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# Understanding individual adoption of mobile instant messaging: a multiple perspectives approach

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**Abstract** Use of mobile instant messaging has grown tremendously in the last few years, and is positioned as a platform for mobile business. This study aims to explore how an individual's intention to use mobile instant messaging is influenced by technical and individual characteristics as well as social influence factors. A research model based on perceived usefulness and perceived enjoyment, including technical characteristics (ease of use and convenience), individual characteristics (computer playfulness and personal innovativeness), and social influence factors (perceived critical mass and identification) was developed. The model was empirically analyzed using structural equation modeling with data from mobile instant messaging service users in Korea. The results indicate that most of the proposed technical characteristics, individual characteristics, and social influence factors have impacts on perceived usefulness and/or perceived enjoyment, which form the intention to use mobile instant messaging. Our findings provide strategic guidelines for service providers with respect to the development and operations of mobile instant messaging.

**Keywords** Mobile instant messaging · Technology adoption · Convenience · Playfulness · Personal innovativeness · Perceived critical mass · Identification

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## 1 Introduction

Instant messaging (IM) is a technology that is used for two-way communication via the Internet. It includes real-time text transmission, chatting, group meetings, etc. With advancements in wireless LAN and mobile technologies such as 3G and 4G, Internet access via mobile devices has increased significantly, and IM has rapidly evolved as a mobile service. In recent years, the use of mobile IM has spread rapidly as most applications are available for free and provide convenient mobile communication. Illustrating this rapid growth, one well-known mobile IM service, WhatsApp, grew from processing 1 billion messages per day in October of 2011, to 10 billion messages per day in August of 2012, to 27 billion messages per day in June of 2013, and finally to 50 billion in January of 2014 [32, 35, 36]. Also, in terms of service, the scope of mobile IM is expanding through the provision of a variety of additional features, such as video file transfer, social games, sticker and cartoon selling, discount coupon distribution, corporate advertising in addition to simple text messaging. Its convenience and new additional functions make mobile IM service an important platform for mobile business, as demonstrated by a renewed focus on adding IM services to desktop operating systems by major vendors like Apple and Microsoft.

The use of mobile IM forms the foundation of the business models for mobile IM service providers. The service providers have developed a wide range of business models, some of these with a strong focus on membership size, and frequency of use (or amount of time spent with the IM client); some with the use of advertising (for example, WeChat), and some with no intent of ever having advertising (for example, WhatsApp). Recently, Facebook bought "WhatsApp", a mobile IM provider with upwards

of 450 million users, and 70 % of whom use it every day, for the amount of USD 19 billion despite a low level of profits at $1 per year per user after the first year of use [3]. From a recent report by Juniper Research [41], they expect "instant messaging to account for 75 % of mobile messaging traffic by 2018, but only generate 2 % of revenues." Thus, the sustainability of the business model behind IM is not clear. In addition, as exemplified by Facebook's acquisition of WhatsApp, the revenue stream do not justify the purchase amount (in a traditional setting this would be about ten times the annual revenues), we reason that the actual membership size and frequency of use of the service are arguably used as the foundation for the evaluation of the mobile business model. Thus, an improved understanding of factors influencing IM use is critical in designing sustainable business models.

Although the use of mobile IM has grown at increasing rates, and has become an important business platform for the mobile environment, studies investigating individuals' use of mobile IM still leave room for improved understanding. Previous studies have analyzed the effects of certain variables from specific perspectives, such as network externalities [53], critical mass [19], or flow experience [30], on individuals' mobile IM usage. However, our understanding of the impact of the specific variables is not sufficient to fully explain individuals' behavior with regard to mobile IM usage, and does not provide strategic insights for IM service providers to increase users' interest in their services (which is a foundation for their business models). More specifically, to fully understand individuals' behaviors regarding the use of information technology (IT), analysis of a synthesis of multiple perspectives, rather than one specific perspective, is desirable [37].

Accordingly, this study will analyze the factors influencing individuals' mobile IM use from multiple perspectives. Specifically, we propose the influencing factors of individuals' mobile IM use from technical, individual, and social influence perspectives; develop a research model integrating these factors; and empirically analyze the model using structural equation modeling (SEM) with data from users of a mobile IM service. This research can help to improve understanding of users' mobile IM usage behavior, and also provide strategic insights for service providers to conduct business effectively, and design more sustainable business models.

## 2 Theoretical background and hypothesis development

### 2.1 Technology acceptance and flow theory

In the IM adoption literature, the theories that are most commonly used to develop a base model to predict individuals' IM usage are the technology acceptance model (TAM) and Flow theory. Proposed by Davis [10], the TAM, based on Fishbein and Ajzen's [15] theory of reasoned action (TRA), is a model that explains and predicts IT usage. This model includes perceived usefulness and perceived ease of use as the main factors influencing acceptance of IT. Perceived usefulness is defined as "the degree to which a person believes that a particular technology would enhance his or her job performance" [10, p. 320]. Perceived ease of use is "the degree to which a person believes that the utilization of a particular technology would be free of effort" [10, p. 320]. TAM has been extensively applied to user acceptance research studying various types of technologies. Numerous studies support TAM, maintaining that it is a robust and parsimonious model for the explanation of technology usage [30]. TAM has also been commonly used to explain user adoption of IM (e.g., [24, 25, 53]). In our study, perceived usefulness thus refers to a mobile IM user's belief that it enables him or her to communicate with others more effectively and improves his or her efficiency in sharing information and connecting with others.

Although the two variables of TAM—perceived usefulness and perceived ease of use—are proposed as the main factors influencing intention to use IT, studies in IM literature have excluded perceived ease of use as a variable influencing intention to use IM. This is mainly because empirical studies have found that perceived ease of use has little or no effect on behavioral intention after the technology has been adopted for a period of time [24]. Thus, we propose the following hypothesis regarding TAM:

**H1** Perceived usefulness positively affects behavioral intention to use mobile IM.

Alongside TAM, flow theory has frequently been used as the theoretical framework to explain and predict the usage of IM (e.g., [30, 52, 53]). Flow is defined as "the holistic sensation that people feel when they act with total involvement" [9, p. 36]. When people are in the flow state, they become totally involved in their activity, and are unable to recognize changes in their surroundings [20]. This optimal experience is known to lead to a variety of consequences such as communication, exploratory behavior, learning, positive affect and computer use [16]. Thus, flow theory has been used to address the effect of users' optimal experiences in a variety of contexts, including mobile games, online shopping, e-learning, and IM [53]. Although different viewpoints on the components of flow exist in IM studies, enjoyment is commonly used as the construct to measure flow experiences. Enjoyment as an intrinsic motivation variable, as well as a component of flow, is defined as "the extent to which the activity of using the technology artifact is perceived to be enjoyable in its

own right, apart from any performance consequences that may be anticipated" [11, p. 1113]. It has been found to have a significant impact on a user's technology acceptance, especially with regard to hedonic systems [44]. In the mobile IM environment, perceived enjoyment hence refers to a mobile IM user's belief that using it is enjoyable, pleasurable, and fun. Lu et al. [30] argued that IM has rich entertainment value, and that users obtain a great deal of enjoyment when using it; thus, its users will be intrinsically motivated to adopt it. Li et al. [24] also argued that the hedonic aspect of using IM for fun and pleasure might suggest that enjoyment is the dominant predictor of intention to use the technology. Thus, we hypothesize the following:

**H2** Perceived enjoyment positively affects behavioral intention to use mobile IM.

## 2.2 Technical characteristics of mobile IM adoption

In TAM studies, technical or system characteristics have frequently been proposed as the external variables of TAM. Although a variety of technical characteristics (e.g., ease of use, information quality, response time, accessibility, security, convenience, and output quality) have been proposed as the factors influencing IT adoption in previous studies, we focus on two specific technical characteristics—ease of use and convenience—because ease of use has been regarded as the most important factor related to the use of IT [10], and because convenience represents the technical characteristic of ubiquitous technologies such as mobile internet [50].

### *2.2.1 Ease of use*

In the information systems (IS) literature, ease of use has been regarded as a factor influencing user satisfaction [14], and also as a determinant of IT adoption [10]. Thus, ease of use has been considered an important technical element in developing IS [49]. DeLone and McLean [12] proposed ease of use as a measurement of system quality reflecting technical features. Studies on human–computer interactions have suggested that ease of use has become an inherent feature of the technology [24]. Although, in previous studies, perceived ease of use has been excluded from the set of the factors that has a direct influence on the intention to use mobile IM [24], in TAM-related studies, ease of use has been suggested as an antecedent of perceived usefulness and perceived enjoyment [42]. Thus, we hypothesize:

**H3** Ease of use positively affects perceived usefulness of mobile IM.

**H4** Ease of use positively affects perceived enjoyment of using mobile IM.

### *2.2.2 Convenience*

In the IT context, convenience can be viewed as the user's ability to utilize the technology regardless of place and time [50]. Liao and Cheung [26] regarded convenience as a driver of Internet banking, as individuals can transact over the Internet at any time in any properly equipped location. Yoon and Kim [50] considered convenience as a silent determinant of individuals' acceptance of ubiquitous computing and empirically tested whether convenience had an impact on perceived usefulness. Deng et al. [13] argued that mobile IM enables users to conduct ubiquitous interactions with their peers, thus being tremendously convenient for its users. In the current technological environment, mobile IM provides users with more opportunities to have a conversation with their friends at any place and enables more frequent exchange of useful information at any time. Therefore, the following hypothesis can be established.

**H5** Convenience positively affects perceived usefulness of mobile IM.

**H6** Convenience positively affects perceived enjoyment of using mobile IM.

It is worthwhile to distinguish between the constructs "convenience" and the previously discussed construct "ease of use". In the IT context, "ease of use" typically refers to "the degree to which a person believes that the utilization of a particular technology would be free of effort" [10, p. 320], while the definition of "convenience" means the user's ability to utilize the technology regardless of place and time [50].

## 2.3 Individual characteristics of mobile IM adoption

Individual characteristics are potentially important to the successful use of technologies, as we observe that different individuals have different needs [6]. Although prior studies have tested the influence of numerous individual factors on technology acceptance outcomes [23], we focus on two specific individual characteristics that are likely to have a significant effect on intention to use mobile IM—computer playfulness and personal innovativeness.

### *2.3.1 Computer playfulness*

Computer playfulness is an individual trait that is defined as "the degree of cognitive spontaneity in microcomputer interactions" [47, p. 204]. There are two playfulness

constructs in the IS literature: the first, a trait construct, treats playfulness as a motivational characteristic of individuals; the second, a state construct, defines playfulness as a situational characteristic of the interaction between an individual and the situation [33]. Webster and Martocchio [47] developed the computer playfulness construct based on the traits that are comparatively stable characteristics of individuals who are relatively invariant to situational stimuli. In TAM studies, computer playfulness has been shown to have impact on cognitive absorption [2] and perceived enjoyment [43]. Thus, we also hypothesize:

**H7** Computer playfulness positively affects perceived enjoyment of using mobile IM.

Although researchers agreed that computer playfulness impacts perceived usefulness through perceived ease of use [43], we argue that computer playfulness will have a direct impact on perceived usefulness of mobile IM. This is because mobile IM, a type of hedonic system, aims to provide self-fulfilling value to its user. Thus, we hypothesize:

**H8** Computer playfulness positively affects perceived usefulness of mobile IM.

#### 2.3.2 *Personal innovativeness*

Personal innovativeness in IT is defined as "the willingness of an individual to try out any new information technology" [1, p. 206]. Agarwal and Prasad [1] proposed an influential personal trait variable in relation to technology innovation adoption behaviors. They described personal innovativeness as epitomizing the risk-taking propensity that exists in certain individuals and not in others. Personal innovativeness was initially proposed as a moderator of—but later re-conceptualized as a direct determinant of—perceived usefulness and perceived ease of use [48]. Lewis et al. [23] found that personal innovativeness is significantly correlated to perceived usefulness and perceived ease of use. Lu et al. [29] argued that since individuals with higher innovativeness tend to take more risks, it is reasonable to expect them to develop more positive intentions toward adoption of an IS innovation such as a wireless mobile technology. Meanwhile, Agarwal and Karahanna [2] proposed that the individual traits of personal innovativeness and playfulness are important determinants of cognitive absorption in regard to use of the World Wide Web. Thus, we hypothesize:

**H9** Personal innovativeness positively affects perceived usefulness of mobile IM.

**H10** Personal innovativeness positively affects perceived enjoyment of using mobile IM.

### 2.4 Social influence factors and mobile IM adoption

Although the original TAM excludes social influence from its formulation, recent IM studies based on TAM have considered the importance of social influence in the use of IM [19]. We focus on two specific social influence factors that are likely to influence an individual's mobile IM usage: perceived critical mass and identification. These factors are chosen since they have been frequently used in TAM studies and in the literature on virtual communities as the influencing factors in forming intentions.

#### 2.4.1 *Perceived critical mass*

Perceived critical mass as a social influence factor has recently received attention with respect to the adoption of IM [19]. Perceived critical mass is defined as "the degree to which a person believes that most of his or her peers are using the system" [28, p. 95]. It entails subjective perceptions of whether an innovation (technology) has attracted a critical mass of users [45]. Markus [31] first applied critical mass theory to the diffusion of technologies. The critical mass concept, in particular, has received attention with respect to the adoption of communication technologies; this is because an individual may use a communication technology based on a subjective perception of the critical number of current users [24]. Several studies have shown that perceived critical mass has a significant influence on intentions to use IM [24, 40, 45]. Thus, we also hypothesize:

**H11** Perceived critical mass positively affects behavioral intention to use mobile IM.

Perceived critical mass, which is the perception of the number of users of a technology, may be considered evidence of the objective reality of the diffusion of the technology. Along this line of reasoning, if an individual perceives that many people are using a technology, he or she may accept it as objective evidence of the usefulness of the technology [24]. Hence, the perception that the technology is useful can be internalized as user beliefs. In addition, the effect of perceived critical mass on perceived usefulness has been found in previous empirical studies [24, 25, 28]. Thus, we hypothesize:

**H12** Perceived critical mass positively affects perceived usefulness of mobile IM.

Though the relationship between perceived critical mass and perception of enjoyment is not fully explored, some studies on technology adoption have found that a positive relationship exists (e.g., [24, 25]). Li et al. [24] argued that if an individual perceives that many of his or her friends and relationship partners are using IM, the perception of

**Table 1** Summary of constructs, theories, and empirical evidence

| Constructs in research model | Theory or empirical source |
|---|---|
| Perceived usefulness, ease of use | Technology Acceptance model (TAM) [10] |
| Perceived enjoyment | Flow theory [9] |
| Perceived critical mass | Critical mass theory [31] |
| Identification | Theory of social influence [21] |
| Computer playfulness, personal innovativeness | Agarwal and Prasad [1], Agarwal and Karahanna [2] |
| Convenience | Yoon and Kim [50], Liao and Cheung [26] |

having fun collectively, or being in each other's presence via IM, may be higher. As a result, we hypothesize:

**H13** Perceived critical mass positively affects perceived enjoyment of using mobile IM.

#### 2.4.2 *Identification*

Identification refers to "the process whereby individuals see themselves as one with another person or group of people" [34, p. 256]. According to Kelman [21], social influence operates through one or more of three distinct processes: compliance, identification, and internalization. Identification is said to occur when an individual adopts a behavior to establish or maintain "a satisfying self-defining relationship to another person or group" [21, p. 53]. Friends registered in mobile IM can be regarded as a unique group. According to Chiu et al. [8], the perception of togetherness of a group elevates an individual's activeness to share knowledge. A number of studies have shown that identification has a significant impact on individuals' knowledge-sharing intention [51]. Thus, we hypothesize:

**H14** Identification positively affects behavioral intention to use mobile IM.

Although identification is known to be useful in explaining individuals' willingness to maintain committed relationships with the community, little is known of its relationship with perceived usefulness and perceived enjoyment in TAM literature. However, when we talk to close friends, we experience a great deal more fun, and if we frequently communicate with close friends through a communication technology, we may perceive the communication technology as a more useful tool. Therefore, identification may have a positive impact on perceived usefulness and perceived enjoyment of using mobile IM:

**H15** Identification positively affects perceived usefulness of mobile IM.

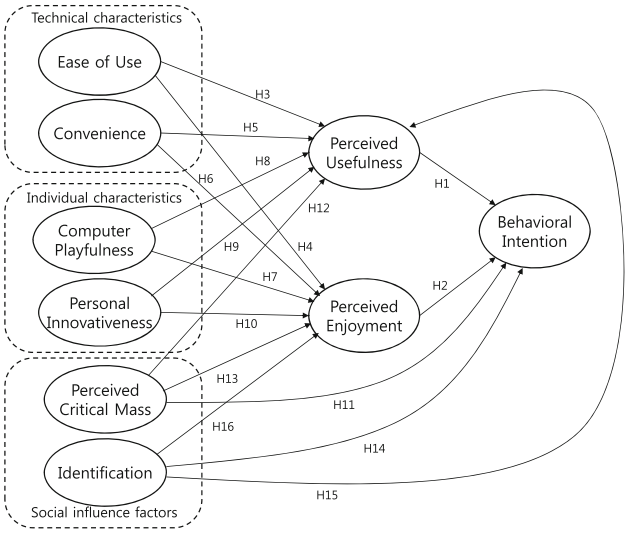


**Fig. 1** Research model

**H16** Identification positively affects perceived enjoyment of using mobile IM.

### 2.5 Research model

The model for this research is based on perceived usefulness and perceived enjoyment, including technical characteristics (ease of use and convenience), individual characteristics (computer playfulness and personal innovativeness), and social influence factors (perceived critical mass and identification). A summary of the constructs and the theoretical or empirical research sources are summarized in Table 1.

Based on the above, we propose a multi-perspective research model positing that technical, individual, and social influence factors affect perceived usefulness and perceived enjoyment in the IM domain. In turn, the two belief variables (usefulness and enjoyment) impact the behavioral intention to use mobile IM. Figure 1 represents this research model.

## 3 Research methodology

### 3.1 Data collection

Since a diverse population in Korea uses mobile IM, the respondents were randomly selected from diverse groups of individuals from a high school, a university campus, and the streets. They were asked to participate in a survey for KakaoTalk, which is one of the most successful mobile IMs in South Korea, and is available for free from the Google Play store, as well as from the iTunes store. Five

**Table 2** Descriptive statistics of respondents' characteristics

| Measure | Value | Frequency (%) |
|---|---|---|
| Gender | Male | 207 (52.3) |
| | Female | 189 (47.7) |
| Age | Younger | 72 (18.2) |
| | 20–24 | 216 (54.5) |
| | 25–29 | 53 (13.4) |
| | 30–34 | 16 (4.0) |
| | 35–39 | 11 (2.8) |
| | 40–44 | 14 (3.5) |
| | 45–49 | 11(2.8) |
| | Older | 3 (0.8) |
| Job | None | 7 (1.7) |
| | Students | 331 (83.6) |
| | Office workers | 16 (4.0) |
| | Housewives | 5 (1.3) |
| | Experts | 17 (4.3) |
| | Others | 20 (5.0) |
| Education | High school or below | 15 (3.8) |
| | University student | 330 (83.3) |
| | Bachelor degree | 32 (8.1) |
| | Master degree or over | 19 (4.8) |
| Subscription period of the IM | <1 years | 59 (14.9) |
| | 1–2 | 152 (38.4) |
| | 2–3 | 113 (28.5) |
| | More than 3 | 72 (18.2) |

hundred (500) questionnaires were distributed, from which 396 usable questionnaires were collected and utilized in the analysis. Of the respondents, 207 were male and 189 were female, approximately 55 % were aged between 20 and 24, and about 85 % had over 1 year of mobile IM experience. Detailed descriptive statistics relating to the respondents' characteristics are shown in Table 2.

We first performed Harman's one-factor test with the data that were collected in order to overcome the concern of common method bias in the survey design. In this test, all the principle constructs are entered into an Exploratory Factor Analysis (EFA). Evidence for common method bias exists when a single factor emerges from the analysis, or when one general factor accounts for the majority of the covariance among the measurements [39]. In the EFA, nine factors came from the analysis and these explained 32.0, 8.3, 6.3, 5.1, 4.4, 3.9, 3.7, 3.3, and 3.1 of the variance respectively. Thus, the results do not indicate substantial common method bias.

### 3.2 Measurements

The questionnaire used for data collection contained scales to measure the various constructs of the research model. The measurements for perceived usefulness, perceived enjoyment, and behavioral intention constructs were adapted from Lin and Lu's [27] and Li et al. [24] studies. The measurements for the ease of use construct and the convenience construct were adapted from studies conducted by Lu et al. [30] and Yoon and Kim [50] respectively. The measurements for the computer playfulness and the personal innovativeness constructs were adapted from Agarwal and Karahanna's [2] study. The measurements for the perceived critical mass and the identification constructs were adapted from studies conducted by Li et al. [24] and Yoon and Wang [51] respectively. In the questionnaire, all items were measured using a seven-point Likert scale, with responses ranging from "strongly disagree" to "strongly agree." All items in the questionnaire are shown in "Appendix".

## 4 Results

The SEM approach was used to validate the research model. Partial Least Squares (PLS-Graph Version 3.0) was employed to perform the analysis. PLS employs a component-based approach for estimation. This approach is best suited for analyzing complex models with latent variables [38] and is more appropriate for performing exploratory-level studies [7]. Thus, PLS was used to accommodate the presence of a large number of latent variables and an exploratory-level study.

### 4.1 Reliability and validity of measurement items

Partial Least Squares can test the convergent and the discriminant validity of the scales. In a confirmatory factor analysis (CFA), as done by PLS, convergent validity is shown when each of the measurement items loads significantly, with the $p$ value of its $t$ value well within the 0.05 level, on its assigned construct [18]. Table 3 shows the factor loadings of the measurement items and $t$ values.

All $t$ values in the Table 3 are above 1.96. The factor loadings of all items also loaded highly (above 0.60). This demonstrates convergent validity of all the measurement items for the constructs.

Discriminant validity is shown when the following two things occur: (1) measurement items load more strongly on their assigned construct than on the other constructs in the CFA, and (2) when the square root of the average variance extracted (AVE) of each construct is larger than its correlations with the other constructs [18].

As shown in Table 3, all the measurement items loaded considerably stronger on their respective factor than on the other constructs. Table 3 shows the square root of the AVE and the inter-construct correlations. Comparisons of the correlation with the square root of the AVE show that all

**Table 3** Results of confirmatory factor analysis

| Construct | Construct loading scores | | | | | | | | | *t* value |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | |
| *Perceived usefulness* | | | | | | | | | | |
| PU1 | **0.84** | 0.50 | 0.50 | 0.39 | 0.56 | 0.24 | 0.22 | 0.31 | 0.35 | 37.77 |
| PU2 | **0.88** | 0.50 | 0.52 | 0.46 | 0.56 | 0.32 | 0.28 | 0.34 | 0.37 | 52.59 |
| PU3 | **0.91** | 0.53 | 0.53 | 0.50 | 0.63 | 0.27 | 0.22 | 0.39 | 0.36 | 92.67 |
| PU4 | **0.85** | 0.59 | 0.55 | 0.53 | 0.63 | 0.31 | 0.20 | 0.46 | 0.38 | 52.85 |
| *Perceived enjoyment* | | | | | | | | | | |
| PE1 | 0.62 | **0.95** | 0.45 | 0.43 | 0.53 | 0.33 | 0.28 | 0.34 | 0.37 | 87.87 |
| PE2 | 0.59 | **0.97** | 0.47 | 0.45 | 0.51 | 0.39 | 0.30 | 0.34 | 0.42 | 183.23 |
| PE3 | 0.54 | **0.95** | 0.41 | 0.46 | 0.51 | 0.38 | 0.26 | 0.33 | 0.41 | 104.97 |
| *Behavioral intention* | | | | | | | | | | |
| INT1 | 0.54 | 0.39 | **0.94** | 0.37 | 0.47 | 0.20 | 0.17 | 0.32 | 0.24 | 73.97 |
| INT2 | 0.61 | 0.47 | **0.95** | 0.45 | 0.50 | 0.21 | 0.17 | 0.41 | 0.29 | 134.50 |
| INT3 | 0.53 | 0.44 | **0.90** | 0.34 | 0.40 | 0.16 | 0.18 | 0.29 | 0.27 | 60.33 |
| *Ease of use* | | | | | | | | | | |
| EOU1 | 0.40 | 0.37 | 0.36 | **0.83** | 0.52 | 0.25 | 0.21 | 0.44 | 0.27 | 33.99 |
| EOU2 | 0.42 | 0.38 | 0.31 | **0.87** | 0.50 | 0.26 | 0.19 | 0.48 | 0.29 | 46.64 |
| EOU3 | 0.55 | 0.43 | 0.39 | **0.88** | 0.67 | 0.21 | 0.20 | 0.47 | 0.29 | 65.64 |
| EOU4 | 0.49 | 0.43 | 0.39 | **0.88** | 0.66 | 0.28 | 0.23 | 0.52 | 0.29 | 56.44 |
| *Convenience* | | | | | | | | | | |
| CV1 | 0.57 | 0.42 | 0.37 | 0.65 | **0.84** | 0.20 | 0.22 | 0.42 | 0.29 | 44.09 |
| CV2 | 0.49 | 0.41 | 0.38 | 0.56 | **0.77** | 0.26 | 0.27 | 0.49 | 0.34 | 25.22 |
| CV3 | 0.59 | 0.43 | 0.47 | 0.58 | **0.87** | 0.28 | 0.24 | 0.49 | 0.34 | 38.84 |
| CV4 | 0.59 | 0.52 | 0.40 | 0.48 | **0.80** | 0.24 | 0.22 | 0.34 | 0.34 | 39.26 |
| *Computer playfulness* | | | | | | | | | | |
| CP3 | 0.28 | 0.30 | 0.18 | 0.28 | 0.23 | **0.83** | 0.28 | 0.20 | 0.38 | 23.20 |
| CP4 | 0.30 | 0.37 | 0.14 | 0.19 | 0.25 | **0.86** | 0.25 | 0.09 | 0.32 | 31.93 |
| CP5 | 0.15 | 0.19 | 0.17 | 0.20 | 0.22 | **0.62** | 0.13 | 0.32 | 0.27 | 7.55 |
| *Personal innovativeness* | | | | | | | | | | |
| PI1 | 0.28 | 0.27 | 0.20 | 0.26 | 0.32 | 0.22 | **0.85** | 0.17 | 0.33 | 17.45 |
| PI3 | 0.12 | 0.12 | 0.07 | 0.05 | 0.12 | 0.20 | **0.63** | 0.04 | 0.25 | 7.21 |
| PI4 | 0.14 | 0.22 | 0.11 | 0.15 | 0.14 | 0.25 | **0.74** | 0.14 | 0.25 | 10.71 |
| *Perceived critical mass* | | | | | | | | | | |
| PCM1 | 0.22 | 0.23 | 0.23 | 0.41 | 0.29 | 0.19 | 0.07 | **0.73** | 0.21 | 17.99 |
| PCM2 | 0.39 | 0.32 | 0.31 | 0.48 | 0.47 | 0.21 | 0.15 | **0.89** | 0.24 | 58.43 |
| PCM3 | 0.41 | 0.32 | 0.37 | 0.50 | 0.47 | 0.17 | 0.14 | **0.88** | 0.34 | 54.97 |
| PCM4 | 0.39 | 0.30 | 0.31 | 0.48 | 0.49 | 0.20 | 0.20 | **0.85** | 0.41 | 33.93 |
| *Identification* | | | | | | | | | | |
| ID1 | 0.37 | 0.31 | 0.20 | 0.25 | 0.33 | 0.33 | 0.29 | 0.31 | **0.80** | 24.12 |
| ID2 | 0.37 | 0.41 | 0.28 | 0.32 | 0.37 | 0.38 | 0.31 | 0.39 | **0.88** | 57.86 |
| ID3 | 0.41 | 0.39 | 0.27 | 0.30 | 0.37 | 0.40 | 0.37 | 0.31 | **0.93** | 87.98 |
| ID4 | 0.33 | 0.35 | 0.26 | 0.27 | 0.32 | 0.34 | 0.33 | 0.27 | **0.89** | 43.08 |

correlations between the two constructs are less than the square root of the AVE of both constructs.

To assess the reliability of a measurement item, the study computed a composite construct reliability coefficient, as shown in Table 4. Composite reliabilities ranged from 0.79 (for personal innovativeness) to 0.97 (for perceived enjoyment), which exceeded the recommended level of 0.60 [4]. The AVE ranged from 0.56 (for personal innovativeness) to 0.91 (for perceived enjoyment), which also exceeded the recommended level of 0.50 [17]. The

**Table 4** Average variance extracted and correlation matrix

| Construct | Mean (SD) of construct | Factor | | | | | | | | | CCR | AVE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | | |
| Perceived usefulness | 5.53 (1.31) | (0.87) | | | | | | | | | 0.93 | 0.76 |
| Perceived enjoyment | 4.80 (1.55) | 0.61 | (0.95) | | | | | | | | 0.97 | 0.91 |
| Behavioral intention | 5.57 (1.45) | 0.60 | 0.47 | (0.93) | | | | | | | 0.95 | 0.86 |
| Ease of use | 5.72 (1.19) | 0.54 | 0.47 | 0.42 | (0.87) | | | | | | 0.92 | 0.75 |
| Convenience | 5.48 (1.22) | 0.68 | 0.54 | 0.49 | 0.69 | (0.82) | | | | | 0.89 | 0.68 |
| Computer playfulness | 4.49 (1.12) | 0.33 | 0.38 | 0.21 | 0.28 | 0.30 | (0.78) | | | | 0.82 | 0.60 |
| Personal innovativeness | 4.22 (1.26) | 0.26 | 0.29 | 0.19 | 0.24 | 0.29 | 0.29 | (0.75) | | | 0.79 | 0.56 |
| Perceived critical mass | 5.78 (1.23) | 0.44 | 0.35 | 0.37 | 0.55 | 0.53 | 0.22 | 0.17 | (0.84) | | 0.91 | 0.71 |
| Identification | 4.62 (1.42) | 0.42 | 0.42 | 0.29 | 0.33 | 0.39 | 0.42 | 0.37 | 0.36 | (0.88) | 0.93 | 0.77 |

Values in brackets are square root of AVE

*CCR* Composite construct reliability, *AVE* average variance extracted

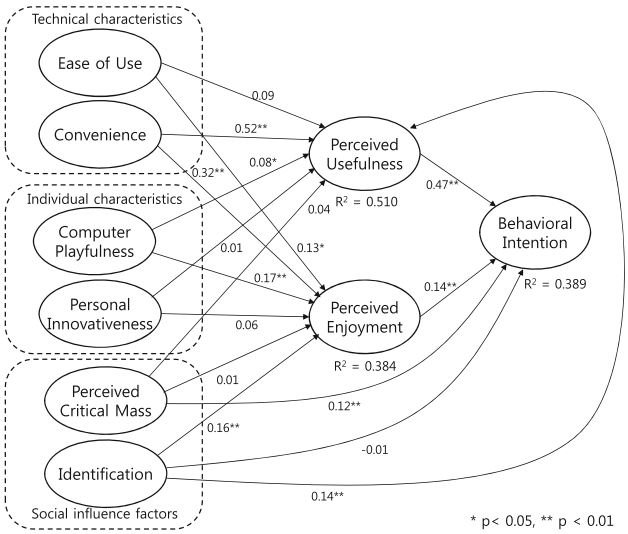


**Fig. 2** Path diagram for research model

results, therefore, demonstrate a reasonable reliability level for the measured items.

## 4.2 Hypothesis testing results

Having assessed the structural model, we examine the coefficients of the causal relationships between constructs, in order to validate the hypothesized effects. Figure 2 illustrates the paths and their significance for the structural model. The coefficients, their $t$ value on the structural model, and the coefficients of determination ($R^2$) for each dependent construct are shown in Table 5.

Based on the structural model, we performed hypotheses testing. As indicated in Table 5, the results of the hypotheses regarding the base model show that all paths are significant. Specifically, perceived usefulness and perceived enjoyment have significant impact on behavioral intention to use mobile IM, both significant at the $\alpha = 0.01$. Therefore, H1 and H2 are supported. The results of the hypotheses exploring the effects of technical characteristics show that ease of use has a significant impact on perceived enjoyment, with $\alpha = 0.05$, and that convenience has a significant impact on both perceived usefulness and perceived enjoyment, with $\alpha = 0.01$. However, ease of use was found to have no significant impact on perceived usefulness. Thus H4, H5, and H6 are supported, and H3 is rejected. The results of the hypotheses exploring the effects of individual characteristics show that computer playfulness has a significant impact on perceived enjoyment and perceived usefulness, with $\alpha = 0.01$ and $\alpha = 0.05$ respectively; however, personal innovativeness has no significant impact on either perceived usefulness or perceived enjoyment. Thus H7 and H8 are supported, and H9 and H10 are rejected. Finally, the results of the hypotheses exploring the effects of social influence factors show that perceived critical mass has a significant impact on behavioral intention to use mobile IM, with $\alpha = 0.01$; however, it has no significant impact on perceived usefulness and perceived enjoyment. Identification has no significant impact on behavioral intention to use mobile IM; however, it has a significant impact on both perceived usefulness and perceived enjoyment, with $\alpha = 0.01$. Thus H10, H15, and H16 are supported, and H12, H13, and H14 are rejected.

In addition, about 39 % of the variance of behavioral intention to use ($R^2 = 0.389$) is explained by perceived usefulness, perceived enjoyment, perceived critical mass, and identification, and 51 % of the variance of perceived usefulness ($R^2 = 0.510$) and 38 % of the variance of perceived enjoyment ($R^2 = 0.384$) are explained by ease of use, convenience, computer playfulness, personal innovativeness, perceived critical mass, and identification.

**Table 5** Hypothesis testing results

| Hypothesis | Path | Path coefficient | *t* value |
|---|---|---|---|
| H1 | Perceived usefulness → behavioral intention | 0.47 | 8.69** |
| H2 | Perceived enjoyment → behavioral intention | 0.14 | 2.88** |
| H3 | Ease of use → perceived usefulness | 0.09 | 1.39 |
| H4 | Ease of use → perceived enjoyment | 0.13 | 1.86* |
| H5 | Convenience → perceived usefulness | 0.52 | 7.51** |
| H6 | Convenience → perceived enjoyment | 0.32 | 5.44** |
| H7 | Computer playfulness → perceived enjoyment | 0.17 | 3.80** |
| H8 | Computer playfulness → perceived usefulness | 0.08 | 1.93* |
| H9 | Personal innovativeness → perceived usefulness | 0.01 | 0.22 |
| H10 | Personal innovativeness → perceived enjoyment | 0.06 | 1.29 |
| H11 | Perceived critical mass → behavioral intention | 0.12 | 2.46** |
| H12 | Perceived critical mass → perceived usefulness | 0.04 | 0.71 |
| H13 | Perceived critical mass → perceived enjoyment | 0.01 | 0.11 |
| H14 | Identification → behavioral intention | −0.01 | 0.22 |
| H15 | Identification → perceived usefulness | 0.14 | 2.68** |
| H16 | Identification → perceived enjoyment | 0.16 | 2.78** |

Perceived usefulness $R^2$: 0.510

Perceived enjoyment $R^2$: 0.384

Behavioral intention $R^2$: 0.389

* Significant at the 0.05 level

** Significant at the 0.01 level

Table 5 shows the results of the hypotheses testing in more detail.

## 5 Discussion and conclusions

In this research, we explored the effects of factors derived from multiple perspectives on the use of mobile IM. A research model based on perceived usefulness and perceived enjoyment, including technical characteristics (ease of use and convenience), individual characteristics (computer playfulness and personal innovativeness), and social influence factors (perceived critical mass and identification) was developed. Several insights are derived from analyzing the research model, and these are presented below.

First, the results of this study reveal that technical characteristics play an important role in users' mobile IM use. The study showed that convenience has the greatest impact on both perceived enjoyment and perceived usefulness. This result confirms that the concept of convenience is a core determinant of individuals' use of IT in the mobile computing context, which is an initial stage of the ubiquitous computing environment [50]. The study also showed that ease of use had a significant impact on perceived enjoyment; however, it had no significant impact on perceived usefulness. Although previous research has found that perceived ease of use has a direct impact on perceived usefulness, we found that ease of use has an indirect impact on perceived usefulness through a mediator—perceived convenience. Some studies (e.g., [50]) already argued that perceived ease of use influences perceived usefulness through perceived convenience. However, in the mobile IM market it is possibly conceivable that IM applications are simple and fairly standard, and that the audience for these apps is one that understands the mobile technology use well (due to its ubiquity). Thus, perceived usefulness is primarily driven by other elements.

Second, the results of this study show that individual characteristics also have an effect on the formation of the intention to use mobile IM. Computer playfulness was shown to have a significant impact on perceived usefulness and perceived enjoyment, although its effect on perceived usefulness is slight (path coefficient: 0.08). In TAM studies, computer playfulness has been shown to have an impact on perceived usefulness through perceived ease of use or perceived enjoyment [43]. Our study showed that computer playfulness had a direct impact on perceived usefulness. This result may be caused by the hedonic nature of mobile IM. Since individuals' playfulness is a self-fulfilling tendency, those who have a high level of playfulness may think of hedonic systems such as mobile IM as being useful. Although previous research has argued that individuals with higher personal innovativeness are expected to develop more positive beliefs about the target technology [1], this study showed that personal innovativeness had no significant impact on either perceived usefulness or perceived enjoyment. On one hand, this makes sense, as one would expect anyone (not just innovators, but also followers) to derive usefulness and enjoyment from IM technology. One the other hand, personal innovativeness has been known to have a significant impact on trying a

new technology with risk taking [48]. Today, we argue that people usually use mobile IM predominantly for personal purposes, which often is not considered to be risky. Thus, at the current time, risk taking in using mobile IM probably has little effect on adoption in the mobile IM environment, and thus personal innovativeness is not a major influencer vis-à-vis usefulness and enjoyment. However, as organizations are adopting IM for professional use, the link between personal innovativeness and risk would warrant further research.

Third, this study suggests that social influence factors also play an important role in users' mobile IM use. Perceived critical mass had a direct impact on behavioral intention to use mobile IM and identification was shown to have a significant impact on perceived usefulness and perceived enjoyment. However, perceived critical mass had no significant impact on perceived usefulness and perceived enjoyment. These results differ from those of previous studies [24, 25, 28]. A possible explanation for these results might be that the effect of perceived critical mass on perceived usefulness and perceived enjoyment is mediated by other external variables, such as ease of use, convenience, and identification, in the research model. In order to test our assertion, we removed ease of use, convenience, and identification constructs from the research model and tested the new research model. The results showed that the perceived critical mass has a significant impact on perceived enjoyment and perceived usefulness, with $\alpha = 0.01$. This finding provided support for our assertion. On the contrary, identification has a significant impact on perceived usefulness and perceived enjoyment but no direct impact on behavioral intention to use mobile IM. It seems possible that these results are due to the fact that the effect of identification on behavioral intention to use mobile IM is fully mediated by perceived usefulness and perceived enjoyment. We performed full mediation analysis (four step approach) proposed by Baron and Kenny [5] to validate our assertions. The result showed full mediation, and provided support for our assertion. Specifically, the more individuals experience the feeling of togetherness or closeness with people who communicate through mobile IM, the stronger they may perceive usefulness and enjoyment of the technology; thus this increased perceived usefulness and enjoyment would have a positive impact on their intention to use mobile IM.

### 5.1 Contributions and implications

This study has important implications for research and practice. Recently, there has been a tremendous increase in the use of mobile IM; nevertheless, studies regarding individuals' use of mobile IM have analyzed the effects of specific variables from single perspectives, such as from network externalities or flow experience theories on individuals' mobile IM usage. Based on a synthesis of multiple perspectives, this study analyzes the factors influencing individuals' mobile IM use. Therefore, the first contribution of this study is its analysis of individuals' use of mobile IM based on a synthesized model of multiple perspectives, which revealed that most of the proposed technical and individual characteristics and social influence factors play important roles in users' mobile IM usage. More specifically, this study found that the convenience of technical characteristics has the greatest impact on the mediated variables—perceived enjoyment and perceived usefulness—of the adoption of mobile IM. Second, this study identified a new role of computer playfulness in a hedonic system context. In the TAM literature, the relationship between computer playfulness and perceived usefulness was not previously explored. This study found that computer playfulness had a significant impact on perceived usefulness and perceived enjoyment of using mobile IM. Third, this study revealed the impact pathways of the social influence factors affecting individuals' intention to use mobile IM. Namely, perceived critical mass has a direct impact on behavioral intention to use mobile IM, while identification has an indirect impact on this intention through perceived usefulness and perceived enjoyment. In addition, introducing the identification construct into the TAM context can be regarded as a contribution of this study. Finally, through analyzing the proposed model, this study provided a basis for developing an extended TAM for new information technologies that includes hedonic and interpersonal features.

The findings of this study also have important implications for practitioners. First, the results indicate that convenience is critical for increasing the usability and the pleasure the users derive from mobile IM use. In information technologies, convenience means that the user is able to utilize the technology anytime and anywhere. Thus, in the mobile IM context, the convenience construct should include not only mobility—that users use the technology anywhere—but also availability—that users can use the technology anytime. Therefore, operations managers of mobile IM services must design and develop a high-availability system to offer this convenience to their customers. This may, for example, take the form of better integration of the IM, and the availability of the IM across computing platforms. Second, this study shows that identification plays an important role in individuals' mobile IM usage. The results imply that quality of interpersonal relationships among the mobile IM communicators, such as sense of kinship and closeness, is more important in determining users' mobile IM use than the number of mobile IM connectors. Therefore, IM designers and

operators should focus on enhancing the quality of the users' personal connections rather than the excessive expansion of their users' connectors.

### 5.2 Limitations and further research issues

Although our findings have meaningful implications for researchers and practitioners, our study has some limitations. First, this study classified the external variables influencing an individual's use of mobile IM into technical characteristics, individual characteristics, and social influence factors, and established the hypotheses with only two selected factors from each category. There is a need to undertake further research that includes more diverse factors in the research model and to empirically analyze these factors. Second, the measurement items for computer playfulness were adapted from Agarwal and Karahanna's [2] study; developed by Webster and Martocchio [47]; and verified by several studies (e.g., [46]). However, in this study, quite a few measurement items of the construct dropped out due to low-level factor-loading values for convergent validity. Most of the previous studies that include the personal trait variable were conducted in Western countries, whereas this study was undertaken in Korea. This difference can cause low construct validity. Therefore, further research should develop more applicable measurement items for the constructs applicable in other regions of the world. Finally, we realize that the study was using data collected from a single country, South Korea, which has the highest Internet penetration of any country (at about 91 %), and the Internet household penetration is at 97.3 % (ITU 2012). South Korea ranks first in the International Telecommunications Union's (ITU) information and communications technology (ICT) Development Index (IDI), and has one of the largest social media communities in the world [22]. As such, South Korea is a leading country with respect to ICT use, and is an appropriate context for studying IM use. In order to confirm the generalizability of the research results herein with respect to other countries, further research is needed.

## Appendix

Perceived usefulness: Likert scale ranging from strongly disagree to strongly agree

PU1 Using KakaoTalk enables me to communicate with others more effectively.
PU2 Using KakaoTalk improves my efficiency in sharing information and connecting with others.
PU3 KakaoTalk is a useful service for interaction with others.
PU4 Overall, KakaoTalk is useful to me.

Perceived enjoyment: Likert scale ranging from strongly disagree to strongly agree

PE1 Using KakaoTalk is enjoyable.
PE2 Using KakaoTalk is pleasurable.
PE3 I have fun using KakaoTalk.

Behavioral intention: Likert scale ranging from strongly disagree to strongly agree

BI1 I plan to use KakaoTalk in the future.
BI2 I intend to continue using KakaoTalk in the future.
BI3 I expect my use of KakaoTalk to continue in the future.

Ease of use: Likert scale ranging from strongly disagree to strongly agree

EOU1 Learning to operate KakaoTalk is easy.
EOU2 It is easy for me to become skillful at using KakaoTalk.
EOU3 It is easy to use KakaoTalk to communicate with others.
EOU4 Overall, KakaoTalk is easy to use.

Convenience: Likert scale ranging from strongly disagree to strongly agree

CV1 Using KakaoTalk enables me to communicate with others at a time that is convenient for me.
CV2 Using KakaoTalk enables me to communicate with others anyplace.
CV3 Using KakaoTalk gives me convenience in communicating with others.
CV4 I find KakaoTalk convenient for interacting with others.

Computer playfulness: Likert scale ranging from strongly disagree to strongly agree

*CF1* *When using KakaoTalk I am spontaneous. (dropped).*
*CF2* *When using KakaoTalk I am unimaginative.* (dropped).*
CF3 When using KakaoTalk I am flexible.
CF4 When using KakaoTalk I am creative.
CF5 When using KakaoTalk I am playful.
*CF6* *When using KakaoTalk I am unoriginal.* (dropped).*
*CF7* *When using KakaoTalk I am uninventive.* (dropped).*

Personal innovativeness: Likert scale ranging from strongly disagree to strongly agree

PI1 If I heard about a new information technology, I would look for ways to experiment with it.
*PI2* *In general, I am hesitant to try out new information technologies.* (dropped).*
PI3 Among my peers, I am usually the first to try out new information technologies.
PI4 I like to experiment with new information technologies.

Perceived critical mass: Likert scale ranging from strongly disagree to strongly agree

PCM1 Many friends use KakaoTalk.
PCM2 Of the people I communicate with regularly, many use KakaoTalk.
PCM3 A large percentage of the people I communicate with use KakaoTalk.
PCM4 In my community, I see many people using KakaoTalk.

Identification: Likert scale ranging from strongly disagree to strongly agree

ID1 I feel a sense of kinship with people with whom I frequently communicate using KakaoTalk.
ID2 I have a feeling of togetherness or closeness with people with whom I frequently communicate using KakaoTalk.
ID3 There is a close identity between me and the people with whom I interact using KakaoTalk.
ID4 When I use KakaoTalk, I sometimes identify with people.

Note: * Reversed scale.

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