Mobile Payment With Alipay: An Application of Extended Technology Acceptance Model

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ABSTRACT In recent years, mobile payment as an innovative payment method has triggered a payment revolution in China. Understanding and investigating the psychological elements and influence paths that affect the user's willingness to use mobile payment are of great importance. The main purpose of this study is to investigate the effects of a user's risk perception, perceived ease of use, perceived usefulness, and attitude on a user's willingness to use Alipay, by using an extended version of the technology acceptance model (TAM). The model was tested with the use of structural equation modeling (SEM), and the data was collected from 491 users in China. The results show that perceived ease of use and perceived usefulness has a significant effect on users' attitudes and intentions to use Alipay, and the risk perception has a negative effect on perceived ease of use and perceived usefulness. Meanwhile, risk perception also has a direct effect on users' attitudes and intentions to use Alipay. These results suggested that when users perceived that the risks of using Alipay are higher, they will hold a negative attitude using Alipay and less likely to use Alipay. Based on these results, the possible implications have been identified.

INDEX TERMS Alipay, online payment, risk perception, usefulness.

I. INTRODUCTION

With the rapid development of the economy and the maturity of related technologies such as Internet payment, mobile payment as an innovative payment method has quietly triggered a payment revolution in China in recent years. The popularity of the Internet and the expansion of mobile Internet users play a crucial role in promoting mobile payment. As of December 2017, the number of Internet users in China has reached 772 million; the Internet penetration rate has reached 55.8 percent. In addition, the number of mobile Internet users has reached 753 million; the number of mobile Internet users has increased from 95.1 percent in 2016 to 97.5 percent in 2017.[1] According to the data of the "Monthly Monitoring Report of China's Third-Party Payment Comprehensive Payment Market" by Analysis think tank, the total market size of China's third-party mobile payment market has exceeded 40 trillion yuan in the first quarter of 2018. Currently in China's major cities, mobile payments are booming, covering all aspects of people's lives. Breakfast, chain stores, e-commerce shopping, you can all use the QR code to complete the payment. The daily payment habits that are not used to wallets are gradually becoming popular. In May 2017, 20 countries from the "Belt and Road" ranked China's "new four major inventions", namely mobile payments, high-speed rails, shared bicycles and the online shopping. The mobile payments ranked first, which helped China's economy expand rapidly.

With the booming mobile payment, the Chinese market has cultivated two mobile payment giants (i.e., Alipay and WeChat), which currently cover more than 90% of the domestic market in China. According to iiMedia Research, the amount of Alipay transactions in the first quarter of 2018 was 49.9%, and WeChat payment was 40.7%.[2] Compared to other mobile payment platforms (such as E-wallet, Baidu wallet, etc.), WeChat and Alipay have penetrated into every aspect of people's lives and become the leader in the field of third-party payment. As two mobile payment giants, the competition for market share is fierce. At present, in the scale of mobile payment transactions, Alipay is stronger than WeChat, and on the scale of users, WeChat is stronger than Alipay. Alipay is more used for online payments, and WeChat

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[1] https://www.analysys.cn/article/analysis/detail/20018904

[2] http://www.iimedia.cn/

is more used for offline payments. The two companies continue to launch a series of marketing measures to improve user stickiness. For example, when Alipay launched the direct deduction of the payment under the Alipay red envelope, WeChat launched an offline consumption rush-free activity. In addition, although WeChat and Alipay have occupied most of the market share, it does not mean that they can sit back and relax, because new and strong competitors are gradually emerging. On December 11 of 2017, China Union Pay teamed up with commercial banks, payment institutions and other industry parties to jointly release the banking industry's unified App-"Cloud Flash Pay", aimed to counterattack the mobile payment market and eager to take a slice of this market. In the future, as the scale of users continues to grow and the application scenarios continue to expand in breadth and depth, competition among third-party payment companies will intensify.

In the competitive market environment, residents hold "currency votes" [1]. How to understand users' functional requirements, enhance users' product experience and enhance users' stickiness is the key for enterprises to gain competitive advantages. The degree of psychological understanding and recognition of users for any kind of innovative technical products is an important factor for the successful promotion of new technology products in the market [2]. Therefore, it is of great theoretical and practical significance to discover and analyze the factors and paths that influence users on the innovative technology products to help enterprises improve product functions and operation mode; thereby enhance users' sense of experience and brand loyalty. Taking this as the starting point of the research, based on the classic Technology Acceptance Model (TAM), the present study constructed an integrated TAM model with the risk factors of technical products to explore risk perception, perceived usefulness and perceived ease of use in Alipay. The conclusion of the study is expected to provide theoretical reference for enterprises to improve product service capabilities and enhance the competitiveness of enterprises.

The next structural arrangement of this study is as follows: Section 2 presents the literature review. Section 3 focuses on research design and data collection. Section 4 presents the data analysis and the results. Section 5 and 6 conclude and discuss the study based on the findings, while also pointed out the implications and limitations of the findings, and providing suggestions for future research.

II. LITERATURE REVIEW
Drawing on the theory of reasoned action, technology acceptance model TAM was proposed by Davis et al. (1989). TAM uses a causal relationship between belief–attitude–behavior to explain and predict the acceptance of new technology among potential users. TAM introduces two key factors, that is perceived usefulness and perceived ease of use [3]. Perceived usefulness reflects the degree to which individuals think that using a specific technical system will improve their work performance, while perceived ease of use reflects

the degree to which individuals believe that using a specific technical system will be free of effort. In this model, attitude refers to the subjective positive or negative feelings when individuals use the system, while intention reflects the measurable extent to which individuals are willing to take a particular behavior [4]. TAM states three specific ideas to predict the user's acceptance of technology: First, whether a user accepts a specific technical system is determined by the behavioral intention, and the behavioral intention is determined by the user's attitude and perceived usefulness; Second, the attitude is jointly determined by perceived usefulness and perceived ease of use, while perceived usefulness is determined by perceived ease of use and the external variables; Third, perceived ease of use is determined by external variables, while external variables are some of the key factors that can be observed in a specific application scenario [5].

In China, mobile payment systems such as Alipay and WeChat payment have been widely used and popularized as an emerging innovative electronic payment product. Due to the advantages of simplicity, high efficiency, and high interpretation, TAM has been widely applied in the past research on the user's behaviors of various information technologies [6]. For example, [7] found that perceived ease of use is the crucial factor in predicting the success of mobile games. Reference [8] extended the TAM with perceived validity and perceived language independence for explaining and predicting user's acceptance of software measures. Reference [9] added self-efficacy and subjective norm to TAM to analyze the user's E-learning (GETAMEL) behavior. Reference [10] used extended TAM with perceived enjoyment and perceived mobility to analyze the psychological elements influencing the user's mobile-social network games (M-SNGs).

In short, TAM is by far the most widely used and most influential theoretically predictive interpretation model in the previous theoretical research on the analysis and prediction of information technology adoption behavior. Research has shown that TAM has a significant impact on the user's attitudes. In addition, the reliability and validity of the scale design have also been extensively verified [11]. Drawing on this discussion, we use TAM to analyze the current Chinese consumers' adoption of mobile payment technology.

In China, during the past few years Alipay has become largely popular as an emerging innovative electronic payment product. Alipay has emerged as stronger mobile payment platforms in the market with more than 1 billion users [12]. We, therefore, chose Alipay for our research and proposed following hypotheses:

H1: *Perceived ease of use is positively related to perceived usefulness.*

H2: *Perceived ease of use is positively related to the user's attitude.*

H3: *Perceived ease of use is positively related to the user's intention.*

H4: *Perceived usefulness is positively related to the user's attitude.*
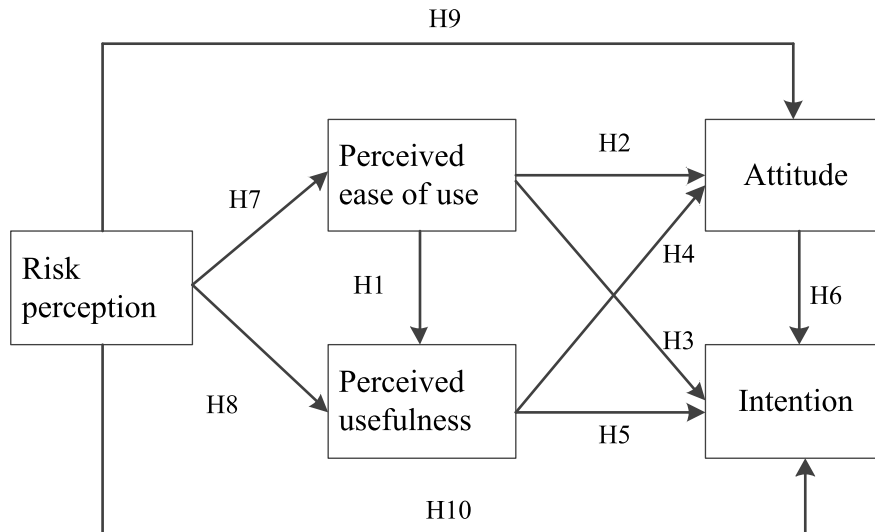
FIGURE 1. Proposed research model.

H5: *Perceived usefulness is positively related to the user's intention.*

H6: *The use's attitude is positively related to the user's intention.*

Previous studies have shown that the correct and reasonable selection of external variables plays an important role in the rational interpretation of the model in a specific research situation [13]. Therefore, this research decides to introduce appropriate impact factors to improve the interpretation ability of the model in the Alipay adoption situation. As a new technology, risk is one of its important characteristics [14]. In the process of product promotion, consumers' perception of the risk is an important indicator of the adoption and use of the new technology [15]. The risk perception is a subjective judgment made by people about the characteristics and severity of a particular risk and is an important indicator for measuring public psychological panic. Reference [16] pointed out that consumers' risk perception plays the most important role among all factors affecting consumers' online shopping.

The emergence of Alipay has brought great convenience to users. At the same time, as a new mobile payment service, Alipay still have some risks, such as credit card cashing, network fraud, and some operational risks [17]. At present, the risks are mainly concentrated on policy risks, financial legal risks, reputation risks, and technical risks [18]. Mobile payment technical risks include data transmission security and the users' information security, which is the most concerned issue for mobile payment users [19]. Reference [20] pointed out that password protection is not very important when the mobile phone is only used as a communication tool. However, as a payment tool, the loss of the mobile phone and the decryption of the password may cause significant losses to the user. Reference [21] pointed out that user's perceived risk of a particular technology product will directly affect the attitude and willingness to use the product. Reference [22] indicated that the consumer's perceived ease of use and perceived usefulness of a new product are directly affected by perceived risk. Higher risk perception weakens the user's perceived ease of use and perceived usefulness and even causes users to abandon the use of the product. Reference [23] believed that the occurrence of product risk events seriously reduces product or corporate brand reliability and consumers' loyalty to the products. In short, consumers' risk perceptions play an important role in the acceptance of a new technology product. Therefore, this paper introduces risk perception and builds an extended TAM model to analyze the user's acceptance of mobile payment technology. Here, we proposed the following assumptions:

H7: *The user's risk perception is negatively related to perceived ease of use.*

H8: *The user's risk perception is negatively related to perceived usefulness.*

H9: *The user's risk perception is negativly related to attitude.*

H10: *The user's risk perception is negatively related to intention.*

III. RESEARCH DESIGN AND DATA COLLECTION
A. MEASUREMENT ITEM DESIGN
The research data for the present research were obtained by using a questionnaire survey. Hence, it was needed to design a questionnaire. The core element of the questionnaire was the measurement items of the variables [24]. In this research, the measurement items of the variables were all referenced previous studies and modified to meet the current research background [25], [26]. Two procedures were used to design the measurement items. Firstly, the research group referenced previous studies and then changed the wordings of several items to meet the current research background.

TABLE 1. Respondents' demographic information.

Demographic characteristic		Number	Percentage
Gender	Male	232	47.25%
	Female	259	52.75%
Age	Lower than 18	15	3.05%
	18-30	193	39.31%
	31-45	154	31.36%
	46-60	80	16.29%
	Larger than 60	49	9.98%
Educational level	Junior school and below	59	12.02%
	High school or junior college	130	26.48%
	Bachelor degree	213	43.38%
	Master's or higher degree	89	18.13%
Monthly household income (¥)	Less than 5,000	87	17.72%
	5,000-15,000	217	44.20%
	15,001-30,000	118	24.03%
	More than 30,000	69	14.05%

Secondly, a pilot survey was performed to judge the scientific nature of the questionnaire. According to the feedbacks of the respondents, the measurement items were modified again and the final measurement items of the variables were obtained.

The measurement items of risk perception were referenced the works of [17], [27] and [28]. Risk perception was measured with three items: "I am afraid that my personal information will be shared", "I am afraid that my account information will be disclosed" and "I am afraid that my payment information will be stolen by third-party software". The measurement items of the variables of technology acceptance model (e.g., perceived usefulness, perceived ease of use, attitude and intention) were referenced the works of [29]–[32]. Each variable was measured by three measurement items. Perceived ease of use was measured by "It is easy for me to learn how to use Alipay", "It is convenient for me to install Alipay on mobile phones" and "If I use Alipay, there should be no problems". Perceived usefulness was measured by "Using the Alipay for payment can save me a lot of time", "Using the Alipay for payment can make my life more convenient" and "Using the Alipay for payment can promote the development of e-commerce". Attitude toward using Alipay was measured by "It is good to use Alipay when paying", "It is advisable to use Alipay when paying" and "It is a good choice to use Alipay when paying". Intention to use Alipay was measured by "I am willing to use Alipay when paying", "I am planning to use Alipay when paying" and "I would like to use Alipay when paying". All of these measurement items were measured using 5-point Likert scales.

B. SAMPLE AND PROCEDURE

There were three parts of the questionnaire. The first part was used to introduce the basic background information of

Alipay. The second part was used to collect the basic demographic information of the respondents. The third part was the measurement items of the variables. Given that it is difficult and time-consuming to conduct the questionnaire survey to collect the data [33], [34], the research group commissioned a professional survey company to conduct the questionnaire survey. The survey was conducted from November 9th to November 22th in 2018.

Online questionnaire survey was conducted since that the company has a large number of registered online members. The company sent the questionnaire to its registered members and invited them to answer the questionnaire. A total of 704 registered members filled out the questionnaire. Among them, 213 questionnaires were incomplete and illogical. After deleting these questionnaires, the remaining 491 valid questionnaires were eventually used for the following data analysis. The detailed demographic information of these 491 respondents was presented in Table 1. As shown in Table 1, it was known that most respondents were relatively young (concentrated on 18-45 years old); well-educated and in the middle of the income scale. In general, the characteristic of the sample was consistent with the characteristics of the Smartphone users. Hence, the sample was representative.

IV. ANALYSIS AND RESULTS
A. RELIABILITY AND VALIDITY ANALYSIS

Smart-PLS 3.0 and SPSS 19.0 software packages were applied to conduct data analysis. According to [35] and [36], it is known that before conducting the reliability and validity analysis, it is needed to obtain the factor loading of each measurement item. The factor loading of each measurement item should be more than 0.70; otherwise the measurement item should be deleted in the following data analysis [35].

TABLE 2. Loading and cross-loading of measurement item.

Construct	Item	RP	PEU	PU	AT	INT
Risk perception (RP)	RP1	0.90	0.10	0.14	0.05	0.16
	RP2	0.88	0.14	0.17	0.07	0.12
	RP3	0.88	0.05	0.26	0.07	0.12
Perceived ease of use (PEU)	PEU1	0.10	0.82	0.08	0.00	0.02
	PEU2	0.12	0.88	0.12	0.05	0.06
	PEU3	0.03	0.78	0.14	0.00	0.05
Perceived usefulness (PU)	PU1	0.17	0.09	0.81	0.03	0.12
	PU2	0.20	0.14	0.88	0.03	0.07
	PU3	0.20	0.12	0.88	0.08	0.18
Attitude (AT)	AT1	0.10	0.02	0.02	0.93	0.07
	AT2	0.03	0.01	0.05	0.89	0.05
	AT3	0.04	0.05	0.05	0.84	0.02
Usage Intention (INT)	INT1	0.10	0.09	0.07	0.02	0.78
	INT2	0.11	0.00	0.12	0.04	0.80
	INT3	0.14	0.05	0.16	0.05	0.86

Note: The bold elements are the factor loadings of measurement items and others are the cross-loadings of measurement items.
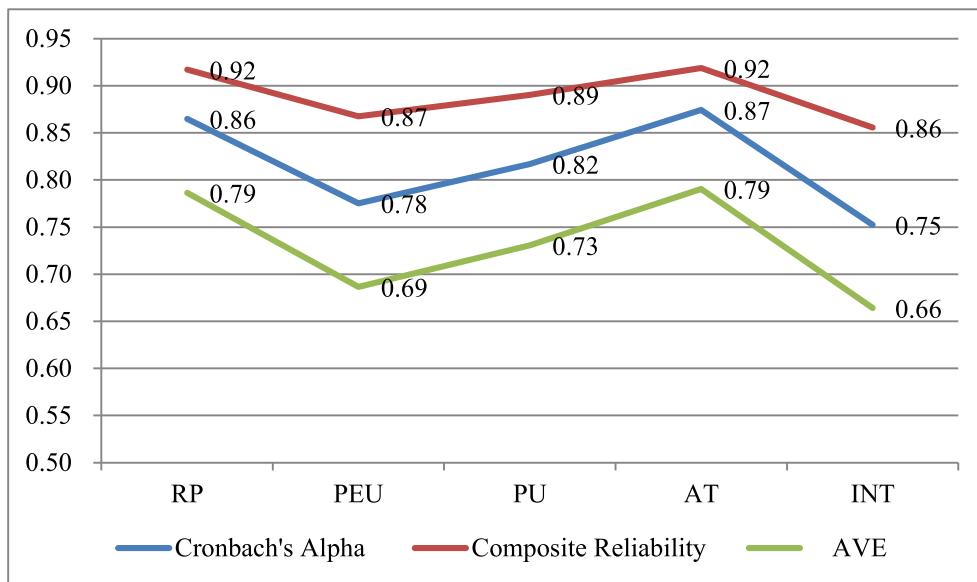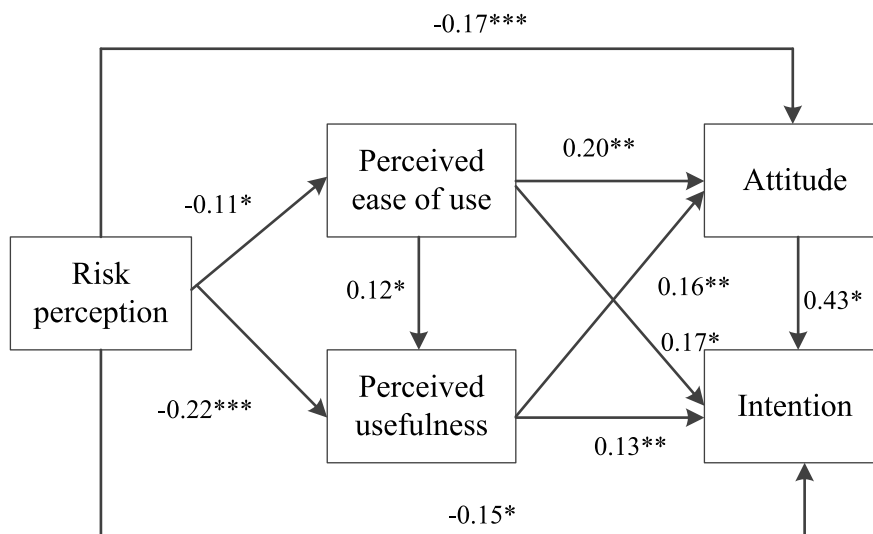

FIGURE 2. Results of reliability and validity analysis.

The factor loading of each measurement item was shown in Table 2. Table 2 suggested that all the factor loadings of the measurement items were larger than 0.70. Hence, all the measurement items were retained for data analysis.

Reliability was often assessed by Cronbach's alpha and composite reliability [37]. According to [37], when the values of Cronbach's alpha and composite reliability were larger than 0.70, it can be acknowledged that the reliability of the constructs were acceptable. Validity was often assessed by factor loading and average variance extracted (AVE) [37]. When the factor loading of each measurement item was larger than 0.70 and the value of AVE was greater than the benchmark of 0.50, it can be say that the validity of the constructs is well [37]. The results of reliability and validity analysis were presented in Figure 2. As shown in Table 2 and Figure 2, all the values of Cronbach's alpha, composite reliability and

Note: * p < 0.05, ** p < 0.01 and *** p < 0.001.

FIGURE 3. Results of hypotheses testing analysis.

the factor loading of each measurement item were larger than 0.70, and the value of AVE was greater than 0.50. Hence, the reliability and validity of the variables were all acceptable.

B. HYPOTHESES TESTING ANALYSIS

The results of hypotheses testing analysis were presented in Figure 3. According to Figure 3, it is known that perceived ease of use has a positive and significant influence on perceived usefulness (b=0.12, p<0.05), attitude toward using Alipay (b=0.20, p<0.01) and intention to use Alipay (b=0.17, p<0.05). Meanwhile, perceived usefulness has a positive and significant influence on attitude (b=0.16, p<0.01) and intention to use Alipay (b=0.13, p<0.01). Attitude also positively and significantly associated with intention to use Alipay (b=0.43, p<0.05). Thus, Hypotheses 1 to 6 were supported.

Furthermore, the results suggested that users' risk perception has a negative influence on perceived ease of use (b= -0.11, p<0.05) and perceived usefulness (b=-0.22, p<0.001). In addition, the results also suggested that users' risk perception has a negative influence on users' attitude toward using Alipay (b=-0.17, p<0.001) and intention to use Alipay (b= -0.15, p<0.05). These findings suggested that the potential risks associated with using Alipay negatively affected users' perceived ease of use and perceived usefulness of using Alipay, attitude toward using Alipay and intention to use Alipay.

V. DICUSSIONS

The present study suggested that perceived ease of use and perceived usefulness has a significant effect on users' attitudes and intentions to use Alipay. This means that when the interface of Alipay is easy to operate and the users perceive

that Alipay has significant advantages to them (e.g., save time and convenient), they are tend to hold a positive attitude toward using Alipay and more likely to use it. Hence, to motivate individuals to use Alipay, several measures should be taken to improve the level of users' perceived ease of use and perceived usefulness. For example, the interface of Alipay should be designed more intelligent and friendly to make it easier to operate. Several advertisements should be made to propagate the advantages of using Alipay to users. Meanwhile, some experiential activities can also be provided to users. These experiential activities have direct effects on improving perceived ease of use and perceived usefulness.

Furthermore, the results also indicated that risk perception has a negative effect on perceived ease of use and perceived usefulness. Meanwhile, risk perception also has a direct effect on users' attitudes and intentions to use Alipay. These results suggested that when users perceived that the risks of using Alipay are higher, they will hold a negative attitude using Alipay and less likely to use Alipay. At the same time, the level of perceived ease of use and perceived usefulness will also be decreased. To some extent, the core determinant of promoting individuals to use Alipay is risk perception. Several measures can be taken to decrease users' risk perception when using Alipay. For example, relevant laws and regulations can be made to regulate online transactions and payment. Advanced security technology can be used to prevent personal information from being leaked and stolen by third-party software.

VI. CONCLUSIONS AND LIMITATIONS

As a convenient and new payment mode, Alipay has attracted the attention of researchers and the users of Smartphone.

This research aimed to understand the determinants of using Alipay. The study indicated that the individuals' intentions to use Alipay are mainly determined by their risk perceptions, perceived ease of use and perceived usefulness. Specifically, perceived ease of use and perceived usefulness have positive effects on users' attitudes and intentions to use Alipay. Perceived ease of use also positively affected perceived usefulness. Risk perception not only has a negative effect on perceived ease of use and perceived usefulness but also has a direct negative effect on users' attitudes and intentions to use Alipay. To motivate individuals to use Alipay, the main focus should be on risk perception, perceived ease of use and perceived usefulness. In general, this research highlighted the importance of risk perception, perceived ease of use and perceived usefulness in motivating individuals to use Alipay. Based on these results, the possible implications have been identified.

Though the present research is important to motivate individuals to use Alipay, there are some limitations of this study. Firstly, the survey was commissioned a professional survey company to perform and the survey was conducted online. This may limit the diversity of the sample. In the following studies, more channels and ways can be adopted to conduct the survey to enlarge the diversity of the sample. Secondly, this research only considered the effects of risk perception, perceived ease of use and perceived usefulness. Other determinants such as social influence and habit were not considered. Hence, in the following studies, these determinants can be studied and discussed. Finally, this research only explored the determinants of users' intentions to use Alipay. In fact, in reality, many individuals are Alipay users. Hence, it is needed to study which factors affect their Alipay usage behaviors. This research topic should be paid attention to in the future research.

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