Understanding the Role of Individual Perception on Mobile Payment: Moderating or Mediating

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Abstract—As mobile payment is rapidly introduced and popularized around the world, user intention is of vital importance to service providers to win customers for such new technology. Our research focuses on understanding the role of individual perception on the relationship between individual innovativeness and user intention. In our paper individual perception includes three aspects: perceived usefulness, perceived ease of use and perceived risk. We empirically examine both moderating model and mediating model and find that different aspects of individual perception play different roles between individual innovativeness and user intention. The result shows that perceived usefulness and perceived ease of use are mediators while perceived risk is a moderator. More surprisingly, we also find that social influence has a positive effect on the individual innovativeness.

Index Terms—mobile payment, individual innovativeness, individual perception, moderator, mediator

I. INTRODUCTION

With the rapid growth of the number of people who use mobile phones and the development of the wireless internet technology, mobile payment has entered consumers’ daily lives. According to a report issued by China Internet Network Information Center, the number of mobile internet users reaches 464 million in 2013, which accounts for 78.5% of the country’s total internet users of 591 million [1]. Another data from iResearch shows that the number of people who use smart-phones had reached 320 million in 2012, which is 28.7% of its phone users. The same report predicts that this number will be more than 50% [2] in 2016. Along with the growing population of the smart phone users and the upgrading of wireless internet, the number of mobile internet users will keep increasing rapidly in the coming years and thus stimulates the development of mobile services such as mobile payment in China. Mobile payments are payments for goods, services, and bills with a mobile device (such as a mobile phone, smart-phone, or personal digital assistant) by taking advantage of wireless and other communication technologies. The trading volume of the mobile payment market in China had reached 151.4 billion in 2012, and will break 1 trillion in 2016 [2]. As in China mobile payment is still a new technology, it has a lot of potential. Attracted by this huge market, providers have already launched a variety of services of mobile payment. Given that there are substantial risks facing the mobile payment users, the user intention and adoption are critically important for the service providers to promote their services and to achieve competitiveness. Therefore, a deeper understanding on the factors affecting user intention and adoption of mobile payment services is needed.

In prior work in the information systems field toward technology acceptance, instrumental beliefs such as perceive usefulness, perceived ease of use and perceived risk have been seen as the key factors which drive user intention [3], [4]. Research from behavioral sciences and individual psychology indicates that social influences and individual innovativeness are also important factors affecting user intention [5]-[9]. However, it is not entirely clear yet how these factors have impacts on mobile payment services, which we consider a highly risky innovation in the context of traditional Chinese consumers. Therefore, we inform our research by the commonly accepted innovation diffusion theory.

According to the innovation diffusion theory [10], individual innovativeness is a personal trait which exists before individuals are exposed to an innovation and will have an effect on user intention, and different individuals have different levels of innovativeness. Facing a new technology, individuals will have perceptions on the technology based on their beliefs and external stimuli, and the perceptions are distinguished among individuals. In the present research, individual perception includes three aspects: perceived usefulness, perceived ease of use and perceived risk. Some research has shown that each of these three factors has a significant relationship with user intention [11], [12]. Empirical studies also find that social influence and individual innovativeness have an effect on the individual perception [4], [13]. But the roles of these factors in affecting user intention in mobile payment services still need further examination.

In terms of adoption of mobile payment, most potential consumers do not have substantial prior knowledge and experience to help them establish clear perception toward this new technology. In our research, we examine both of the moderating and mediating models to understand the role of individual perception on the relationship between individual innovativeness and user intention. If individual perception is showed to be a significant moderator, it means that the effect of individual innovativeness on user
intention depended on individual perception. Thus, we can suggest that the formation of the perception is more related with the influence from external environment, not much related with self-innovativeness, cultivating and improving the perception is still important to people who even have the high level of innovativeness. If individual perception is a significant mediator, it means that individual innovativeness has an effect on user intention through individual perception. Thus, we can propose that individual innovativeness is an important factor affecting the formation of perception about mobile payment, and the personal characteristic of innovation is the main source of the perception.

People are generally in social situations. Social influence plays an important role in individual behavioral intention. People will change some innate characteristics such as innovativeness when they communicate and interact with other people in social environments. In the present research, we empirically examine the implications of such proposition.

The rest of the paper is organized into four sections as follows. In Section 2, we present the literature review and hypotheses, and then propose the conceptual model. In Section 3, we describe the methodology and present the results of the empirical analysis Discussion and conclusions are presented in Section 4. Finally, Section 5 presents limitations and future research.

II. LITERATURE REVIEW AND HYPOTHESIS

A. Individual Innovativeness

In general research about individual innovativeness, it has been considered that Individual has high level of innovativeness are more active in seeking new idea. They are risk-seeker and have more positive intention toward new technology [14], [15]. Ref. [5] suggests that different people develop different beliefs or perceptions about new information technology, and individual innovativeness moderated the relationship between individual perceptions and user intention. Recent studies have thought that individual innovativeness plays an important role in determining the user intention of IT technology, and find that individual innovativeness has a positive effect on the user intention [16]-[19]. Thus, we empirically test that:

H1: Individual innovativeness has a positive effect on user intention.

B. Individual Perception

Technology acceptance model and its extensions [3], [13], [20] are perhaps most widely used models to examine the user acceptance of technology. The model has two main constructs: perceived usefulness (PU), the degree to which a person believes that using this system will enhance his or her work performance, and perceived ease of use (PEOU) the degree to which a person believes that using this system will be free of effort. Ref. [11] examined that perceived usefulness and perceived ease of use toward Enterprise Resource Planning have significant positive effect on user intention. Ref. [21] suggested that perceived usefulness has significant positive effect on use attitude. Ref. [22] suggested that perceived ease of use has significant positive effect on use attitude. And some studies have shown that individual innovativeness has a positives effect on these two perceptions [4], [7].

As we focus on mobile payment, which for most people in China is a new technology and have not used before, and majority of people in China are averse to risk which is influenced by traditional culture, we put perceived risk into the individual perception. Perceived risk has been used as an important factor to examine consumers’ behavior in making the decision since 1960s [23]. Users perceive potential risks from the immature system and technology, such as the security of the account and privacy information. These potential risks will make the individual has less desire on using mobile payment. The individual with high innovativeness are more willing to take the risk, and using new technology is easier to high innovativeness individual. Empirical research have examined that individual innovativeness has a negative effect on perceived risk [8], [19].

As we have mentioned in the introduction, when consumers consider whether to adopt a new technology, they may not have enough knowledge to build clear perception about it. In our research, we integrated these three perceptions to understand the role of individual perception between individual innovativeness and user intention. Thus, we propose:

H2: Individual perception moderated the relationship between the individual innovativeness and user intention.

H3: Individual perception mediated the relationship between the individual innovativeness and user intention.

C. Social Influence

Recent researches have pay attention on social influence. Unified theory of acceptance and use of technology (UTAUT) model is recognized social influence as one of the determinants of users’ behavioral intention to adopt a new technology [6]. Social influences have been regarded as a critical factor in the study of users’ behavioral intention. In our research, we define social influence as individuals’ perceived pressures from other people in social networks on adoption or innovation. Individual innate innovativeness will be changing when they communicate and interact with other people in social network. If a person in a social environment which people more prefer to choose new things, he or she will have a higher level of individual innovation. Ref. [24] argued that interpersonal influence has an effect on consumer innovativeness. Consistent with the literature, we test the following hypothesis:

H4: Social influence has a positive effect on individual innovativeness.

Fig. 1 shows our research model with both the moderating and mediating formulations.
convergent validity is indicated in Table II. As all item loadings are higher than 0.7 and significant at 0.001 which can be concluded by the T value. The values of average variance extracted (AVE) of all items are larger than 0.6 and the values of composite reliability (CR) of all items are higher than 0.8, which means that the questionnaire has a good convergent validity. In addition, the last column in Table II shows that the values of Cronbach’s Alpha of all items are higher than 0.8, indicating a good reliability.

**TABLE II. STANDARDIZED ITEM LOADING, AVE, CR AND CRONBACH’S ALPHA VALUE**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Item</th>
<th>Standardized item loading</th>
<th>AVE</th>
<th>CR</th>
<th>Cronbach’s Alpha value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived usefulness</td>
<td>PU1</td>
<td>0.824</td>
<td>0.6</td>
<td>0.8</td>
<td>0.45</td>
</tr>
<tr>
<td></td>
<td>PU2</td>
<td>0.800</td>
<td>0.45</td>
<td>0.8</td>
<td>0.45</td>
</tr>
<tr>
<td></td>
<td>PU3</td>
<td>0.785</td>
<td>0.785</td>
<td>0.8</td>
<td>0.45</td>
</tr>
<tr>
<td>Perceived ease of use</td>
<td>PEOU1</td>
<td>0.826</td>
<td>0.7</td>
<td>0.8</td>
<td>0.32</td>
</tr>
<tr>
<td></td>
<td>PEOU2</td>
<td>0.862</td>
<td>0.32</td>
<td>0.8</td>
<td>0.32</td>
</tr>
<tr>
<td>Perceived Risk</td>
<td>Risk1</td>
<td>0.987</td>
<td>0.7</td>
<td>0.8</td>
<td>0.43</td>
</tr>
<tr>
<td></td>
<td>Risk2</td>
<td>0.703</td>
<td>0.43</td>
<td>0.8</td>
<td>0.43</td>
</tr>
<tr>
<td>Individual innovativeness</td>
<td>Indi1</td>
<td>0.807</td>
<td>0.6</td>
<td>0.8</td>
<td>0.33</td>
</tr>
<tr>
<td></td>
<td>Indi2</td>
<td>0.785</td>
<td>0.6</td>
<td>0.8</td>
<td>0.33</td>
</tr>
<tr>
<td></td>
<td>Indi3</td>
<td>0.778</td>
<td>0.33</td>
<td>0.8</td>
<td>0.33</td>
</tr>
<tr>
<td>Social influence</td>
<td>Social1</td>
<td>0.884</td>
<td>0.6</td>
<td>0.8</td>
<td>0.48</td>
</tr>
<tr>
<td></td>
<td>Social2</td>
<td>0.808</td>
<td>0.48</td>
<td>0.8</td>
<td>0.48</td>
</tr>
<tr>
<td></td>
<td>Social3</td>
<td>0.722</td>
<td>0.48</td>
<td>0.8</td>
<td>0.48</td>
</tr>
<tr>
<td>User intention</td>
<td>Intention 1</td>
<td>0.869</td>
<td>0.8</td>
<td>0.23</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intention 2</td>
<td>0.803</td>
<td>0.23</td>
<td>0.8</td>
<td>0.23</td>
</tr>
</tbody>
</table>

Note: AVE=average variance extracted; CR=composite reliability.

**TABLE III. THE SQUARE ROOTS OF AVE (BOLD AT DIAGONAL) AND FACTORS CORRELATION COEFFICIENTS**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Item</th>
<th>Standardized item loading</th>
<th>AVE</th>
<th>CR</th>
<th>Cronbach’s Alpha value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PU</td>
<td>PU</td>
<td>0.803</td>
<td>0.803</td>
<td>0.803</td>
<td>0.803</td>
</tr>
<tr>
<td>Perceived ease of use</td>
<td>PEOU</td>
<td>0.844</td>
<td>0.844</td>
<td>0.844</td>
<td>0.844</td>
</tr>
<tr>
<td>Social influence</td>
<td>Social1</td>
<td>0.807</td>
<td>0.807</td>
<td>0.807</td>
<td>0.807</td>
</tr>
<tr>
<td></td>
<td>Social2</td>
<td>0.807</td>
<td>0.807</td>
<td>0.807</td>
<td>0.807</td>
</tr>
<tr>
<td></td>
<td>Social3</td>
<td>0.807</td>
<td>0.807</td>
<td>0.807</td>
<td>0.807</td>
</tr>
<tr>
<td>User intention</td>
<td>Intention 1</td>
<td>0.869</td>
<td>0.869</td>
<td>0.869</td>
<td>0.869</td>
</tr>
<tr>
<td></td>
<td>Intention 2</td>
<td>0.803</td>
<td>0.803</td>
<td>0.803</td>
<td>0.803</td>
</tr>
</tbody>
</table>

Note: AVE=average variance extracted; PU=perceived usefulness; PEOU=perceived ease of use; SL=social influence; Indi= individual innovativeness; PR= perceived risk; UI=user intention

For the discriminate validity, we compared factor correlation coefficients and the square root of each factor’s AVE. Table III shows that all factors have sufficient discriminate validity as the square root of each factor’s AVE is significantly higher than its correlation coefficients with other factors. So we can conclude that both the reliability and validity of the questionnaire are good. The value of fit indices (GFI=0.920, AGFI=0.872, CFI=0.944, NFI=0.921, NNFI=0.921, RMSEA=0.075) of confirmatory factor analysis are better than the recommended values and this means a good fitness for our model.

Next, we examined the hypotheses of two models. First, we analyzed interaction effects of individual perception for hypothesis 2. Then we followed the
method from [26], [27] to test hypothesis 3. Table IV shows the results.

<table>
<thead>
<tr>
<th>TABLE IV. RESULTS OF MODELS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderating model</td>
</tr>
<tr>
<td>Path</td>
</tr>
<tr>
<td>PU→Indi</td>
</tr>
<tr>
<td>PEOU→UI</td>
</tr>
<tr>
<td>PR→UI</td>
</tr>
<tr>
<td>SI→Indi</td>
</tr>
</tbody>
</table>

Note: *, significant at p<0.05; **, significant at p<0.01;***, significant at p<0.001;

For the moderating model, we can find that interaction effects of PU×Indi and PEOU×Indi have insignificant effect on user intention; therefore we can consider that perceived usefulness and perceived ease of use are not moderator of the relationship between individual innovativeness and user intention. But the interaction effect of PR×Indi has significant negative effect on user intention at the 0.01 level, and perceived risk has no direct effect on user intention, so we can believe that perceived risk is a pure moderator between individual innovativeness and user intention. Thus, hypothesis 2 is partly supported.

For the mediating model, following the method from [26], [27], the following four conditions must meet to build partial mediation: 1) Independent variable has a significant effect on the dependent variable. 2) Independent variable has a significant effect on the presumed mediator. 3) Presumed mediator has a significant effect on the dependent variable. 4) Both independent variable and presumed mediator have a significant effect on the dependent variable. When these four conditions are met, it is a partial mediator. According to these, we can find that from above Table IV that perceived usefulness and perceived ease of use are both partial mediators. Perceived risk has insignificant effect on user intention, thus perceived risk is not a mediator. Hypothesis 3 is also partly supported. Individual innovativeness has a significant positive effect on user intention, thus support hypothesis 1. Last row in Table IV shows that social influence has a significant positive effect on the individual innovativeness, support hypothesis 4. Here is an interesting finding from the mediating model: individual innovativeness has a positive effect on perceived risk at the 0.001 level, which is just the opposite to our hypothesis in the literature review.

IV. DISCUSSION AND CONCLUSIONS

We empirically examined two models, the moderating model and the mediating model, to understand the role of individual perception on the relationship between individual innovativeness and user intention in mobile payment services. The research result shows that perceived usefulness and perceived ease of use are mediators while perceived risk is a moderator.

In terms of perceived usefulness and perceived ease of use, we can find that individual innovativeness has an effect on user intention through these two perceptions. It means that the personal characteristic of innovation is the main source of the perception when a potential consumer considers mobile payment services. Individual innovativeness is an important factor affecting the formation of these two perceptions about mobile payment.

In terms of perceived risk, however, we can find that the level of perceived risk affects the relationship between individual innovativeness and user intention. The higher the degree of perceived risk, the less is the effect of individual innovativeness on user intention on mobile payment. Therefore, we can conclude that the formation of perceived risk is more related with the influence from external environment, and that it has less to do with with self-innovativeness.

Additionally, social influence has a significant positive effect on individual innovativeness, supporting our hypothesis 4. This result shows that the social network positively affects the individuals’ innate innovativeness. Individuals enhance their innate innovativeness through the influence from their social networks.

One interesting result has been found when we examined the mediating model is that individual innovativeness has a significant positive effect on perceived risk, which is just the opposite from what we have in the literature. Here we give two possible explanations. First, for the individuals who have high levels of innovativeness, it will be easier to find substitute technology than those who have low levels of innovativeness. As we mentioned, mobile payment is still a new technology for Chinese consumers and most of them are risk-averse, so the individuals who have high levels of innovativeness are more likely to find the substitute technology which is more familiar and safer to them. Second, individuals might have already known their own characteristics of innovation when they completed the questionnaire. Therefore, they consisted with this identity and noted that mobile payment is a highly risky technology for those who have low levels of innovativeness, as these people are very sensitive to risk. Thus, individual innovativeness has a positive effect on user intention.

V. LIMITATIONS AND FUTURE RESEARCH

There several limitations in our research. First, in Table II, the items for all factors showed an acceptable level of reliability and convergent validity, however, several items (PEOU 3, PR 2, UI 3) have been dropped because of the low level of item loading for reliability.
Second, the data was collected in a university in China, thus the generalization of the results may be limited.

For the further research, there are several possible implications. First, individual perception has other components, such as perceived enjoyment and perceived compatibility. These factors are also important perceptions which may affect user intention, but the roles and formations of them have yet to be examined. Second, other social influence such as culture should be considered in future research, which we consider the next step in our research program. Third, we only consider the relationship between social influence and individual innovativeness, but from other perspectives of social influence such as institutional perspective, social influence may have richer effects on individual perception.

APPENDIX A QUESTIONNAIRE

Perceive usefulness [7]:
1) Mobile payment enables me to conduct payment quickly.
2) Mobile payment enables me to conduct transactions conveniently
3) I feel that mobile payment is useful.

Perceive ease of use [7]:
1) Learning to use mobile payment is easy for me.
2) Skillfully using mobile payment is easy for me.
3) Overall, mobile payment is easy to use (dropped).

Perceived risk [8]:
1) When I use mobile payment to send some private information, I feel unsafe.
2) When I use mobile payment, I worry about the safety of my account (dropped).
3) When I lose my mobile device, my account will be in dangerous.

Social influence [4]:
1) People who influence my behavior think I should use mobile payment.
2) Adopting mobile payment will give me a positive feeling in my social circle.
3) In my social circle, adopting mobile payment will give me a sense of status.

Individual innovativeness [7]:
1) If I know a new technology, I will try to use it.
2) In my social circle, I always try the one who first use a new technology.
3) Even if using a technology will cost some money, I would like to try it.

User intention [4]:
1) If I have the chance, I will adopt mobile payment.
2) I have a positive attitude toward mobile payment.
3) I intend to adopt mobile payment in the future (dropped).

REFERENCES


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