Computers in Human Behavior 27 (2011) 883–889

Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh

Examining mobile instant messaging user loyalty from the perspectives of network externalities and flow experience

Tao Zhou [a], Yaobin Lu [b,*]

[a] School of Management, Hangzhou Dianzi University, Hangzhou 310018, PR China
[b] School of Management, Huazhong University of Science and Technology, Wuhan 430074, PR China

ARTICLE INFO

Article history:
Available online 3 December 2010

Keywords:
Network externalities
Flow experience
Mobile IM
Loyalty

ABSTRACT

Due to the intense competition and low switching cost, building user loyalty is critical for mobile instant messaging (IM) service providers. Integrating both perspectives of network externalities and flow experience, this research identified the factors affecting mobile IM user loyalty. Network externalities include referent network size and perceived complementarity. Flow experience includes perceived enjoyment and attention focus. We conducted data analysis with structural equation modeling (SEM). The results show that both network externalities and flow experience significantly affect perceived usefulness and satisfaction, further determining user loyalty. Thus mobile service providers need to improve their IM platforms, and deliver positive network externalities and good usage experience to users. Then they can facilitate users' loyalty.

1. Introduction

The application of third generation (3G) mobile communication technologies has triggered the rapid development of mobile commerce. A report indicates that 40% of adult Americans go online wirelessly with cell phones (PewInternet, 2010). A China Internet Network Information Center (CNNIC) report shows that the number of mobile Internet users in China has reached 277 million, accounting for 66% of the Internet population (420 million) (CNNIC, 2010). These figures demonstrate the great user base and market potential of mobile commerce. Faced with this opportunity, mobile service providers have released a variety of services, such as mobile instant messaging (IM), mobile games and mobile payment. Among them, mobile IM, which enables users to conduct ubiquitous interactions with their peers, represents a popular mobile service in China and has ever been used by 61.5% of mobile Internet users (CNNIC, 2010). In US, about 30% of cell phone users have adopted mobile IM (PewInternet, 2010). There are many mobile IM products in the Chinese market, such as mobile QQ, mobile MSN, China Mobile Fetion, and Mobile Wangwang. These mobile IM products have similar functions such as text chat and facial emotion icons, and there exists intense competition among them. Thus a challenge facing mobile service providers is to retain their customers. On the other hand, the switching cost is low. Users can easily switch from a mobile IM platform to another. Thus, it is imperative to identify the factors affecting user loyalty towards mobile IM. Then mobile service providers can adopt effective measures to improve users' stickiness to their IM platforms.

As a real-time communication tool, mobile IM may produce significant network externalities as the number of users increases (Lin & Bhattacherjee, 2008). Network externalities mean that users can get additional values as mobile IM user network expands (Strader, Ramaswami, & Houle, 2007). For example, a user can communicate with more peers when the number of mobile IM users increases. Another example is that with the wide adoption of mobile IM, users have access to rich value-added applications, such as avatar shows, games, and music, which can improve their experience. Network externalities have received a considerable attention in economics (Dickinger, Arami, & Meyer, 2008). In the information systems discipline, network externalities have been integrated with the technology acceptance model (TAM) to explain user adoption of Internet IM (Wang, Hsu, & Fang, 2004), interactive information technologies (Lin & Bhattacherjee, 2008), communication technologies (Strader et al., 2007), and short message services (SMS) (Lu, Deng, & Wang, 2010). Thus network externalities are a significant determinant of user behavior. Users are probably more willing to continue using a mobile IM platform that can bring them network externalities.

On the other hand, due to the constraints of mobile terminals, such as small screens, low resolution and inconvenient input, mobile users' experience has been negatively affected (Lee & Benbasat, 2004). This will decrease their continuance usage intention. In this research, we measure user experience with flow, which represents an optimal experience (Hoffman & Novak, 2009). Extant research has found the effect of flow experience on user behavior in a

* Corresponding author.
E-mail addresses: zhoutao@hdu.edu.cn (T. Zhou), luyb@mail.hust.edu.cn (Y. Lu).

0747-5632/$ - see front matter © 2010 Elsevier Ltd. All rights reserved.
doi:10.1016/j.chb.2010.11.013

variety of contexts, including mobile TV (Jung, Perez-Mira, & Wiley-Patton, 2009), mobile games (Ha, Yoon, & Choi, 2007), online shopping (Guo & Klein, 2009; Guo & Poole, 2009), e-learning (Ho & Kuo, 2010), and IM (Zaman, Anandarajan, & Dai, 2010). Flow also positively affects users' continuance intention. Deng, Turner, Gehling, and Prince (2010) noted that cognitive absorption (similar to flow) affects users' satisfaction, which further determines their continuance usage of mobile Internet services. Lee, Kang, and McKnight (2007) proposed that flow affects online banking user behavior through satisfaction. Hausman and Siekpe (2009) found that flow affects online consumers' purchase and return intention.

The purpose of this paper is to theoretically propose and empirically validate a research model to identify the effects of both network externalities and flow experience on mobile IM user loyalty. Network externalities include referent network size and perceived complementarity, whereas flow experience includes perceived enjoyment and attention focus. We involve perceived usefulness and satisfaction as mediators.

2. Research model and hypotheses

2.1. Network externalities

Network externalities mean that a user's utility increases with the number of users (Strader et al., 2007). Products or services that demonstrate network externalities are called network goods. Network externalities include two categories: direct externalities and indirect externalities (Katz & Shapiro, 1985). Direct externalities are associated with user number. For example, when the user base of a mobile IM platform expands, individual user can interact with more peers. Indirect externalities mean that many complementary products, services and functions are available to users with the network growth (Strader et al., 2007). For example, the wide adoption of Windows operation systems leads to the fact that there are rich software and applications running on them. In contrast, due to its limited number of users, Linux has fewer available applications. Another example is that as more users adopt wideband Internet, the price is lower and the access speed is faster.

Following Lin and Bhattacherjee (2008), we measured network externalities with two factors: referent network size and perceived complementarity. Referent network size reflects the number of people in a user's social circle that adopts a mobile IM platform (Lin & Bhattacherjee, 2008). Users employ mobile IM to interact with their friends, colleagues and relatives. Whether these groups adopt a mobile IM platform will affect their adoption and usage decision. Thus we are concerned with referent network size rather than the total network size. When referent network size is large, users can communicate with more peers. This may improve their perceived usefulness and satisfaction. In contrast, when referent network size is small, users may perceive low utility and give up using a mobile IM platform. Previous research has suggested the effect of referent network size on perceived usefulness (Lu et al., 2010; Strader et al., 2007; Wang et al., 2004). Thus, we propose,

H1.1. Referent network size significantly affects perceived usefulness.

H1.2. Referent network size significantly affects user satisfaction.

Compared to referent network size that represents direct network externalities, perceived complementarity represents indirect network externalities (Lin & Bhattacherjee, 2008). Perceived complementarity means that as user base expands, users can acquire many complementary functions and services (Strader et al., 2007), which bring additional values to them. For example, when more users adopt a mobile IM, they are able to access rich entertainment applications, such as games, music and avatar shows, which are developed by third-party organizations. These ancillary services will advance users' perceived utility and satisfaction as they can access various services via a single platform. The effect of perceived complementarity on perceived usefulness has been supported in previous research (Lin & Bhattacherjee, 2008). Thus,

H2.1. Perceived complementarity significantly affects perceived usefulness.

H2.2. Perceived complementarity significantly affects user satisfaction.

2.2. Flow

Flow is described as a holistic sensation that people feel when they act with total involvement (Csikszentmihalyi & Csikszentmihalyi, 1988). Flow is characterized by: (1) a seamless sequence of responses facilitated by machine interactivity, (2) intrinsic enjoyment, (3) a loss of self-consciousness, and (4) self-reinforcement (Hoffman & Novak, 1996; Novak, Hoffman, & Yung, 2000). Flow indicates that users' skills and challenges reach a good balance. When skills are larger than challenges, users feel bored. In contrast, when challenges are larger than skills, users are anxious. If both skills and challenges are lower than the threshold values, users feel apathy. Only when both skills and challenges exceed the threshold values and have a good fit will users experience flow.

As an elusive and broad concept, there exist different viewpoints on the components of flow (Hoffman & Novak, 2009). Koufaris (2002) noted that online flow experience includes three dimensions: perceived enjoyment, perceived control and attention focus. Guo and Poole (2009) suggested that flow includes six constructs: concentration, perceived control, mergence of action and awareness, transformation of time, transcendence of self, and autotelic experience. Hausman and Siekpe (2009) reported that flow includes four dimensions: challenge, concentration, control and enjoyment. Zaman and colleagues (2010) found that flow can be measured with two factors: perceived enjoyment and concentration. Among the components of flow, perceived enjoyment and attention focus are two of the most-often used factors (Finneran & Zhang, 2005; Hoffman & Novak, 2009). They are also directly used to measure flow in recent research (Lu, Zhou, & Wang, 2009; Zaman et al., 2010). Thus we will adopt perceived enjoyment and attention focus to measure flow experience.

Perceived enjoyment reflects that users acquire enjoyment and pleasure when they use mobile IM. Users adopt mobile IM to not only conduct communication, but also acquire enjoyment. Especially, as a personal communication tool, IM represents an entertainment platform rather than a productivity tool (Lin & Bhattacherjee, 2008). Thus perceived enjoyment is an important factor affecting user adoption of IM (Li, Chau, & Slyke, 2010). Perceived enjoyment represents an intrinsic motivation that emphasizes the usage process itself, compared to the extrinsic motivation such as perceived usefulness that emphasizes the outcome (Davis, Bagozzi, & Warshaw, 1992). If users get enjoyment when using mobile IM, their perceived usefulness may be improved because a good experience leads to their positive expectations towards future results (Deng et al., 2010). Agarwal and Karahanna (2000) noted that cognitive absorption (including perceived enjoyment) has a strong effect on the perceived usefulness of WWW. Ha and colleagues (2007) found that perceived enjoyment significantly affects the perceived usefulness of mobile gaming.

In addition, perceived enjoyment also affects user satisfaction. Users often expect to acquire enjoyment when using mobile IM. When their expectations are met, they will be satisfied. The effect

of perceived enjoyment on satisfaction has been validated in prior research. Kamis, Stern, and Ladik (2010) noted that online shopping enjoyment affects user satisfaction. Deng et al. (2010) found that cognitive absorption affects user satisfaction with mobile Internet services. Thus, we propose,

H3.1. Perceived enjoyment significantly affects perceived usefulness.

H3.2. Perceived enjoyment significantly affects user satisfaction.

Attention focus is another dimension of flow and reflects users' immersion when they use mobile IM (Koufaris, 2002). Users often use mobile IM on movement such as in subways. This may affect their attention focus and usage experience. In addition, users may simultaneously perform multiple tasks, such as using mobile IM, listening to music and accessing Internet. If they have low immersion when using mobile IM, they may have a poor experience. This will affect their perceived usefulness and satisfaction. Prior research has also noted the effect of cognitive absorption (including focused immersion) on perceived usefulness (Agarwal & Karahanna, 2000) and satisfaction (Deng et al., 2010). Thus,

H4.1. Attention focus significantly affects perceived usefulness.

H4.2. Attention focus significantly affects user satisfaction.

2.3. Network externalities and flow

Network externalities may affect perceived enjoyment. When referent network size is larger, users can communicate with more peers. They can also build their interest groups to conduct group chat. This will bring them more enjoyment (Lin & Bhattacherjee, 2008). Also when many ancillary functions are available to users, they can use mobile IM to play games, listen to music and watch videos via a single platform. These value-added functions may also improve users' enjoyment (Koufaris, 2002). Thus,

H5. Referent network size significantly affects perceived enjoyment.

H6. Perceived complementarity significantly affects perceived enjoyment.

2.4. Perceived usefulness, satisfaction and loyalty

Perceived usefulness reflects a user's living and working efficiency and quality improvement associated with using mobile IM. Perceived usefulness is a main component of TAM (Davis, 1989). Satisfaction represents a user's accumulated feelings developed by multiple interactions with mobile service providers (Kuo, Wu, & Deng, 2009). Loyalty reflects a user's continuance usage behavior and positive recommendations (Gefen, 2002). Drawing on the expectation confirmation theory (ECT), perceived usefulness as a post-adoption expectation affects user satisfaction (Bhattacherjee, 2001). In addition, perceived usefulness has been found to be a significant factor affecting both the initial usage and continuance usage (Venkatesh & Davis, 2000). Kim and Son (2009) also revealed the significant effect of net benefits, including perceived usefulness and satisfaction, on user loyalty towards online services. Thus, we posit,

H7. Perceived usefulness significantly affects user satisfaction.

H8. Perceived usefulness significantly affects user loyalty.

H9. User satisfaction significantly affects loyalty.

Fig. 1 presents the research model. Network externalities include two factors: referent network size and perceived complementarity. Flow experience also includes two factors: perceived enjoyment and attention focus. Both network externalities and flow experience are proposed to affect loyalty through perceived usefulness and satisfaction.

3. Data collection

3.1. Instrument development

The research model includes seven factors. Each factor was measured with multiple items. All items were adapted from extant literature to improve content validity (Straub, Boudreau, & Gefen, 2004). Both referent network size and perceived complementarity were measured with items adapted from Lin and Bhattacherjee (2008). Items of referent network size reflect that most peers such as friends and colleagues use a mobile IM product. Items of perceived complementarity reflect the ancillary functions of mobile IM, such as games, skins and file transference. Perceived enjoyment, attention focus and perceived usefulness were measured with items from Koufaris (2002). Items of perceived enjoyment reflect the fun, excitement, enjoy and interest associated with using mobile IM. Items of attention focus reflect users' immersion and concentration. Items measuring perceived usefulness reflect the working and living quality and efficiency improvement derived from using mobile IM. Items of satisfaction were adapted from Spreng, MacKenzie, and Olshavsky (1996) to reflect users' content, satisfaction and pleasure. Items of loyalty were adapted from Gefen (2002) to reflect users' continuance usage and recommendation.

All items were first translated into Chinese by a researcher. Then another researcher translated them back into English to ensure consistency. When the instrument was developed, it was tested among ten users that had rich mobile IM usage experience. Then according to their comments, we revised some items to make them clear and understandable. The final items and their sources are listed in Appendix A. All items were measured with a five-Likert scale, ranging from strongly disagree (1) to strongly agree (5).

3.2. Procedures and participants

Data were collected at a university campus and two China Mobile service halls, which are located in an Eastern China city where mobile commerce is relatively better developed than other regions. China Mobile is the largest telecommunication operator in China. There are plenty of mobile users at these places (including campus and service halls) and this will expedite our data collection process. We randomly contacted users and asked those having mobile IM usage experiences to fill the questionnaires. Then

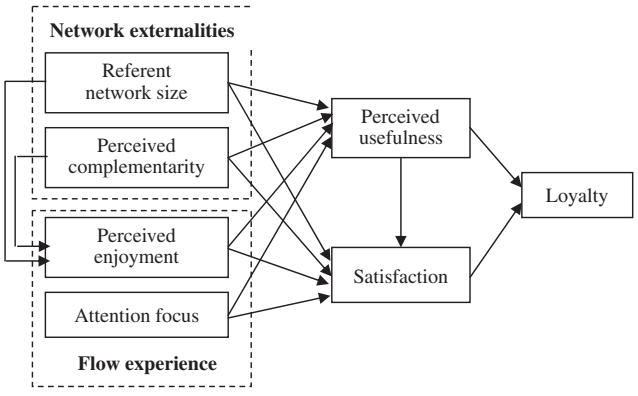

Fig. 1. Research model.

we scrutinized all questionnaires and dropped those that had too many missing values. As a result, we obtained 223 valid responses. More than half of the respondents (56.1%) were university students. We feel that incorporating students into our sample is appropriate because they represent the largest group (35.2%) of mobile Internet users in China (CNNIC, 2010). In terms of gender, 60.5% were male. Most of the respondents (89.7%) used mobile IM over once each day. The frequently used mobile IM platforms included mobile QQ, China Mobile Fetion, mobile MSN and mobile Wangwang.

We performed two tests to examine the common method variance (CMV). First, we conducted a Harman's single-factor test (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). The results indicate that the largest variance explained by individual factor is 13.015%. Thus none of the factor can explain the majority of the variance. Second, we modeled all items as the indicators of a single factor representing the common method effect (Malhotra, Kim, & Patil, 2006). The results show a poor fitness. For example, the goodness of fit index (GFI) is 0.656 (<0.9) and the root mean square error of approximation (RMSEA) is 0.152 (>0.08). The results of both tests indicate that CMV is not a significant problem in our research.

4. Data analysis

Following the two-step approach recommended by Anderson and Gerbing (1988), our data analysis includes two steps. First, we examined the measurement model to test reliability and validity. Then we examined the structural model to test research hypotheses and fitness.

First, we conducted a confirmatory factor analysis (CFA) to examine the validity. Validity includes convergent validity and discriminant validity. Convergent validity measures whether items can effectively reflect their corresponding factor, whereas discriminant validity measures whether two factors are statistically different. Table 1 lists the standardized item loadings, the average variance extracted (AVE), composite reliability (CR) and Cronbach Alpha values. As shown in the table, most loadings are larger than 0.7 and T values indicate that all loadings are significant at 0.001. All AVEs exceed 0.5 and all CRs exceed 0.7. Thus the scale has a good convergent validity (Bagozzi & Yi, 1988; Gefen, Straub, & Boudreau, 2000). In addition, all Alpha values are larger than 0.7, demonstrating a good reliability (Nunnally, 1978).

Table 2 lists the square root of the AVE and factor correlation coefficients. As shown in the table, for each factor, the square root of the AVE is significantly larger than its correlation coefficients with other factors. Thus the scale has a good discriminant validity (Fornell & Larcker, 1981; Gefen et al., 2000).

Second, we employed structural equation modeling (SEM) LISREL8.72 to test the structural model. Table 3 lists path coefficients and their significance. Table 4 presents the recommended and actual values of some fit indices. Except GFI, the actual values of other fit indices are better than the recommended values. This shows a good fitness of the research model (Gefen et al., 2000). The explained variance of perceived usefulness, satisfaction and

Table 2
The square root of AVE (shown as bold at diagonal) and factor correlation coefficients.

	RNS	PC	PE	AF	PU	SAT	LOY
RNS	**0.885**						
PC	0.205	**0.789**					
PE	0.152	0.538	**0.743**				
AF	0.136	0.400	0.397	**0.744**			
PU	0.488	0.626	0.624	0.425	**0.786**		
SAT	0.269	0.599	0.615	0.371	0.646	**0.794**	
LOY	0.147	0.542	0.571	0.444	0.588	0.640	**0.797**

Table 3
Path coefficients and their significance.

Hypothesis	Path	Path coefficient	Supported or not
H1.1	RNS → PU	0.33**	Yes
H1.2	RNS → SAT	0.01	No
H2.1	PC → PU	0.28**	Yes
H2.2	PC → SAT	0.33**	Yes
H3.1	PE → PU	0.44***	Yes
H3.2	PE → SAT	0.34**	Yes
H4.1	AF → PU	0.13*	Yes
H4.2	AF → SAT	0.02	No
H5	RNS → PE	0.04	No
H6	PC → PE	0.55***	Yes
H7	PU → SAT	0.32**	Yes
H8	PU → LOY	0.44***	Yes
H9	SAT → LOY	0.33**	Yes

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

Table 1
Standardized item loadings, AVE, CR and Alpha values.

Factor	Item	Standardized item loading	AVE	CR	Alpha
Referent network size (RNS)	RNS1	0.865	0.78	0.88	0.88
	RNS2	0.904			
Perceived complementarity (PC)	PC1	0.806	0.62	0.83	0.83
	PC2	0.811			
	PC3	0.749			
Perceived enjoyment (PE)	PE1	0.719	0.55	0.83	0.83
	PE2	0.687			
	PE3	0.783			
	PE4	0.778			
Attention focus (AF)	AF1	0.752	0.55	0.83	0.83
	AF2	0.715			
	AF3	0.752			
	AF4	0.758			
Perceived usefulness (PU)	PU1	0.834	0.62	0.83	0.83
	PU2	0.793			
	PU3	0.728			
Satisfaction (SAT)	SAT1	0.715	0.63	0.84	0.83
	SAT2	0.862			
	SAT3	0.797			
Loyalty (LOY)	LOY1	0.714	0.63	0.84	0.83
	LOY2	0.864			
	LOY3	0.805			

Table 4
The recommended and actual values of fit indices.

Fit index	chi^2/df	GFI	AGFI	CFI	NFI	NNFI	RMSEA
Recommended value	<3	>0.90	>0.80	>0.90	>0.90	>0.90	<0.08
Actual value	1.99	0.864	0.822	0.970	0.943	0.965	0.067

Note: chi^2/df is the ratio between Chi-square and degrees of freedom, GFI is Goodness of Fit Index, AGFI is Adjusted Goodness of Fit Index, CFI is Comparative Fit Index, NFI is Normed Fit Index, NNFI is Non-Normed Fit Index, RMSEA is Root Mean Square Error of Approximation.

Table 5
A summary of results.

Factor	Statistically significant determinants (ordered by the effect)	Statistically insignificant determinants
Perceived usefulness	Perceived enjoyment, referent network size, perceived complementarity, attention focus	–
Satisfaction	Perceived enjoyment, perceived complementarity, perceived usefulness	Referent network size, attention focus
Perceived enjoyment	Perceived complementarity	Referent network size
Loyalty	Perceived usefulness, satisfaction	–

loyalty is 67.8%, 71% and 52.2%, respectively. Table 5 presents a summary of results.

5. Discussion

From Table 3, we can find that except H1.2, H4.2 and H5, other hypotheses are supported. Referent network size, perceived complementarity, perceived enjoyment and attention focus affect perceived usefulness. However, only perceived complementarity and perceived enjoyment affect satisfaction. In addition, perceived complementarity has a significant effect on perceived enjoyment. Perceived usefulness affects satisfaction, and both factors predict user loyalty.

Among the factors affecting perceived usefulness, perceived enjoyment has a relatively larger effect ($\beta = 0.44$). This result is consistent with previous findings (Ha et al., 2007) and indicates that users are very concerned with the enjoyment derived from using mobile IM. Compared to Internet IM, mobile IM enables users to maintain the "always online" status and interact with their peers at anytime from anywhere. Thus users can acquire much enjoyment from using mobile IM, which helps improve their working and living efficiency and effectiveness. Two factors of network externalities including referent network size and perceived complementarity also have significant effects on perceived usefulness. Users adopt mobile IM to interact with peers in their social circle. When most of these peers use a mobile IM platform, users must choose it to facilitate communications because mobile IM platforms have not realized interconnection. This also leads different mobile IM products to form their own user segmentation. For example, mobile MSN users are mainly white-collar workers or those often communicating with their foreign friends. In contrast, as a localized mobile IM platform, mobile QQ is mainly popular among young people, especially students. The results also indicate that mobile IM's ancillary functions (perceived complementarity) affect perceived usefulness. These ancillary services provide great convenience to users. They can enjoy rich services in a single platform and do not need to turn to other sites for additional services, such as music, game and video. Thus mobile service providers can provide alternative value-added services to users. For example, a special function of China Mobile Fetion is that when the other party is not online, text chat information can be sent to his/her mobile phone with free SMS. This ensures the real-time delivery of information and is a useful function for users. Attention focus has a relatively lower effect on perceived usefulness. Mobile service providers can improve their interface design and provide a clear and easy-to-use IM platform to users (Lee & Benbasat, 2004). This may alleviate users' cognitive burden and help them acquire immersion.

The results indicate that perceived enjoyment and perceived complementarity affect user satisfaction. Thus, mobile service providers need to deliver reliable and fast-response services to users because users always expect to conduct ubiquitous communications by using mobile IM (Junglas & Watson, 2006). If mobile IM is often unavailable or has a slow response, users' experience including perceived enjoyment may be negatively affected and their satisfaction will decrease. On the other hand, mobile service providers can present featured functions to users and improve their satisfaction. For example, mobile IM platforms can use mobile phone locatability to alert users when their friends are nearby (Junglas & Watson, 2008). This brings an impressive usage experience to users and may improve their satisfaction. However, some users may think that this service violates their privacy because it utilizes users' location information (Xu & Gupta, 2009; Xu, Teo, Tan, & Agarwal, 2009). Thus mobile service providers need to get users' permission before presenting this service to users. We did not find the direct effects of referent network size and attention focus on user satisfaction. However, both factors indirectly affect satisfaction through perceived usefulness. This shows the mediation effect of perceived usefulness.

We found that perceived complementarity has a significant effect on perceived enjoyment. This shows that there exists a significant correlation between network externalities and flow experience. Thus when mobile IM exerts positive network externality effects, users' experience can be improved. In fact, besides the basic text chat, mobile IM platforms also provide many value-added services such as games, music and avatar shows. These services bring much enjoyment to users. For example, mobile QQ as the most popular Chinese mobile IM platform has rich entertainment functions, such as games, music, pets and films. In comparison, mobile MSN has fewer entertainment functions. Thus mobile MSN can consider enriching its entertainment functions, thus enhancing user enjoyment.

Perceived usefulness affects satisfaction and both factors determine user loyalty. These results are roughly consistent with previous research findings (Bhattacherjee, 2001; Kim & Son, 2009). Compared to the effect of satisfaction, perceived usefulness has a relatively larger effect on loyalty. This shows that users are utilitarian. They are concerned whether mobile IM can improve their communication effectiveness and efficiency. Then they decide their continuance usage.

This research has some limitations. First, we conducted this research in China where mobile commerce is developing rapidly but is still in its early stage. Thus our results need to be generalized to other countries that have a developed mobile commerce. Second, flow is an elusive and broad concept (Hoffman & Novak, 2009). This research measured flow with two factors: perceived enjoyment

and attention focus. Future research can consider other components of flow experience such as perceived control, curiosity and interest. Third, we included perceived usefulness and satisfaction as the mediators between network externalities, flow experience and loyalty. There exist other possible mediators such as commitment and perceived value. Future research can explore their effects. Fourth, we mainly conducted a cross-sectional study. However, user behavior is dynamic. Thus a longitudinal research may provide more insights on user behavior development.

6. Theoretical and managerial implications

From a theoretical perspective, this research identified the significant effects of network externalities and flow experience on mobile IM user loyalty. Although network externalities have received a considerable attention in economics and traditional information systems (Dickinger et al., 2008), they have seldom been tested in the context of emerging mobile services such as mobile IM, which is an interactive communication tool owning a large number of users. Our results indicate that both factors of network externalities, including referent network size and perceived complementarity, affect mobile IM user loyalty through perceived usefulness and satisfaction. This enriches extant research on network externalities and advances our understanding of mobile user behavior. Future research can further examine network externalities in other contexts such as mobile mail. We found that flow experience composed of perceived enjoyment and attention focus has a significant effect on user loyalty. Especially, perceived enjoyment has strong effects on perceived usefulness and satisfaction, further determining loyalty. Thus acquiring enjoyment is critical to users' continuance usage of a mobile IM platform. This result is roughly consistent with Koufaris (2002)'s findings that reveal the effect of perceived enjoyment on online consumers' intention to return to a website. We also found that there exists a significant correlation between network externalities and flow experience. More specifically, perceived complementarity affects perceived enjoyment. Future research can further explore their correlation in other contexts.

From a managerial perspective, our results imply that mobile service providers need to take both network externalities and flow experience into consideration when encouraging users' loyalty towards mobile IM. In terms of network externalities, it is difficult for mobile service providers to control referent network size, but they can affect perceived complementarity by providing ancillary functions to users. With respect to flow experience, we found that perceived enjoyment has a strong indirect effect on user loyalty through perceived usefulness and satisfaction. Considering the limitations of mobile terminals such as small screens and inconvenient input, mobile service providers need to improve their interface design and bring an engaging usage experience to users (Lee & Benbasat, 2004). In addition, whether users can conduct ubiquitous communications with their peers through mobile IM may also affect their enjoyment (Lee, 2005). Hence mobile service providers need to deliver reliable services and prompt responses to users. The results also show that perceived complementarity significantly affects perceived enjoyment. This indicates that mobile service providers can increase their IM platform's entertainment functions such as games, music and video to present users with an enjoyable experience.

7. Conclusion

Due to its advantages such as ubiquity and immediacy, mobile IM has acquired users' wide adoption. However, because of the intense competition and low switching cost, building users' loyalty and retaining them is vital to mobile service providers. Integrating both perspectives of network externalities and flow experience, this research identified the factors affecting mobile IM user loyalty. The results show that network externalities and flow experience have significant effects on perceived usefulness and satisfaction, both of which predict user loyalty. Thus, mobile service providers need to enhance their IM platforms, delivering positive network externalities and good usage experience to users. This will enable users to acquire expected utility from using mobile IM services and improve their satisfaction. Then they may develop their loyalty towards mobile IM, which means customer retention for mobile service providers. Nevertheless, our results need to be interpreted with caution as most of our subjects are students. Although they represent a major group of mobile Internet users, future research needs to generalize our results to other samples, such as working professionals.

Acknowledgements

This work was partially supported by a grant from the National Natural Science Foundation of China (71001030, 70971049, 71061160505), a grant from the Humanities and Social Sciences Foundation of the Ministry of Education (09YJC630052), a grant from the China Postdoctoral Science Foundation (201003478), and a grant from the Zhejiang Provincial Social Science Foundation (10CGJJ05YBQ).

Appendix A. Measurement items and their sources

Referent network size (RNS) (adapted from Lin and Bhattacherjee (2008))

- RNS1: Most of my friends are using this mobile IM.
- RNS2: Most of my classmates (colleagues) are using this mobile IM.

Perceived complementarity (PC) (adapted from Lin and Bhattacherjee (2008))

- PC1: A wide range of games is available on this mobile IM.
- PC2: A wide range of images, skins and emotional icons is available on this mobile IM.
- PC3: A wide range of support tools (such as photograph sharing and file transference) is available on this mobile IM.

Perceived enjoyment (PE) (adapted from Koufaris (2002))

- PE1: I feel that using this mobile IM is fun.
- PE2: I feel that using this mobile IM is exciting.
- PE3: I feel that using this mobile IM is enjoyable.
- PE4: I feel that using this mobile IM is interesting.

Attention focus (AF) (adapted from Koufaris (2002))

- AF1: When using this mobile IM, I was absorbed intensely in the activity.
- AF2: When using this mobile IM, my attention was focused on the activity.
- AF3: When using this mobile IM, I concentrated fully on the activity.
- AF4: When using this mobile IM, I was deeply engrossed in the activity.

Perceived usefulness (PU) (adapted from Koufaris (2002))

- PU1: Using this mobile IM can improve my living and working quality.

- PU2: Using this mobile IM can improve my living and working efficiency.
- PU3: This mobile IM is useful to my living and working.

Satisfaction (SAT) (adapted from Spreng et al. (1996))

- SAT1: I am satisfied with using this mobile IM.
- SAT2: I am contented with using this mobile IM.
- SAT3: I am pleased with using this mobile IM.

Loyalty (LOY) (adapted from Gefen (2002))

- LOY1: I will continue using this mobile IM.
- LOY2: I will recommend this mobile IM to others.
- LOY3: I will consider this mobile IM as my first choice when conducting mobile chat.

References

Agarwal, R., & Karahanna, E. (2000). Time flies when you are having fun: Cognitive absorption and beliefs about information technology usage. *MIS Quarterly, 24*(4), 665–694.

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological bulletin, 103*(3), 411–423.

Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science, 16*(1), 74–94.

Bhattacherjee, A. (2001). Understanding information systems continuance: An expectation-confirmation model. *MIS Quarterly, 25*(3), 351–370.

CNNIC. 26th Statistical survey report on the internet development in China, China Internet Network Information Center. (2010). <http://www.cnnic.cn>.

Csikszentmihalyi, M., & Csikszentmihalyi, I. S. (1988). *Optimal experience: Psychological studies of flow in consciousness*. Cambridge: Cambridge University Press.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1992). Extrinsic and intrinsic motivation to use computers in the workplace. *Journal of Applied Social Psychology, 22*(14), 1111–1132.

Deng, L., Turner, D. E., Gehling, R., & Prince, B. (2010). User experience, satisfaction, and continual usage intention of IT. *European Journal of Information Systems, 19*(1), 60–75.

Dickinger, A., Arami, M., & Meyer, D. (2008). The role of perceived enjoyment and social norm in the adoption of technology with network externalities. *European Journal of Information Systems, 17*(1), 4–11.

Finneran, C. M., & Zhang, P. (2005). Flow in computer-mediated environments: Promises and challenges. *Communications of the Association for Information Systems, 15*, 82–101.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39–50.

Gefen, D. (2002). Customer loyalty in e-commerce. *Journal of the AIS, 3*, 27–51.

Gefen, D., Straub, D. W., & Boudreau, M. C. (2000). Structural equation modeling and regression: Guidelines for research practice. *Communications of the Association for Information Systems, 4*(7), 1–70.

Guo, Y. M., & Klein, B. D. (2009). Beyond the test of the four channel model of flow in the context of online shopping. *Communications of the AIS, 24*(1), 837–856.

Guo, Y. M., & Poole, M. S. (2009). Antecedents of flow in online shopping: A test of alternative models. *Information Systems Journal, 19*(4), 369–390.

Ha, I., Yoon, Y., & Choi, M. (2007). Determinants of adoption of mobile games under mobile broadband wireless access environment. *Information and Management, 44*(3), 276–286.

Hausman, A. V., & Siekpe, J. S. (2009). The effect of web interface features on consumer online purchase intentions. *Journal of Business Research, 62*(1), 5–13.

Ho, L.-A., & Kuo, T.-H. (2010). How can one amplify the effect of e-learning? An examination of high-tech employees' computer attitude and flow experience. *Computers in Human Behavior, 26*(1), 23–31.

Hoffman, D. L., & Novak, T. P. (1996). Marketing in hypermedia computer-mediated environments: Conceptual foundations. *Journal of Marketing, 60*(3), 50–68.

Hoffman, D. L., & Novak, T. P. (2009). Flow online: Lessons learned and future prospects. *Journal of Interactive Marketing, 23*(1), 23–34.

Jung, Y., Perez-Mira, B., & Wiley-Patton, S. (2009). Consumer adoption of mobile TV: Examining psychological flow and media content. *Computers in Human Behavior, 25*(1), 123–129.

Junglas, I. A., & Watson, R. T. (2006). The u-constructs: Four information drives. *Communications of the AIS, 17*(4), 569–592.

Junglas, I. A., & Watson, R. T. (2008). Location-based services. *Communications of the ACM, 51*(3), 65–69.

Kamis, A., Stern, T., & Ladik, D. M. (2010). A flow-based model of web site intentions when users customize products in business-to-consumer electronic commerce. *Information Systems Frontier, 12*(2), 157–168.

Katz, M. L., & Shapiro, C. (1985). Network externalities, competition, and compatibility. *American Economic Review, 75*(3), 424–440.

Kim, S. S., & Son, J.-Y. (2009). Out of dedication or constraint? A dual model of post-adoption phenomena and its empirical test in the context of online services. *MIS Quarterly, 33*(1), 49–70.

Koufaris, M. (2002). Applying the technology acceptance model and flow theory to online consumer behavior. *Information Systems Research, 13*(2), 205–223.

Kuo, Y.-F., Wu, C.-M., & Deng, W.-J. (2009). The relationships among service quality, perceived value, customer satisfaction, and post-purchase intention in mobile value-added services. *Computers in Human Behavior, 25*(4), 887–896.

Lee, K. C., Kang, I. W., & McKnight, D. H. (2007). Transfer from offline trust to key online perceptions: An empirical study. *IEEE Transactions on Engineering Management, 54*(4), 729–741.

Lee, T. (2005). The impact of perceptions of interactivity on customer trust and transaction intentions in mobile commerce. *Journal of Electronic Commerce Research, 6*(3), 165–180.

Lee, Y. E., & Benbasat, I. (2004). A framework for the study of customer interface design for mobile commerce. *International Journal of Electronic Commerce, 8*(3), 79–102.

Li, D., Chau, P. Y. K., & Slyke, C. V. (2010). A comparative study of individual acceptance of instant messaging in the US and China: A structural equation modeling approach. *Communications of the Association for Information Systems, 26*, 85–106.

Lin, C.-P., & Bhattacherjee, A. (2008). Elucidating individual intention to use interactive information technologies: The role of network externalities. *International Journal of Electronic Commerce, 13*(1), 85–108.

Lu, Y., Deng, Z., & Wang, B. (2010). Exploring factors affecting Chinese consumers' usage of short message service for personal communication. *Information Systems Journal, 20*(2), 183–208.

Lu, Y., Zhou, T., & Wang, B. (2009). Exploring Chinese users' acceptance of instant messaging using the theory of planned behavior, the technology acceptance model, and the flow theory. *Computers in Human Behavior, 25*(1), 29–39.

Malhotra, N. K., Kim, S. S., & Patil, A. (2006). Common method variance in IS research: A comparison of alternative approaches and a reanalysis of past research. *Management Science, 52*(12), 1865–1883.

Novak, T. P., Hoffman, D. L., & Yung, Y.-F. (2000). Measuring the customer experience in online environments: A structural modeling approach. *Marketing Science, 19*(1), 22–42.

Nunnally, J. C. (1978). *Psychometric theory*. New York: McGraw-Hill.

PewInternet. *Mobile Access.* (2010). <http://pewinternet.org/Reports/2010/Mobile-Access-2010.aspx>.

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88*(5), 879–903.

Spreng, R. A., MacKenzie, S. B., & Olshavsky, R. W. (1996). A reexamination of the determinants of consumer satisfaction. *Journal of Marketing, 60*(3), 15–32.

Strader, T. J., Ramaswami, S. N., & Houle, P. A. (2007). Perceived network externalities and communication technology acceptance. *European Journal of Information Systems, 16*(1), 54–65.

Straub, D., Boudreau, M.-C., & Gefen, D. (2004). Validation guidelines for IS positivist research. *Communications of the AIS, 13*, 380–427.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science, 46*(2), 186–204.

Wang, C. C., Hsu, Y., & Fang, W. (2004). Acceptance of technology with network externalities: An empirical study of Internet instant messaging services. *Journal of Information Technology Theory and Application, 6*(4), 15–28.

Xu, H., & Gupta, S. (2009). The effects of privacy concerns and personal innovativeness on potential and experienced customers' adoption of location-based services. *Electronic Markets, 19*(2–3), 137–149.

Xu, H., Teo, H.-H., Tan, B. C. Y., & Agarwal, R. (2009). The role of push–pull technology in privacy calculus: The case of location-based services. *Journal of Management Information Systems, 26*(3), 135–173.

Zaman, M., Anandarajan, M., & Dai, Q. (2010). Experiencing flow with instant messaging and its facilitating role on creative behaviors. *Computers in Human Behavior, 26*(5), 1009–1018.