




Influence of smartphone use motives on smartphone addiction during the COVID-19 epidemic in China: the moderating effect of age

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Accepted: 13 June 2022

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Abstract

With the development of science and technology, the phenomenon of smartphone addiction has become very common. However, smartphone addiction has adverse consequences. To date, few studies have examined psychological crises and smartphone use motives during the coronavirus disease 2019 (COVID-19) pandemic according to age. Therefore, this study aimed to examine the influences of different types of smartphone use motives on smartphone addiction and explore the moderating effect of age on adolescents and adults. A total of 1346 participants (600 adults and 746 adolescents) completed questionnaires on their motives for smartphone use and smartphone addiction. Results indicated significant positive correlations between smartphone use motives and smartphone addiction. In the moderation model, mood regulation, social relations, pastime, and conformity significantly and directly predicted smartphone addiction; however, perceived enjoyment did not. Age played a moderating role in the prediction of smartphone addiction. Teenagers and adults have different motives for smartphone use, and different motives have different effects on adolescents and adults. Adolescents have higher coping motivation and conformity motivation than adults, and for adolescents, perceived pleasure motivation has a significant impact on smartphone addiction. For adults, perceived pleasure and social relationship motivation have a significant impact on smartphone addiction. Therefore, interventions for smartphone addiction can be developed by investigating the motives of use among different people, and age should be considered when developing interventions for smartphone addiction.

Keywords Smartphone addiction · Smartphone use motivation · Stage of psychosocial development · Age difference · COVID-19

Smartphones have become an important part of people's daily lives, and are becoming increasingly popular and are periodically upgraded (Mahapatra, 2019). According to the 48th Statistical Report on the Development of China's Internet Network, by June 2021, China's Internet users had reached 1.011 billion, of which 99.6% used smartphones to access the Internet (China Internet network information center. The 48th Statistical Report on Internet Development Status in China). Previous studies have found that the prevalence of adolescent smartphone addiction is 22.8% (Zou

et al., 2019), and that about 21.3% of adults have smartphone addiction (Long et al., 2016).

The outbreak of COVID-19 has provided an environmental background for smartphone addiction. In the first half of 2020, people have been living in isolation for months, and universities and primary schools cannot start school as scheduled. In this context, smartphones and other electronic products are particularly important to both teenagers and adults (Blasi et al., 2019; Hu et al., 2021). Studies have found that the rate of smartphone addiction in adults is 27.1% (Hassan et al., 2020), and that in adolescents is 23.3%~38.9% (Duan et al., 2021; Esmailpour et al., 2021). These data cannot be ignored, and the generation of behavior cannot be separated from the drive of motivation (Xu et al., 2012). Therefore, it is feasible to study smartphone addiction from the perspective of smartphone use motives (Chen et al., 2017; Lee & Park, 2014). People of different ages have different motives. Teenagers expect to establish identity, while adults expect

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to obtain love and satisfaction (Kraut et al., 1998; Leung, 2017; Mansourian et al., 2014). Therefore, it is necessary to study the impact of smartphone use motives on smartphone addiction by taking age as a variable. At present, the COVID-19 situation around the world has not been completely eliminated. Understanding how to effectively intervene in smartphone addiction has practical significance.

Smartphone addiction and its negative effects

At present, there is no consistent definition of smartphone addiction. Most researchers classify smartphone addiction as a behavioral addiction, which is defined as non-material dependence caused by excessive engagement in various activities mediated by smartphones, resulting in physiological, psychological, and social function damage (De-Sola Gutierrez et al., 2016; Lapiere et al., 2019; Liu et al., 2017). It manifests similarly to substance addictions such as alcohol and drugs, including tolerance, withdrawal symptoms, salience, conflict, emotional change, craving, and feeling out of control (Lee et al., 2014; Liu et al., 2017). Individuals at risk of smartphone addiction usually show negative emotions such as obedience, passivity, depression, despair, self-blame, and self-pity in the face of pressure. They often show withdrawal from social interactions and experience adverse reactions (Elhai et al., 2017; Yang et al., 2019).

Living environment is an important predictor of addiction (Islam & Hossin, 2016). During the severe epidemic period, the practice of home isolation limited people's scope of activities. Smartphones provide browsing, communication, playback, games, and other functions. People can obtain information related to the epidemic through smartphones. The use of smartphones helps to avoid face-to-face contact, and yet maintain social activities with the outside world (Caponnetto et al., 2021; Long et al., 2016). Smartphone Internet access is also the simplest way to avoid negative emotions such as loneliness and fear brought by COVID-19. Therefore, people may overuse smartphones and ignore other aspects of life, resulting in smartphone addiction (Blasi et al., 2019; Hu et al., 2021; Islam et al., 2020). A survey conducted in March 2020 (severe epidemic period) shows that people spend an average of 30.8 h online every week, which was higher than that in June 2019 (pre-epidemic stage) and March 2021 (epidemic control stage). Smartphone addiction also shows a similar trend. Smartphone addiction in the severe epidemic period was found to be higher than that in the basic control period (CNNIC, 2020; Hu et al., 2021). Based on the above situation, it is highly necessary to study smartphone addiction.

The relationship between smartphone use motives and smartphone addiction

Motivation is the engine of all activities. When a behavior satisfies people's motivation, it drives them to repeat the behavior continuously, even leading to addiction (Xu et al., 2012). In the field of cyberpsychology, the role of motivation in promoting people's continued use of smartphones has been supported by abundant evidence. Studies have shown that while satisfying people's motivation for entertainment and social interaction, the smartphone also leads to the risk of excessive use (Shen et al., 2021; Wang et al., 2015), which in turn harms individuals' physical and mental well-being. Therefore, it is of great importance to explore the association between various motivations and smartphone addiction as well as its influencing factors (Chen et al., 2017; Lee & Park, 2014).

Studies have confirmed the relationship between different motivations and IT addiction in the general situation. Hormes (2016) proposed a four-motive framework that contains four motivation dimensions that may contribute to network addiction: social, coping, enhancement, and conformity. There is much evidence to support the four-motivation framework. The communicating function of smartphones can help individuals maintain social connection, which further increases the sense of social belonging and satisfies their motivation to socialize (Ahn & Shin, 2013; Coan, 2011). At the same time, it was found that people's expectations of smartphone use tended to be those of relaxation, enjoyment, and avoidance of boredom. The features above suggest that using smartphones can help individuals avoid negative feelings and enhance positive feelings, which in turn satisfies coping or enhancement motivation (Chen et al., 2017; Lepp et al., 2017). In addition, the tendency to keep in touch with friends and peers, etc., is also an important motivation for individuals to overuse smartphones (Chen et al., 2017; Stewart et al., 2006). Based on the four-motive framework, Chen and colleagues (Chen et al., 2017) further optimized the measurement indicators of motivations. They applied perceived enjoyment as the indicator of enhancement motivation; social relationships as the indicator of social motivation; mood regulation and pastimes as indicators of coping motivation; and conformity was used in the measurement of conformity motivation. Chen's study (2017) further verified the predictive effect of use motivation on smartphone addiction and the moderating effect of gender on the relationship.

The outbreak of COVID-19 has profoundly affected people's daily life. Due to the implementation of control measures and the fear of the pandemic, people's daily

activities of work, study, and social interaction have been greatly reduced, which has led to the further accentuation of smartphone addiction (Cattellino et al., 2021; Elhai et al., 2017; Kayis et al., 2021). Studies during the pandemic period have shown that the anxiety induced by COVID-19 has significantly increased people's dependence on smartphones, and the prohibition of direct social interaction has also promoted the use of the Internet and smartphones (Caponnetto et al., 2021; Elhai et al., 2017; Zhan et al., 2021). Further investigations on the use of smartphones during the pandemic revealed that participation in communication, social networking, and entertainment (videos, games, etc.) was the main purpose for which people used smartphones (Hosen et al., 2021). Previous studies have explored the characteristics and influencing factors of individual smartphone use during the pandemic, but have not been able to systematically investigate the relationship between use motivation and smartphone addiction in the crisis context. The life changes resulting from the pandemic may cause changes in the relationship between the four motives and smartphone addiction compared to the everyday situation. Among them, the reduction of practical social contact may promote individuals' behaviors of seeking online social interactions (Caponnetto et al., 2021; Hu et al., 2021). The increase in negative affections and the decrease of positive affections may lead to an increase in individuals' coping and enhancement motivation (Kayis et al., 2021). Meanwhile, the uncertain environment of the pandemic may also enhance the need for conformity.

Therefore, combined with the special background of the pandemic, the current study further explored the association between the motivation of smartphone use and smartphone addiction based on the five-dimension measures of perceived enjoyment, social relationships, mood regulation, pastimes, and conformity from Chen's (2017) study. Based on previous evidence, we hypothesized positive correlations between individuals' motivations and smartphone addiction (H1).

Age as a moderating variable

As of June 2021, the survey found that adults accounted for a large proportion of Internet users, making up 17.4% of Internet users aged 20–29 and 20.3% of Internet users aged 30–39. However, the younger Internet users cannot be ignored. The number of Internet users aged 6–19 reached 158 million, accounting for 15.7% of the total Internet users (CCNIC). The developmental decompensation hypothesis holds that the process of “psychological compensation” will occur when an individual is hindered by factors interfering in the normal development process (Gao & Chen, 2006). If an individual can actively improve the hindering factors to

meet their development needs, they gain constructive compensation. If an individual's psychological resources cannot help the individual repair the hindering factors, pathological compensation, such as pathological smartphone use, will occur to compensate for their unmet psychological needs (Wu et al., 2019). According to Erikson's theory of psychosocial development stages, individuals of different ages have different psychological needs due to different crises. The main task of teenagers is to establish identity or their image among others, or to find their emotional position in the social collective. In the transition period from childhood to adulthood, teenagers will experience rapid changes in their physiological, psychological and cognitive functions. They are likely to engage in some dangerous behaviors for exploration and emotional relief (Hessler & Katz, 2010). Researchers found that the main motivation for teenagers to use mobile social networks is to obtain information, maintain relationships and meet pleasure needs. They like to use smartphones to contact their parents, get physical and psychological support from their parents, establish their own social networks, cultivate independence, and deal with their own affairs through smartphones (Huhtiniemi et al., 2019; Jiang et al., 2017; Leung, 2017), while the needs of adults have become love and satisfaction. People expect to establish close relationships, avoid loneliness, contribute to society and community and avoid a sense of uselessness. Compared with teenagers, adults are relatively mature in mind. When their interpersonal relationship is in crisis, they will mobilize their own regulation mechanism and adopt constructive strategies to improve rather than tend to escape or immerse in the virtual world created by smartphones (Kraut et al., 1998; Mansourian et al., 2014). Adults' use of smartphones mainly includes the needs of obtaining information, interpersonal communication, games, and shopping (Chen et al., 2017), as well as the needs of venting emotions, emotional communication, and highlighting fashion (Cai, 2011). There is a significant positive correlation between adults' loneliness, entertainment motivation, escape motivation and excessive use of smart phones (Shen, 2018; Wang, 2018). Zhang (2020) found that loneliness in adults is more closely related to smartphone addiction than in adolescents.

During the epidemic prevention and control period in 2020, teenagers learned online. Some children who were not allowed to use smartphones at ordinary times also had more opportunities to use smartphones. They used smartphones to play online games and keep in touch with their friends. With regard to adults, employees such as teachers and government workers needed to work via the internet. Some people, such as migrant workers, couriers, and offline business owners, for whom it is inconvenient to go out to work during the epidemic, also needed to use smartphones for epidemic information, pastime, and entertainment (Duan et al., 2021; Hu et al., 2021; Islam et al., 2020). For people

of different ages, the reasons for using smartphones vary, but it is undeniable that smartphones are indispensable to many people during the epidemic. Adults and adolescents have different use motives, so we hypothesized that age plays a moderate role in the prediction of smartphone use motivation on smartphone addiction (H2).

Purpose and hypotheses of this study

As shown in Fig. 1, we established the model to examine the influence of smartphone use motives on smartphone addiction and explore the moderating effect of age, to provide a theoretical basis and direction for future research on smartphone addiction. Two hypotheses are proposed: (1) There are significant positive correlations between smartphone use motives and smartphone addiction, (2) Age plays a moderating role in the prediction of smartphone addiction.

Methods

Sample

The study protocol was approved by the Ethics Committee of the Center for Studies of Social Psychology at Central China Normal University (CSSP-2,020,021), comprising investigations toward adolescent and adult populations. The cross-age study was conducted on February 16, 2020, during which period China was experiencing a severe outbreak. Restricted by the pandemic control measures, we researched via a commonly used platform for online investigations in China (www.wjx.com). Yu and Huang (2011) suggested that the differences between participants' responses on traditional paper and online questionnaires are not significant.

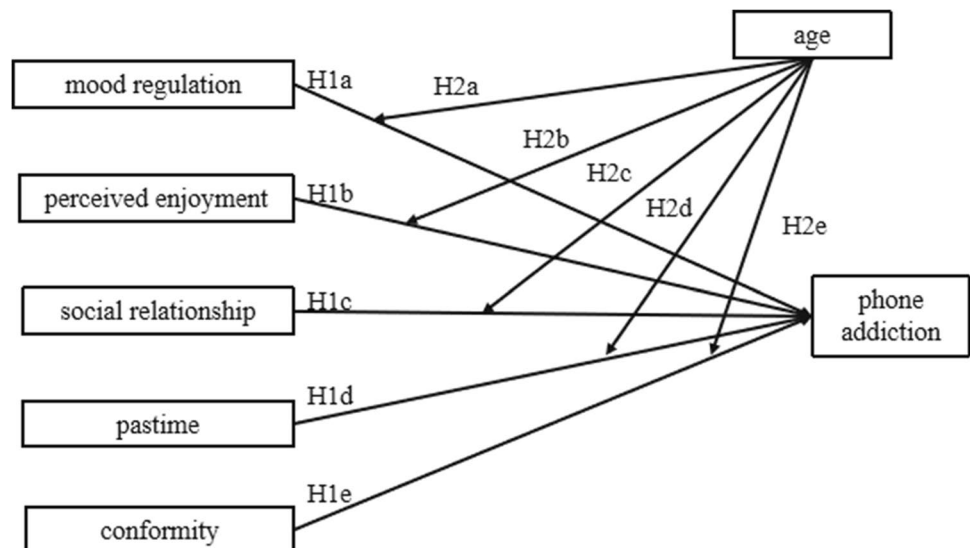
The questionnaires were distributed in online subject pools and participants voluntarily participated in the survey by clicking the questionnaire link. The data were screened based on the following criteria: (1) the participant read the instructions and voluntarily engaged in the survey; (2) the whole survey was completed as required. The final sample includes 1353 participants, among which 746 were adolescents, consisting of 334 males (44.8%), and 412 females (55.2%). The age distribution was 12–18 years ($M = 15.83$, $SD = 1.89$). Among the 600 adults, 53 were men (8.8%), and 547 (91.2%) were women. The age distribution was 19–59 years ($M = 38.50$, $SD = 10.64$).

Variables and measurements

Smartphone addiction

In this study, the Smartphone Addiction Scale-Short version (SAS-SV) compiled by Kwon and others (Kwon et al., 2013) was used. The scale consists of 10 items, which are divided into three dimensions: addiction, tolerance, and withdrawal. Some questions include “I often feel anxious when I am not using my smartphone” and “I find it difficult to control my use of my smartphone.” Responses are rated on a six-point Likert scale ranging from “strongly disagree – 1” to “strongly agree – 6,” with higher scores indicating more addictive smartphone behavior. The Chinese version of the scale has been verified to be reliable and valid and can be used for the assessment of smartphone addiction among adolescents (Xiang et al., 2019). In this study, the influence of smartphone use on work and study was combined into one topic, and the score was changed to a five-point Likert scale. In this study, Cronbach's α was 0.82.

Fig. 1 Research model



Motives for smartphone use

This study used the Smartphone Use Motivation Scale compiled by Chen and others (Chen et al., 2017) based on the theory of IT addiction. The scale regards smartphone addiction as a special form of IT addiction, with a total of 20 topics, including perceived enjoyment, social relations, mood regulation, pastime, and conformity dimensions. The scale uses a seven-point scale ranging from “strongly disagree – 1” to “strongly agree – 7.” The higher the score, the stronger the motivation for smartphone use. This research selected 10 items from the scale, and each of the five dimensions was assessed with two questions. Perceived enjoyment topics were “I think using a smartphone is a kind of enjoyment” and “I think using smartphones is interesting,” and the Cronbach’s α coefficient of internal consistency was 0.86; the social relationship questions were “I use a smartphone to communicate with others” and “I use a smartphone to share my daily life with others,” and Cronbach’s α was 0.65; the mood regulation topics were “When I am anxious and depressed, I feel better by using my smartphone” and “I forget my worries and worries by using my smartphone.” Cronbach’s α was 0.84; pastime topics were “I use my smartphone to kill time” and “I use my smartphone to avoid boredom,” and Cronbach’s α was 0.89; conformity questions were “I use my smartphone to gain the approval and affection of others” and “I use my smartphone so that I do not feel neglected” and Cronbach’s α was 0.85. The Cronbach’s α of the Motives for Smartphone Use scale was 0.83.

Results

Correlation coefficients between variables

Table 1 presents the correlation matrix between the variables. All five dimensions of phone usage motivation were positively correlated with phone addiction. Participants’

age was negatively correlated with mood regulation ($r = -0.084, p < 0.01$), enjoyment ($r = -0.296, p < 0.01$), and conformity ($r = -0.139, p < 0.01$), but not with perceived enjoyment and social relationships. Participants’ gender was negatively correlated with pastime ($r = -0.102, p < 0.01$) and conformity ($r = -0.094, p < 0.01$). Education level was positively correlated with pleasure ($r = 0.119, p < 0.01$) and pastime ($r = 0.122, p < 0.01$), but not with mood regulation, social relationships, and conformity. To test the moderation model, we treated participants’ gender and education level as control variables, and explored the influence of the five dimensions of phone usage motives on phone addiction, as well as the moderating effect of age.

Differences in phone usage motives and phone addiction between teenagers and adults during COVID-19

Independent samples t-tests found that mood regulation motivation of teenagers ($M = 4.27, SD = 1.42$) were significantly higher than adults ($M = 4.10, SD = 1.43$), $t = -2.077, p < 0.05$; pastime motivation of teenagers ($M = 4.36, SD = 1.56$) were significantly higher than adults ($M = 3.76, SD = 1.75$), $t = -6.569, p < 0.001$, for conformity motivation, teenagers ($M = 2.98, SD = 1.55$) scored significantly higher than adults ($M = 2.65, SD = 1.46$), $t = -4.016, p < 0.001$. However, there were no significant differences in perceived enjoyment, social relationships, and phone addiction between teenagers and adults (Table 2).

The moderating effect of age in smartphone use motives and addiction

With participants’ gender and education level as control variables, we explored the moderating effect of age on the five dimensions of smartphone use motives and addiction using Model 1 of PROCESS 3.4. The results showed that mood regulation ($\beta = 0.143, t = 3.328, p < 0.001$),

Table 1 Correlation between participants’ gender, age, education level and smartphone motivation, smartphone addiction

Variables	1	2	3	4	5	6	7	8	9
1 Gender	1								
2 Age	0.373**	1							
3 Education level	0.223**	0.271**	1						
4 mood regulation	-0.003	-0.084**	0.016	1					
5 perceived enjoyment	0.02	-0.031	0.119**	0.478**	1				
6 Social relationship	-0.022	-0.001	-0.005	0.315**	0.255**	1			
7 pastime	-0.102**	-0.296**	0.122**	0.375**	0.337**	0.195**	1		
8 Conformity	-0.094**	-0.139**	0.045	0.380**	0.249**	0.371**	0.386**	1	
9 Smartphone addiction	0.035	-0.058*	0.118**	0.330**	0.268**	0.113**	0.360**	0.300**	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, $N = 1353$, with 7 participants’ age information miss

Table 2 Difference in usage motivation and phone addiction between teenagers and adults

	Age	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>Sig.</i>
mood regulation	1	4.10	1.43	-2.077*	1344.00	0.038
	2	4.27	1.42			
Perceived enjoyment	1	4.33	1.39	-0.004	1344.00	0.997
	2	4.33	1.29			
Social relationship	1	4.30	1.42	-0.574	1344.00	0.566
	2	4.34	1.39			
pastime	1	3.76	1.75	-6.569***	1213.19	0.000 ^a
	2	4.36	1.56			
Conformity	1	2.65	1.46	-4.016***	1344.00	0.000
	2	2.98	1.55			
Smartphone addiction	1	2.95	0.70	0.037	1344.00	0.970
	2	2.95	0.76			

1 = adults (N = 600), 2 = teenagers (N = 746), a means no satisfaction of homogeneity of variance

Table 3 The moderating effect of age in usage motivation and phone addiction

	mood regulation	perceived enjoyment	Social relationship	pastime	Conformity
Direct effect	0.143***	0.023	0.146**	0.132***	0.157***
β (Int)	0.015	0.076**	-0.057*	0.018	-0.008
<i>Se</i> (Int)	0.026	0.029	0.028	0.023	0.026
<i>t</i> (Int)	0.563	2.655	-2.021	0.794	-0.309
Moderating effect 1	-	0.099***	0.089***	-	-
Moderating effect 2	-	0.175***	0.032	-	-
<i>R</i> ²	12.30%	8.61%	3.35%	13.98%	10.55%
<i>F</i>	37.60***	25.25***	9.29***	43.54***	31.62***

N = 1346, Int = phone usage motivation * age, Moderating effect 1 = adults, moderating effect 2 = teenagers

social relationship ($\beta = 0.146$, $t = 3.197$, $p < 0.01$), pastime ($\beta = 0.132$, $t = 3.672$, $p < 0.001$), and conformity ($\beta = 0.157$, $t = 3.694$, $p < 0.001$) positively predicted smartphone addiction. However, perceived enjoyment ($\beta = 0.023$, $t = 0.499$, $p = 0.618$) did not predict smartphone addiction (Table 3).

Participants' age had a significant moderating effect on perceived enjoyment ($\beta = 0.076$, $t = 2.655$, $p < 0.01$) and smartphone addiction. Specifically, when perceived enjoyment increases, there is a greater likelihood of smartphone addiction, and this effect was stronger in teenagers than in adults. Additionally, the moderating effect of age was significant between social relationships ($\beta = -0.057$, $t = -2.201$, $p < 0.05$) and smartphone addiction. For mood regulation ($\beta = 0.015$, $t = 0.563$, $p = 0.574$), pastime ($\beta = 0.018$, $t = 0.794$, $p = 0.427$), and conformity ($\beta = -0.008$, $t = -0.309$, $p = 0.757$), no moderating effect was found for age (Table 3; Fig. 2).

Furthermore, simple slope analysis (Fig. 3) found that for teenagers, perceived enjoyment was a significantly positive predictor of smartphone addiction, *simple slope* = 0.175, $t = 8.798$, $p < 0.001$, $CI = 0.1361-0.2143$; and no predictive effect was found for social relationships, *simple slope* = 0.032, $t = 1.691$, $p = 0.091$, $CI = -0.0051-0.0694$.

For adults, perceived enjoyment (*simple slope* = 0.099, $t = 4.772$, $p < 0.001$, $CI = 0.0583-0.1398$;) and social relationships (*simple slope* = 0.089, $t = 4.293$, $p < 0.001$, $CI = 0.0483-0.1295$) significantly predicted smartphone addiction. To summarize, when perceived enjoyment motives increase, the difference in likelihood of smartphone addiction between teenagers and adults increases. However, when the motive for social relationships increases, the difference in the likelihood of smartphone addiction between teenagers and adults decreases.

Discussion

The present study focused on the relationship between smartphone use motives and smartphone addiction during the COVID-19 pandemic. Based on the theory of social development stage and the developmental decompensation hypothesis, a moderation model with five smartphone use motives as predictive variables, age as a moderating variable, and smartphone addiction as the outcome variable was constructed. Through a survey of 600 adults and 746 adolescents, the results indicated significant positive correlations

Fig. 2 The moderation model of age in phone usage motivation and phone addiction

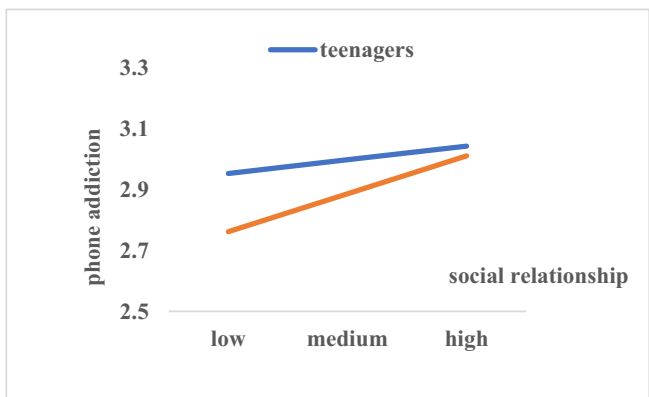
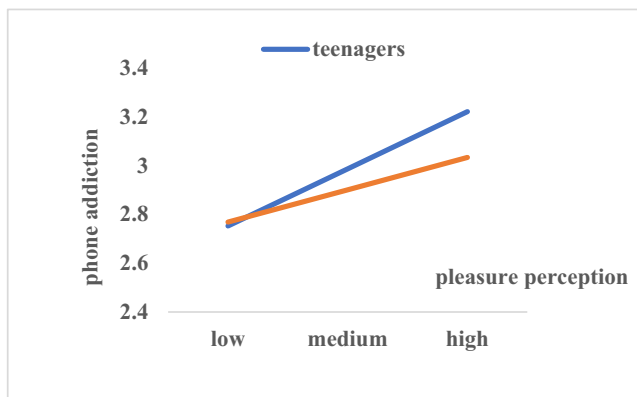
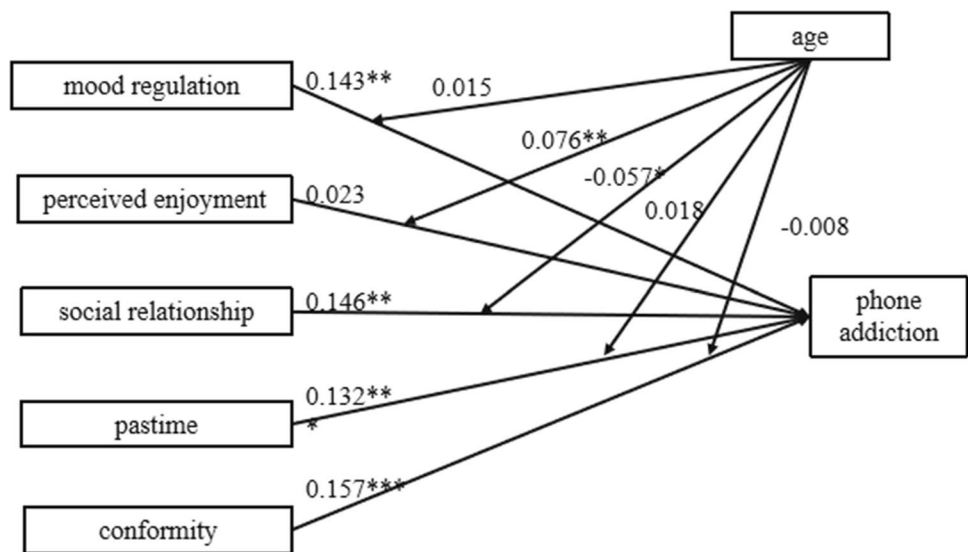


Fig. 3 The moderating effect of age on perceived pleasure, social relations and mobile phone addiction

between smartphone use motives and smartphone addiction, in which age plays a moderating role.

Smartphone use motives and smartphone addiction

The results show that it is feasible to study smartphone addiction from the perspective of smartphone use motivation. During the epidemic period, there is a positive correlation between five smartphone use motives and smartphone addiction, supporting H1. The four indicators of mood regulation, social relations, pastime and conformity have a significant impact on smartphone addiction; that is, coping motivation, social motivation and conformity motivation have an impact on behavior results. However, the effect of perceived pleasure as an indicator of enhanced motivation on smartphone addiction is not significant, which is different from the previous research results. In the research of Chen (2017), perceived pleasure, mood regulation, pastime and conformity have an impact on smartphone addiction,

and social relations have no impact. This may be due to the impact of the epidemic and the reduction of social activities during the epidemic. Smartphones are an effective way to reduce face-to-face communication, avoid virus transmission and help individuals keep in touch with the outside world (Blasi et al., 2019; Caponnetto et al., 2021; Kayis et al., 2021). The effects of mood regulation, pastime and conformity on smartphone addiction are consistent with previous studies. The main purpose of people using smartphones is information exchange, entertainment and avoiding the decrease of positive emotions and the increase of negative emotions (Hosen et al., 2021; Kayis et al., 2021). Intervention on smartphone addiction based on smartphone use motives is an effective path.

Moderating role of age

There is no significant difference between adolescents and adults in the scores of smartphone addiction, indicating that

adolescents and adults face the same risk of smartphone addiction; however, the results of the moderating model show that there are differences in their smartphone use motives. The impact of smartphone use motives on smartphone addiction is moderated by age. This result is in line with H2. The scores of the three indicators of conformity, mood regulation and pastime of adolescents are significantly higher than those of adults; that is, adolescents have stronger coping motivation and conformity motivation, which is consistent with the results of previous studies that adolescents have the need to alleviate emotions and obtain peer support (Hessler & Katz, 2010; Leung, 2017). There is no significant difference between adolescents and adults in the scores of perceived pleasure and social relations, but age plays a regulatory role in the impact of perceived pleasure and social relations on smartphone addiction. When the level of perceived pleasure motivation increases, the possibility of teenagers' smartphone addiction is higher than adults. The impact of social relations on adults' smartphone addiction is significant. However, the impact on teenagers' smartphone addiction is not significant, which is consistent with the performance of teenagers in the current epidemic. Teenagers spend more time on Internet activities to cope with the negative consequences of the epidemic, including changes in academics and lifestyle, and reduce the impact of the virus on mental health (Duan et al., 2021; Islam et al., 2020). Just as Erikson's theory of psychosocial development stages proposes, adolescents' needs lie in acquiring a sense of identity, while adults' needs lie in establishing intimate relationships, and different needs produce different motives. Compared with adolescents, adults have stronger social relationship needs. The reduction of social activities during the epidemic leads to psychological loneliness. The social use of the Internet helps to seek connection (Ahn & Shin, 2013; Kayis et al., 2021). Good interpersonal relationship helps to reduce the harm of the virus (Hu et al., 2021; Van Tongeren et al., 2015). Age should be fully considered when intervening in smartphone addiction.

Theoretical implication and application value

The theoretical implications of this study are as follows: First of all, the present study verifies previous research findings that smartphone use motives are positively correlated with smartphone addiction, and significantly predict smartphone addiction, which shows that it is very feasible and necessary to study smartphone addiction from the perspective of smartphone use motives (Coan, 2011; Lee & Park 2014; Chen et al., 2017). Second, the study expands the model of the smartphone addiction mechanism. To expand on previous studies, our study introduced the age variable and divided addicts into adolescents and adults, which is in line with the characteristics of different stages of human

development. It directly compared the smartphone use motives of adolescents and adults and found two results: the two groups differ on smartphone use motives, and age has a moderating effect on the prediction of smartphone addiction. For adolescents, perceived enjoyment significantly predicts smartphone addiction, while for adults, both perceived enjoyment and social relationships are predictors.

On the other hand, the study of smartphone addiction has practical application value. First, the global epidemic has not been completely controlled. This environment increases the frequency of individuals using smartphones and leads to the risk of smartphone addiction (Blasi et al., 2019; Islam et al., 2020; Hu et al., 2021), but excessive smartphone use cannot effectively deal with the negative impact of the epidemic, and will reduce individual happiness (Kayis et al., 2021). Second, the results of this study provide a direction for the intervention on smartphone addiction. According to the different motives of smartphone addiction, we can increase social infrastructure, entertainment items and enhance individual communication to meet individual coping motivation, social motivation, and conformity motivation. Finally, this study underlines the differences in smartphone use motivation among different age groups. Different measures should be taken when intervening in smartphone addiction for individuals of different ages. For example, when preventing or intervening in smartphone addiction for teenagers in school, schools can organize more activities to meet students' coping motivation, conformity motivation and enhanced motivation, and pay attention to teenagers' emotional state, entertainment items, and correctly guide their conformity psychology. For adults, when counselors intervene in smartphone addiction according to their enhanced motivation and social motivation, it can exercise their interpersonal skills and improve their positive emotional experience.

Limitations and prospects

The present study explores the effects of different types of smartphone use motives on smartphone addiction during the COVID-19 pandemic and further tests the moderating role of age. This study has important theoretical and practical implications. However, it also has some limitations, which warrant further consideration in the future.

First, this study takes age as the adjustment variable to investigate the differences in smartphone use motivation between teenagers and adults. The results of this study show that there are significant differences between them. However, Erikson divides human development into eight stages. Due to the development of electronic technology, people's needs will keep pace with the times. In the future, we can make a more detailed division of age, such as investigating smartphone use motivation of children, adolescents, middle-aged and the elderly and its impact on smartphone addiction.

Second, the study adopted a questionnaire method, which lacks flexibility, and may miss some detailed and deep-seated problems. Future research can be supplemented by an interview method that can provide a clear and deep understanding of the motives of smartphone use, the context of smartphone addiction, and the mechanism of smartphone addiction in different groups.

Third, other moderating variables may exist. The current study considers age as the moderating variable and controls for gender and level of education, but there are other possible variables. Future research can focus on social status, mood, personality characteristics, and other factors, clarify the mechanism of smartphone addiction, and provide specific directions for intervention in smartphone addiction.

Fourth, this study was conducted during the epidemic. The research results are similar to the results of the normalized environment before the epidemic. It is very feasible to study smartphone addiction from the perspective of motivation, but the addiction rate during the epidemic is higher than that in the normalized environment. Now the domestic epidemic is basically stable, and the impact of smartphone motivation on smartphone addiction is worthy of further research.

Conclusions

The following conclusions were drawn: higher smartphone use motivation is associated with smartphone addiction. Furthermore, smartphone addiction was significantly predicted by four of the five usage motives examined; specifically, mood regulation, social relationships, pastime, and conformity. On the other hand, the motive of perceived enjoyment did not significantly predict smartphone addiction. Adolescents and adults have different motives for smartphone use, and different motives have different influences on adolescents and adults. Interventions for smartphone addiction can be performed considering age-related characteristics.

Acknowledgements This manuscript has not been published or presented elsewhere in part or in entirety and is not under consideration by another journal. All study participants provided informed consent, and the study design was approved by the appropriate ethics review board. We have read and understood your journal's policies, and we believe that neither the manuscript nor the study violates any of these. There are no conflicts of interest to declare. As for data, it can be obtained through contacting the corresponding author's email.

Funding Major Projects of the National Social Science Foundation of China(18ZDA331).

Later Funded Projects of the National Social Science Foundation of China(20FSHB003).

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