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Why do people play on-line games? An extended TAM with social influences and flow experience

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Abstract

On-line games have been a highly profitable e-commerce application in recent years. The market value of on-line games is increasing markedly and number of players is rapidly growing. The reasons that people play on-line games is an important area of research. This study views on-line games as entertainment technology. However, while most past studies have focused on task-oriented technology, predictors of entertainment-oriented technology adoption have seldom been addressed.

This study applies the technology acceptance model (TAM) that incorporates social influences and flow experience as belief-related constructs to predict users' acceptance of on-line games. The proposed model was empirically evaluated using survey data collected from 233 users about their perceptions of on-line games. Overall, the results reveal that social norms, attitude, and flow experience explain about 80% of game playing. The implications of this study are discussed.

Keywords: On-line game; TAM; Social influence; Flow experience

1. Introduction

After the bursting of the dot-com bubble of the late 1990s, almost all Internet-related industries suffered recession, except for that of games, which include computer games, on-line games, video games and hand-held games. They have created huge profits in recent years [23,44]. With increasing Internet usage, on-line games have become very popular. In Taiwan, 40% of the Internet users have played on-line games [62]. The value of the global on-line game market will reach US$ 2.9 billion by 2005, increased markedly from US$ 670 million in 2002 [22]. Related business opportunities have driven an investigation of why the on-line games attracted attention. Nevertheless, empirical study of the factors governing user adoption of on-line games have remained limited.

On-line games are one type of entertainment-oriented and Internet-based information technology (IT). On-line games typically are multiplayer games that enable users to fantasize and be entertained. Specifically, role-playing type on-line games resemble text-based Multi-User Dungeons (MUDs), which are hybrids of adventure games and chatting. On-line players enjoy more user friendly interfaces and multi-media effects via graphical operations than are provided by traditional MUDs. Additionally, the Internet allows on-line game users to assume a broad

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range of fantasy roles, interact with one another and even create their own virtual worlds.

The question of what factors contribute to user intention to play on-line games is important. During the past decade, researchers have applied the technology acceptance model (TAM) to examine IT usage and have verified that user perceptions of both usefulness and ease-of-use are key determinants of individual technology adoption [6,49,54,57,60,75]. However, perceived usefulness (PU) and ease-of-use may not exactly reflect the motivation of on-line games users. Factors contributing to the acceptance of an Internet-based IT are likely to vary in three areas: purpose, operation, and communication effects.

(a) *Purpose of IT usage*: Traditionally, the main reason for using IT was to enhance work effectiveness and productivity. However, with the arrival of the Internet, IT began to be for more than work. Indeed, in the Yahoo! directory, parts of the web sites are entertainment-oriented web sites [63]. Notably, people play on-line games mainly for their leisure and pleasure.

(b) *Changes in IT operation*: Traditionally, IT was option or menu-driven. perceived ease-of-use (PE) critically affected user adoption. But in the Internet era, multimedia and hyperlinks have replaced traditional operations; e.g., on-line game players enjoy easier-to-use interfaces and multimedia effects due to graphical operations [11].

(c) *Value-added by connection*: IT not only fulfills fundamental MIS functions, such as data analysis and management, but also assists in user communication. This communication has significantly affected virtual community [5,70]. Additionally, the interpersonal interactions among game players can create cohesive communities.

The purpose of this study was to extend the TAM to include the influences of on on-line games in user behavior. Specifically, this work proposed that additional variables, such as social influences and flow experience, enhanced our understanding of on-line game user behavior. The importance of these two variables can be explained with reference to existing literature on influences in social psychology, and flow experience in flow theory [18,29,47]. This work applied a structure equation model (SEM) to assess the empirical strength of the relationships in the proposed model [45].

2. Theoretical background

2.1. Technology acceptance model

TAM has received considerable attention of researchers in the information system (IS) field over the past decade. It is an adaptation of Theory of Reasoned Action (TRA). According to TRA, belief (an individual's subjective probability of the consequence of a particular behavior) influences attitude (an individual's positive and negative feelings about a particular behavior), which in turn shapes behavioral intention (BI). Davis [24] further adapted the belief-attitude-intention-behavior causal chain to predict user acceptance of IT. Previous research has demonstrated the validity of TAM across a wide range of IT [12,17,34,41,43].

TAM attempts to predict and explain system use by positing that perceived usefulness and perceived ease-of-use are two primary determinants of IS acceptance (Fig. 1). The former is defined as "*the degree to which a person believes that using a particular system would enhance his or her job performance*" and the latter is defined as "*the degree to which using the technology will be free of effort*." Both PU and PE influence the individual's attitude toward using a system (A). Attitude and PU, in turn, predict the individual's behavioral intention (BI) to use it. Additionally, PE will also influence PU. In other words, the user interface improvements strongly impact PU and acceptance.

Furthermore, both types of beliefs are subject to the effects of external variables. For example, Lin and Lu applied TAM to predict the acceptance of web sties. The external variables included IS quality, including information quality, response time, and system accessibility. Their results indicated that these critical external variables significantly affect PU and PE of web sites. Hence, by manipulating them, system developers can better control users' beliefs about the system, and subsequently, their behavioral intentions and system use.

Comparing the TAM to other theoretical models designed for understanding IS adoption behavior has yielded mixed results [25,28]. For instance, Chau and Hu [13] compared TAM with TPB and found that TAM may be more appropriate for examining telemedicine technology acceptance. However, Plouffe et al. [66] suggested that the perceived characteristics

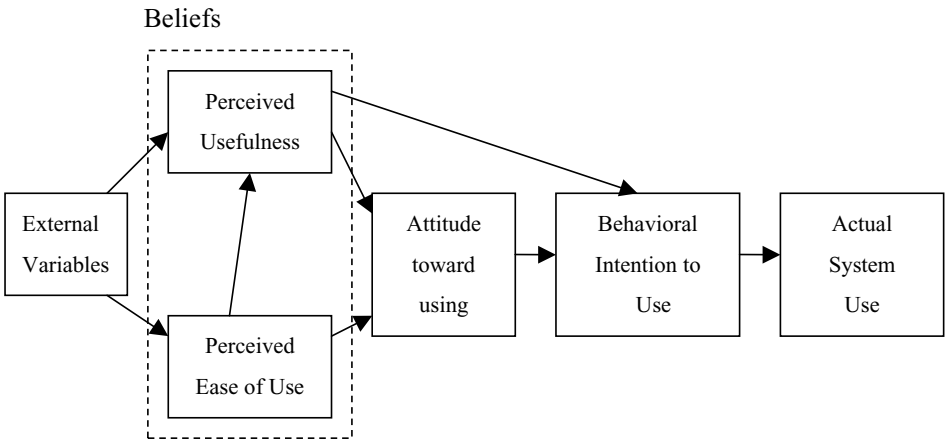

Fig. 1. Technology acceptance model (adapted from Davis et al. [25]).

of innovating (PCI) set of beliefs explains substantially more variance than does TAM. Their study provided managers with more detailed information about the drivers of technology innovation adoption. Dishaw and Strong also suggested that an integrated model (an extension of TAM to include Task–Technology Fit (TTF) constructs) may provide more explanatory power than can either model alone.

TAM has also been revised to incorporate additional variables with specific contexts, as shown in Table 1. Moon and Kim proposed a new variable ('perceived playfulness (PP)') for studying WWW acceptance. Extending perceived playfulness into the TAM model enabled better explanation of WWW usage behavior. Similarly, numerous extended variables with specific contexts have been added to TAM, such as perceived enjoyment (PET) in using the Internet [78], perceived critical mass (PCM) in groupware usage [56], perceived user resources (PR) in bulletin board systems [58], compatibility in virtual stores [15], and psychology (flow and environmental psychology) in a web-based store. These studies with extended beliefs were proposed to improve understanding of user acceptance behavior for specific contexts.

However, in the context of on-line games, flow experience and social factors are considered additional variables. Flow has been studied and identified as a possible measure of on-line user experience [33,39,79,85]. Game playing and multimedia operation may involve unique experiences for players.

Table 1
Previous TAM studies

Authors (years)	Context	Extended perceived variables	Result
Teo et al. [78]	Internet	Perceived enjoyment (PET)	PU → all usage dimensions PET → frequency of Internet usage, daily Internet usage PE → all usage dimensions
Luo and Strong [56]	Groupware	Perceived critical mass (PCM)	PE, PU, and PCM → BI ($R^2 = 0.645$)
Moon and Kim [60]	WWW	Perceived playfulness (PP)	PE, PU, and PP → BI ($R^2 = 0.394$)
Mathieson and Chin [58]	Bulletin board system	Perceived user resources (PR)	PU and PR → BI ($R^2 = 0.402$)
Chen et al. [15]	Virtual store	compatibility	PE, PU, and compatibility → BI
Venkatesh et al. [83]	System	Intrinsic motivation (IM)	PE, PU, and IM → BI ($R^2 = 0.40$)
Legris et al. [51]	Literature review	Voluntariness, experience, subjective norm, image, job relevance, output quality, and result demonstrability	TAM2

Therefore, flow experience was proposed as a motive for playing games here. Additionally, the interactions of game players can create on-line communities. Social interaction also is critical in their growth [67]. Consequently, social influences have also been added as the additional belief, and they have been assumed to influence user participation.

2.2. Flow experience

Csikszentmihalyi introduced the original concept of flow. He defined it as "the holistic experience that people feel when they act with total involvement." This definition suggests that flow consists of four components—control, attention, curiosity, and intrinsic interest. When in the flow state, people become absorbed in their activity: their awareness is narrowed to the activity itself; they lose self-consciousness, and they feel in control of their environment. Such a concept has been extensively applied in studies of a broad range of contexts, such as sports, shopping, rock climbing, dancing, gaming and others [21].

Recently, flow has also been studied in the context of information technologies and has been recommended as useful in understanding consumer behavior [40,64]. For instance, Hoffman and Novak conceptualized flow on the web as a cognitive state during on-line navigation involves (1) high levels of skill and control; (2) high levels of challenge and arousal; and (3) focused attention. It is enhanced by interactivity and telepresence. In subsequent work, Novak et al. developed a structural model based on their previous conceptual model for measuring flow empirically. They confirmed the relationship between these antecedents and flow.

Moreover, other studies have related the concept of flow to information technology, as presented in Table 2. For example, Ghani et al. [32] argued that enjoyment and concernment are two characteristics of flow, and found that perceived control and challenges can predict flow. In subsequent works, Ghani and Deshpande also proposed that skill and challenge directly influence flow.

Trevino and Webster used a different operational definition of flow experience that comprised four dimensions: control, attention focus, curiosity, and intrinsic interest. They modeled computer skill, technology type, and ease-of-use as antecedents of their definition. Webster et al. also used this definition but argued that specific characteristics of the software (flexibility and modifiability) and IT use behaviors (future voluntary use) would lead to flow.

Agarwal and Karahanna [1] noted that cognitive absorption (CA), the state of flow, was important in studying IT use behavior. Specifically, they described five dimensions of CA in the context of software (temporal dissociation, focused immersion, enjoyment, control, and curiosity) and contended that personal innovativeness and playfulness can predict CA.

Table 2
Characteristics of flow

Authors	Applications	Construct	Characteristics
Ghani et al. [32]	Human–computer interactions	Flow	Concentration, enjoyment
Trevino and Webster [79]	Human–computer interactions	Flow	Control, attention focus, curiosity, intrinsic interest
Webster et al. [85]	Human–computer interactions	Flow	Control, attention focus, curiosity, intrinsic interest
Ghani and Deshpande [33]	Human–computer interactions	Flow	Concentration, enjoyment
Hoffman and Novak [39]	Web sites	Flow	Skill/control, challenge/arousal, focused attention, interactivity, telepresnece
Hoffman and Novak [40]	Web sites	Flow	Seamless sequence of responses, intrinsically enjoyable, loss of self-consciousness, self-reinforcing
Novak et al. [64]	Web sites	Flow	Skill/control, challenge/arousal, focused attention, interactivity, telepresnece
Agarwal and Karahanna [1]	Web sites	Cognitive absorption	Control, attention focus, curiosity, intrinsic interest
Moon and Kim [60]	Web sites	Playfulness	Enjoyment, concentration, curiosity
Koufaris [49]	Web sites	Flow	Perceived control, shopping enjoyment, concentration

In summary, Flow is treated as a multi-dimensional construct with characteristics that include control, concentration, enjoyment, curiosity, intrinsic interest, etc. We believe that flow is too broad and ill defined, because it contains many concepts. Nevertheless, we considered the on-line games as an entertainment-oriented technology. Therefore, here, flow is defined as an extremely enjoyable experience, where an individual engages in an on-line game activity with total involvement, enjoyment, control, concentration and intrinsic interest.

2.3. Social influence

Social factors profoundly impact user behavior. Several theories suggest that social influence is crucial in shaping user behavior. For example, in TRA, a person's behavioral intentions are influenced by subjective norms as well as attitude. Innovation diffusion research also suggests that user adoption decisions are influenced by a social system beyond an individual's decision style and the characteristics of the IT.

From social psychological and economic perspectives, two types of social influence are distinguished: social norms and critical mass. Theories of conformity in social psychological have suggested that group members tend to comply with the group norm, and moreover that these in turn influence the perceptions and behavior of members [50]. In economics, the effects of network externality often form perceived critical mass, in turn influencing technology adoption.

Social norms consist of two distinct influences: *informational influence*, which occurs when a user accepts information obtained from other users as evidence about reality, and *normative influence*, which occurs when a person conforms to the expectations of others to obtain a reward or avoid a punishment [27]. These two kinds of influence generally operate through three distinct processes—internalization, identification, and compliance. Informational influence is an internalization process, which occurs when a user perceives information as enhancing his or her knowledge above that of reference groups [48]. Normative influence is a form of identification and compliance. Identification occurs when a user adopts an opinion held by others because he or she is concerned with defining himself or herself as related to the group. Compliance occurs when a user conforms to the expectations of another to receive a reward or avoid rejection and hostility.

(1) *Reference group theory*: Reference group theory indicates that individuals look for guidance from opinion leaders or from a group with appropriate expertise. Accordingly, individuals may develop values and standards for their behavior by referring to information, normative practices and value expressions of a group or another individual [8,65].

(2) *Group influence processes*: This theory proposes that groups influence an individual. An individual attempts to adopt the behavioral norms of the group to strengthen relationships with its members, since he or she desires to be closely identified with the group [35].

(3) *Social exchange theory*: Social exchange theory views interpersonal interactions from a cost–benefit perspective [10]. According to this theory, individuals usually expect reciprocal benefits, such as personal affection, trust, gratitude, and economic return, when they act according to social norms.

2.4. Critical mass

Several studies have examined, from economic perspective, the effects of network externality on IT adoption and innovation [61,74,84]. It refers to the fact that the value of technology to a user increases with the number of its adopters. As email systems increased in popularity, for example, they became increasingly valuable, attracting more users to adopt the technology.

Network externality is derived from Metcalfe's law, which states that the value of a network increases with the square of its number of users. This law looks at the Internet as a communication medium, as a network for exchanging information with other participants. Luo and Strong pointed out that the users may develop perceived critical mass through interaction with others. Perception of critical mass is rapidly strengthened as more people participate in network activities.

3. Conceptual model and hypotheses

Fig. 2 illustrates the extended TAM examined here. It asserts that the intention to play an on-line game is a function of: its perceived usefulness by an individual, social influences (social norms and perceived critical mass), flow experience and attitude. Intention was the

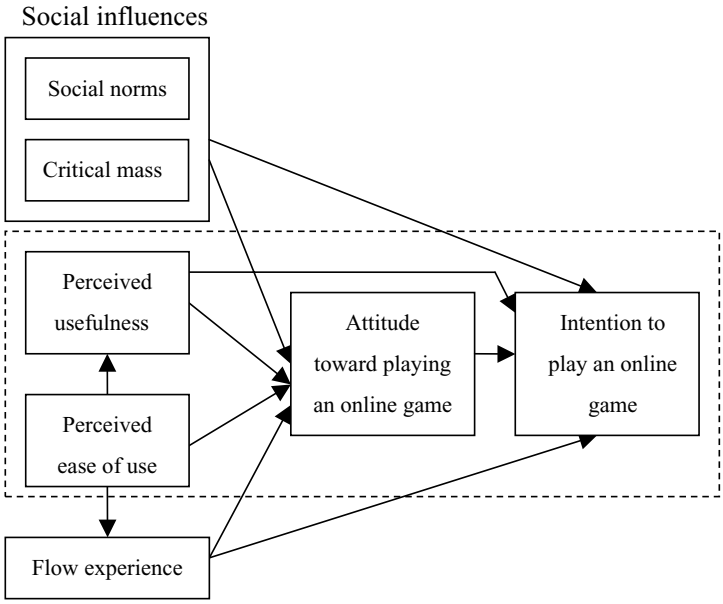

Fig. 2. The research model.

extent to which the user would like to reuse on-line games in future. Moreover, perceived usefulness was defined as the extent to which the user believed that playing on-line games would fulfill the purpose.

The extensions of the research model, namely social influences and flow experience, were hypothesized as being directly related to intention to play an on-line game. Social norm described the extent to which the user perceived that others approved of their playing an on-line game. Additionally, perceived critical mass denoted the extent to which the user believed that most of their peers were playing an on-line game. Furthermore, flow experience was defined as the extent of involvement, enjoyment, control, concentration and intrinsic interest with which users engage in an on-line game activity.

The model further indicated that attitudes mediated the impact of beliefs on intention to play an on-line game. *Attitude* was defined as user preferences regarding on-line game playing, and is influenced by beliefs, including social influences, flow experience, perceived usefulness, and perceived ease-of-use.

Additionally, *perceived ease-of-use* is the extent to which the user believes that playing on-line games was effortless. We also proposed that perceived ease-of-use directly affected flow experience, perceived usefulness, and attitude.

3.1. Flow experience

Past research identified a positive relationship between flow and perceived ease-of-use. Additionally, flow experience seemed to prolong Internet and web site usage [68]. Webster et al. also noted that flow was associated with exploratory behavior and positive subjective experience. Accordingly, the following hypotheses were proposed:

Hypothesis 1. Perceived ease-of-use is positively related to flow experience of playing of an on-line game.

Hypothesis 2. Flow experience is positively related to attitude toward playing an on-line game.

Hypothesis 3. Flow is positively related to intention to play an on-line game.

3.2. TAM

This research model adopted the TAM belief–attitude–intention–behavior relationship, so the following TAM hypothesized relationships were proposed in the context of on-line games:

Hypothesis 4. Perceived ease-of-use is positively related to attitude toward playing an on-line game.

Hypothesis 5. Perceived ease-of-use is positively related to perceived usefulness.

Hypothesis 6. Perceived usefulness is positively related to attitude toward playing an on-line game.

Hypothesis 7. Perceived usefulness is positively related to intention to play an on-line game.

Hypothesis 8. Attitude is positively related to intention to play an on-line game.

3.3. Social influence

Although Davis et al. dropped social influence from TAM, numerous empirical studies have found that social factors positively impact an individual's IT usage [55,77,82]. Additionally, Triandis model [80], TRA, and related theories provide the theoretical bases for the hypothesized relationship between social influences and user behavior. Empirical studies based on these theories have found that social influences positively affect an individual's behavior [16,46,52,53]. Accordingly, the following hypotheses were proposed:

Hypothesis 9. Social norms are positively related to attitude toward playing on-line games.

Hypothesis 10. Social norms are positively related to intention to play the on-line games.

Hypothesis 11. Perceived critical mass is positively related to attitude toward playing an on-line game.

Hypothesis 12. Perceived critical mass is positively related to intention to play an on-line game.

To test these proposed hypothesis, data were collected and analyzed using the structural equation modeling (SEM), a second-generation multivariate technique that combines multiple regression with confirmatory factor analysis to estimate simultaneously a series of interrelated dependence relationships. Recently, SEM has been applied to several fields of study, including education, marketing, psychology, social science and management [42,59,72]. The number of IS studies that use the SEM approach to examine empirically the proposed model is increasing (e.g. [4]).

The test of the proposed model includes an estimation of the two components of a causal model: the measurement and the structural models. The first attempts to represent the relationships between the latent variables and observed variables. The latent variables are empirical measures of the constructs of the proposed model. Each cannot be measured directly but can be measured by a set of observable variables, that are the scale items of questionnaires. The aim of testing the measurement model is to specify how the latent variables are measured in terms of the observed variables, and how these are used to describe the measurement properties (validity and reliability) of the observed variables. Secondly, the structural model investigates the strength and direction of the relationships among theoretical latent variables.

4. Research method

4.1. Data collection

Empirical data were collected by conducting a field survey of on-line game users. Subjects were self-selected by placing messages on over 50 heavily trafficked on-line message boards on popular game-related web sites, including Bahamut (http://www.gamer.com.tw), Gamebase (http://www.gamebase.com.tw), Gamemad (http://www.gamemad.com) and game-related boards such as Yahoo! Kimo (http://www.tw.yhaoo.com), Yamtopia (http://www.yam.com.tw), Openfind (http://www.openfind.com.tw) and campus BBS in Taiwan. The message stated the purpose of this study, provided a hyperlink to the survey form, and, as an incentive, offered respondents an opportunity to participate in a draw for several prizes.

Tan and Teo [76] suggested that on-line field surveys have several advantages over traditional paper-based mail-in-surveys. For instance, they are cheaper to conduct, elicit faster responses, and are geographically unrestricted. Such surveys have been widely used in recent years. IS researchers are coming to accept on-line research [9].

The on-line survey yielded 233 usable responses. Eighty percent of the respondents were male, and 20%

Table 3
Profile of respondents

Measure	Items	Frequency	Percentage
Gender	Male	188	0.80
	Female	45	0.20
Age (years)	~20	154	0.66
	21–25	70	0.30
	>25	9	0.04
Education	Junior school or less	35	0.15
	High school	56	0.25
	Some college	43	0.18
	Bachelor's degree	94	0.40
	Graduate degree	5	0.02
Place of on-line game use	Home	190	0.81
	Campus	15	0.06
	Net café	25	0.10
	Others	3	0.03
Internet Connectivity	ADSL	178	0.76
	Dial-up	8	0.04
	Cable modem	23	0.10
	LAN	13	0.06
	Leased line	7	0.03
	Others	4	0.01
Years of playing on-line game experiences	~1	35	0.15
	1–2	92	0.39
	2–3	60	0.25
	>3	46	0.21

were female; 81% responded from home. Seventy-six percent used ADSL as their main means of access to on-line games. Table 3 summarizes the profiles of the respondents.

4.2. Measurement

The questionnaires were developed from the literature; the list of the items is displayed in Appendix A. The scale items for perceived ease-of-use, perceived usefulness, attitude, and behavioral intention to play were developed from the study of Davis, which has been validated in numerous studies The scales were slightly modified to suit the context of on-line games. Furthermore, to develop a scale for measuring social norms and perceived critical mass, we utilized measures of Fishbein and Ajzen and Luo and Strong, with modifications to suit the setting of on-line games. The scale for flow experience was developed and tested in Novak et al. Each item was measured on a seven-point Likert scale, ranging from "disagree strongly" (1) to "agree strongly" (7).

Both a pre-test and a pilot test were undertaken to validate the instrument. The pre-test involved ten respondents who were experts in the field of on-line games. Respondents were asked to comment on the length of the instrument, the format, and wording of the scales. Finally, after a pilot test that involved 50 respondents, the survey, self-selected from the population of on-line game users, was conducted.

5. Results

5.1. Descriptive statistics

Table 4 presents descriptive statistics. On average, users responded positively to playing on-line games (the averages all exceeded four out of seven, except for flow experience). The fact that the subjects liked playing was unknot surprising. However, the subjects responded positively to ease-of-use in using multimedia operations. This response confirmed that players perceive on-line user interfaces as easy to use. Regarding social influences, the respondents believed that norms and critical mass are perceived while playing on-line games. Players interact socially and exchange information via game systems. This interpersonal interaction generally creates a community. Finally, the surveyed players, on average, seemed to be slightly less concerned with flow experience. Many antecedents, such as skill and challenge, would influence flow experience. To cause flow, a player should increase the challenge level and develop skills to meet the increased challenge [19]. The result indicated that players may see the challenges of on-line games and failing to match their skills.

Table 4
Descriptive statistics

Constructs	Mean	Standard deviation
Social norms	4.4	1.2
Perceived critical mass	5.8	1.0
Perceived usefulness	5.1	1.3
Perceived ease-of-use	4.8	1.2
Flow experience	3.3	1.5
Attitude	5.4	1.1
Intention to play	4.9	1.2

5.2. Measurement model

As shown in Appendix B, the fitness measures, except the GFI, were all within acceptable range. In practice, GFI values above 0.8 are considered to indicate a good fit [73]. Consequently, all the measures indicated that the model fit the data.

As shown in Appendix C, item reliability ranged from 0.69 to 0.97, which exceeds the acceptable value of 0.50 [37]. Consistent with the recommendations of Fornell [30], all composite reliabilities exceeded the threshold value of 0.6. The average variance extracted for all constructs exceeded the benchmark of 0.5 recommended by Fornell and Larcker [31]. Since the three values of reliability were above the recommended values, the scales for measuring these constructs were deemed to exhibit satisfactory convergence reliability.

Appendix D presents the measurements of discriminant validity. The data reveal that the shared variance among variables was less than the variances extracted by the constructs, the value on the diagonals. This showed that constructs are empirically distinct. In conclusion, the test of the measurement model, including convergent and discriminant validity measures, was satisfactory.

5.3. Tests of the structural model

The structural model was tested using LISREL 8. Fig. 3 presents the results of the structural model with non-significant paths as dotted lines, and the standardized path coefficients between constructs. The hypothesized paths from social norms, flow experience, and attitude were significant in the SEM prediction of on-line game intentions. Contrary to our hypotheses (Hypotheses 7 and 12), perceived usefulness and perceived critical mass have no significant direct effect on intention. Notably, however, the perceived ease-of-use and perceived critical mass had indirect effects, mainly through attitude, on intention to play on-line games, as shown in Appendix E.

The effect of attitude on intention to play on-line games was quite strong, as shown by the path coefficient of 0.99 ($P < 0.001$). The other path coefficient ($\beta = 0.16$ and 0.12) from social norms and flow experience to intention to play on-line games was also statistically significant at $P < 0.05$. Together, the three paths accounted for approximately 80% of the observed variance in intent to play on-line games. Notably, Hypotheses 3, 8 and 10 were supported.

Users' attitudes toward playing on-line games were statistically significantly related to perceived critical

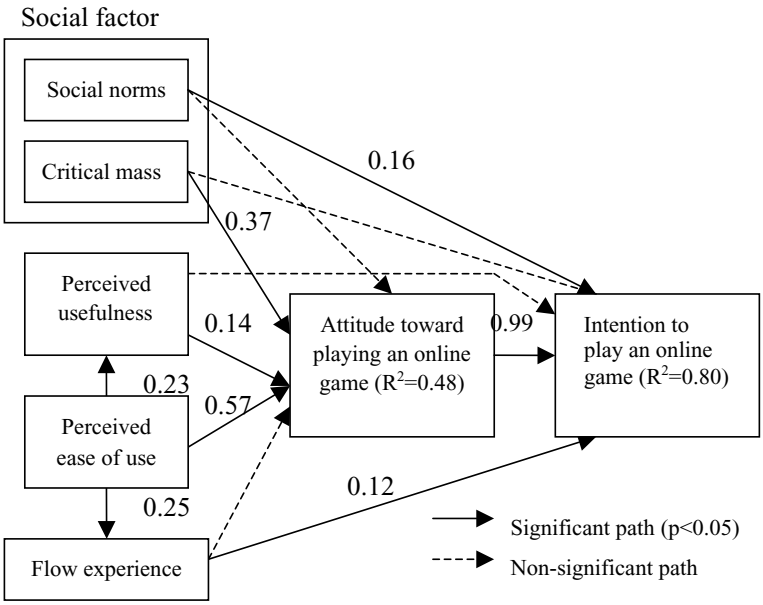

Fig. 3. Results of structural modeling analysis.

mass, perceived usefulness, and perceived ease-of-use. Social norms and flow experience did not significantly affect attitude. The positive effect of perceived critical mass on attitude was strong, as indicated by the path coefficient of 0.37 ($P < 0.001$). The other path coefficients ($\beta = 0.14$ and 0.57) of perceived usefulness and perceived ease-of-use were statistically positively significant at $P < 0.05$. The path from perceived critical mass, perceived usefulness, and perceived ease-of-use explains 48% of the observed variance in attitude. Therefore, Hypotheses 4, 6 and 11 were supported.

Finally, consistent with our expectations, the perceived ease-of-use was positively related to the perceived usefulness and flow experience by the path coefficients of 0.23 and 0.25, respectively. Therefore, Hypotheses 1 and 5 were supported at the 0.05 level of significance.

6. Discussion

This study revealed that the acceptance of on-line games can be predicted by extended TAM ($R^2 = 0.80$). Social norms, attitude, and flow experience significantly and directly affected intentions to play on-line games. Notably, contradicting the findings of previous TAM studies, the results of this study indicate that perceived usefulness does not motivate users to play on-line games, but it directly affects attitude. Perceived usefulness was proposed as a determinant of acceptance. Rationally, players would want to play on-line games only if they found them useful; i.e., on-line game playing must satisfy individual fancy or leisure. However, according to the analytical results, perceived usefulness did not appear to drive user participation. Players thus continue to play without purpose. Hence, we infer that another factors related to the acceptance of entertainment-oriented technologies should be considered. Social factors and flow experience are likely to be important influences on the acceptance of on-line games.

Social influences, including perceived critical mass and social norms, significantly and directly, but separately, affected attitudes and intentions. In the context of traditional IT, TAM omitted social influences. Instead, our findings indicated that social norms and perceived critical mass dominated users' behaviors. This was confirmed in other theories such as TRA, the theory of planned behavior [2,3], the Triandis model, and innovation diffusion theory [69], which applied social factors to explain user behavior.

Flow experience is another important predictor of intention to play on-line games. The result corroborates the findings of Novak et al. that flow experience was related to intention to use a system, while an individual engaged in an activity that supported flow states. Though the flow experience significantly affected acceptance, its mean, as listed in Table 4.

The easy-to-use interface of an on-line game also played a critical role in determining perceptions of usefulness and in forming flow experience. If difficulties of use cannot be overcome, then the user may not perceive the usefulness of the game and may not enjoy the flow experience; he or she may then abandon the on-line game.

7. Implications

7.1. Implications for academic researchers

For academic researchers, this study contributes to a theoretical understanding of the factors that promote entertainment-oriented IT usage such as on-line games. Entertainment-oriented IT differs from task-oriented IT in terms of reason for use. Task-oriented IT usage is concerned with improving organization productivity. Therefore, TAM stresses the importance of perceived usefulness and perceived ease-of-use as key determinants. However, in the context of entertainment-oriented IT, this study demonstrated that the importance of individual intentions tended to need other variables: social norms and flow experience. Furthermore, this dominance was strong, and these variables explained much of the variance in entertainment technology usage.

7.2. Implications for on-line game practitioners

For on-line game practitioners, the results suggest that developers should endeavor to emphasize intrinsic motivation (IM) rather than extrinsic motivation; i.e., the pleasure and satisfaction from performing a behavior [81] versus a behavior to achieve specific goals/rewards [26]. Moreover, perceived usefulness is a form of extrinsic motivation and flow experience, a

form of intrinsic motivation [20]. Flow experience plays an important role in entertainment-oriented applications. Designers should keep users in a flow state. In addition, developers should design user interfaces that increasing perception of ease-of-use to improve flow experience and positive attitudes.

On-line game managers should be aware of the importance of social influences. Interpersonal interaction among game players creates a community in which business value can be created by improving customer loyalty [36]. When users play on-line games intensely, the interaction with other users will cause more to join in. Therefore, managers should strive to attract opinion leaders or community builders to affect others to play on-line games through a normative effect. Moreover, through word-of-mouth communication or mass advertisements, managers can accelerate network effects to achieve a perception of critical mass. The more users in an on-line game, the more user-generated experience it is likely to exchange and thus the more users it will attract. This idea, called the dynamic loop, was found by Hagel and Armstrong to yield increasing returns in a virtual community.

8. Conclusion and limitations

The purpose of this study was to extend TAM to examine the influences on on-line games acceptance. We verified the effect of social norms, perceived critical mass and flow experience on the behavior of on-line game users.

In conclusion, the research presented provides insight into three findings:

1. While most of past studies found consistently perceived usefulness an important predictor in TAM model, we found that this was not always true. On-line game is an entertainment technology, different from a problem-solving technology. While using entertainment technology, people usually want to ''kill time''. As a result, the significant effect of perceived usefulness will decrease. The influence of flow experience and social norms become important.
2. TAM omits social factors in explaining IT usage. However, social norms have a direct impact on the adoption of on-line games. Users may feel obligated to participate because they want to belong to a community.
3. Flow experience may play an important role. Users intend to play entertainment technology continuously where they are completely and totally immersed. Increasing usability through dialogue and social interaction, access, and navigation, is the key to successful management of on-line game communities.

Results should be treated with caution for several reasons. First, this study directly measured flow using a three-item scale following a narrative description of flow, and required users to fill out questionnaires regarding their previous flow experience in on-line games. Thus, a bias exists because the sample was self-selected and only those users with experience answered the questionnaires. However, this approach is consistent with approaches to flow in other literature [14]. Second, the level of analysis is a limiting factor. Since studied social influences and flow experience are additional antecedents of intention to play on-line games, it is impossible to generalize the findings to other entertainment technologies. Finally, this study suggests that researchers should investigate how beliefs (including social factors, PE, PU, and flow experience) are influenced by external factors, such as system characteristics, individuals' personalities, and culture factors to understand better the usage of entertainment technology.

Appendix A

Please circle a score from the scale 1 (disagree strongly) to 7 (agree strongly) below which most closely corresponds with how you perceive with playing an on-line game.

(a) Social norms:
  (S1) My colleagues think that I should play an on-line game.
  (S2) My classmates think that I should play an on-line game.
  (S3) My friends think that I should play an on-line game.

(b) Perceived critical mass:
  (C1) Most people in my group play an on-line game frequently.

(C2) Most people in my community play an on-line game frequently.
(C3) Most people in my class/office play an on-line game frequently.

(c) Perceived ease-of-use:
(P1) It is easy for me to become skillful at playing on-line game.
(P2) Learning to play an on-line game is easy for me.
(P3) It is easy to play.

(d) Perceived usefulness:
Instructions: The purpose of playing on-line game includes relaxation, playfulness, fun, fancy, chat, transaction, etc.
(U1) It enables me to accomplish the purpose of playing game more quickly.
(U2) It enables me to fulfill the purpose of playing game effectively.
(U3) It enables me to satisfy the purpose of playing game easier.

(e) Flow experience:
Instructions: The word ''flow'' is used to describe a state of mind sometimes experienced by people who are totally involved in some activity. One example of flow is the case where a user is playing extremely well and achieves a state of mind where nothing else matter but the on-line game; you engages in an on-line game with total involvement, concentration and enjoyment. You are completely and deeply immersed in it. The experience is not exclusive to on-line game: many people report this state of mind when web pages browsing, on-line chatting and word processing.
Thinking about your won play of the on-line game.
(F1) Do you think you have ever experienced flow in playing on-line game.
(F2) In general, how frequently would you say you have experienced ''flow'' when you play an on-line game.
(F3) Most of the time I play an on-line game I feel that I am in flow.

(f) Attitude toward playing an on-line game:
(A1) I feel good about playing an on-line game.
(A2) I like playing an on-line game.

(g) Behavioral intentions to play an on-line game:
(I1) It is worth to play an on-line game.
(I2) I will frequently play an on-line game in the future.

Appendix B

Fit indices for the measurement model

Measures	Recommended criteria	Suggested by authors	Measurement model
Chi-square/d.f.	<3.0	Hayduk [38]	2.18
GFI	>0.9	Scott [71]	0.88
AGFI	>0.8	Scott [71]	0.83
CFI	>0.9	Bagozzi and Yi [7]	0.94
RMESA	<0.05	Bagozzi and Yi [7]	0.072

Appendix C

Assessing the measurement model

Item	Reliability
Social norms	
S1	0.72
S2	0.88
S3	0.89
Perceived critical mass	
C1	0.69
C2	0.95
C3	0.83
Perceived ease-of-use	
P1	0.75
P2	0.90
P3	0.82
Perceived usefulness	
U1	0.72
U2	0.74
U3	0.88
Flow experience	
F1	0.87
F2	0.97
F3	0.78
Attitude	
A1	0.79
A2	0.88

Appendix C (*Continued*)

Item	Reliability
Intention to play	
I1	0.88
I2	0.76

(a) Item reliabilities.

Construct	Composite reliability	Average variance extracted
Social norms	0.870	0.693
Perceived critical mass	0.867	0.689
Perceived ease-of-use	0.864	0.680
Perceived usefulness	0.825	0.613
Flow experience	0.907	0.767
Attitude	0.820	0.696
Intention to play	0.805	0.675

(b) Construct reliabilities.

Appendix E

Effects on intention to play on-line game

Construct	Direct effects	Indirect effects	Total effects
Social norms	0.16*	−0.04	0.12
Critical mass	−0.16	0.37	0.21**
Perceived usefulness	−0.04	0.14	0.10
Perceived ease-of-use		0.62	0.62***
Flow experience	0.12*	0.03	0.15*
Attitude	0.99***		0.99***
$R^2 = 0.80$			

* $P < 0.05$.
** $P < 0.01$.
*** $P < 0.001$.

Appendix D

Discriminant validity

Variables	Social norms	Perceived critical mass	Perceived ease-of-use	Perceived usefulness	Flow experience	Attitude	Intention
Social norms	0.693						
Perceived critical mass	0.173	0.689					
Perceived ease-of-use	0.068	0.032	0.680				
Perceived usefulness	0.050	0.112	0.049	0.613			
Flow experience	0.019	0.010	0.052	0.032	0.767		
Attitude	0.073	0.152	0.261	0.097	0.041	0.696	
Intention	0.101	0.081	0.321	0.056	0.081	0.492	0.675

Diagonals represent the average variance extracted, while the other matrix entries represent the shared variance (the squared correlations).

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