2.3.3 Effects of Gratifications

Players expect to obtain certain benefits from using mobile casual games. These benefits serve as motivations for adopting new technologies (Venkatesh and Bala, 2008). As previously mentioned, this study considers three types of gamer motivations: utilitarian, hedonic and relational. Utilitarian motivation is considered to be more task-oriented and aimed at the more cognitive, as opposed to emotional, results of technology adoption (Hsiao *et al.*, 2016). This refers to the functional and instrumental value of using the technology (Sheng and Teo, 2012) and, therefore, also to the benefits associated with, and the efficient use of, the game. Prior research has measured

utilitarian motivation based on two constructs: EE and PC (Sheng and Teo, 2012; Hsiao *et al.*, 2016).

EE can cause a user to adopt a more positive attitude (AT) toward a technology and, consequently, use it more. Prior empirical studies show that EE has a positive influence on both PC and AT (Davis *et al.*, 1989; Kim, Mirusmonov *et al.*, 2010; Venkatesh and Bala, 2008), as well as HM (Davis *et al.*, 1992; Sánchez-Franco and Roldán, 2005). Davis *et al.* (1992) found that PC and HM mediate the effects of EE on intention to use. Moreover, in the context of video games, studies have found that EE has a positive impact on AT (Wang and Sun, 2016), as well as on PC, HM and AT toward online game communities (Hsu and Lu, 2007). It has also been found that EE has a positive impact on HM and on AT toward mobile social network games (Park *et al.*, 2014) and online games (Lee, 2009). Ha *et al.* (2007) showed that EE also has a positive effect on PC, HM and AT toward mobile games. Therefore, the following hypotheses are proposed:

Hypothesis 7. *Effort expectancy has a positive impact on the perceived convenience of mobile casual games.*

Hypothesis 8. *Effort expectancy has a positive impact on attitude toward mobile casual games.*

Hypothesis 9. *Effort expectancy has a positive impact on the hedonic motivation of mobile casual games.*

As explained above, PC is a function of effort expectancy, and this construct influences both attitute (AT) and intention to use (IU). People might use a technology because they find it useful and it may improve certain aspects of their lives (Davis and Venkatesh, 1996). PC has been applied to a wide range of information technologies in order to measure innovation performance in work, life and studies (e.g., Liu and Li,

2011). Particularly, in terms of hedonic services, such as mobile games, PC provides benefits to players performing certain activities. As previously mentioned, consumers may use games because they believe they can help them gain certain advantages (Shin and Shin, 2011), or because they may improve their quality of life (Liu and Li, 2011) or performance at work (Xanthopoulou and Papagiannidis, 2012). Mobile casual games go beyond mere entertainment, as they also promote mental activity, social relationships, physical activity and learning, among other aspects. For example, Froschauer *et al.* (2012) showed that a particular mobile game could be used to teach players about art history. Recently, Cornejo *et al.* (2015) showed that older adults' use of casual games had a positive influence on their perception of their cognitive abilities and physical health, in addition to serving as a catalyst for social relationships. PC has been found to have a positive influence on AT toward playing online games (Hsu and Lu, 2004; Liu, 2016; Wang and Sun, 2016) and mobile games (Liu and Li, 2011). Shin and Shin (2011) demonstrated a positive relationship between PC and intention to play social network games. Park *et al.* (2014) later showed that PC positively affects both AT and IU for mobile social network games. Therefore, the following hypotheses are proposed:

Hypothesis 10. *Perceived convenience has a positive impact on attitude toward mobile casual games.*

Hypothesis 11. *Perceived convenience has a positive impact on intention to play mobile games.*

Engl and Nacke (2013) believe that casual games are designed primarily to focus on fun and entertainment, rather than on the achievement of the long-term goals inherent in hardcore games. Many previous studies have shown that HM to use an IS has a positive effect on AT toward the IS and intention to use the IS. For instance, Hsiao *et al.* (2016) demonstrated that HM has a positive influence on continued use of mobile

social apps. Hamari (2015) showed that when a game is enjoyed this increases willingness to play more free-to-play games. Liu (2016) found a positive relationship between hedonic motivation and intention to play (IP) online games. Verkasalo *et al.* (2010) and Wei and Lu (2014) showed that HM has a positive effect on IP mobile games. HM also has a positive impact on AT toward playing mobile games (Ha *et al.*, 2007; Liu and Li, 2011). Similarly, some research has showed that HM has quite a significant effect on AT and direct and indirect effects on IP online games (Lee, 2009) and mobile games (Park *et al.*, 2014). Therefore, the following hypotheses are proposed:

Hypothesis 12. *Hedonic motivation has a positive impact on attitude toward mobile casual games*.

Hypothesis 13. *Hedonic motivation has a positive impact on intention to play mobile casual games*.

Relational motivation (RM) has been identified as a key factor in leading users to continue to play a particular game (Cole and Griffiths, 2007). Gamers increase their number of relationships by playing games, interacting and sharing their experiences in real time or asynchronously (Su *et al.*, 2016; Wei and Lu, 2014). Online gaming can help players develop strong social ties if they engage in other offline and online activities (outside of the game) with other players (Trepte *et al.*, 2012), which may include sharing strategies, tips or even their emotions (e.g., frustration and excitement). Wei and Lu (2014) later found that interaction with others, as an individual gratification, has a direct, positive effect on intention to play mobile social games. Therefore, the following hypothesis is proposed:

Hypothesis 14. *Relational motivation has a positive impact on intention to play mobile casual games*.

2.3.4 Effects of Attitude

According to Ajzen (1991), attitude (AT) is the degree of the individual's favorable or unfavorable feelings toward playing mobile games. The theory of reasoned action (TRA) proposes AT as an essential antecedent of behavioral intention, which predicts individual behavior (Fishbein and Ajzen, 1975). A large number of studies have supported the positive relationship between AT and intention to use electronic services. Hsu and Lu (2004), Liu (2016), and Wang and Sun (2016) found that the impact of AT on IP was quite strong in the context of online games. Shin and Shin (2011) and Jiang *et al.* (2015) showed similar results for social network games and mobile games. Park *et al.*'s (2014) results indicated a similar, but more moderate, relationship with mobile social network games. Therefore, the following hypothesis is proposed:

Hypothesis 15. *Attitude has a positive impact on intention to play mobile casual games.*

2.3.5 Effects of Intention to Play

According to Shaikh and Karjaluoto (2015), most studies on IT/IS adoption focus on behavioral intention. But an individual's performance of a specific behavior is determined by their intention to perform that behavior (Ajzen, 1991; Davis *et al.*, 1989; Fishbein and Ajzen, 1975). Intention encompasses the motivational factors that influence behavior, thereby reflecting the amount of effort people are willing to invest in order to perform a certain behavior – the stronger the intention, the more likely they are to perform that behavior (Ajzen, 1991). Prior studies have determined this positive relationship. For instance, in the context of online games, Lee (2009) showed that IP has a positive relationship with actual behavior. Shin and Shin (2011) obtained similar

results in the field of social network games. Therefore, the following hypothesis is proposed:

Hypothesis 16. *Intention to play has a positive impact on the behavior of users of mobile casual games.*

Figure 1 shows the proposed behavioral model based on these hypotheses.

[Please, insert **Figure 1** about here]

3. Research Method

The empirical data used to test the research model was collected through an online survey of mobile casual game players in Spain. A convenience sampling procedure was used. An announcement on the survey and its goals (including a hyperlink to the survey form) was posted on heavily-trafficked websites. Several steps were taken during the sampling process to minimize the problem of bias: 1) the announcement was published on social media (e.g., Facebook, Twitter and Tuenti) and email lists; 2) participation was voluntary with no reward system that might encourage certain profiles to participate; 3) the purpose of the questionnaire was explained; 4) screening questions were designed to filter out people who did not belong to the target audience; 5) responses showing signs of falsification, such as repetition or very short response intervals, and those with identical IP addresses, were discarded; 6) and, lastly, all incomplete questionnaires were eliminated. Of the 300 gamers who expressed an interest in the survey, 150 completed valid questionnaires. All participants play mobile casual games. Table 1 shows the sample's characteristics. Female and male subjects were nearly equal in number. The largest age group was 18-24 (72%), which is quite common in studies of this type of game (e.g., Chang, 2013; Park *et al.*, 2014). The

largest proportion of educational background was university degree (40.7%). Some 61% of the respondents were university students. On a seven-point Likert scale ranging from "hardly ever play", to "play more than once daily", the average game playing frequency on smartphones was 3.65, and on tablets 2.10. 33.4% of the participants spend more than half an hour daily playing on mobile devices.

[Please, insert **Table 1** about here]

The questionnaire measurement items were developed based on previous studies (Appendix) and checked for reliability and validity. The construct measurements consisted of multiple items on a seven-point Likert scale where, except for the actual use construct, 1 represented "strongly disagree" and 7 "strongly agree". In the actual use construct the two frequency of game playing items were measured on a seven-point scale, ranging from "hardly ever" to " more than once daily ", while the average daily time devoted to play item was measured on a five-point scale:1: less than half an hour; 2: up to one hour; 3: up to two hours; 4: up to three hours; 5: more than three hours. The measures are presented in the Appendix.

4. Results

The results are displayed in two stages: first, in the reliability and validity of the measurement model, and second, in the assessment of the research hypotheses and the structural model with the partial least squares (PLS-SEM) approach. The PLS-SEM technique is appropriate when the normality of the data cannot be guaranteed, allowing one to work with formative constructs and small samples (Hair *et al.*, 2013). For this research model, data analysis was conducted through PLS for two reasons: firstly, because both reflective and formative constructs were included in the model and,

secondly, because it was not guaranteed that most of the data would follow a normal distribution (the Kolmogorov-Smirnov test only accepts H_0 in one of the forty items). Note that the sample size clearly exceeds the minimum value of ten times the largest number of inner model paths directed at a particular construct in the inner model (Barclay *et al.*, 1995).

Human-game interaction and perceived network externalities are represented as second-order constructs, following a two-step approach (Chin, 2010; Henseler and Chin, 2010) for their handling. The items for each dimension were then optimally weighted and combined, using the PLS algorithm, to create a latent variable score. The resulting score reflects the underlying construct more accurately than any of the individual items by accounting for the unique constructs and error measurements that may also affect each item (Chin and Gopal, 1995). As a result, the dimensions of the first-order constructs became the observed indicators of the second-order constructs.

4.1. Measurement model

A bootstrapping procedure (Chin, 1998) was used to estimate the statistical significance of the measurement model and structural model, carried out with 5,000 subsamples, as recommended for final results (Hair *et al.*, 2014). The measurement scales show appropriate psychometric properties (Table 2). All the values obtained for simple and composite reliability are above the recommended value of 0.70 (Hair *et al.*, 1998) for internal consistency and composite reliability (CR), and above 0.5 for average extracted variance (AVE) (Fornell and Larcker, 1981).

[Please, insert **Table 2** about here]

Concerning convergent validity, all the loadings that were obtained are significant for the reflective constructs (Bagozzi and Yi, 1988), except for item PC3. Therefore, PC3 was removed from the analysis; the values of CA, CR and AVE obtained for the PC construct are shown in Table 2. The formative measurement scales (human-game interaction and actual use) follow Hair *et al.*'s (2013, 2014) recommendation of keeping the indicators with weights (instead of loadings) above 0.5, or at least those with significant weights.

Weights allow us to understand the composition of each emergent construct (Calvo-Mora *et al.*, 2005). This was verified for most of the items in the study, except IC1, IC4, IC5 and IC6 for image characteristics and CC2 for communication characteristics. In light of the obtained results, these indicators will most likely be removed from the analysis due to them having low or insignificant weights. Nevertheless, in accordance with Hair *et al.* (2013), these items have been kept in the analysis due to their significant loadings.

Another important aspect to assess in the case of variables with formative indicators is the control of the co-linearity level in order to ensure the stability of the estimations. Accordingly, the variance inflation factor (VIF) must be below 5 (Kleinbaum *et al.*, 1988). All the constructs fulfilled this requisite for the study model (Table 2).

Table 3 shows the results obtained from verifying discriminant validity. Thus, one can see how the square root of the average variance extracted (AVE) for each factor (located on the main diagonal) is always higher than the variance shared between each pair of constructs (Fornell and Larcker, 1981).

[Please, insert **Table 3** about here]

4.2. Model estimation

Once the quality of the measurement instrument had been assessed, the proposed model was estimated, using a two-step approach (Chin, 2010; Henseler and Chin, 2010). First, it is evident that all the dimensions for HMGI and NE have highly significant loadings ($p < 0.001$) on their corresponding constructs (IC: 0.89; CC: 0.89; AC: 0.82; NU: 0.97; NP: 0.97). Furthermore, the other validity and reliability parameters show equally good values for both constructs (AVE: 0.75 HMGI and 0.94 NE; CR: 0.90 HMGI and 0.97 NE; Cronbach´s alpha: 0.83 HMGI and 0.94 NE). The results of the structural model are shown in Table 4.

[Please, insert **Table 4** about here]

All the proposed research hypotheses are positively significant, except hypothesis H7 (EE → PC) and H11 (PC → IP). Furthermore, the explained variance (R^2) of the variable actual use (AU) is 0.42 (see footnote in Table 4). This indicates that the AU of mobile casual games is influenced by the variables proposed in the model, with an explanatory power of 42 percent. In particular, IP mobile games is a very important determinant of AU (H16: $\beta=0.65$ and $p<0.001$), while IP is mainly explained by AT and HM, thus validating the claims in hypotheses H15 and H13. RM also strongly determines this predisposition (confirming hypothesis H14: $\beta=0.13$, $p<0.05$). AT is influenced by HM in the first instance (H12: $\beta=0.60$, $p<0.001$), by PC in the second instance (H10: $\beta=0.24$, $p<0.001$ and by EE in the third instance (H8: $\beta=0.15$, $p<0.05$). HGI and NE have proven to have significant effects on IP through the previous determinants. It is important to note the effects of HGI on HM (H3: $\beta=0.62$, $p<0.001$) and on PC (H1: $\beta=0.55$, $p<0.001$), as well as the effects of NE on EE (H4: $\beta=0.44$,

p<0.001) and on RM (H6: β=0.45, p<0.001). Therefore, the role of these two external influences (HGI and NE) has been confirmed as second-order constructs. The effects of NE and EE on HM (H5: β=0.14, p<0.10; H9: β=0.15, p<0.10; respectively) turned out to be quasi-significant.

[Please, insert **Figure 2** about here]

To complete the analysis, Table 5 shows the model's total effects. In particular, given that HGI and NE are considered as exogenous variables in this study, the total effects of these two variables on both IP and AU are of particular interest. In this sense, HGI has a 0.47 value in total effect on IP and 0.31 on AU (both highly significant (p<0.01)). In addition, NE has a 0.22 value in total effect on IP and 0.14 on AU (both also highly significant (p<0.01)).

[Please, insert **Table 5** about here]

5. Discussion and Conclusions

5.1. Discussion and theoretical contributions

This study has made some theoretical contributions. Firstly, this research helps improve the understanding of the factors influencing the adoption and use of entertainment-oriented mobile technology, such as mobile casual games. Secondly, this study contributes to the existing literature by highlighting the effects of human-mobile game interaction and network externalities on the use of mobile casual games. Thirdly, this is one of the first studies that examines TRA and U&G together in a model based on entertainment apps for mobile devices, classified into three types of motivations (i.e.,

utilitarian, hedonic, and relational), in order to predict players' behavior. Fourthly, the findings reveal that human-game interaction, network externalities and hedonic motivation are the most significant factors motivating people to take part in mobile casual games, whereas effort expectancy, perceived convenience and relational motivation appear to play less crucial roles. The results of the effects of the variables included in the study model are discussed below.

First of all, this study has found that human-game interaction (HGI) has a significant impact on intention to play through its effects on perceived convenience (PC), effort expectancy (EE) and hedonic motivation (HM), and also through attitude toward mobile casual games. The results therefore support previous research showing the influence of HGI on PC and EE (e.g., Choe and Schumacher, 2015; Venkatesh and Bala, 2008), as well as on HM (e.g., Ha *et al.*, 2007; Kim, Mirusmonov *et al.*, 2010). These findings are an important contribution to the study of technological adoption models because recent researches have underestimated the effect of HGI on the use of mobile devices (e.g., Chong *et al.*, 2012; Wei *et al.*, 2009).

Furthermore, this study shows that network externalities (NE) have a strong, positive influence on EE and relational motivation (RM) and a weaker impact on HM. This is an important contribution, since NE have not been widely studied. Previous research has shown their direct influence on attitude (AT) (Hsu and Lu, 2004) and intention to play (IP) a mobile game app (Chang *et al.*, 2014); however, few studies have proven these indirect relationships. The perception that a large number of people use a particular technology has a positive impact on the acceptance of that technology (Rogers, 2003), which explains the positive effect on EE: the more that people are seen to use a given technology, the easier it will seem to use. This is an important contribution, since no prior studies have made this claim in the field of mobile casual

games. The impact observed of NE on RM and HM is consistent with the results obtained by Wei and Lu (2014), although these authors estimated it through a second-order construct (i.e., individual gratifications) in the specific case of mobile social games.

The capacity of mobile games to entertain explains the significant influence of HM on AT and IP. This is an important contribution as it expands upon the findings of previous studies (e.g., Liu and Li, 2011; Wei and Lu, 2014) by proposing that HM has a direct and indirect impact on IP through AT, which is consistent with different previous studies (e.g., Lee, 2009; Park *et al.*, 2014). If users tend to play during their leisure time or while they are awaiting something or somebody, as already mentioned, entertainment becomes one of the main gratifications of playing mobile games.

EE has a significantly low impact on IP through HM and AT. These results are in line with the findings of previous studies (e.g., Ha *et al.*, 2007; Hsu and Lu, 2007; Park *et al.*, 2014) and show that EE has a certain impact on adoption, although other studies have suggested that it has no effect on AT toward games (e.g., Jiang *et al.*, 2015; Liu and Li, 2011). On the other hand, according to the literature, (e.g., Ha *et al.*, 2007; Hsu and Lu, 2007) the relationship between EE and PC is not significant. These results suggest that technology is no longer a handicap for mobile casual game users, hence its weak influence on AT and HM and its lack of importance as an antecedent of PC.

The PC variable has a positive influence on AT, which is in line with other studies (e.g., Liu and Li, 2011; Shin and Shin, 2011; Park *et al.*, 2014). However, unlike Park *et al.*'s (2014) and Shin and Shin's (2011) findings, the results show that the effect of PC on IP is not significant. These results, which are consistent with Jiang *et al.* (2015), can be explained by the fact that users identify the PC of mobile casual games as a contribution to an improvement in their lives through fun, which would,

consequently, explain its positive influence on AT. Nonetheless, the fact that users often play games when they are bored, while waiting for something or somebody (Liu and Li, 2011), conditions its influence on IP within the context of leisure time.

The model also indicates that relational motivation (RM) slightly enhances IP. This supports the findings of prior studies, although the relationship is weaker, possibly because previous studies refer to social network games (Chang, 2013) and mobile social games (Hsiao *et al.*, 2016; Wei and Lu, 2014), where the interaction with other players acquires greater importance, while this study relates to mobile casual games.

5.2. Practical Implications

This research will contribute to improving sector professionals' knowledge of the external factors and motivations that lead users to adopt an entertainment mobile application. These factors can be used to design marketing strategies in order to increase adoption rates.

First, since hedonic motivation is the most important factor influencing attitude and, to a lesser extent, intention to play, developers need to boost the user's enjoyment by improving technological aspects (e.g., image, communication and attractive characteristics). However, since competition in this field is becoming increasingly fierce, marketing managers should promote other variables that currently have very little influence on adoption, such as utilitarian and relational motivation. Games have great potential for promoting learning in children and adults and for memory or reflex training, among other things. Furthermore, human-game interaction has an important influence on both utilitarian and hedonic motivations; therefore, game developers should pay close attention to technical issues such as graphics, scenarios, game speed, sound, as well as other aspects that allow the user to customize their interaction with the game, such as goal setting and options.

Regarding relational motivation, marketing managers should, in the short term, focus on new strategies to achieve a significant increase in the number of players. Similarly, they should improve multiplatform connections so that players can interact outside of the game, through social networks and even in offline environments, perhaps by organizing events.

6. Limitations and Future Research

Due to certain limitations, the results of this study must be interpreted with caution; but this could lead to some interesting lines of future research. First of all, the convenience sample consists of players from only one country and has a very high proportion of players aged under 25. It is, therefore, necessary to conduct further research in other countries and cultures, with a probabilistic sample. A second limitation is that the transversal nature gives us only a snapshot of the current position and does not allow for a dynamic analysis, for example, of how the penetration of mobile phones in daily life influences the technology adoption of casual games.

On the other hand, to widen the scope of the study, future work could examine whether certain player characteristics (e.g. gender, age, length of time playing, gaming frequency) moderate the relationships between the variables of the model. Additionally, future work could also include other variables that directly influence "actual use" to improve the predictive capacity of the model (e.g., players' flow experience, post-consumption satisfaction, time flexibility).

[Please, insert **Appendix** about here]

References

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

Arndt, J. (1967), "Role of Product-Related Conversations in the Diffusion of a New Product", *Journal of Marketing Re*search, Vol. 4 No. 3, pp. 291-295.

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

Barclay, D., Higgins, C. and Thompson, R. (1995), "The partial least squares (PLS) approach to causal modeling: Personal computer adoption and use as an illustration", *Technology Studies,* Vol. 2 No. 2, pp. 285-309.

Calvo-Mora, A., Leal, A. and Roldán, J. L. (2005), "Relationships between the EFQM model criteria: a study in Spanish universities", *Total Quality Management & Business Excellence,* Vol. 16 No. 6, pp. 741-770.

Chang, C.C. (2013), "Examining users′ intention to continue using social network games: A flow experience perspective", *Telematics and Informatics,* Vol. 30 No. 4, pp. 311-321.

Chang, I. C., Liu, C. C. and Chen. K. (2014), "The effects of hedonic/utilitarian expectations and social influence on continuance intention to play online games", *Internet Research,* Vol. 24 No. 1, pp. 21-45.

Chin, W. W. (2010), "How to Write Up and Report PLS Analyses", in Vinzi, V. E., Chin, W. W., Henseler, J. and Wang, H. (Eds.), *Handbook of Partial Least Squares: Concepts, Methods and Applications in Marketing and Related Fields*, Springer, Berlin, pp. 655-690.

Chin, W. W. and Gopal, A. (1995), "Adoption intention in GSS: relative importance of beliefs", *Database,* Vol. 26, pp. 42-64.

Chin, W.W. (1998), "Issues and opinion on structural equation modeling", *MIS Quarterly,* Vol. 22 No. 1, pp. 7-16.

Cho, I., Kichul Kim, J., Park, H., and M. Lee, S. (2014), "Motivations of Facebook Places and store atmosphere as moderator", *Industrial Management & Data Systems,* Vol. 114 No. 9, pp. 1360-1377.

Choe, P. and Schumacher, D. (2015), "Influence of Different Types of Vibrations on Technical Acceptance of a Mobile Game Aiming for Hedonic Satisfaction", *International Journal of Human-Computer Interaction,* Vol. 31 No. 1, pp. 33-43.

Choi, D., and Kim, J. (2004), "Why people continue to play online games: In search of critical design factors to increase customer loyalty to online contents", *CyberPsychology & Behavior,* Vol. 7 No. 1, pp. 11-24.

Chong, A. Y. L., Chan, F. T. and Ooi, K. B. (2012), "Predicting consumer decisions to adopt mobile commerce: Cross country empirical examination between China and Malaysia", *Decision Support Systems,* Vol. 53 No. 1, pp. 34-43.

Cole, H. and Griffiths, M. D. (2007), "Social interactions in massively multiplayer online role-playing gamers", *CyberPsychology & Behavior,* Vol. 10 No. 4, pp. 575-583.

Cornejo, R., Hernandez, D., Tentori, M. and Favela, J. (2015), "Casual gaming to encourage active ageing", *IEEE Latin America Transactions,* Vol. 13 No. 6, pp. 1940-1950.

Davis, F. D. and Venkatesh, V. (1996), "A critical assessment of potential measurement biases in the technology acceptance model: three experiments", *International Journal of Human-Computer Interaction,* Vol. 45 No. 1, pp. 19-45.

Davis, F. D., Bagozzi, R. P. and Warshaw, P. R. (1989), "User acceptance of computer technology: a comparison of two theoretical models", *Management Science,* Vol. 35 No. 8, pp. 982-1003.

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

Davis, R., Lang, B., and Gautam, N. (2013), "Modeling utilitarian-hedonic dual mediation (UHDM) in the purchase and use of games", *Internet Research,* Vol. 23 No. 2, pp. 229-256.

Ding, X. D., Huang, Y. and Verma, R. (2011), "Customer experience in online financial services: A study of behavioral intentions for techno-ready market segments", *Journal of Service Management,* Vol. 22 No. 3, pp. 344-366.

Engl, S. and Nacke, L.E. (2013), "Contextual influences on mobile player experience – a game user experience model", *Entertainment Computing,* Vol. 4 No. 1, pp. 83-91.

Fishbein, M. and Ajzen, I. (1975), *Belief, attitude, intention and behavior: An introduction to theory and research,* Addison-Wesley, Reading, MA.

Fornell, C. and Larcker, D. F. (1981), "Evaluating structural equation models with unobservable variables and measurement error", *Journal of Marketing Research,* Vol. 18 No. 1, pp. 39-50.

Froschauer, J., Zweng, J., Merkl, D., Arends, M., Goldfarb, D. and Weingartner, M. (2012), "ARTournament: a mobile casual game to explore art history", in *2012 IEEE 12th International Conference on Advanced Learning Technologies*, IEEE, pp. 80-84.

Frostling-Henningsson, M. (2009), "First-person shooter games as a way of connecting to people: Brothers in blood", *CyberPsychology & Behavior,* Vol.12 No. 5, pp. 557-562.

Ghani, J.A. and Deshpande, S. P. (1994), "Task characteristics and the experience of optimal flow in Human-Computer Interaction", *Journal of Psychology,* Vol.128 No. 4, pp. 381-391.

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

Hair, J. F., Anderson, R. E., Tatham, R. L. and Black, W. C. (1998), *Multivariate data analysis,* Prentice Hall, London.

Hair, J. F., Hult, G. T. M., Ringle, C. and Sarstedt, M. (2013), *A primer on partial least squares structural equation modeling (PLS-SEM),* Sage Publications, Thousand Oaks, CA.

Hair, J. F., Sarstedt, M., Hopkins, L. and Kuppelwieser, V. G. (2014), "Partial least squares structural equation modeling (PLS-SEM)", *European Business Review,* Vol. 26 No. 2, pp. 106-121.

Hamari, J. (2015), "Why do people buy virtual goods? Attitude toward virtual good purchases versus game enjoyment", *International Journal of Information Management,* Vol. 35 No. 3, pp. 299-308.

Hamari, J., Keronen, L. and Alha, K. (2015), "Why do people play games? A review of empirical studies on game adoption and use", in *Proceedings of the 48th Annual Hawaii International Conference on System Sciences (HICSS)*, Hawaii, USA.

Henseler, J. and Chin, W. W. (2010), "A comparison of approaches for the analysis of interaction effects between latent variables using partial least squares path modelling", *Structural Equation Modeling,* Vol. 17 No. 1, pp. 82-109.

Henseler, J., Ringle, C. M. and Sinkovics, R. R. (2009), "The use of partial least squares path modeling in international marketing", in Sinkovics, R. R. and Ghauri, P. N. (Eds.), *New Challenges to International Marketing (Advances in International Marketing, Volume 20)*, Emerald Group Publishing Limited, pp. 277-319.

Hiltz, S. R. and Turoff, M. (1985), "Structuring computer-mediated communication systems to avoid information overload", *Communications of the ACM*, Vol. 28 No. 7, pp. 680-689.

Hsiao, C. H., Chang, J. J. and Tang, K. Y. (2016), "Exploring the influential factors in continuance usage of mobile social Apps: Satisfaction, habit, and customer value perspectives", *Telematics and Informatics,* Vol. 33 No. 2, pp. 342-355.

Hsiao, K. L. and Chen, C. C. (2016), "What drives in-app purchase intention for mobile games? An examination of perceived values and loyalty", *Electronic Commerce Research and Applications,* Vol. 16, pp. 18-29.

Hsu, C. L. and Lu, H. P. (2004), "Why do people play on-line games? An extended TAM with social influences and flow experience", *Information & Management,* Vol. 41 No. 7, pp. 853-868.

Hsu, C. L. and Lu, H. P. (2007), "Consumer behavior in online game communities: A motivational factor perspective", *Computers in Human Behavior,* Vol. 23 No. 3, pp. 1642-1659

Huang, L. Y. and Hsieh, Y. J. (2011), "Predicting online game loyalty based on need gratification and experiential motives", *Internet Research,* Vol. 21 No. 5, pp. 581-598.

Ji, P., and Fu, W. W. (2013), Love Internet, love online content: Predicting Internet affinity with information gratification and social gratifications. *Internet Research, 23*(4), 396-413.

Jiang, G., Peng, L. and Liu, R. (2015), "Mobile Game Adoption in China: The Role of TAM and Perceived Entertainment, Cost, Similarity and Brand Trust", *International Journal of Hybrid Information Technology,* Vol. 8 No. 4, pp. 213-232.

Jung, Y., Perez-Mira, B. and Wiley-Patton, S. (2009), "Consumer adoption of mobile TV: Examining psychological flow and media content", *Computers in Human Behavior,* Vol. 25 No. 1, pp. 123-129.

Kim, C. S., Oh, E. H., Yang, K. H. and Kim, J. K. (2010), "The appealing characteristics of download type mobile games", *Service Business,* Vol. 4 No. 3-4, pp. 253-269.

Kim, C., Mirusmonov, M. and Lee, I. (2010), "An empirical examination of factors influencing the intention to use mobile payment", *Computers in Human Behavior,* Vol. 26 No. 3, pp. 310-322.

King, D., Delfabbro, P. and Griffiths, M. (2010), "Video game structural characteristics: A new psychological taxonomy", *International Journal of Mental Health and Addiction,* Vol. 8 No. 1, pp. 90-106.

Kleinbaum, D., Kupper, L. and Muller, K. (1988), *Applied regression analysis and other multivariate analysis methods,* PWS-Kent Publishing Company, Boston.

Kuittinen, J., Kultima, A., Niemelä, J. and Paavilainen, J. (2007), "Casual games discussion", in *Proceedings of the 2007 Conference on Future Play,* ACM, pp. 105-112.

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

Lin, C.P. and Bhattacherjee, A. (2008), "Elucidating individual intention to use interactive information technologies: The role of network externalities", *International Journal of Electronic Commerce,* Vol. 13 No. 1, pp. 85-108.

Liu, C. C. (2016), "Understanding player behavior in online games: The role of gender", *Technological Forecasting and Social Change,* Vol. 111, pp. 265-274.

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

McDonald, E. (2017), "The Global Games Market Will Reach $108.9 Billion in 2017 With Mobile Taking 42%", available at: https://newzoo.com/insights/articles/the-global-games-market-will-reach-108-9-billion-in-2017-with-mobile-taking-42/ (accessed 25 February 2018).

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

Park, H. J. and Kim, S. H. (2013), "A bayesian network approach to examining key success factors of mobile games", *Journal of Business Research,* Vol. 66, pp. 1353-1359.

Redmond, W. H. (1991), "When Technologies Compete: The Role of Externalities in Nonlinear Market Response", *Journal of Product Innovation Management,* Vol. 8 No. 3, pp. 170-183.

Rogers, E. M. (2003), *Diffusion of Innovations,* (5th Ed.), Free Press, New York.

Rubin, A. M. (2009), "Uses and Gratifications. An Evolving Perspective of Media Effects", in Nabi, R. L., and Oliver, M. B. (Eds.), *The SAGE handbook of media processes and effects,* Sage Publications Inc., Thousand Oaks, pp. 147-159.

Sánchez-Franco, M. J. and Roldán, J. L. (2005), "Web acceptance and usage model: A comparison between goal-directed and experimental web users", *Internet Research,* Vol. 15 No. 1, pp. 21- 48.

Shaikh, A. A. and Karjaluoto, H. (2015), "Making the most of information technology & systems usage: A literature review, framework and future research agenda", *Computers in Human Behavior,* Vol. 49, pp. 541-566.

Sheng, M. L. and Teo, T. S. (2012), "Product attributes and brand equity in the mobile domain: The mediating role of customer experience", *International Journal of Information Management,* Vol. 32 No. 2, pp. 139-146.

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

Song, J. and Walden, E. (2007), "How consumer perceptions of network size and social interactions influence the intention to adopt peer-to-peer technologies", *International Journal of E-Business Research,* Vol. 3 No. 4, pp. 49-66.

Su, Y. S., Chiang, W. L., Lee, C. T. J. and Chang, H. C. (2016), "The effect of flow experience on player loyalty in mobile game application", *Computers in Human Behavior,* Vol. 63, pp. 240-248.

Trepte, S., Reinecke, L. and Juechems, K. (2012), "The social side of gaming: How playing online computer games creates online and offline social support", *Computers in Human Behavior,* Vol. 28 No. 3, pp. 832-839.

Venkatesh, V. and Bala, H. (2008) "Technology acceptance Model 3 and a Research Agenda on Interventions", *Decision Sciences,* Vol. 39 No. 2, pp. 273-315.

Venkatesh, V., and Davis, F. D. (2000), "A theoretical extension of the technology acceptance model: Four longitudinal field studies", *Management Science,* Vol. 46, pp. 186–204.

Venkatesh, V., Thong, J. Y. and Xu, X. (2012), "Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology", *MIS Quarterly,* Vol. 36 No. 1, pp. 157-178.

Verkasalo, H., López-Nicolás, C., Molina-Castillo, F. J. and Bouwman, H. (2010), "Analysis of users and non-users of smartphone applications", *Telematics and Informatics,* Vol. 27 No. 3, pp. 242-255.

Wang, Q. and Sun, X. (2016), "Investigating game play intention of the elderly using an Extended Technology Acceptance Model (ETAM)", *Technological Forecasting and Social Change,* Vol. 107, pp. 59-68.

Wei, P. S. and Lu, H. P. (2014), "Why do people play mobile social games? An examination of network externalities and of uses and gratifications", *Internet Research,* Vol. 24 No. 3, pp. 313-331.

Wei, T. T., Marthandan, G., Chong, A. Y. L., Ooi, K. B. and Arumugam, S. (2009), "What drives Malaysian m-commerce adoption? An empirical analysis", *Industrial Management & Data Systems,* Vol. 109 No. 3, pp. 370-388.

Witt, U. (1997), "Lock-in vs. critical masses – industrial change under network externalities", *International Journal of Industrial Organization,* Vol. 15, pp. 753-773.

Wu, J. H., Wang, S. C. and Tsai, H. H. (2010), "Falling in love with online games: The uses and gratifications perspective", *Computers in Human Behavior,* Vol. 26 No. 6, pp. 1862-1871.

Xanthopoulou, D. and Papagiannidis, S. (2012), "Play online, work better? Examining the spillover of active learning and transformational leadership", *Technological Forecasting and Social Change,* Vol. 79 No. 7, pp. 1328-1339.

Zhou, T. (2013), "Understanding the effect of flow on user adoption of mobile games", *Personal and Ubiquitous Computing*, Vol. 17 No. 4, pp. 741-748.

Table 1. Characteristics of the respondents

Variable (category)	Percentage
Gender	
Female	52.7
Male	47.3
Age	
14-17	2.7
18-24	72.0
25-34	9.3
35-44	8.7
45 and older	7.3
Education	
No literate or not finish	0.7
Primary	6.0
Secondary	6.7
A Level (senior year of high school)	34.0
Vocational Studies	11.3
University degree	40.7
Other	0.7
Occupation	
Self-employed	3.3
Employee	22.1
Housework	3.3
Unemployed	3.3
University student	61.3
Non-university student	6.7
Monthly income (€)	
No income	60.7
900 or under	22.7
901 – 1,200	10.7
1,201 and above	6.0
How much time do you play on a mobile device as a daily average?	
Less than half an hour	66.7
Up to one hour	22.7
Up to two hours	8.7
Up to three hours	2.0
More than three hours	0

Table 2. Measurement scales

Construct	Item	Loading	Weight	t	CA	CR	AVE	VIF
Image Characteristics (IC)	IC1	0.57***	0.08	0.64	N/A	N/A	N/A	1.00
	IC2		0.43***	2.60				2.04
	IC3		0.55***	4.05				1.00
	IC4	0.43***	0.16	1.24				2.08
	IC5	0.61***	0.16	0.94				2.00
	IC6	0.53***	0.11	0.68				2.00
Communication Characteristics (CC)	CC1		0.56***	3.87	N/A	N/A	N/A	2.00
	CC2	0.83***	0.17	0.84				2.00
	CC3		0.40*	1.69				2.00
Attractive Characteristics (AC)	AC1		0.54***	3.00	N/A	N/A	N/A	2.00
	AC2		0.54***	2.84				2.00
Number of users (NU)	NU1	0.98***		167.30	0.96	0.98	0.93	
	NU2	0.96***		66.87				
	NU3	0.96***		110.13				
Number of peers (NP)	NP1	0.91***		31.63	0.91	0.95	0.85	
	NP2	0.93***		59.40				
	NP3	0.92***		55.90				
Perceived Convenience (PC)	PC1	0.93***		40.10	0.85	0.93	0.87	
	PC2	0.92***		51.37				
	PC3	0.05		---				
Effort Expectancy (EE)	EEU1	0.84***		23.12	0.85	0.91	0.77	
	EEU2	0.92***		46.21				
	EEU3	0.87***		33.92				
Hedonic Motivation (HM)	HM1	0.88***		29.93	0.89	0.92	0.71	
	HM2	0.88***		30.11				
	HM3	0.93***		70.92				
	HM4	0.58***		7.29				
	HM5	0.89***		41.74				
Relational Motivation (RM)	RM1	0.86***		26.20	0.83	0.90	0.74	
	RM2	0.84***		17.95				
	RM3	0.89***		21.63				
Attitute (AT)	AT1	0.91***		44.46	0.72	0.84	0.65	
	AT2	0.52***		4.57				
	AT3	0.92***		51.01				
Intention to play (IP)	IP1	0.94***		51.45	0.93	0.95	0.87	
	IP2	0.92***		30.72				
	IP3	0.94***		61.74				
Actual use (AU)	AU1		0.80***	8.79	N/A	N/A	N/A	2.00
	AU2		0.26*	1.88				2.00
	AU3		0.29*	1.95				

Note: CA = Cronbach´s α; CR = Composite reliability; AVE = Average variance extracted

N/A = Not applicable. ***p<0.01; **p<0.05; *p<0.10

Table 3. Discriminant validity (square root of the AVE value on the main diagonal)

	IC	CC	AC	NU	NP	PC	EE	HM	RM	AT	IP	AU
G	N/A											
CC	0.71	N/A										
AC	0.56	0.61	N/A									
NU	0.51	0.54	0.42	0.96								
NP	0.54	0.54	0.37	0.89	0.92							
PC	0.61	0.48	0.48	0.33	0.34	0.93						
EE	0.40	0.41	0.39	0.50	0.58	0.35	0.88					
HM	0.74	0.68	0.58	0.58	0.57	0.63	0.51	0.84				
RM	0.41	0.45	0.45	0.47	0.39	0.43	0.34	0.45	0.86			
AT	0.72	0.61	0.55	0.51	0.53	0.67	0.54	0.80	0.36	0.81		
IP	0.70	0.64	0.54	0.66	0.69	0.61	0.63	0.77	0.44	0.81	0.93	
AU	0.64	0.54	0.52	0.54	0.49	0.46	0.41	0.70	0.46	0.62	0.65	N/A

Table 4. Results of hypothesis test

Relationship	Beta (β)	T value (bootstrap)	Results
H1. HGI → PC	0.55***	6.17	Supported
H2. HGI → EE	0.21*	1.79	Supported
H3. HGI → HM	0.62***	8.07	Supported
H4. NE → EE	0.44***	3.73	Supported
H5. NE → HM	0.14*	1.69	Supported
H6. NE → RM	0.45***	6.74	Supported
H7. EE → PC	0.04	0.44	Not supported
H8. EE → AT	0.15**	2.41	Supported
H9. EE → HM	0.15*	1.65	Supported
H10. PC → AT	0.24***	3.18	Supported
H11. PC → IP	0.01	0.09	Not supported
H12. HM → AT	0.60***	8.28	Supported
H13. HM → IP	0.26**	2.15	Supported
H14. RM → IP	0.13**	2.07	Supported
H15. AT → IP	0.54***	4.82	Supported
H16. IP → AU	0.65***	12.70	Supported

R^2(AT)=0.73; R^2(IP)= 0.70; R^2(EE)= 0.34; R^2(HM) = 0.64; R^2(PC)= 0.33; R^2(RM)= 0.20; R^2(AU)= 0.42; Q^2(AT)= 0.45; Q^2(IP)= 0.58; Q^2(EE)= 0.25; Q^2(HM)= 0.45; Q^2(PC)= 0.29; Q^2(RM)= 0.13; Q^2(AU)= 0.16

***p<0.001; **p<0.05; *p<0.10

Table 5. Model's total effects

	HGI	NE	PC	EE	HM	RM	AT	IP	AU
HGI	---	---	0.56	0.21	0.65	---	0.56	0.47	0.31
NE	---	---	0.02	0.44	0.21	0.45	0.20	0.22	0.14
PC	---	---	---	---	---	---	0.24	0.14	0.09
EE	---	---	0.04	---	0.15	---	0.25	0.18	0.12
HM	---	---	---	---	---	---	0.60	0.58	0.38
RM	---	---	---	---	---	---	---	0.13	0.09
AT	---	---	---	---	---	---	---	0.54	0.35
IP	---	---	---	---	---	---	---	---	0.65
AU	---	---	---	---	---	---	---	---	---

Appendix. Measures used in this study

Measures	Item	Measurement items	Sources
Image Characteristics	IC1	Mobile casual games are realistic.	Kim *et al.* (2010)
	IC2	Mobile casual games are fantastic.	
	IC3	Mobile casual games are dynamic.	
	IC4	The mobile casual game is preceded by levels according to scenario.	
	IC5	There is a game flow that keeps the gamer interested in the mobile casual game.	
	IC6	There is a background story that keeps the gamer interested in the mobile casual game.	
Communication Characteristics	CC1	Mobile casual games can be used anytime.	Kim *et al.* (2010)
	CC2	Mobile casual game speed is not inconvenient to use.	
	CC3	Proper sound efects are supplied according to situations in the mobile casual games.	
Attractive Characteristics	AC1	The mobile casual game provides enough information to play.	Kim *et al.* (2010)
	AC2	I can set the mobile casual game to my taste with a map, scenario, other options and other various selective functions.	
Number of Users	NU1	I perceive that a good number of people play mobile casual games.	Wei and Lu (2014)
	NU2	I perceive most people play mobile casual games.	
	NU3	I perceive that there will be many more people playing mobile casual games in the future.	
Number of Peers	NP1	I perceive that many friends around me play mobile casual games.	Wei and Lu (2014)
	NP2	I perceive that most of my friends play mobile casual games.	
	NP3	I perceive that many friends will play mobile casual games in the future.	
Perceived Convenience	PC1	I think mobile casual games are useful to me.	Shin and Shin (2011)
	PC2	It would be convenient for me to play mobile casual games.	
	PC3	I do not think mobile casual games can help me with many things.* (dropped)	
Effort Expectancy	EE1	Learning how to play mobile casual games is easy for me.	Venkatesh *et al.* (2012)
	EE2	My interaction with mobile casual games is clear and understandable.	
	EE3	I find mobile casual games easy to use.	
Hedonic Motivation	HM1	Playing mobile casual games makes me relax	Shin and Shin (2011), and Wei and Lu (2014)
	HM2	Playing mobile casual games brings me pleasure.	
	HM3	I enjoy playing mobile casual games.	
	HM4	I do not enjoy doing things with mobile casual games.*	
	HM5	I find mobile casual games enjoyable and fascinating.	
Relational Motivation	RM1	I think playing mobile casual games enables me to interact with others.	Wei and Lu (2014)
	RM2		

Measures	Item	Measurement items	Sources
	RM3	I think playing mobile casual games can fulfill my need for interacting with others. I think playing mobile casual games increases my opportunities to interact with others.	
Attitude	AT1	I would have positive feelings towards mobile casual games in general.	Shin and Shin (2011)
	AT2	Using mobile casual games does not appeal to me.*	
	AT3	It would be a good idea to play mobile casual games.	
Intention to Play	IP1	I am willing to play mobile casual games.	Wei and Lu (2014)
	IP2	I will give playing mobile casual games a try.	
	IP3	I will take the initiative to play mobile casual games.	
Actual use	AU1	How often do you play mobile casual games on a smartphone?	Lee (2009)
	AU2	How often do you play mobile casual games on a tablet?	
	AU3	How long do you spend playing mobile casual games as a daily average?	

*****Reverse scoring

Figure 1. Research model

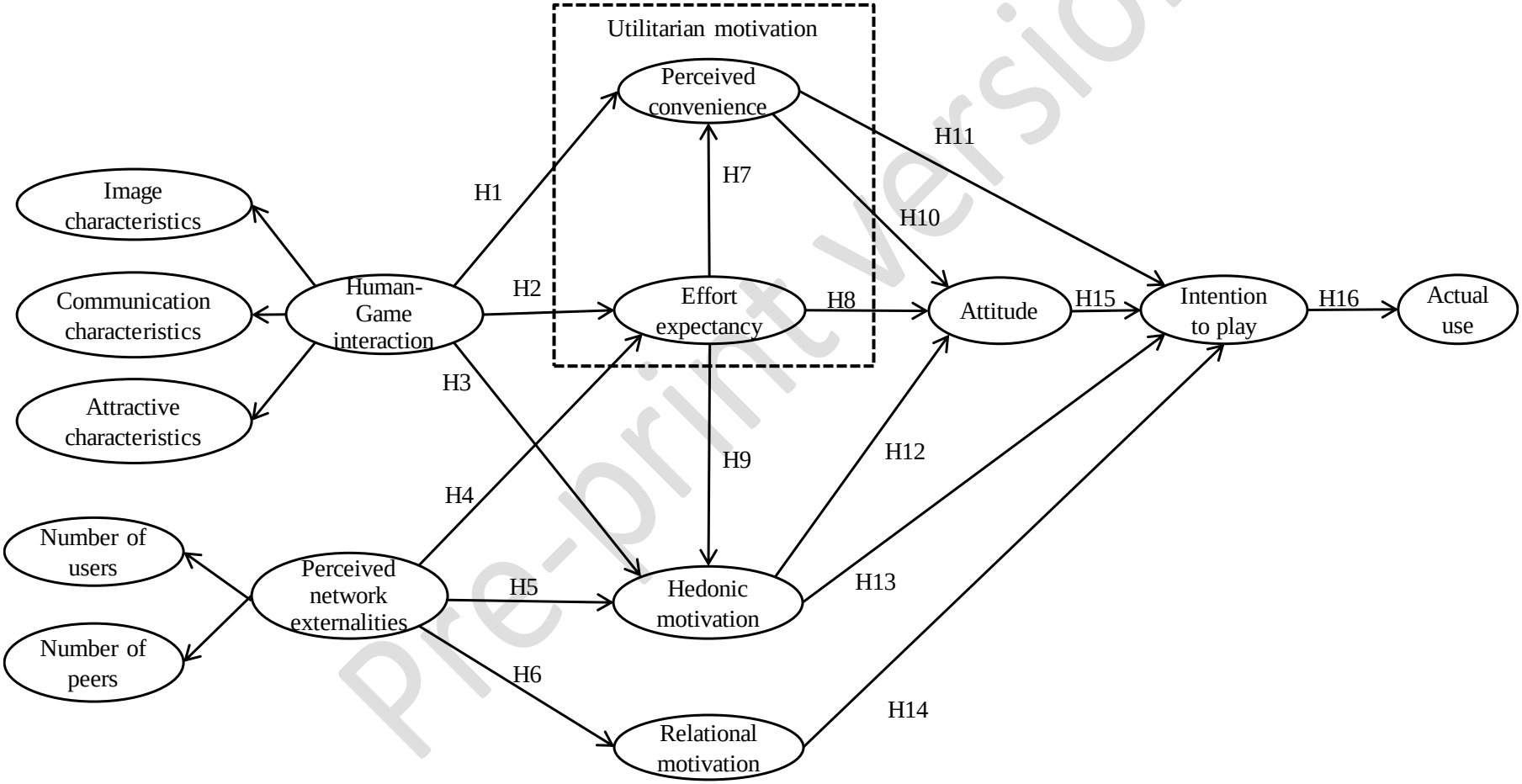
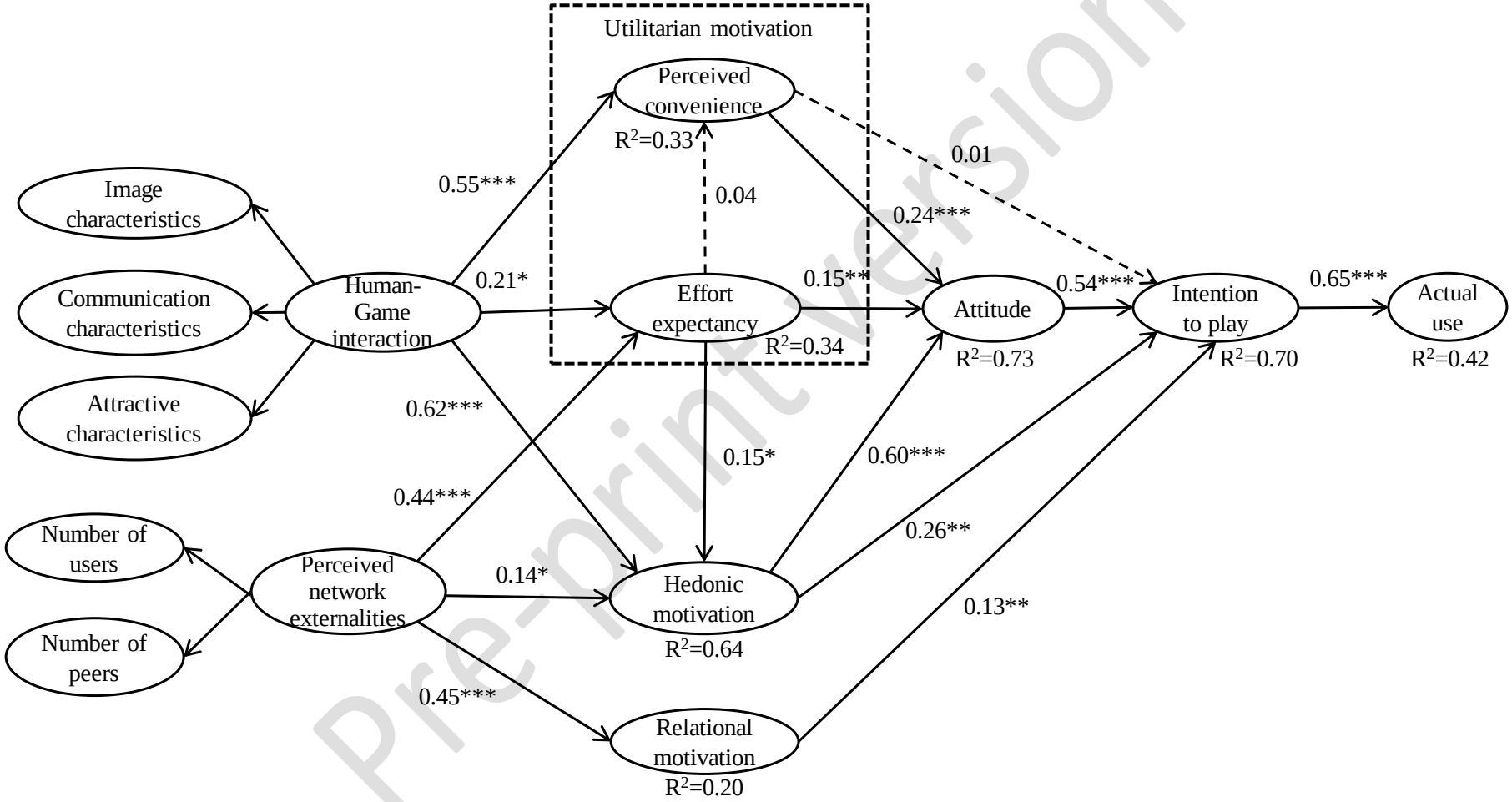


Figure 2. Research results



Note: ***p<0.001; **p<0.05; *p<0.10