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Analysis of Consumers' Innovation Resistance Behavior to Facial Recognition Payment: An Empirical Investigation

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Full Research Paper**Analysis of Consumers' Innovation Resistance Behavior to Facial****Recognition Payment: An Empirical Investigation***Min Zhang¹, Luyao Wang², Yimin Zou³, Weiwei Yan^{4*}*¹School of Information Management, Wuhan University, Wuhan, 430072, China²School of Information Management, Wuhan University, Wuhan, 430072, China³School of Economics and Management, Zhejiang Normal University, Zhejiang, 321004, China⁴School of Information Management, Wuhan University, Wuhan, 430072, China

Abstract: Systematically combing and deeply understanding users' innovation resistance behavior of facial recognition payment is of positive significance to the product innovation and customer relationship management of service providers. Through integrating innovation resistance theory, privacy calculus theory, and Antecedents-Privacy Concerns-Outcomes model, this article proposed a research model. Research data (N=494) is collected by questionnaire and hypotheses were analyzed by structural equation modeling. The results show that facial privacy concerns positively influence perceived payment risks and negatively influence perceived payment benefits in three behaviors. Additionally, perceived payment risks positively influence opposition and rejection, while perceived payment benefits negatively influence postponement and opposition. As for the moderation effect, gender and platform trust are successively tested throughout the process, and the effect is various in different resistance behaviors.

Keywords: Innovation resistance behavior; Information privacy; Facial recognition payment; Structural equation modeling

1. INTRODUCTION

With the popularity of intelligent mobile terminals and the maturity of information technology, the mobile payment services provided by banking and non-banking financial institutions are gradually integrated into people's daily life. Simultaneously, facial recognition payment (FRP), which has been considered as an outstanding innovative science and technology in the field of mobile payment, has attracted the attention of industries. In short, FRP is based on facial recognition technology and captures human images and compares them with previously recorded images in a database ^[1]. The unique facial features are conveniently captured compared to traditional payment methods.

Just as a coin has two sides, most innovative technologies have their advanced side and worrying side. The facial information required for FRP is closely related to individuals' biological characteristics, which is more sensitive to privacy compared to name, signature, phone number, and residential address ^[2]. Therefore, FRP not only brings convenience for consumers, but also causes concerns about information privacy. In practice, the damage caused by the leakage or abuse of face information is more serious than ordinary personal information ^[2].

At present, the application of FRP ought to be explored while related researches are still in the development stage. Generally, existing researches can be divided into four categories: Firstly, researches on the supervision and governance of FRP. The regulations and regulatory agencies in different countries are different, and the corresponding supervisory standards need to be improved with the application of technology. Secondly, researches on the related technologies of FRP. Some scholars have explored innovative solutions to optimize the security and efficiency of FRP, while standardized facial recognition technology and system application mode still need to be further explored ^[2]. Thirdly, researches exploring users' FRP behavioral characteristics by qualitative research

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methods. For instance, Zhong et al.^[3] revealed that perceived enjoyment, facilitating conditions, personal innovativeness, coupon availability, perceived ease of use, perceived usefulness, and users' attitude positively influence consumers to use FRP. Besides, scholars often adopted models from information system, such as TAM, UATAM and other models^[3, 4]. Fourthly, researches on the privacy of face information. The commonly used theories are trust theory, privacy computing theory, privacy paradox, and information boundary theory. From the perspective of information, ethics, and behaviors, researches contain qualitative researches on privacy characteristics and privacy protection, and quantitative researches on influencing factors of privacy concerns, privacy trust, privacy leakage^[5, 6]. In summary, the first and the second category of research are becoming more and more saturated, with the continuous maturity of technology and the gradual improvement of regulatory policy system. On the other hand, the third category of research and the fourth category of research are becoming more and more important, with the continuous promotion of industrial application to the depth and breadth. Nowadays, consumers generally show varying degrees of concern, and some consumers have taken innovation resistance behavior.

Through the literature review, we found two research gaps that need to pay more attention. Firstly, innovation resistance is a resistance behavior continuously from positive or habitual resistance to active resistance behavior, and contains three forms of postponement, opposition, and rejection^[7]. There are few empirical studies on the above three subcategories of consumers' innovation resistance behavior to FRP. Secondly, previous studies have demonstrated that gender and platform trust significantly influence consumers' intention when online purchase, mobile payment, and information privacy, but their roles on FRP have not explored. Therefore, two research questions (RQs) were proposed:

RQ1: what are the influencing factors of three forms of consumers' innovation resistance behavior of FRP?

RQ2: How does the moderation effect of gender and platform trust affect consumers' innovation resistance behavior of FRP?

To solve the RQs above, this research is tested by the Structural Equation Modelling (SEM) method, which is beneficial to the relations of variables and the statistical significance. The moderation effect of gender and platform trust is also explored. Innovation resistance theory, privacy calculus theory (PCT), and Antecedents-Privacy Concerns-Outcomes model (APCO) are applied, which contribute to reveal individuals' decisions about privacy disclosure and factors to affect privacy concerns.

The remainder is organized as follows. The next section presents the theoretical background. Then, section 3 introduces the theoretical hypothesis, and section 4 describes the research methodology and data analysis. Afterward, section 5 discusses the results and gives some discussions and implications. Finally, section 6 describes limitations and future research directions.

2. THEORETICAL BACKGROUND

2.1 Innovation Resistance Theory

Innovation resistance is the natural response of consumers to the change of status quo caused by innovative technology^[7]. From the perspective of adoption behavior, innovation resistance behavior includes three types, namely postponement, opposition, and rejection. Among the three dimensions, rejection adoption is the strongest resistance. Postponement means that consumers prefer to wait for the development of innovation and delay using the products or services, even if consumers can accept current innovation. Opposition indicates that consumers are persuaded that the innovative product is unsuitable, which leads to attacking the innovative product by creating negative word of mouth. Rejection shows that consumers do not adopt innovative products or services, and consumers' natural conservatism will impact the rejection. With the development of the conception of innovation resistance, scholars have gradually understood the influencing factors of innovation resistance, such as

environmental factors, technical reliability, consumer openness, perceived usefulness, perceived risk, perceived benefits [4, 8].

2.2 Antecedents-Privacy Concerns-Outcomes (APCO) model

The APCO (antecedents-privacy concerns-outcomes) model integrated the Information Boundary Theory (IBT) and previous research results of privacy. The APCO model is constructed as an integrated organism, and indicated that the comprehensive consideration of antecedents and outcomes of privacy concerns could effectively enhance the value of empirical researches on information privacy. This model summarized five antecedents that affect privacy concerns, namely privacy experience, privacy awareness, personality differences, demographic differences, and culture/climate. Meanwhile, taking privacy concerns as independent variables, the outcomes of privacy concerns are summarized and extracted, such as behavioral response, perceived risk, perceived benefits. The APCO model also includes the conception of privacy calculus—a cognitive analysis used by individuals to determine their behavioral reaction by risk and benefit [9].

2.3 Privacy calculus theory (PCT)

Privacy Calculus Theory (PCT) was first put forward by Culnan and Armstrong^[9]. PCT regarded the individual's decision-making behavior on privacy disclosure as a kind of computing behavior, and explains why individuals participate in information-sharing behaviors despite the privacy concerns. In the process of trade-off, negative consequences are rationally weighed against goals and possible outcomes, aiming to maximize benefits and minimize the risks of information disclosure [10]. In PCT, perceived benefits are consumers' expected judgment of service benefits, while the perceived risks are consumers' expected judgment of possible adverse effects after information disclosure. Under different technology and research circumstance, the performance of privacy computing and the trade-off of consumers' privacy decisions will be different. Privacy computing theory has been widely applied in researching privacy information-related behaviors such as privacy protection and privacy disclosure.

3. THEORETICAL HYPOTHESES

3.1 Facial privacy concerns

Privacy concerns refer to consumers' concerns about collecting and using personal information by platforms and institutions. Individuals have the right to decide how to transmit their private information, and they will perceive higher risks and lower benefits of information disclosure with higher information sensitivity and privacy concerns^[11]. As facial recognition technology matures, facial privacy concerns occur. Consumers have to provide their facial biometric information, and make the information stored in the database to authenticate. In this study, facial privacy concerns refer to consumers' concerns about the collection and use of facial information in the context of FRP. When consumers pay more attention to facial privacy, they will perceive higher payment risks and lower benefits. Based on the above analysis, the hypotheses are put forward:

H1: Facial privacy concerns positively affect perceived payment risk;

H2: Facial privacy concerns negatively affect perceived payment benefits.

3.2 Perceived payment risks

Perceived risk indicated the uncertainties in e-commerce and impeded consumers from making business decisions [12]. Research have proved that perceived risks influenced consumers' attitudes and purchase behaviors [12]. In this study, perceived payment risks refer to the technical security risk, financial loss risk, and privacy exposure risk perceived by consumers in the process of FRP. Technical security risk refers to the risk of product performance or function failure caused by face recognition technology, financial loss risk refers to the loss of capital and property, and privacy exposure risk refers to the risk of illegal collection and abuse of individual information. When consumers perceive the higher degree of payment risk, they will perform innovation resistance

behavior: postponement, opposition, or rejection. Based on the above analysis, the hypotheses are put forward:

H3(a): Perceived payment risks positively affect consumers' postponement behavior;

H3(b): Perceived payment risks positively affect consumers' opposition behavior;

H3(c): Perceived payment risks positively affect consumers' rejection behavior.

3.3 Perceived payment benefits

Perceived benefits refer to consumers' potential benefits and positive benefits subjectively perceived by products or services [13]. According to the privacy computing theory, perceived benefits is one of the important factors affecting consumers' attitudes and behaviors, and the influence of perceived benefits on consumers' behaviors has been verified. Liang and Shiau[14] found that consumers' perceived value affects consumers' behavior to use services under the influence of privacy concerns. In this study, perceived payment benefits refer to the convenience and usefulness of services perceived by consumers in the context of FRP. When consumers perceive higher payment benefits, they are more willing to postpone and correspondingly reduce their tendency to oppose and reject. Based on the above analysis, the hypotheses are put forward:

H4(a): Perceived payment benefits positively affect consumers' postponement behavior;

H4(b): Perceived payment benefits negatively affect consumers' opposition behavior;

H4(c): Perceived payment benefits negatively affect consumers' rejection behavior.

3.4 The moderation effect of gender

Existing privacy literature left mixed conclusions on gender and privacy protection and disclosure behaviors. On the one hand, gender is related to privacy concerns, and females showed more privacy concerns behaviors [15]. Gender tends to process the available information in the online market differently, resulting in different adoption behavior. On the other, gender significantly influences consumers to perceived risks and benefits, and women perceived more risks [16]. Perceived benefits and perceived risks indicate consumers' psychological and emotional perceptions of an online product or service, which influence consumers' purchase decisions. When using FRP, men and women with different facial privacy concerns have different psychological perceptions and information processing. Thus, we postulate:

H5(a): Gender moderates the relationship of facial privacy concerns to perceived payment risks;

H5(b): Gender moderates the relationship of facial privacy concerns to perceived payment benefits.

3.5 The moderation effect of platform trust

Trust, a confidence belief that consumers' personal information submitted to the service provider can be handled reliably and safely, plays an important role in affecting consumers' privacy protection and disclosure behaviors[17]. The higher degree of trust between the individual and the platform, the lower individual's awareness of information security precautions[18]. Chen et al.[19] explored the moderating effects of gender and trust on the relationships of perceived benefits and risks on users' online behavior, and revealed that trust moderated perceived risks and satisfaction. This study believes that platform trust refers to the degree of consumers' trust in the platform which provides FRP service. The stronger consumers' perception of platform trust, the lower effect of perceived risks on consumers' innovation resistance behavior. The stronger consumers' perception of platform trust, the stronger effect of perceived benefits on consumers' innovation resistance behavior. Therefore, we postulate:

H6(a/b/c): Platform trust negatively moderated perceived risks on consumers' postponement/opposition/rejection behavior;

H7(a/b/c): Platform trust positively moderated perceived benefits on consumers' innovation postponement/opposition/rejection behavior.

Based on the discussion above, the research model is shown in Figure1.

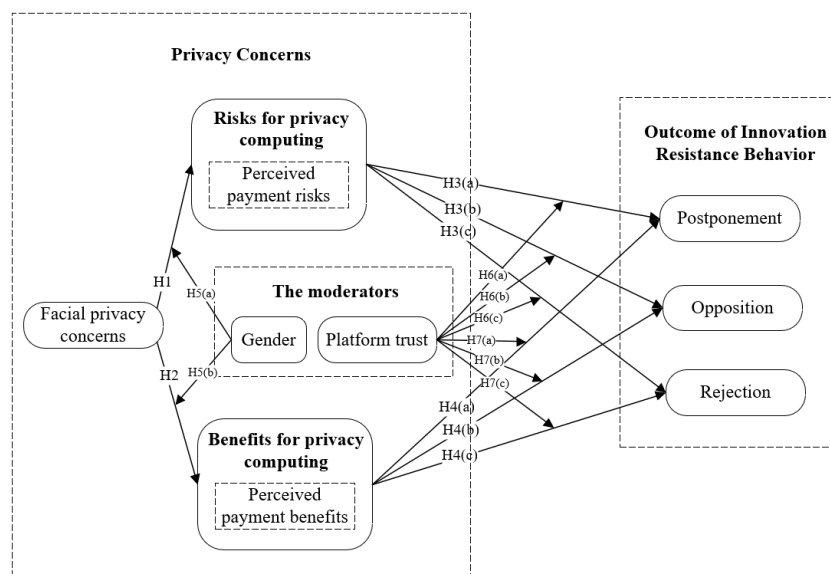


Figure 1. Research model

4. RESEARCH METHODOLOGY

4.1 Survey design and data collection

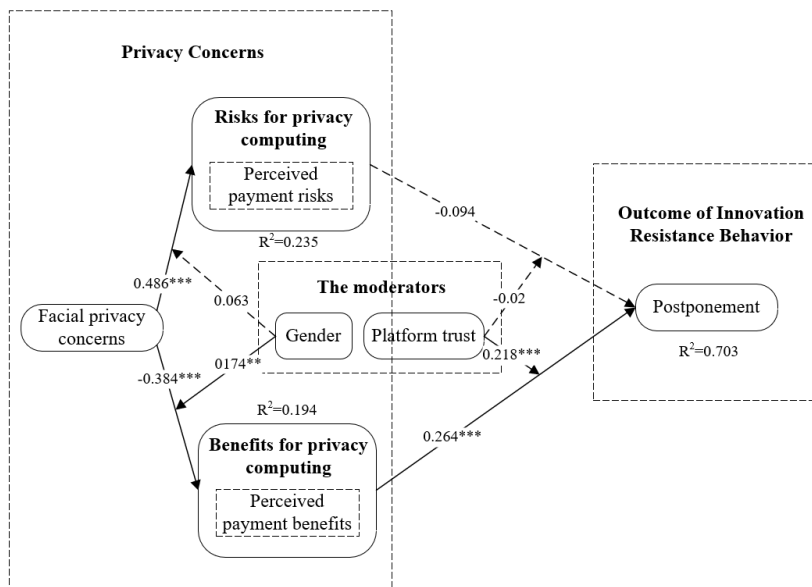
In the pre-test phase, 15 researchers in related fields and 15 consumers who have not used FRP were invited to conduct the questionnaire twice. The final questionnaire contains consumers' information and main modules. All items are based on the original related literature and adjusted according to the research background. Items are measured by the 7-point Likert scale. The variable of facial privacy concerns come from Malhotra et al.^[20]; Perceived payment risks come from Pavlou^[21]; perceived payment benefits come from Bhattacharjee^[22]; Postponement, opposition and rejection come from Szmigin and Foxall^[7]. In the phase of collecting data, this questionnaire was distributed on a well-known questionnaire platform. At first, 792 questionnaires were received. After screening, 494 questionnaires were valid.

4.2 Descriptive analysis

The objects of this survey are consumers who have not used FRP. They are mainly 18-35 years old (75.7%), with slightly more men (56.7%), and their education levels are primarily undergraduate and master's degrees (81.8%). The time of using mobile payment is within 1-5 years (77.5%), and the frequency of no less than once a month is 74.5%. In the following analysis, reliability was measured by the value of Cronbach's α , Composite Reliability (CR), the AVE value and R^2 . When the α value and CR value are larger than 0.7, the variables have high consistency. When the AVE value is greater than 0.5 and the AVE square root is greater than the correlation coefficient, the model has a good verification effect. R^2 is considered acceptable in the range of 0.1-0.2 in consumer behavior research^[23]. The models of consumers' postponement, opposition, and rejection all have a good explanatory power. Besides, SmartPLS 2.0 was used to calculate the path coefficient and significance level.

4.3 Analysis of consumers' innovation resistance behavior of postponement

The results of the model of postponement were shown. According to Figure 2, H1 ($t=6.707^{***}$, $p<0.001$), H2 ($t=6.905^{***}$, $p<0.001$) and H4 ($t=5.020^{***}$, $p<0.001$) were supported, while H3 was rejected ($t=1.322$, $p=0.187$). With regard to the moderation effect, gender moderated the relationship of facial privacy concern to perceived payment benefits (H5b: $t=3.413^{***}$, $p<0.001$), and platform trust moderated the relationship of perceived payment benefits to postponement (H7a: $t=3.851^{***}$, $p<0.001$). Besides, H5a (H5b: $t=1.028$, $p=0.304$) and H6a (H5b: $t=0.720$, $p=0.472$) were rejected.

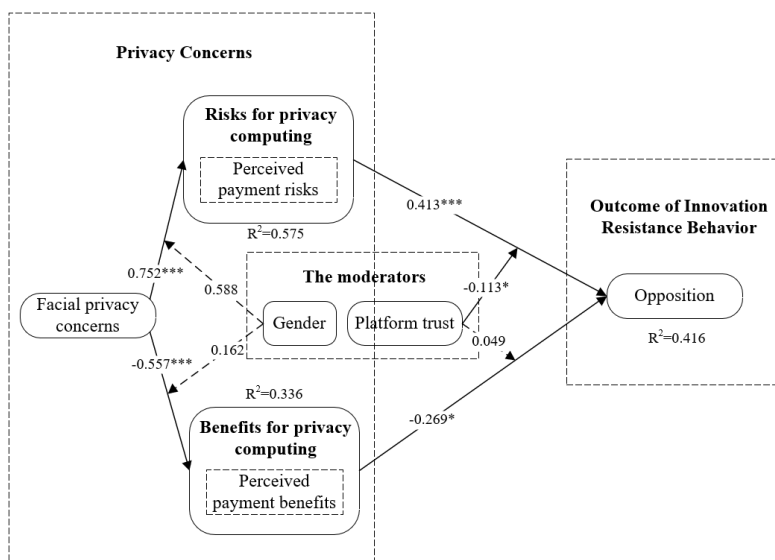


Note: ***, **, * represent $p < 0.001$, $p < 0.01$, $p < 0.05$ respectively. The solid line with arrow indicates that the hypothesis is valid, while the dotted line indicates that the hypothesis is not valid.

Fig2. Results of consumers’ innovation resistance behavior of postponement to adopt the FRP

4.4 Analysis of consumers’ innovation resistance behavior of opposition

As illustrated in Figure3, H1 ($t=13.042^{***}$, $p < 0.001$), H2 ($t=7.588^{***}$, $p < 0.001$), H3 ($t=3.781^{***}$, $p < 0.001$) and H4 ($t=2.467^*$, $p < 0.05$) were supported. As for the moderation effect, H5a ($t=0.543$, $p=0.588$), H5b ($t=1.401$, $p=0.162$) and H7b ($t=0.878$, $p=0.381$) were rejected except for H6b ($t=1.977^*$, $p < 0.05$), indicating that platform trust moderated the relationship of perceived payment risks to opposition.



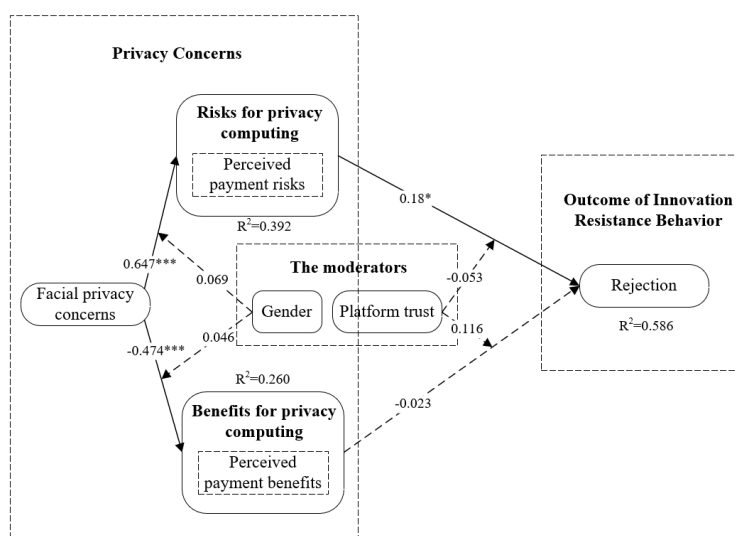
Note: ***, **, * represent $p < 0.001$, $p < 0.01$, $p < 0.05$ respectively. The solid line with arrow indicates that the hypothesis is valid, while the dotted line indicates that the hypothesis is not valid

Fig3. Results of consumers’ innovation resistance behavior of opposition to adopt the FRP

4.5 Analysis of consumers’ innovation resistance behavior of rejection

According to the results in Figure4, H1 ($t=8.207^{***}$, $p < 0.001$), H2 ($t=8.013^{***}$, $p < 0.001$) and H3 ($t=2.083^*$, $p < 0.05$) were supported, while H4 ($t=0.230$, $p=0.818$) were rejected. All the hypotheses about moderators were

rejected.



Note: ***, **, * represent $p < 0.001$, $p < 0.01$, $p < 0.05$ respectively. The solid line with arrow indicates that the hypothesis is valid, while the dotted line indicates that the hypothesis is not valid

Fig4. Results of consumers' innovation resistance behavior of rejection to adopt the FRP

5. DISCUSSION

5.1 Discussion of results

Above all, facial privacy concerns positively affect perceived payment risks and negatively affected perceived payment benefits in the three innovation resistance behaviors. The higher consumers pay attention to facial privacy, the higher payment risks and lower payment benefits are perceived. After that, the results of perceived payment risks and perceived payment benefits show that: Perceived payment risks have no impact on postponement, while positively influence opposition and rejection; Perceived payment benefits positively influence postponement, while negatively influence opposition and have no impact on rejection. The influence of perceived payment risks on postponement is weakened, and consumers tend to wait and see due to benefits which will trigger postponement. This may be because consumers pay more attention to benefits and ignore risks even after privacy calculation [24]. Besides, consumers will take rejection behavior when they feel a high level of facial privacy concerns and risks no matter what the benefits are.

In addition, the moderation effects of gender and platform trust indicate that: For one thing, gender moderates the relationship of facial privacy concerns to perceived payment benefits in consumers' postponement behavior, especially for women. The existing literature also proved that women have a higher awareness of privacy protection and are more sensitive to perceived benefits [15]. For another, platform trust positively moderates the relationship of perceived payment benefits to postponement, and negatively moderates the relationship of perceived payment risks to opposition. Platform trust not only influences consumers' awareness of information protection and privacy concerns, but also moderates the effect of consumers' perceived risks and benefits on their behavior [18, 19].

5.2 Theoretical implications

Two theoretical contributions are pointed: Firstly, this research explored information privacy on the context of FRP. The proposed model expanded the scope of information privacy research, and integrated the APCO model and privacy calculation theory. Besides, the influencing factors of consumers' innovation resistance behavior of FRP were summarized through literature investigation. On this basis, three kinds of consumers' innovation

resistance behavior of postponement, opposition, and rejection are empirically verified. Secondly, this research investigated the moderation effect of gender and platform trust. Gender is an individual's characteristic, and platform trust is an external condition that influences consumers' judgments on products. Men and women have different methods to process information, and perceive different risks and benefits while shopping online [16]. After that, platform trust further moderates consumers' innovation resistance behavior when weighing perceived payment risks and perceived payment benefits. Therefore, this research provides several interesting insights into consumers' innovation resistance behavior by the combinations.

5.3 Practical implications

As far as facial privacy concerns are concerned, three suggestions are proposed. Firstly, product designers need to optimize products and upgrade services. For instance, strengthening privacy encryption technologies like image desensitization. Secondly, the managers should improve the privacy policy. On the one hand, they should actively feedback policy suggestions and assist regulatory governments in improving the national privacy protection laws. On the other hand, they should strengthen industry self-discipline. The regulatory approach in the EU (through the GDPR) can be referred to. Thirdly, the promotion and operation personnel should pay attention to the feedback about FRP, to ensure that the advantages can be correctly recognized and create a friendly atmosphere to accept FRP.

Based on perceived payment risks and perceived payment benefits, product designers need to first pay attention to reducing the security risks, financial risks, and privacy risks of FRP products. Consumers' perception of payment risks can be reduced by ensuring the security of financial transactions, maintaining smooth property loss complaint channels, and monitoring the probability of data theft. Secondly, the promoters can formulate more personalized external incentive measures apart from price concessions. Unique incentives can be created by innovation ecosystem from interfirm cooperation, such as in the form of video website members, virtual currency in products, and game coupons.

As for the moderation effect of gender and platform trust, product designers should notice that women perceived more enjoyment while using FRP, and pay more attention to product/service prices. Firstly, various beauty filters can be added to increase the novelty of FRP. Secondly, a detailed and simple explanation of privacy safety guarantees should be displayed before consumers use the service to reduce concerns. Thirdly, the promoters can concentrate on advertising the good reputation and high quality of the FRP platform to eliminate consumers' concerns and increase consumers' trust in the platform.

6. LIMITATIONS AND FUTURE RESEARCH

Primarily, the discussion of individual factors of consumers deserves further exploration in the research content. Other individual characteristics also impact innovation resistance behavior, such as age differences, personal innovation, relative experience. After that, the research method can be improved with the combination of other methods in behavioral researches. For instance, user behavior portrait analysis can draw more interesting conclusions. Cross-contrast analysis can analyze the dynamic process of consumers' innovative resistance to FRP.

7. CONCLUSION

Integrating innovation resistance theory, privacy calculus theory, and Antecedents-Privacy Concerns-Outcomes model, this research empirically analyzed the formation mechanism of consumers' innovation resistance of FRP. The moderation effects of gender and platform trust were also explored. Finally, implications for researchers and practitioners were also provided, which will enrich present academic research and has practical values in understanding consumers' innovation resistance behavior.

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