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Exploring seniors' continuance intention to use mobile social network sites in China: a cognitive-affective-conative model

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Abstract

With the rapid increase of senior users in mobile social network sites (MSNS), how to attract and maintain seniors' continuous usage is more and more important for the social network sites to keep their competitiveness. The purpose of this study is to disclose the cognitive-affective-conative process of seniors' MSNS continuous using intention. Using data from 374 WeChat senior respondents, the integrated model was developed based on expectation-confirmation model of information system continuance, perceived ease of use, emotional attachment and related explanatory variables, and validated in the Chinese context. The results indicated that: (1) Satisfaction and emotional attachment play partly and full mediator role between the perceived usefulness, confirmation of expectation, perceived ease of use and continuance intention. In addition, perceived usefulness is directly positively associated with continuance intention; (2) Emotional attachment has the largest association with continuance intention in all the factors; (3) Satisfaction, relatedness need satisfaction and competence need satisfaction are positively associated with emotional attachment, and the relatedness need satisfaction has the strongest association among these three factors; (4) Unexpectedly, autonomy need satisfaction has no significant association with emotional attachment and the effect of declining physiological conditions has no significant association with perceived ease of use. This research enriches the existing work by explaining the underlying cognitive-affective-conative process of seniors' MSNS continuance using. It also provides guidance to keep the loyalty of senior users for MSNS practitioners.

Keywords Senior · Mobile social network sites · Cognitive-affective-conative · ECM-ISC · Emotional attachment · Continuance intention

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1 Introduction

China has become one of the fastest aging countries. According to the National Bureau of Statistics, by the end of 2018, the elderly population over 60-year-old has reached 244.9 million, making up 17.9% of the total population. It is estimated that China's elderly population over 60 will reach a peak of 487 million, accounting for 34.9% of the total population by 2050 [1]. The change of demographic structure brings a significant influence on the user structure of mobile internet. From 2012 to 2017, the number of mobile internet users has increased by 79% in China. Notably, the growth rate of senior users is 1.6 times that of the overall mobile internet user's growth rate [2]. In the context of slow growth of social network users [3], senior users have become a significant new growth point that cannot be ignored for social network sites to keep continuous competitiveness. Especially, with the deepening of the aging process, this trend will increasingly deepen. Faced with a huge senior

user market, some internet companies have designed specialized software for seniors. For example, Alibaba has recruited Taobao senior user researchers over 60-year-old offering high salaries. The purpose is to deeply experience the products and find problems from the perspective of the elderly group so as to help products enter the senior user market.

Although more and more seniors use mobile social network sites (MSNS), there are still many problems hindering their continuance using. For example, design concerns (e.g., interface is inconsistent, language is not clear, information is not correct), frustration with site tools and so on [4, 5]. Some problems, such as lack of personal relevance and friends online, may lead to give up MSNS for senior users [6]. For MSNS managers, keeping competitive advantage needs expanding user base and retaining users [7]. Only acquiring users and facilitating their adoption may be not enough for service providers, because fierce competition exists among various MSNS products. More and more MSNS products designed for the senior users appear, such as Sugar Beans, JinShi, LaoYou Live Broadcast and so on. The senior users can easily move from one MSNS product to another for low switching cost. According to research by Reichheld and Schefter [8], the cost of developing a new customer is five times that of keeping a regular customer. Much funds and resources have been invested by MSNS managers for entering the senior MSNS market. If the senior users abandon it after initial usage, the MSNS managers will suffer great losses and fail to succeed. Thus, it is essential to explore the factors affecting seniors' MSNS continuance usage.

Most existing MSNS usage behavior studies mainly targeted at young people [7, 9, 10]. Limited Information system researchers have examined seniors' MSNS usage behavior from the perspectives of motivational theory [4, 6, 11, 12], social capital theory [13], socioemotional selectivity theory [14], UTAUT [5], diffusion of innovations, uses and gratifications theory as well as media richness theory [15, 16] and attachment theory [17–19]. However, most of these extant researches focused on the acceptance stages and explained the motivation of why seniors adopted the MSNS. The existing researches seldom focused on the post-adoption stage to explore the cognitive-affective-conative process of senior users' continuance using behavior. In addition, we do not know which cognitive and affective factors have a stronger or weaker association with seniors' MSNS continuance using behavior. This may hinder our comprehensive understanding of seniors' MSNS continuance using. The willingness of human behavior will be influenced by both cognition and emotion. Previous researches indicated that consumer's IT service continuance usage intention was determined by a combination effect of cognitive and affective factors [20]. Thus, the purpose of this study is to explore the formation mechanism of seniors' MSNS continuance usage intention after their initial adoption from the cognitive-affective-conative perspective.

Given that MSNS are technological information systems, this study uses the expectation-confirmation Model of Information System Continuance (ECM-ISC) established by Bhattacherjee [21] as a reference framework. ECM-ISC is chosen for a number of reasons. It is specifically designed to explain and predict technology continuance using. ECM-ISC explains the anomalous phenomenon of acceptance-discontinuance by including the post-acceptance variables (satisfaction, confirmation, etc.). Numerous studies have demonstrated that the ECM-ISC has a strong robustness to explain the user's IS continuous using behavior in various contexts, such as mobile instant messaging, smartphone banking, mobile shopping apps, ubiquitous media systems, mobile Fintech payment services and so on [22–26]. Another reason why we chose the ECM-ISC to explain the senior MSNS continuance using behavior is that it discloses the Cognitive-Affective-Conative process of information system (IS) continuance usage [20]. Therefore, ECM-ISC model has a strong theoretical fit with the purpose of our research. It is helpful to explore the Cognitive-Affective-Conative formation process of senior users' MSNS continuance usage intention.

Although numerous high-level studies had demonstrated that ECM-ISC has a strong robustness to explain information system continuance using behavior [27], the model still has some limitations. In order to improve the predictive power of ECM-ISC in specific research background, some extensions and modifications should be proposed [28, 29]. Thus, based on the characteristics of seniors' MSNS usage behavior, in addition to the original constructs in ECM-ISC, perceived ease of use and emotional attachment were separately incorporated into the cognitive and affective parts. At the same time, influencing factors of perceived ease of use and formation path of emotional attachment would also be analyzed.

To summarize, the present study aims to answer the following research questions:

1. How do specific cognitive factors, i.e., perceived usefulness, confirmation of expectations, perceived ease of use, and affective factors, i.e., satisfaction, attachment, together affect continuance intention? What is the internal relationship between cognitive factors and affective factors?
2. Which cognitive and affective factors have a stronger association with the seniors' MSNS continuance using behavior?
3. For different affective factors, i.e., satisfaction and emotional attachment, what is the relationship between them and what is the difference between their formation paths?

2 Literature review

2.1 Research on the use of MSNSs for seniors

With the rapid increasing of MSNSs senior users, an increasing number of information system scholars begin to pay attention to this phenomenon. Motivational theory was widely used as theoretical basis in extant works. Gu et al. [6] examined the motivations and obstacles to adopt social network services for seniors. The main motivations included communication convenience and social connections. Obstacles included negative social influence, physical and psychological barriers of technology usage. Jung et al. [12] investigated the primary motivations for seniors' Facebook using and how they participated in the specific activities. Jung et al. [4] drew up in-depth interviews to examine the primary reasons for seniors' using and not using Facebook. Kim et al. [11] reported that intrinsic and extrinsic motivation affect flow experience, which further influence seniors' subjective well-being and travel-related purchase intention. In addition, social capital theory and socioemotional selectivity theory were used to examine the psychological and behavior characteristics of seniors' MSNS using. Chang et al. [13] drew social capital theory as the theoretical basis and found that sharing vision, community identification, and social interaction ties are the important factors affect seniors' knowledge sharing. Chang et al. [13] also revealed the positive influence of sharing knowledge on seniors' meaning in life. Rui et al. [14] drew on the socioemotional selectivity theory to investigate how seniors' WeChat network usage characteristics predicted their psychological well-being and subjective well-being in the context of China.

Furthermore, UTAUT, diffusion of innovations, uses and gratifications theories were also used to explain seniors' adoption and continuance usage of MSNS. For example, Sawe et al. [5] adopted the UTAUT to explain the seniors' acceptance and adoption of online SNS. The key influencing factors included perceived privacy, security and trust, proclivity to give and get information, content of online SNS. Yang and Lin [15] integrated the uses and gratification theory and the media richness theory to examine why seniors adopted ubiquitous mobile social services. Kim et al. [16] combined both perspectives of diffusion of innovations as well as uses and gratification theory to explain why senior intent to continuously use MSNS.

Attachment theory was adopted in previous researches to explain the seniors' MSNS continuance using behavior. Kim et al. [18] examined the effect of extrinsic motivations (usefulness), intrinsic motivations (enjoyment) and ease of use on the attachment, which further influence seniors' using intention of mobile devices in tourism context. Kim

et al. [17] combined both perspectives of social capital and attachment theory to examine seniors' loyalty to social network sites. Kim et al. [19] noted that social capital and altruism influence seniors' attachment on social network sites, which further influence their revisit intention. From these studies, we can infer that attachment is an important factor related to the seniors' behavior.

As evidenced by these studies, information system scholars have examined seniors' MSNS usage behavior from multiple perspectives, for example the motivational theory, social capital theory, socioemotional selectivity theory, UTAUT, diffusion of innovations theory, uses and gratifications theory, media richness theory as well as attachment theory. However, the existing researches seldom examined the co-effects of cognition and affective factors on the seniors' MSNS continuance usage behavior. In other words, the formation process of Cognitive-Affective-Conative of seniors' MSNS continuance usage remains a black box.

Thus, based on the existing research, the following expansion will be made: (1) Firstly, different from the studies focusing on the adoption stage [4–6, 15], we draw on ECM-ISC to extend the existing researches to the post-adoption stage. ECM-ISC provides a useful theoretical framework which further explained the Cognitive-Affective-Conative process of the seniors' continuous using behavior; (2) Secondly, based on the works of Kim et al. [17–19], we find that attachment is the significant determinant of seniors' MSNS usage. Thus, consistent with these researches, we also use the attachment theory as the theoretical basis. However, this research extends the studies of Kim et al. [17–19]: By integrating ECM-ISC, we can compare which factors of cognition and affect have greater influence. At the same time, we explain the formation of emotional attachment from the view of demand satisfaction instead of motivation. We will also explain the relationship between satisfaction and attachment.

2.2 ECM-ISC

Based on the expectation-confirmation theory, ECM-ISC proposed by Bhattacherjee aimed to examine the cognitive and affective influence factors of information system continuous usage [21]. Bhattacherjee [21] argued that ECM-ISC was better than TAM to predict continuance by including post-acceptance variables (satisfaction, confirmation, etc.). TAM mainly focuses on the motivations of users to adopt the new IS. However, initial adoption is only the beginning of IS success which is ultimately dependent on IS continuance using. The ECM-ISC suggests satisfaction and perceived usefulness are the significant positive predictors of users' continuance intention. In turn, users' satisfaction is primarily associated with confirmation of expectation from prior information system using and secondarily with their perceived

usefulness. The users' confirmation level positively influences their post-acceptance perceived usefulness.

Since its inception, various types of IS continuance usage studies based on ECM-ISC were springing up. At the same time, as ECM-ISC is a broader theoretical framework, in order to enhance the explanatory power of ECM-ISC, scholars have expanded the model according to the specific research background. Oghuma et al. [21] examined the factors that affect users' mobile instant messaging continuance intention by expanding the ECM-ISC with perceived service quality and perceived usability to cover the context of post-consumption stage. Susanto et al. [21] developed an extended framework based on ECM-ISC and other variables including perceived security, privacy, trust and self-efficacy to examine the determinants of users' smartphone banking continuance intention. Carillo et al. [21] extended ECM-ISC with individual media dependency to predict the ubiquitous media systems continuance intention. Sarkar and Khare [21] integrated the ECM-ISC framework with network externalities, flow, word-of-mouth to examine the continuance using of mobile shopping apps. Lim et al. [23] explored the mobile Fintech payment services continuance intention based on ECM-ISC which was extended with perceived security and knowledge.

In order to promote the predictive power of ECM-ISC in explaining seniors' MSNS continuance using phenomenon, we will integrate ECM-ISC with perceived ease of use, attachment and related explained variables which base on the seniors' characteristic.

2.3 Attachment theory

Attachment is a psychological construct, which originated from the research of parent-child relationship by British psychologist Bowlby. It has been investigated in different interpersonal contexts such as romantic partners [30], friendships [31] and consanguinity [31]. On the premise that attachment is a relationship-based concept, this theory has also been extended beyond interpersonal relationships, for example, possession attachment [32], brand attachment [33, 34], consumer-retailer attachment [35], place attachment [36] and so on.

Information system attachment has received attention from researchers in recent years. For example, Read et al. [37] examined e-reader adoption by the integrated model of technology acceptance and emotional attachment. Choi [37] proposed that information system attachment affects community participation intention. Kim et al. [17] noted that social capital and group attachment affect the seniors' loyalty toward social network sites.

Attachment is a powerful motivator of behavior [38]. Attachment to the information system product is a key driving factor for the online behavior, such as word-of-mouth,

community involvement and information sharing [39, 40]. In other words, if a user attach to an information product, he or she will invest more resources (e.g., time and energy) to maintain this relationship.

2.4 Self-determination theory

Self-determination theory claims that users' intrinsic motivation and behaviors shaping are supported and maintained by the satisfaction of three basic psychological needs including autonomy, competence and relatedness [41]. Unlike most human needs, they are universal, innate and enduring [42, 43]. Autonomy need is defined as a desire of having the authority to make the decision by one's own choice, self-governance or not under anyone's pressure. Relatedness need refers to the desire of being cared about or avoid feeling isolated. Competence need refers to innate tendency of individuals to pursue feelings of challenge their actions, effectiveness or achievement throughout their lives [41, 43, 44].

Existing research in diverse domains demonstrated that when the self-determined needs for autonomy, relatedness and competence are satisfied, they will positively improve the users' behavior outcome, such as attachment to the brands, the attachment to a celebrity, integrated resort and so on. For example, Thomson [43] claimed that if a human brand can satisfy the personal need of autonomy, relatedness and competence, a strong human brand attachment will be formed. Jillapalli and Wilcox [45] showed that when the students' competence and relatedness need are satisfied by the professors, the student will form stronger attachment toward the professor. At the same time, the attachment to the professors will influence students' trust and satisfaction and further determine the willingness of students to advocate their professor as a brand. Both studies from Proksh et al. [46] and Loroze and Braig [47] found that competence need satisfaction is an importance predictor for the brand attachment development. Ahn and Back [48] found that the more integrated resort experience fulfilled the need of autonomy, relatedness and competence, the customers are more likely attach to it.

Thus, the present study will draw on the self-determination framework to examine the relationship between seniors' three kinds of needs satisfaction from MSNS and their attachment toward the MSNS.

2.5 The cognitive-affective-conative model

The cognitive-affective-conative (CAC) model has been widely adopted to describe the formation of attitude [49, 50]. Cognitive factor refers to people's belief about the attributes of attitude objects. The formation of cognition is usually based on objective evaluation and understanding of the objects' characteristics. Affective factor is the emotional

response which forms based on cognition. Conative factor is a behavioral tendency which forms based on cognitive and affective factors.

The CAC model was widely applied in previous studies to explore the users' attitudes toward IS. For example, based on the CAC model, Huang et al. [51] explored the middle-aged adults' attitudes toward health app usage. Under the framework of CAC, Fang et al. [52] established an integrated model to investigate the e-tailing consumer loyalty from a transactional and relational perspective. Lin et al. [20] drew on CAC model to examine the dedication and constraint factor of IT product loyalty.

Previous studies showed that IS product continuance usage intention would be influenced by cognitive and affective factors [53–55]. Thus, the CAC model provides an ideal theoretical framework. This study will apply CAC model to explore how seniors form their MSNS continuance using intention.

3 Research model and development of hypotheses

3.1 The cognitive-affective-conative model of seniors' MSNS continuance intention

In the context of the framework of Cognitive-Affective-Conative model, we proposed the research model by extending the ECM-ISC with perceive ease of use, emotional attachment and related explanatory variable. By integrating these constructs into the ECM-ISC, the present study will provide a convincing explanation of seniors' Cognitive-Affective-Conative process of MSNS continuance using intention. The integrated model is constructed as described in the following.

Perceived ease of use which originated from TAM established by Davis [56] was integrated into the model in the cognitive part. In the post-adoption phase, perceived ease of use is still an important influence factor for the seniors' MSNS continuance usage behavior. Because it is not easy for them to improve operational proficiency. Some seniors have made a lot of efforts to learn how to use MSNS, but soon they forgot how to use it. They may still encounter many operational difficulties after the adoption. If they feel the MSNS is easy to use, it will strengthen their willingness to continue use. Although perceived ease of use was excluded in ECM-ISC by Bhattacherjee for the inconsistent relationship with satisfaction by informal test, some subsequent IS studies still demonstrated that perceived ease of use is positively related to satisfaction [26, 57, 58].The relationship between perceived ease of use and the usage intention of information systems is different for various categories of

users [59]. Thus, we incorporate perceived ease of use into the research model.

Computer anxiety and decreased physical function, which are two prominent features for senior users, affect perceived ease of use. Most of seniors begin to use the internet when they reach middle age or even older age. Computer anxiety is a common psychological barrier for seniors when using the MSNS product. On the other hand, along with the growth of age, the memory, vision and body flexibility of the senior will decline. Decreased physical function is an important difference between the senior and young user, which brings inconvenient to the operation of MSNS for the seniors. Thus, the effects of computer anxiety as well as physical function decline on the perceived ease of use will also be analyzed.

Satisfaction is the only affective factor in ECM-ISC which concerns the transient affect associated with prior user experience [60]. For some senior users, MSNS is not only a tool, but also a channel for maintaining emotion. Some senior users who continue to use MSNS are very active in it and even stick to it. MSNS has become indispensable part of their lives. Thus, satisfaction is insufficient to explain the long-term stable emotional linkage mechanism behind this phenomenon.

Emotional attachment theory as the optimal framework for interpreting intimacy can explain the enduring and stable affect relationship [60]. Strong emotions attachment will lead the user to spend more time and energy [33]. Thus, emotional attachment as a more enduring and stable affect variable is incorporated into the model in affective part to compensate the deficit of satisfaction in ECM-ISC. At the same time, the forming path of emotion attachment will also be analyzed based on the ARC model.

The conceptual model is depicted in Fig. 1. In the integration model, the cognitive factors including confirmation of expectations, perceived usefulness and perceived ease of use are included. The affective factors include satisfaction and emotional attachment. The conative factor will be explained by continuance intention.

3.2 Cognitive stage

3.2.1 Confirmation of expectations

Confirmation of expectations refers to users' perception of the coincidence degree between information system usage expectation and actual usage feeling [21]. According to the cognitive dissonance theory, seniors may feel psychological tension or cognitive dissonance if their pre-adoption usefulness experiences are not confirmed in the process of actual use. The users will adjust their usefulness perceptions to remedy the cognitive dissonance. For the senior user, they may not have a clear usefulness perception before the acceptance. Their expectations may be low when they are
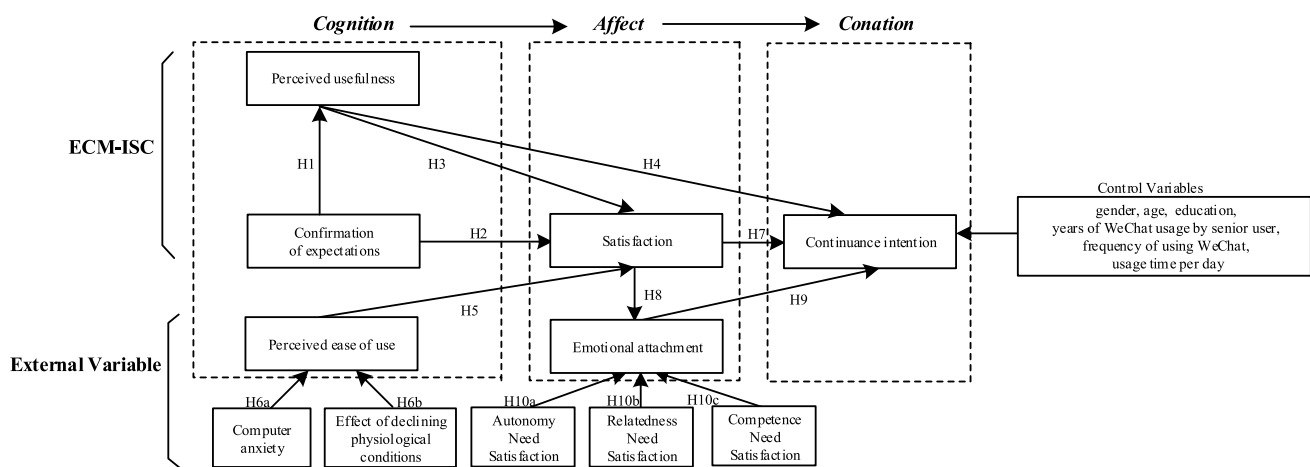
Fig. 1 Research model

uncertain about the benefits of MSNS, and the sense of usefulness will increase when they realize the benefits of MSNS with increasing of usage experience. Some researches note that the confirmation of expectations would promote users' perceived usefulness and disconfirmation would weaken perceived usefulness [27].

Confirmation of expectation indicates the realization of the expected usefulness or benefits of MSNS using, while disconfirmation of expectation indicates failure to fulfill the initial expectation. According to the ECT (Expectation-Confirmation Theory), confirmation of expectations formed by actual use are positively associated with the user satisfaction. Numerous studies also showed that confirmation is a significant positive determinant factor for the user satisfaction [27, 61]. Thus, this study hypothesizes that:

H1 Seniors' confirmation of expectations of MSNS is positively associated with their MSNS perceived usefulness;

H2 Seniors' confirmation of expectations of MSNS is positively associated with their satisfaction with MSNS.

3.2.2 Perceived usefulness

Perceived usefulness refers to the degree to which the information system can help the users in achieving their goals [56]. The seniors will find the information system is useful and then continue to use when it is helpful to reach a certain target. MSNS can facilitate information searching and relationship cultivation for the seniors. For example, several studies showed that MSNSs are used for tourism information searching, word-of-mouth and health knowledge reading [17, 62]. It is also helpful to bridge the geographic gap, especially for the seniors who live alone or far away from the children. Several studies showed that user satisfaction

with the SNS was positively affected by perceived usefulness [63]. Perceived usefulness of online service websites positively affects users' continuance using intentions [52]. Therefore, this study hypothesizes that:

H3 Seniors' perceived usefulness of MSNS is positively associated with their satisfaction with MSNS;

H4 Seniors' perceived usefulness of MSNS is positively associated with their MSNS continuance intention.

3.2.3 Perceived ease of use

Perceived ease of use refers to the potential users' perception of effortless using of the new technology. Previous studies showed that perceived ease of use was positively related to satisfaction. For example, Liao et al. [57] suggested that perceived ease of use of Cyber University System is positively associated with users' satisfaction. Liu et al. [58] showed that perceived ease of use is positively related to users' satisfaction toward using internet. Carillo et al. [26] found that there is a positive relationship between the level of perceived ease of use and the level of satisfaction in the context of ubiquitous media systems. Nowadays, most social media designs have ignored the needs and user accessibility of the seniors who will become the majority users [64]. For example, small and artistic fonts of the web pages make reading difficult, not easy to identify functional buttons, not clearly aware of the classification of the menu on the website, text input complexity, clumsy in using the hardware and so on [65]. All of these difficulties will affect the perceived ease of use of senior users and further influence their satisfaction. Thus, according to the prior research, the hypothesis is proposed as following:

H5 Seniors' perceived ease of use is positively associated with their satisfaction with MSNS.

Computer anxiety is defined as the fear and uneasiness feeling when people use computers [66]. A large number of empirical studies showed that computer anxiety is negatively related to perceived ease of use [67, 68]. Various barriers may cause computer anxiety to seniors. For example, the complexity of computer hardware and software operations, the lack of computer-related knowledge experience and the low computer self-efficacy will make seniors feel anxiety when operating computers and using related software. This sense of anxiety further affects the seniors' perception of information product usability. Thus, computer anxiety has become the main obstacle for the seniors' adoption and continuous usage of information products [69]. Therefore, this study hypothesizes that:

H6a Seniors' computer anxiety is negatively associated with their perceived ease of use with MSNS.

The effect of declining physiological conditions refers to the consequence caused by declining physiological conditions which reflect as limited mobility, greater effort needed to daily activities and so on. The effect of declining physiological conditions of seniors will cause them to feel inconvenient or uneasy to using new information products [70]. For example, vision degeneration makes difficult for seniors to see the text contents or images on the web page. Muscle degeneration and slow nerve conduction velocity cause their fingers to be less flexible in the operation of the mouse, and declining memory causes they can't remember the sequence of operations clearly.

In general, due to the effect of declining physiological conditions for senior, more difficulties are caused in information technology products use, which will decrease the perceived ease of use of MSNS. Therefore, this study hypothesizes that:

H6b The effect of declining physiological conditions for seniors is negatively associated with their perceived ease of use with MSNS.

3.3 Affective stage

3.3.1 Satisfaction

Satisfaction refers to users' overall fulfillment emotional state based on the expectation- confirmation judgement of a product or service. Ding and Chai's [71] study revealed that positive emotions are positively associated with continuance intention. Satisfaction is a positive emotion which relates to the users' prior expectation. The seniors will be satisfied if the functions of MSNS meet or exceed their prior expectations. The positive effect of satisfaction on users' continuous usage intention has been empirically tested in different environments such as Instant Messaging, Blog, Photo-sharing, Check-in and Note-taking apps [72–76]. Satisfied users will be more loyal. Satisfied elderly users have higher usage rates than unsatisfied senior users. Therefore, this study hypothesizes that:

H7 Seniors' satisfaction with MSNS is positively associated with their MSNS continuance intention.

Satisfaction is a direct and transient emotion while attachment is a stable and enduring emotion, and they are interdependent with each other. For example, in the context of marketing, if the brand fails to meet or exceed the users' satisfaction at the outset, the users' desire to use the brand will decrease. The possibility of developing a deeper relationship between the user and the brand will also be reduced. Thus, satisfaction is the cornerstone of brand attachment's formation. In the same way we would expect that the greater satisfaction the greater likelihood of senior user attaching to MSNS. Therefore, this study hypothesizes that:

H8 Seniors' satisfaction with MSNS is positively associated with their MSNS attachment.

3.3.2 Emotional attachment

The most important feature of attachment is strong motivation and behavior orientation [77]. Numerous psychological researches had verified the relationship between attachment and various social behaviors [78]. Four unique behaviors related to attachment have been identified in the field of mother and infant attachment: (1) proximity seeking; (2) secure-base behavior; (3) safe haven; (4) separation distress. In the marketing context, several studies showed that consumers who are emotionally attached to the products are more likely to devote more time and energy, undertake more demanding behavior, such as word-of-mouth, premium purchase and so on [33, 79]. In the information system context, some researchers found that higher levels of users' emotional attachment to large online community sites will motivate more retention and participation on the sites [80, 81]. Thus, this study posits that seniors' attachment to the MSNS will lead to continuance intention:

H9 Seniors' emotional attachment with MSNS is positively associated with their MSNS continuance intention.

3.3.3 Need satisfaction and emotional attachment

Autonomy need satisfaction from MSNS refers to the fulfillment emotional state of having the authority to make the decision by one's own choice, self-governance in using MSNS. Autonomy needs can be satisfied via MSNS in the following aspects: as a typical application of the Web 2.0, MSNS provide a variety of functions that allow participants to choose and communicate freely [82]. On the one hand, content can be accessed from MSNS without limitation of time and space. MSNSs also allow seniors to freely choose what to share and how to present themselves (i.e., read, listen to, public of log and personal status et al.). On the other hand, on MSNSs, seniors can freely express their opinions and engage in behavior that reflects their true self without being constrained by the influence of others in the real-life social. This brings a greater feeling that they are self-chosen and self-governed in using MSNS, which satisfies the autonomy need. The existing studies showed that the satisfaction of autonomy need is a significant positive indicator of attachment [41–43, 48]. Thus, based on the existing studies, we propose that the function of MSNSs enable seniors to experience the autonomy need satisfaction which contributing to the formation of attachment toward MSNS:

H10a The more autonomy need satisfaction from MSNS, the greater attachment to the MSNS will be formed for the seniors.

Relatedness need satisfaction from MSNS refers to the emotional fulfillment state of being cared about or avoid feeling isolated in using MSNS. Relatedness need can be satisfied via MSNS in the following aspects: on the one hand, MSNSs provide a good channel to communicate with the family members and friends, especially for the senior with limited mobility [83], which is helpful to obtain emotional support and intimate experiences. On the other hand, MSNSs provide abundant and diversified information, which not only helps the seniors know more about the outside world, but also increases the seniors' life fun and reduces the feeling of loneliness. In addition, MSNSs can make personalized recommendations based on the senior user's browsing history and some MSNSs platform even send blessings on special holidays, which makes the senior feel the MSNS knows what they want and therefore feel closeness. Generally, MSNS are helpful to decrease the depression, social isolation and obtain the feeling of being cared for [84], which will bring the feeling of relatedness need satisfaction for the seniors. Prior studies indicated that relatedness need satisfaction is positively related to the attachment [41–43, 45, 48]. Thus, based on the prior studies, we proposed that the function of MSNS enables the senior to experience the

relatedness need satisfaction which is positively related to the formation of attachment toward MSNS:

H10b The more relatedness need satisfaction from MSNS, the greater attachment to the MSNS will be formed for the seniors.

Competence need satisfaction from MSNS refers to the fulfillment emotional state of achievement or effectiveness in using MSNS. Competence needs can be satisfied via MSNS in the following aspects: first, the virtual community in MSNS provides opportunities for the seniors to contribute knowledge and show their talents when they engage in certain activities. Some senior users even become opinion leaders which is helpful to display skillfulness and bring the feeling of achievement. Second, some MSNS provide simple practical tools. For example, life payment, ticket purchase, accessing pension details, access to health care services and so on, greatly facilitate the daily life of the seniors, especially for those with reduced mobility [5]. The usage of these tools in MSNSs greatly improves the sense of effectiveness in dealing daily affairs. The sense of achievement and effectiveness from the usage process of MSNSs would satisfy the competence needs for senior users. Prior studies showed that satisfaction of competence need has a positive relationship with attachment [41–43, 45–48]. Thus, based on the exiting researches, we propose that the function of MSNS enables the senior to experience the competence need satisfaction which contributing to the formation of attachment toward MSNS:

H10c The more competence needs satisfaction from MSNS, the greater attachment to the MSNS will be formed for the seniors.

3.4 Mediation role of the affective factors

3.4.1 General mediation role of satisfaction

According to the ECM, expectation confirmation and perceived usefulness had indirect effect on IS continuance intention via the satisfaction [21]. Consumers will predict the utility of products or services, and when the actual utility reaches or exceeds expectations, consumers will be satisfied and continuously use the product or service. On the contrary, when its actual performance fails to meet users' expectations, consumers' satisfaction will decline or they may even give up using the product or service [85]. Ooi et al. [86] also found that perceived ease of use and perceived usefulness of mobile social learning platforms are positively associated with users' satisfaction which further leaded to continuance using. Thus, based on the prior studies, we posit that perceived usefulness, perceived ease of use and confirmation of

expectation indirect influences the seniors' MSNS continuance intention via satisfaction:

H11a Satisfaction mediates the relationship between perceived usefulness and continuance intention;

H11b Satisfaction mediates the relationship between confirmation of expectation and continuance intention;

H11c Satisfaction mediates the relationship between perceived ease of use and continuance intention.

3.4.2 Multiple mediation role of satisfaction and emotional attachment

Both the cognitive and affective factors influence the users' continuance intention in the IT context [20]. Cognition, affect and conation influence each other progressively, following the sequence of cognitive-affective-conative [20]. Among them, cognition is an important beginning predictor of users' affect, which will further associate with the continuance intention. Prior work has shown that confirmation of expectations, perceived usefulness and perceived ease of use are positively associated with satisfaction [26, 27, 58, 61, 63]. Meanwhile, satisfaction positively related to the continuance intention through emotional attachment [86, 87]. Thus, we posited that expectation confirmation, perceived ease of use and perceived usefulness are positively related to the satisfaction, and satisfaction will further relate to continuance intention via emotional attachment:

H12a Satisfaction and emotional attachment have multiple mediating effects between expectation confirmation and continuance intention;

H12b Satisfaction and emotional attachment have multiple mediating effects between perceived ease of use and continuance intention;

H12c Satisfaction and emotional attachment have multiple mediating effects between perceived usefulness and continuance intention.

Based on the above hypotheses, the conceptual model is proposed as shown in Fig. 1. This model examines the key factors that influence the seniors' MSNS continuance using intention. Meanwhile, according to prior research, MSNS users' continuance intention may be influenced by demographic factors [88]. In order to take full consideration of individual different factors that may influence continuance intention, the present research included gender, age and education as the control variables for continuance intention. In

addition, years of WeChat usage by senior user, frequency of using WeChat, and usage time per day were also considered.

4 Method

4.1 Measurement

Eleven reflective constructs were included in the research model. The initial questionnaire includes 37 items. All constructs were measured with multiple-item perceptual scales. All of the items were adapted from the extant literature which have been pre-validated with higher validity and reliability. At the same time, most of the scales referred to in this study have a similar status to the present study. We also revised it according to the characteristics of the MSNS senior users. To ensure consistency, all items were translated into Chinese firstly by one researcher. After that, another researcher translated it into English. Items by Bhattacherjee [21] were used to measure the constructs of confirmation of expectations, satisfaction, continuance intention. Confirmation of expectations and satisfaction were measured by three items. Continuance intention were measured by four items. Three items of perceived usefulness were adapted from Bhattacherjee [21] and Li and Zhao [89]. Items from Phang et al. [70] were used to measure the constructs of perceived ease of use, computer anxiety and the effect of declining physiological conditions and each construct with three items. Three items of emotional attachment were adapted from Kim et al. [18]. Items from Thomson [43] and Ahn and Back [48] were used to measure the constructs of autonomy need satisfaction, relatedness need satisfaction and competence need satisfaction and each construct with three items.

At the beginning of the questionnaire, the instruction was designed to explain the purpose and significance of the survey, the methods and requirements for completing the questionnaire, the anonymity and confidentiality of the questionnaire and the unit of investigation. There were two sections in the main body of this questionnaire. The first section included the demographic questions of respondents and WeChat using experience. The second section included feature questions to measure the research model constructs. A seven-point Likert scale was used to measure the each item, which ranges from 1 to 7 (1 = "strongly disagree"; 7 = "strongly agree").

In order to ensure content validity, three professors in the research field of MSNS and senior user behavior of IS were invited to evaluate whether the questionnaire was suitable to evaluate the seniors' MSNS using behavior. They were also required to check whether some measurement items were needed to add, delete or reword. Then, the revised questionnaire was pre-tested on 20 MSNS senior users aged 60-year-old and above. According to their feedback, several

items were modified to ensure understandability and internal consistency among each construct. For example, one item was deleted from continuance intention for overlapping meaning (e.g., "I intend to use MSNS for a long time in the further"). Some ambiguous items, i.e., declining physiological conditions, autonomy need satisfaction and competence need satisfaction were reworded to ensure comprehensibility and clarity. In total there were 36 question items in the main part of the questionnaire except the questions referring to the descriptive demographic information and WeChat using experience which were available at the beginning of the questionnaire. The final items of measurement scales used in the survey are listed in "Appendix A".

4.2 Sampling design

In China, WeChat is the most popular social software for seniors. By the first quarter of 2019, the WeChat active users reached 1.1 billion, and over 61 million of the users were aged between 55 and 70. Comparing with the other early SNS products, for example QQ and Weibo, the senior users prefer to use WeChat [90]. Because of the good user experience and operability, some senior users who have no computer knowledge or know nothing about the network can also operate it. Even some senior users start to access the Internet and use cellphones from WeChat [90]. According to the report of WeChat Life and Family Feeding for the Elderly [91], the average daily length of using WeChat for the senior users is 1.37 h, which is only 0.49 h less than that of the young users. For most of senior users, WeChat has become an indispensable part in their daily life. It has become a normal life state to chat with friends, read and share information through WeChat. In China, WeChat senior users are the most typical representatives of MSNS senior users. At the same time, WeChat senior users have a higher rate of continuance usage. Thus, they were selected as the research respondents.

There are various definitions of a senior person, according to different studies, for example, 50-year-old or above [16], 55-years-old or above [19] and 60-year-old or above [12]. According to the Law of the People's Republic of China on the Protection of the Rights and Interests of Seniors, people who are 60-year-old or above can be defined as senior. Considering the research background of the present study is in China, the senior age is defined as 60 years and over.

The total sample size required is 218 which calculated by Gpower3.1. In order to efficiently collect the sample, a professional questionnaire platform (Wen Juan Xin) was employed. Quota sampling was used to collect the data. Firstly, we published the questionnaire on Wen Juan Xin. A total of 420 WeChat senior users (60-year-old and above) were randomly selected from the panel database of Wen Juan Xin. Then, by WeChat account of selected

respondents reserved in the panel database, we contacted these senior respondents and forwarded the questionnaire to them. At the same time, we explained the purpose of the survey and the method of answering the questionnaire. The selected respondents were also asked about the WeChat using experience, if the participant does not continuously use WeChat, the follow-up survey will not be conducted. In the process of filling out the questionnaire, if the respondents omit to answer some questions, when they click the next page, the system automatically jumped to the unanswered question and prompted the respondents in the red font. The respondents could skip to the next page until they completed all the questions on the current page. If there was an unanswered question, the questionnaire could not be submitted successfully. After answering all of the questions, a lottery page appeared. The participants who completed the questionnaire would randomly pick up some prizes, such as 20 RMB telephone charges, Mi sports bracelet and so on. If the questionnaires were completed too quickly, or with obvious repetition pattern, the system would identify it and dropped out. Finally, 374 valid questionnaires were obtained. "Appendix B" shows the basic information of the sample.

4.3 Statistical analysis

Two tests were conducted to examine the CMV (common method variance). Firstly, we carried out Harman's single factor test. The results of this analysis showed that the largest variance is 12.73% which was explained by an individual factor. Therefore, the majority of the variance cannot be explained by any one of the factors on its own. Secondly, all items were modeled as indicators of a factor representing the method effect. A weak fitness was indicated by the results. For instance, GFI (the goodness of fit index) is 0.541 (< 0.9). RMSEA (the root means square error of approximation) is 0.145 (> 0.08). Therefore, based on above tests, we can indicate that CMV will not significantly affects this quantitative research.

5 Data analysis

Data analysis was conducted by structural equation modeling (SEM) analysis by SPSS22.0 and AMOS 24.0. SEM was performed by two-step method [92]: first, we tested the validity and reliability of the measurement model by confirmatory factor analysis (CFA); Second, we examined the research hypotheses and model fitness of the structural model.

5.1 Estimation of the measurement model

5.1.1 Evaluation of validity

Convergent validity and discriminant validity were tested to evaluate the construct validity by confirmatory factor analysis (CFA). As shown in Table 1, all the items' standardized path loading is greater than 0.70 and T values indicates that all loadings are significant at 0.001 level. The average variance extracted (AVE) of each construct is greater than 0.5 and the composite reliability (CR) of each construct is greater than 0.7. Therefore, convergent validity is confirmed [93]. Discriminant validity was assessed by comparing the square root of AVE and correlation coefficients [94]. The results listed in Table 2 showed that the square root of

AVE is significantly higher than its correlation coefficients between each pair of constructs in all cases. Therefore, the discriminant validity is verified.

5.1.2 Evaluation of reliability

Cronbach's alpha, composite reliability and AVE coefficients were used to evaluate the reliability. As shown in Table 1, the values of these statistics are clearly larger than the required minimum values, thus, suggesting good reliability.

5.2 Estimation of the structural model

Actual results and recommended values of fit indices of the structural model are listed in Table 3.

Table 1 Standardized loadings, AVE, CR and Alpha values

Factor	Item	Standardized loading	Alpha	CR	AVE
Confirmation of expectations (CE)	CE1	0.732	0.814	0.834	0.626
	CE2	0.824			
	CE3	0.815			
Satisfaction (SA)	SA1	0.846	0.795	0.876	0.703
	SA2	0.792			
	SA3	0.875			
Continuance intention (CI)	CI1	0.845	0.854	0.857	0.668
	CI2	0.861			
	CI3	0.741			
Perceived usefulness (PU)	PU1	0.946	0.792	0.889	0.728
	PU2	0.842			
	PU3	0.762			
Perceived ease of use (PEU)	PEU1	0.843	0.864	0.854	0.662
	PEU2	0.742			
	PEU3	0.852			
Computer anxiety (CA)	CA1	0.916	0.741	0.926	0.807
	CA2	0.841			
	CA3	0.935			
Effect of declining physiological conditions (EDPC)	EDPC1	0.847	0.762	0.822	0.608
	EDPC2	0.741			
	EDPC3	0.746			
Emotional attachment (EA)	EA1	0.837	0.894	0.885	0.719
	EA2	0.844			
	EA3	0.862			
Autonomy need satisfaction (ANS)	ANS1	0.691	0.810	0.781	0.545
	ANS2	0.706			
	ANS3	0.811			
Relatedness need satisfaction (RNS)	RNS1	0.728	0.792	0.831	0.622
	RNS2	0.812			
	RNS3	0.823			
Competence need satisfaction (CNS)	CNS1	0.786	0.756	0.854	0.661
	CNS2	0.854			
	CNS3	0.798			

According to the recommended value in the previous studies [95–97], all the fit indices are larger than the recommended values. Thus, these model-fit indices are acceptable.

5.2.1 Main effect test

The standardized path coefficients and corresponding significance are listed in Fig. 2. All hypotheses are supported by the data except H6b and H10a. The confirmation of expectations was positively associated with perceived usefulness ($\beta = 0.42$, $p < 0.01$) and satisfaction ($\beta = 0.46$, $p < 0.01$), respectively, therefore H1 and H2 are supported.

Perceived usefulness was positively associated with satisfaction ($\beta = 0.31$, $p < 0.01$) and continuance intention ($\beta = 0.22$, $p < 0.01$), therefore H3 and H4 are supported. Perceived ease of use was positively associated with satisfaction ($\beta = 0.34$, $p < 0.01$), thereby confirming H5. Meanwhile, computer anxiety ($\beta = -0.32$, $p < 0.01$) was negatively associated with perceived ease of use, thereby confirming H6a. Satisfaction was respectively positively associated with continuance intention ($\beta = 0.23$, $p < 0.01$) and emotional attachment ($\beta = 0.15$, $p < 0.01$), therefore H7 and H8 are confirmed. Emotional attachment ($\beta = 0.47$, $p < 0.01$) positively associated with continuance intention,

Table 2 The square root of AVE and factor correlation coefficients

	CE	SA	CI	PU	PEU	CA	EDPC	EA	ANS	RNS	CNS
CE	0.791										
SA	0.514	0.838									
CI	0.125	0.546	0.817								
PU	0.165	0.412	0.465	0.853							
PEU	0.365	0.358	0.469	0.269	0.814						
CA	0.452	0.214	−0.146	0.456	0.486	0.898					
EDPC	0.214	−0.165	0.147	−0.214	−0.156	0.351	0.780				
EA	0.512	−0.147	0.416	0.365	0.249	0.349	0.549	0.848			
ANS	0.328	0.289	0.259	−0.264	0.278	−0.165	−0.246	0.548	0.738		
RNS	0.249	0.254	0.451	−0.214	0.418	0.249	0.346	−0.115	0.459	0.789	
CNS	−0.175	0.179	0.264	0.165	0.321	0.218	.0249	0.214	−0.26	−0.216	0.813

Table 3 Overall model indices for the research model and the recommended fit indices

Fit indices	Chi^2/df	GFI	AGFI	CFI	NFI	NNFI	RMSEA
Recommended value	< 3	> 0.9	> 0.8	> 0.9	> 0.9	> 0.9	< 0.08
Actual value	2.21	0.915	0.826	0.932	0.942	0.936	0.034

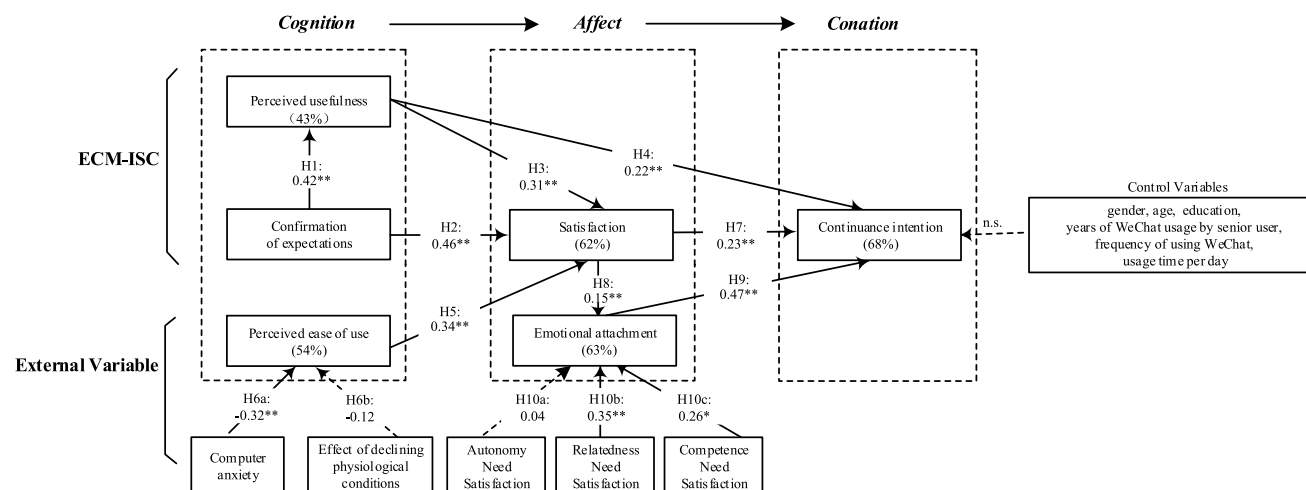Chi^2 = 1067.43, df = 483, $p < 0.01$

Fig. 2 Structural model. (*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$)

thereby confirming H9. Finally, both relatedness need satisfaction ($\beta = 0.35$, $p < 0.01$) and competence need satisfaction ($\beta = 0.26$, $p < 0.05$) are positively associated with the emotional attachment, thereby H10b and H10c are confirmed.

All of the control variables, such as age ($\beta = -0.02$, $p > 0.1$), gender ($\beta = 0.03$, $p > 0.1$), education ($\beta = 0.01$, $p > 0.1$), years of WeChat usage by senior user ($\beta = 0.01$, $p > 0.1$), frequency of using WeChat ($\beta = -0.01$, $p > 0.1$), and usage time per day ($\beta = -0.02$, $p > 0.1$) were found to be insignificant.

Figure 2 illustrates the R^2 of the proposed research model and the path coefficients of the research model. The confirmation of expectations explains 43% of variance in the perceived usefulness ($R^2 = 0.43$). Computer anxiety explains 54% of variance in the perceived ease of use ($R^2 = 0.54$). Perceived usefulness, confirmation of expectations and perceived ease of use explain 62% of variance in satisfaction ($R^2 = 0.62$). Relatedness need satisfaction and competence need satisfaction explain 63% of the variance in emotional attachment ($R^2 = 0.63$). Perceived usefulness, satisfaction and emotional attachment explain 68% of variance in continuance intention ($R^2 = 0.68$).

5.2.2 Mediation effect test

Following the studies of Nitzl et al. [98] and Gong et al. [99], we performed the two-step bootstrapped confidence intervals (CIs) mediation test.

In step 1, we determine the significance of indirect effects. If 95% of CIs of the indirect effect do not include zero, it can be assumed that the indirect effect is significant. Thus, as shown in Table 4, the 95% CIs of indirect effect of both the general mediation relationship and multiple mediation relationship do not include zero, thereby these six indirect effects are significant. H11 a, b, c and H12 a, b, c are therefore supported.

As shown in Table 4, (1) Path a_{1-n} (i.e., a_1, a_2, $a_3 \dots a_n$) refers to the path from independent variables to the first

mediating variables; (2) Path a_{1-n}' (i.e., a_1', a_2', $a_3' \dots a_n'$) refers to the path from the first mediating variables to the second mediating variables; (3) Path b_{1-n} (i.e., b_1, b_2, $b_3 \dots b_n$) refers to the path from the last mediating variables to the dependent variables; (4) For the general mediation relationship H11a,b,c, the indirect effect is calculated by $a_{1-n}b_{1-n}$ (i.e., $a_{1*}b_1$, $a_{2*}b_2$, $a_{3*}b_3$) [98], for example H11a = 0.31*0.23; For the multiple mediation relationship H12a,b,c, the indirect effect is calculated by $a_{4-n}a_{1-n}'b_{4-n}$ (i.e., $a_{4*}a_1'{}_*b_4$, $a_{5*}a_2'{}_*b_5$, $a_{6*}a_3'{}_*b_6$) [98]: H12a = 0.31*0.15*0.47. The indirect effect values of H11a,b,c and H12a,b,c are listed in Table 5.

In step 2, we determine the significance of direct effect and the mediation effect type. For general mediation relationship, the direct effect c_{1-n} (i.e., c_1, c_2, c_3) refers to the direct path from independent variables to the dependent variables when simultaneously considered with path a_{1-n} and path b_{1-n}. For multiple mediation relationship, direct effect c_{4-n} (i.e., c_4, c_4, c_6) refers to the direct path from independent variables to the dependent variables when simultaneously considered with path a_{4-n}, path a_{1-n}' and path b_{4-n}. Similarly, if 95% of CIs of direct effect do not include zero, it can be assumed that the direct effect is significant. Thus, as shown

Table 5 Indirect effect

Indirect hypothesis	Indirect effect value	Supported or not
General mediation relationship		
H11a: PU→SA→CI	0.07**	Yes
H11b: CE→SA→CI	0.11**	Yes
H11c: PEU→SA→CI	0.08**	Yes
Multiple mediation relationship		
H12a: PU→SA→EA→CI	0.02**	Yes
H12b: CE→SA→EA→CI	0.03**	Yes
H12c: PEU→SA→EA→CI	0.02**	Yes

$*P < 0.05$; $**P < 0.01$; $***P < 0.001$

Table 4 Bootstrapped conidence intervals (CIs) mediation test

	95% CIs	Significance or not	95% CIs	Significance or not	Mediation type
General mediation relationship	Indirect effect(ab)		Direct effect (c)		
H11a: PU(a_1)→SA(b_1)→CI(c_1)	[0.058, 0.196]	Yes	[0.069, 0.198]	Yes	Partial
H11b: CE(a_2)→SA(b_2)→CI(c_2)	[0.083, 0.215]	Yes	[−0.07, 0.34]	No	Full
H11c: PEU(a_3)→SA(b_3)→CI(c_3)	[0.060, 0.194]	Yes	[−0.02, 0,15]	No	Full
Multiple mediation relationship	Indirect effect (a a'b)		Direct effect (c)		
H12a: PU(a_4)→SA(a_1')→EA(b_4)→CI(c_4)	[0.034, 0.145]	Yes	[0.036, 0.153]	Yes	Partial
H12b: CE(a_5)→SA(a_2')→EA(b_5)→CI(c_5)	[0.043, 0.156]	Yes	[−0.04,0.35]	No	Full
H12c: PEU(a_6)→SA(a_3')→EA(b_6)→CI(c_6)	[0.037, 0.113]	Yes	[−0.05,0.31]	No	Full

in Table 4, the direct effect of c_1 and c_4 is significant, c_2, c_3, c_5, c_6 are insignificant.

If both the indirect effect and the direct effect are significant, a partial mediation exists. If the indirect effect is significant and the direct effect is insignificant, a full mediation exists [98, 99]. Thus, the results show that satisfaction partly and fully mediated the effects of perceived usefulness, perceived ease of use and confirmation of expectations on continuance intention. Satisfaction and emotional attachment jointly partly and fully mediated the effects of perceived usefulness, perceived ease of use and confirmation of expectations on continuance intention.

5.2.3 Total effects test

Following the studies of Gong et al. [99], we examined the total effects of all the cognition factors and affective factors on continuance intention. Differently to the direct effect in Table 4, the direct effect in Table 6 refers to the direct path from independent variables to dependent variables without consider the mediation path. The indirect effect is the total indirect effect between independent variables and dependent variables. For example, the indirect effect between perceived usefulness and continuance intention = the indirect effect value of "PU → SA → CI" + the indirect effect value of "PU → SA → EA → CI" = 0.31* 0.23 + 0.31*0.15*0.47; The indirect effect between confirmation of expectations and continuance intention = the indirect effect value of "CE → SA → CI" + the indirect effect value of "CE → PU → CI" + the indirect effect value of "CE → PU → SA → CI" + the indirect effect value of "CE → SA → EA → CI" + the indirect effect value of "CE → PU → SA → EA → CI" = 0.46*0.23 + 0.42*0.22 + 0.42* 0.31*0.23 + 0.46*0.15* 0.47 + 0.42* 0.31*0.15*0.47; The total effect is equal to the direct effect plus indirect effect.

The result are shown in Table 6. The total effect of influence factors on continuance intention in the model, from large to small, is emotional attachment, perceived usefulness, satisfaction, confirmation of expectations, perceived ease of use.

6 Discussion

Based on the above statistical analysis, the intrinsic relationships between cognitive factors and emotional factors in the forming process of seniors' MSNS continuance using intention were specifically discussed.

We have examined the direct and indirect relationship between cognitive, affective factor and continuance intention to explore how cognitive and affective factors, together affect continuance intention.

First, the direct relationships between cognitive factor and affective factor were analyzed. As shown in Fig. 2, most of the direct paths were supported by the results.

From cognitive to affective stages, H2, H3 and H5 were supported and reflect the direct relationship between cognitive factor and affective factor. Confirmation of expectations is positively associated with satisfaction. This suggests that the higher the confirmation of expectation, the higher the satisfaction, which corresponds with the finding of Oghuma et al. [99]. Perceived usefulness positively relates to satisfaction, which implies that promoting the utilitarian value of MSNSs is helpful to improve the seniors' product satisfaction. Perceived ease of use has a positive direct association with satisfaction, which corresponds with the finding of Carillo et al. [26]. Perceived ease of use is still an important factor when considering some special user groups. The conclusion that the perceived ease of use has different effects in different age groups [59] is confirmed. In addition, H6a was supported implying that computer anxiety has a negative association with perceived ease of use. When senior users experience computer anxiety, they will think that MSNS products are difficult to operate. This finding implies that negative mood negatively affects the perception of ease of use of information products.

From affective stage to conative stage, H7 and H9 were supported, reflecting the direct relationship between affective factor and conative factor. Satisfaction and emotional attachment have a direct positive association with continuance intention, which corresponds with the findings of Ding [72], Ren et al. [80] and Jin et al. [81]. This result indicates

Table 6 Direct, Indirect and Total Effect Test

Independent variables	Dependent variables	Direct effect	Indirect effect	Total effect
Emotional attachment	Continuance Intention	0.47**	–	0.47**
Perceived usefulness	Continuance intention	0.22**	0.09**	0.31**
Satisfaction	Continuance intention	0.23**	0.07**	0.30**
Confirmation of expectations	Continuance Intention	–	0.27**	0.27**
Perceived ease of use	Continuance intention	–	0.10**	0.10**

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$

that both satisfaction and emotional attachment are positive affected, which are crucial for the formation of loyalty.

At the same time, H4 was supported, which reflects the relationship between cognitive and conative factor. The direct association between perceived usefulness and continuance intention implies that product usefulness will directly motivate senior users to continue using MSNS when they feel it is useful. H1 was supported reflecting the direct positive relationship between confirmation of expectations and perceived usefulness. This suggests that seniors' perception of MSNS usefulness may be adjusted by the extent of confirmation.

Secondly, as shown in Table 5, all of the indirect paths were supported by the results. The indirect relationship between cognitive factor and affective factor reflected the Cognitive-Affective-Conative formation process of seniors' MSNS continuance using intention. The indirect relationship between the cognitive and affective factors were analyzed as presented in the following.

H11a,b,c were supported, which implies that all of the cognitive factors including perceived usefulness, confirmation of expectations and perceived ease of use indirectly affect continuance intention via satisfaction. Satisfaction plays an important role as a mediator variable. These results indicate that the senior users will form cognition after using MSNS, which includes perceived usefulness, confirmation of expectations and perceived ease of use, and then make good or bad emotional evaluation that is satisfaction or dissatisfaction, which will further influence their continuance using intention.

H12a, b, c were supported which reflected the multi-mediating role of satisfaction and emotional attachment between three cognitive factors and continuance intention. These results imply that satisfaction, which is formed by evaluating the MSNS using experience in terms of perceived usefulness, confirmation of expectations and perceived ease of use, is positively associated with emotional attachment, which will further lead to continuance intention. Satisfaction and emotional attachment play a mediating role in this process. These results reflect the accumulation and transmission of emotions between satisfaction and emotional attachment, which corresponds with the findings of Lam and Shankar [87] and Ooi et al. [86]. At the same time, we extended the existing researches by adding the cognitive factors to discover the chain relationship between cognition and emotions.

Moreover, satisfaction and emotional attachment play a different mediator role between the cognitive and affective factors. Satisfaction and attachment partly mediate the relationship between perceived usefulness and continuance intention, which imply that a portion relationship between

perceived usefulness and continuance is mediated through satisfaction and attachment. Perceived usefulness still explains a portion of continuance intention that is independent of satisfaction and attachment. However, satisfaction and attachment fully mediate the relationship between perceived ease of use, confirmation of expectation and continuance intention, which implies that the relationship between perceived ease of use, confirmation of expectations and continuance intention is completely transmitted with the help of satisfaction and attachment.

As shown in the Table 6, the order of the total effect of cognitive and affective factors on the continuance intention is as follows, from large to small: emotional attachment, perceived usefulness, satisfaction, confirmation of expectations, perceived ease of use. Among these factors, emotional attachment plays the most important role. This finding implies that emotional attachment has a significant important association with continuance intention. This result is in line with the existing studies [17–19], which highlighted the important effect of attachment on users' revisit intention toward SNS in the context of tourism. Meanwhile, we extended the extant studies [17–19] by comparing the effect of cognitive factors and affective factors.

The results also indicated that satisfaction is directly associated with emotional attachment, which predicts a positive relationship between short-term emotion of satisfaction and long-term stable emotion of attachment. These results explore the formation path of emotional attachment. In addition, both satisfaction of relatedness need and competence need are positively associated with emotional attachment. In particular, the effect of relatedness need satisfaction on emotional attachment is stronger than that of satisfaction and competence need satisfaction on the emotional attachment. This suggests that pursuing being cared about or avoiding feelings of isolation is the main driver for seniors attaching to MSNSs. This result agrees with the extant works of Leist [100] and Chang et al. [101]. MSNSs are effective tools to help seniors to connect with the outside world regardless of location or time, narrowing the generation gap and promoting the communication of elderly people in their daily life, providing emotional and moral support, especially those who are physically inconvenient.

However, hypotheses H6b and H10a were not supported. H6b was not supported which shows that the effect of declining physiological conditions is not a significant influence factor of perceived ease of use. One possible reason is that most of MSNS senior users are people with relatively healthy and with a younger mentality. The declining of comprehension ability, vision and hearing loss is not obvious. Some elderly people can use magnifying glasses and other auxiliary tools to overcome physical dysfunction. Thus,

declining physiological conditions is not a significant factor to influence the perceived ease of use.

At the same time, H10a was not supported which implies that autonomy need satisfaction from MSNSs has an insignificant association with emotional attachment. One explanation is that the common feature of most current internet applications is also giving users enough freedom. In other words, the seniors' satisfaction of autonomy need can also be achieved when using other internet products. Therefore, users' autonomy need satisfaction which is met by MSNS cannot reach the level of user attachment.

7 Theoretical and practical implications

7.1 Theoretical implications

As theoretical implications, the present study makes the following contributions to academia.

First, with the increasing number of senior users in MSNS, maintaining the MSNS continuance usage behavior of senior users is of great significance for improving the competitiveness of social network platforms. However, the vast majority of MSNS continuance studies are mainly targeted at younger groups of users [7, 9, 10]. Thus, the present study expands MSNS usage research by exploring the formation of seniors' MSNS continuance usage intention.

Second, previous studies of seniors' MSNS usage behavior were mostly based on motivational theory [4, 6, 11, 12], social capital theory [13], socioemotional selectivity theory [14], UTAUT [5], diffusion of innovations, uses and gratifications theory as well as media richness theory [15, 16]. However, these studies rarely explore the process of Cognitive-Affective-Conative in the post-adoption stage. This study contributes to existing research work by extending the research scope to the continuance usage stage and discloses the underlying mechanism of cognition and affect interaction process of seniors' MSNS continuance usage intention. On the one hand, we examined the direct relationship between cognitive and affective factors, respectively, in the stage of cognitive-affective, affective-conative and cognitive-conative. On the other hand, we provided a more comprehensive cognitive-affective-conative formation mechanism by indirect paths tests. Unlike previous studies that only considered the general mediation effect of satisfaction [102–104], this study supplemented emotional attachment to further enrich the affective stage in this process. By investigating the multiple mediation effects of satisfaction and emotional attachment, the present research further explored the transfer effect of short-term emotion and stable emotion between cognition and intention. At the same time, based on the mediation effect type test, we further investigate the different mediation

types of satisfaction and emotional attachment between different cognitive factors and conative factor.

Third, in accordance with prior studies it is shown that emotional attachment is a significant factor for seniors' MSNS usage [17–19]. The present study extended these researches by comparing the cognitive factors (perceived usefulness, confirmation of expectation, perceived ease of use) and affective factors (satisfaction, emotional attachment) on continuance intention, and confirmed that emotional attachment has the strongest association with continuance intention among all antecedent variables. It explains the long-term and stable emotional connection mechanism between MSNS and senior users; this makes up the deficiency that the satisfaction variables in the ECM-ISC can only explain the short-term emotional state of the user. These findings confirm the importance of bridging emotional attachment to the MSNS, which extends the prior works on seniors' usage behavior.

Finally, this study verifies the different formation path of two different affective factors. For emotional attachment, formation path is the satisfaction of relatedness and competence needs. For satisfaction, the main formation path is confirmation of expectations, perceived ease of use and perceived usefulness. Thus, emotional attachment is mainly motivated by internal needs. Satisfaction is mainly influenced by the cognition factors. At the same time, this study confirms the relationship between satisfaction and emotional attachment. Satisfaction is significantly associated with emotional attachment. It explains the relationship between short-term and long-term affective factors.

7.2 Practical implications

From a practical perspective, findings from the present research imply that MSNS developers and operators should consider both cognition factors and affective factors in order to facilitate seniors' continuance using. The research also indicates that the forming process of continuance intention follows the Cognitive-Affective-Conative model which implies that affective factors play an important transmission function. Thus, in addition to improving the utilitarian value of the product, strengthening the emotional connection between the product and the user is a superior strategy.

Firstly, to achieve higher satisfaction, promoting perceived useful, confirmation of expectations and perceived ease of use of the product is a useful strategy. MSNS managers should understand the expectation of the MSNS product, optimize product performance (e.g., make the words larger, prominently display the most frequent items) based on the characteristics of senior users and improve their satisfaction with MSNS. The specific practical implications as following.

This study shows that perceived usefulness is an important factor. Based on our previous interviews with MSNS senior users, we found that information usefulness and social usefulness are the two important factors affecting seniors' satisfaction and continuance intention, implying that MSNS companies should enhance the perceived usefulness of MSNSs from the perspectives of information and social contacting. For MSNS practitioners, personalized information recommendation strategy can be implemented according to senior users' preferences (e.g., health, medical services, living tips and tourism), geographic location, friend' similarity and so on. At the same time, low-quality information should be filtered out to improve information quality. This can also be done by strengthening the social function of software, such as improving the quality of video and voice calls, designing senior versions to improve the user experience according to the usage habits of the seniors, guiding users to establish social groups based on their hobbies, experience, age, location and so on (e.g., schoolfellows, old army comrades and townsmen). Friend recommendation can be carried out according to the degree of association among users. For the vertical MSNS, some offline thematic communication activities can also be organized to increase the communication between senior users.

MSNS managers must understand senior users' expectations to design products that can meet or exceed their expectations for improving user satisfaction. Expectation management strategy can be performed to improve the competitiveness of MSNS companies. For example, companies should analyze the expectations and needs of senior users through interviews, product satisfaction surveys, user feedback, analyzing and evaluating senior users' expectations and needs in order to find effective treatments, giving prompt feedback based on their expectations and needs evaluation. At the same time, due to various influence factors, senior users' expectations will be changed. Thus, the management strategy should be adjusted dynamically according to the situation.

MSNS companies must be aware that perceived ease of use is an important influence factor for seniors' MSNS usage satisfaction. At the same time, computer anxiety indirectly influences satisfaction through perceived ease of use. Thus, MSNS designers must understand the physical and mental characteristics of the seniors to avoid complex designs. For example, providing a voice message function makes up for the typing difficulty of some senior users. Releasing official video and graphic tutorials helps senior users overcome forgetfulness in learning. Each tutorial contains 1–2 min of short video and detailed step-by-step graphic descriptions including most commonly used functions by senior users, such as adding friends, adjusting fonts, sending voices, voice/video calls and so on. The content of the tutorial should also be automatically matched according to the mobile operating system. The MSNS administrator should be gradually enriched to improve the tutorial content based on feedback from senior users. These tutorials can help the seniors to self-study, reduce the learning threshold and alleviate their anxiety in the learning process.

Secondly, satisfaction is insufficient for loyalty. It is only the foundation of building deeper emotional connections. MSNS companies still face the risk of satisfied user switching to competitors. To achieve more stable and sustainable continuance usage behavior, cultivating emotional attachment is a superior strategy than focusing on seniors' satisfaction. Emotional attachment can be formed by satisfying the seniors' internal need of competence and relatedness. For example, encouraging seniors to publish their life updates, or giving positive comments to each other will enhance the self-confidence of the seniors and meet the needs of their competence. This can also be done by adding some novel and interesting functions to the MSNS platform which further strengthens the interaction between senior users to counter the fleeting freshness. Based on the continuous social interaction, it will strengthen the emotional communication between users and is also helpful in forming the users' emotional attachment toward the platform.

8 Conclusion

Following the Cognitive-Affective-Conative pattern, this research extends ECT-ISC with perceived ease of use, emotional attachment and related explanatory factors to identify the cognition and affective factors affecting seniors' MSNS continuance usage intention. The results highlight the important role of attachment in affecting seniors' MSNS using behavior. Furthermore, the research also examines the formation path of emotional attachment.

The limitations of the research can be summarized in the following: Firstly, the present study was conducted in China, as a result whether the conclusions are applicable to other countries is unknown. Accordingly, future research can be conducted in other countries to enhance the generalization. Secondly, this research has not examined the seniors' actual continuance usage behavior, stopping at the continuance intention. Future research can examine the actual using behavior. Thirdly, at the current stage, MSNS senior users in China are mainly concentrated in younger senior users, therefore it is relatively difficult to collect questionnaires for senior users aged 66 and over. As a result, the sample size over 66-year-old is relatively small. However, with the deepening of aging, the number of older MSNS senior users will gradually increase. In the future, multi-groups of senior users in different age stage (e.g., 60–69 years old, 70–79 years old, 80 and above years old) can be analyzed to examine the effect

of aging process on the MSNS usage by the seniors. Fourthly, due to the limited conditions, we have not included all the influence factors in the model, such as mobile apps self-efficacy, perceived interactive richness. Thus, future research can further examine the effect of these variables.

Compliance with ethical standards

Ethical approval Ethics approval was sought and granted by the Academic Committee, School of Management, Hangzhou Dianzi University, Hangzhou, China.

Appendix A

See Table 7.

Appendix B

See Table 8.

Table 7 Measurement Scales

Variable	Questions	Source
Confirmation of expectations (CE)	My experience with using WeChat was better than what I expected	Bhattacherjee [21]
	The service level provided by WeChat was better than I expected	
	Overall, most of my expectations from using WeChat were confirmed	
Satisfaction (SA)	How do you feel about the overall experience of WeChat use	Bhattacherjee [21]
	Very dissatisfied/Very satisfied	
	Very displeased/Very pleased	
	Very frustrated/Very contented	
Continuance intention (CI)	I intend to continue my use of WeChat in the future	Bhattacherjee [21]
	I intend to increase my use of WeChat in the future	
	I will keep using WeChat as regularly as I do now	
Perceived usefulness (PU)	I find WeChat to be useful in my daily life	Bhattacherjee [21] Li and Zhao [89]
	Using WeChat help me to get information more conveniently	
	WeChat is useful in contacting with my friends	
Perceived ease of use (PEU)	Easy to learn how to use the WeChat	Phang et al. [70]
	Easy to use the WeChat service	
	Not difficulty in using the WeChat	
Computer anxiety (CA)	Computer makes me nervous	Phang et al. [70]
	Computer makes me uncomfortable	
	Get worried when I think of using computers	
Effect of declining physiological conditions (EDPC)	Requires me to exert more effort to perform daily activities	Phang et al. [70]
	Limits the kind of activities that I can perform	
	Causes me to have difficulty in performing daily activities	
Emotional attachment (EA)	Using WeChat is part of me	Kim et al. [11]
	I am attached to using WeChat	
	Using WeChat is important to me	
Autonomy Need Satisfaciton (ANS)	WeChat makes me feel free to be who I am	Thomson [43] Ahn and Back [48]
	WeChat makes me feel pressured in some ways (reverse coded)	
	WeChat makes me feel controlled(reverse coded)	
Relatedness need satisfaciton (RNS)	WeChat makes me feel cared about	Thomson [43] Ahn and Back [48]
	WeChat brings a feeling of closeness to me	
	I feel connected to WeChat	
Competence need satisfaciton (CNS)	WeChat makes me feel very capable	Thomson [43] Ahn and Back [48]
	WeChat makes me feel inadequate or incompetent (reverse coded)	
	WeChat makes me feel very effective	

Table 8 Basic information of study participants

Demographic variables	Category	Frequency	Percent (%)
Gender	Male	195	52
	Female	179	48
Education	Primary school or below	59	16
	Secondary school	139	37
	Junior College	108	29
	University	68	18
Age	60–65	231	62
	66–70	87	23
	71–80	56	15
For how many years have you used WeChat?	year < 1	94	25
	$1 \leq years < 2$	175	47
	$2 \leq years < 3$	74	20
	$3 \leq years$	31	8
How often do you check WeChat?	$\geq$ Once a day	217	58
	4–6 times a week	84	22
	1–3 times a week	73	20
How much time do you spend on WeChat per day?	≤ 30 min	124	33
	30 min to 1 h	198	53
	$1 \leq hours < 2$	44	12
	$2 \leq hours$	8	2

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