

# Peer Phubbing and Chinese College Students' Smartphone Addiction During COVID-19 Pandemic: The Mediating Role of Boredom Proneness and the Moderating Role of Refusal Self-Efficacy

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**Purpose:** COVID-19 has had a huge impact on the physical behavior and mental health of people. Long-term and strict isolation policies are widely used to ensure social distancing, which may cause excessive smartphone use and increase the risk of smartphone addiction. Previous researchers have identified that some factors that affect smartphone addiction, but there was little research conducted during COVID-19 pandemic. The present study aims to examine the effect of peer phubbing on smartphone addiction, how boredom proneness may mediate this effect, and lastly how refusal self-efficacy may moderate the indirect and direct pathways during COVID-19 pandemic.

**Methods:** A total of 1396 college students (mean age=20.48, SD=1.08) were surveyed and completed four scales (Peer Phubbing Scale, Refusal Self-efficacy Scale, Smartphone Addiction Index Scale, Boredom Proneness Scale). The statistical analyses were conducted by SPSS 22.0 and SPSS PROCESS macro.

**Results:** This study found that peer phubbing was positively associated with smartphone addiction. Boredom proneness mediated the effect of peer phubbing and smartphone addiction. Furthermore, refusal self-efficacy moderated the relationship between peer phubbing and smartphone addiction as well as boredom proneness and smartphone addiction. Specifically, peer phubbing had a greater impact on smartphone addiction for college students with higher levels of refusal self-efficacy, and the boredom proneness on smartphone addiction was stronger for college students with low levels of refusal self-efficacy.

**Conclusion:** This study is important in investigating how peer phubbing is related to the smartphone addiction of Chinese college students during COVID-19 pandemic. The results suggest that college students' boredom proneness and refusal self-efficacy may be prime targets for prevention and intervention programs. Thus, this study explored "how" and "when" peer phubbing may enhance college students' smartphone addiction during COVID-19 pandemic.

**Keywords:** COVID-19, peer phubbing, boredom proneness, smartphone addiction, refusal self-efficacy, Chinese college students

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## Introduction

COVID-19 has had a huge impact on the physical behavior and mental health of people. Research on pandemic influenza found that closing schools and mandatory staying at home can reduce infection rates by more than 90%.<sup>1</sup> However, long-term and strict isolation policies are widely used to ensure social distancing, which may

cause major changes in young people's social networks and behaviors. After the isolation is lifted, people still need to maintain social distancing. Social distancing had led to an increase in the use of the smartphone for collecting epidemic information, work, study, relieving from boredom, social networking online,<sup>2,3</sup> then the use of smartphones plays an important role in life during COVID-19 pandemic. Nevertheless, excessive smartphone use may have harmful consequences. For example, persons used smartphones frequently, leading to Internet addiction. The risk of addiction is certainly high (eg, smartphone addiction),<sup>4,5</sup> including content related to digital media and social networks<sup>3</sup> during COVID-19 pandemic. The relationship between smartphone use and adaptive functions as an inverted U-shaped curve.<sup>6</sup> Smartphone addiction has not been uniformly defined, but it can be considered a form of technology addiction.<sup>7,8</sup> It is defined as the addictive behavior of escaping reality or creating pleasure from using a -smartphone,<sup>9</sup> which is similar to the symptoms described in Diagnostic and Statistical Manual of Mental Disorders (DSM-5) as compulsive behavior, impairment of functionality, withdrawal, and tolerance.<sup>10</sup> Smartphone addiction is also correlated with neck and hand pain.<sup>11</sup> Therefore, previous researchers have identified some factors that affect smartphone addiction, but there was little research conducted during COVID-19 pandemic, which is one of the focus points of the current study.

A survey conducted in the United States showed that 90% of participants had used smartphones during recent social activities and 86% of friends had used smartphones at the same time.<sup>12</sup> People often use smartphones and ignore others, and researchers call this phenomenon phubbing.<sup>13</sup> Despite previous studies that have shown that there is a positive correlation between phubbing and smartphone addiction,<sup>14,15</sup> little is known about the relationship between peer phubbing and smartphone addiction during COVID-19 pandemic. Thus, we aimed to investigate whether peer phubbing is significantly associated with smartphone addiction among Chinese college students during COVID-19 pandemic and examined the underlying mediating and moderating mechanisms in this association.

## Peer Phubbing and Smartphone Addiction

Phubbing is made up of two words: "phone" and "snubbing", which refers to focusing on smartphones and neglecting others in social interactions. It was coined as part of the Macquarie Dictionary.<sup>14,16</sup> Phubbing behavior

has some similarities with smartphone addiction, but it also has differences with smartphone addiction. As a result of the structure of smartphones, phubbing behavior could be seen as a disturbance at the intersection of smartphone addiction.<sup>15</sup> According to DSM Criteria, phubbing behavior is considered as an addictive behavior like smartphone addiction.<sup>17</sup> Researchers have found that both phubbing behavior and smartphone addiction have social impairment on individuals, especially on interpersonal relationships,<sup>2,14</sup> such as in employer-employee relationships in the workplace,<sup>18</sup> romantic relationships,<sup>19</sup> and parent-child interaction in the family.<sup>20</sup> However, in contrast with smartphone addiction, phubbing behavior has become a socially acceptable behavior<sup>14</sup> that is much more devious and pervasion. The addiction literature boomed before phubbing became prevalent.<sup>17</sup>

Peer phubbing is a person who is the same age or who has the same social status, which the person looks at a smartphone and snubs others. It has become a common phenomenon to check smartphones while engaging in other activities in college.<sup>21,22</sup> According to the social bonding theory, problematic behavior is caused by the reduction or breakdown of social bonds.<sup>23</sup> As individuals grow older, they turn from parents to peers for intimacy and emotional support.<sup>24</sup> During the pandemic, college students had to keep social distancing to communicate and access information about the outbreak via smartphone, increasing the amount of time and frequency spent on smartphone. Therefore, individuals felt neglected, which reduced their chances of interacting with peers. Individuals failed to establish good relationships with the people around them (ie, peers). Thus, the constraints on them would be weakened, which would eventually lead to the emergence of problematic behaviors. Recent research has found that, in order to obtain satisfaction, individuals will interact with others online and spend more time using smartphones, which increases the risk of smartphone addiction. These findings suggest that peer phubbing may play an important role in college students' smartphone addiction during COVID-19 pandemic.

## Boredom Proneness as a Mediator

The social bonding theory<sup>23</sup> can explain the phenomenon that many people suffer from peer phubbing which leads to the increase of smartphone addiction. However, many other individuals are insusceptible in everyday life. Therefore, in examining the consequences of peer phubbing, it is important to consider the possible mediators that

may play a role in increasing smartphone addiction. Boredom is generally defined as a state characterized by unpleasant feelings, lack of stimulation, and low physiological arousal.<sup>25</sup> Boredom proneness is a stable boredom experience in various environments.<sup>26</sup> According to the arousal theory, boredom proneness is caused by the mismatch between personal needs and the availability of environmental stimulation.<sup>27</sup> Phubbing has been found to have a negative effect on interpersonal relationships.<sup>28</sup> Pandemic-related social distancing may lead to fewer socialization options.<sup>29</sup> Relationship satisfaction will be reduced by phubbing,<sup>30</sup> then individuals' needs are not being met, leading to boredom proneness. Boredom proneness is an important risk factor of smartphone addiction.<sup>31,32</sup> Due to the diverse internet-based functions and accessibility of smartphones during COVID-19 period,<sup>2,33</sup> individuals may increase smartphone use. When individuals felt bored, they may tend to use smartphones to get rid of boredom. Individuals with high boredom tendency are more likely to indulge in smartphones to relieve boredom.<sup>25</sup> Therefore, we propose that peer phubbing would have an indirect positive impact on smartphone addiction via boredom proneness as a mediator during COVID-19 pandemic.

## The Moderating Role of Refusal Self-Efficacy

Peer phubbing may increase college students' smartphone addiction through the mediating role of boredom proneness, but there is a diverse range of sensitivity among individuals with regard to how they respond to peer phubbing. In other words, not all college students may experience the detriments of peer phubbing or boredom proneness. One key buffering mechanism may be refusal self-efficacy. The present study tests that the indirect association between peer phubbing and smartphone addiction would be moderated by refusal self-efficacy.

In line with social-cognitive theory, self-efficacy is about feeling confident in your skills and feeling able to use them.<sup>34</sup> Refusal of self-efficacy is the individual's ability to resist temptation.<sup>35</sup> A number of findings have demonstrated that there is a negative relationship between refusal self-efficacy and addictive behavior.<sup>35,36</sup>

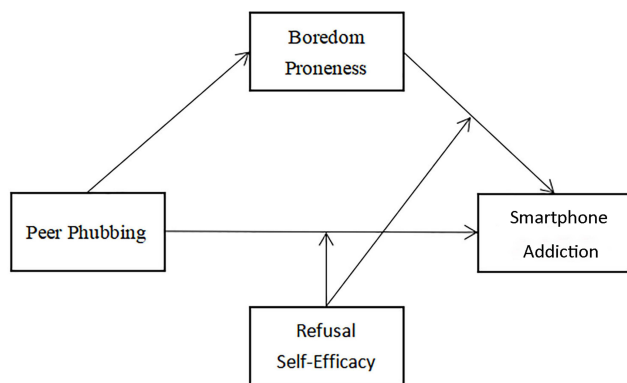
The risk-buffering hypothesis proposes that favorable individual characteristics such as refusal self-efficacy can attenuate the relation between environmental risk factors and problem behaviors.<sup>37</sup> According to the hypothesis,

protective factors can weaken the adverse effects of risk factors, refusal self-efficacy may act as a buffer between peer phubbing and smartphone addiction as well as boredom proneness and smartphone addiction. The interaction of protective factors (refusal self-efficacy) and risk factors (peer phubbing, boredom proneness) may reduce the likelihood of adverse outcomes (smartphone addiction). In other words, a high level of refusal self-efficacy may have some positive impacts on an individual's cognitions. College students have "cognitions" about how to refuse peer phubbing, which could decrease the level of smartphone addiction. Meanwhile, a high level of refusal self-efficacy could help college students to keep positive emotions,<sup>36,38,39</sup> which could decrease the level of boredom proneness. Then, it assists individuals to better cope with stressful events that subsequently would decrease the level of smartphone addiction.

Empirical studies have supported this hypothesis. For instance, Golestan and Abdullah<sup>40</sup> found that the existence of a significant moderating function of self-efficacy regarding the effect of environmental risk factors on cigarette smoking behavior amongst youngsters. Likewise, Jang et al<sup>41</sup> found that drinking refusal self-efficacy moderated the relationship between descriptive norms and adolescent drinking behavior, such that participants with higher refusal self-efficacy were less likely to be affected by descriptive norms. Ehret et al<sup>42</sup> also found a moderation effect of refusal self-efficacy such that individuals low in protective behavioral strategies and low in refusal self-efficacy are at increased risk for alcohol use. To our knowledge, yet little study has examined whether refusal self-efficacy is a protective factor that buffers the adverse impact of peer phubbing on smartphone addiction as well as boredom proneness and smartphone addiction during COVID-19 pandemic.

## The Present Study

Taken together, the aims of this study were threefold. First, we tested whether peer phubbing is significantly associated with smartphone addiction. Second, the current study examined whether boredom proneness would mediate the relationship between peer phubbing and smartphone addiction. Third, we tested whether refusal self-efficacy would moderate the association between peer phubbing and smartphone addiction (Figure 1). Based on the literature review, we proposed the following hypotheses:



**Figure 1** The proposed theoretical model.

**Hypothesis 1:** Peer phubbing is positively related to smartphone addiction.

**Hypothesis 2:** Boredom proneness would mediate the relationship between peer phubbing and smartphone addiction.

**Hypothesis 3:** Refusal self-efficacy would moderate the association between peer phubbing and smartphone addiction as well as boredom proneness and smartphone addiction.

## Materials and Methods

### Participants

The survey was approved by the ethics committee of the first author's university and all participants provided informed consent. Participants were recruited from two colleges in Jiangxi, China. After removing invalid observations (ie, missing data or other errors), 1396 participants were included in the final analyses. The mean age was 20.48 ( $SD = 1.08$ , age range = 18–23 years, 41.29% female).

### Instruments

#### Peer Phubbing Scale

The nine-item Peer Phubbing Scale was revised by replacing “partner” with “peer”, which was adapted from the Partner Phubbing Scale.<sup>19</sup> Peer Phubbing Scale was used to examine participants' perceived peer phubbing. Participants rated each item (eg, My peer glance at his/her cell phone when talking to me) on a 5-point scale ranging from 1 = very hard to 5 = very easy. Higher scores indicate higher levels of peer phubbing. Confirmatory factor analysis (CFA) of Peer Phubbing Scale suggested that the one-factor model fit the data well: CFI=0.90, TLI=0.90, RMSEA=0.08, 90% CI = [0.06, 0.09],

SRMR=0.05. For the current study, Cronbach's  $\alpha$  was 0.91. The reliability index and cultural adaptation of the scale applied in research of Chinese samples are well.<sup>43</sup>

#### Refusal Self-Efficacy Scale

The five-item Refusal Self-efficacy Scale revised by Xu et al<sup>44</sup> was used to measure the resistance efficacy of problematic behaviors. This scale was adapted from the Resistance efficacy Scale.<sup>45</sup> Participants rated each item (eg, Suppose you are with peers, some of them are playing with smartphones, and you have smartphones with you, and they say that if you want to play, you can play with smartphones now. Are you willing to refuse verbally and do not play with smartphones?) on a 5-point scale ranging from 1 = never to 5 = always. Higher scores indicate higher levels of the resistance efficacy of the individual. For the current study, Cronbach's  $\alpha$  was 0.90. The reliability index and cultural adaptation of the scale applied in research of Chinese samples are well.<sup>46–48</sup>

#### Smartphone Addiction Index Scale

The seventeen-item Smartphone Addiction Index Scale revised by Huang et al<sup>49</sup> was used to measure participants' smartphone addiction. This scale was adapted from the Mobile Phone Addiction Index.<sup>50</sup> Participants rated each item (eg, Your friends and family have complained because you are using your phone) on a 5-point ranging from 1 = never to 5 = always, with higher scores indicating higher levels of smartphone addiction. For the current study, Cronbach's  $\alpha$  was 0.89. The reliability index and cultural adaptation of the scale applied in research of Chinese samples are well.<sup>49,51,52</sup>

#### Boredom Proneness Scale

The twelve-item Boredom proneness Scale revised by Li et al<sup>53</sup> was used to measure participants' anonymity perpetration. This scale was adapted from the Boredom Proneness Scale-Short Form.<sup>54</sup> Participants rated each item (eg, I always feel the surrounding environment is monotonous and boring) on a 7-point scale ranging from 1 = strongly disagree to 7 = strongly agree. Higher scores indicate higher levels of perceived anonymity of the individual. For the current study, Cronbach's  $\alpha$  was 0.91. The reliability index and cultural adaptation of the scale applied in research of Chinese samples are well.<sup>53,55,56</sup>

### Procedure

Due to government issued orders to keep social distancing during COVID-19 pandemic, questionnaires were distributed electronically via the Internet. The survey was hosted

**Table 1** Bivariate Correlations of the Study Variables

	<b>M</b>	<b>SD</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
1.Age	20.48	0.44	1					
2.Gender	0.49	1.08	−0.04	1				
3.Peer phubbing	3.21	0.18	0.01	0.06*	1			
4.Boredom proneness	4.15	0.31	0.01	−0.12*	0.17***	1		
5.SA	2.71	0.37	0.01	0.01	0.52***	0.26***	1	
6.RSE	3.81	0.12	0.02	0.16	0.20	0.27	−0.21***	1

**Notes:**  $N = 1396$ , \*\*\* $p < 0.001$ . \* $p < 0.05$ ; gender is a dummy variable, boy = 0, girl = 1, the average meant the proportion of girls.

**Abbreviations:** SA, smartphone addiction; RSE, refusal self-efficacy.

on Survey Star (Changsha Ranxing Science and Technology, Shanghai, China) from March 01–19, 2021 and all responses were anonymous. Participation in the study was entirely voluntary and no compensation was given for their participation.

## Statistical Analysis

Tests of normality revealed that the study variables showed no significant deviation from normality (ie, Skewness  $< |3.0|$  and Kurtosis  $< |10.0|$ ).<sup>57</sup> Descriptive statistics were first calculated. PROCESS Models 4 and 15 macro for SPSS were used to test the mediation and moderated mediation models with 5000 random sample bootstrapping confidence intervals (CIs).<sup>58</sup> All variables were standardized prior to being analyzed.

## Results

### Preliminary Analyses

The descriptive statistics of the core variables and their bivariate correlation coefficients are shown in Table 1. Peer phubbing was positively correlated with both boredom proneness and smartphone addiction. Boredom proneness was positively correlated with smartphone addiction. Smartphone addiction was negatively correlated with refusal self-efficacy. Therefore, Hypothesis 1 was supported.

### Testing for Mediation Effect

The hypothesis assumed that boredom proneness mediates the relation between peer phubbing and smartphone addiction. To test this hypothesis, we used Model 4 of the SPSS macro PROCESS complied by Hayes (2017). The regression results for testing mediation are reported in Table 2. Results indicated that peer phubbing was positively related to boredom proneness ( $\beta = 0.43$ ,  $p < 0.001$ , 95% CI [0.39, 0.48]) and smartphone addiction ( $\beta = 0.59$ ,  $p < 0.001$ , 95% CI [0.56, 0.63]). The residual direct effect of peer

phubbing on smartphone addiction remained positive ( $\beta = 0.51$ ,  $p < 0.001$ , 95% CI [0.46, 0.56]). These results show that boredom proneness partially mediated the association between peer phubbing and smartphone addiction (indirect effect = 0.38, SE = 0.02, 95% CI [0.33, 0.46]), and the mediation effect accounted for 35.59% of the total effect of peer phubbing on smartphone addiction. Results showed that all two mediating pathways in Figure 1 were significant, supporting Hypothesis 2.

### Moderated Mediation Effect Analysis

We used model 15 in SPSS macro PROCESS, which fits into the moderated mediating model hypothesized in this study, to analyze whether boredom proneness could moderate the direct association between peer phubbing and smartphone addiction, and the mediating effect of boredom proneness (specially, the association between boredom proneness and smartphone addiction). The results are presented in Table 2.

The moderated mediation model showed that peer phubbing was positively associated with boredom proneness ( $\beta = 0.43$ ,  $p < 0.001$ , 95% CI [0.38, 0.48]), which is consistent with the mediating model analysis. Moreover, the dependent variable model showed that peer phubbing was positively associated with smartphone addiction ( $\beta = 0.52$ ,  $p < 0.001$ , 95% CI [0.47, 0.57]), while boredom proneness was positively associated with smartphone addiction ( $\beta = 0.25$ ,  $p < 0.001$ , 95% CI [0.21, 0.30]). Furthermore, the predictive effects of the interaction of peer phubbing and refusal self-efficacy ( $\beta = 0.06$ ,  $p < 0.05$ , 95% CI [0.02, 0.10]), and the interaction of boredom proneness and refusal self-efficacy for smartphone addiction ( $\beta = -0.05$ ,  $p < 0.01$ , 95% CI [−0.08, −0.01]) were both significant. These results indicated that refusal self-efficacy could moderate the associations linking peer phubbing and boredom proneness to smartphone addiction (ie, refusal self-efficacy could significantly moderate the associations between peer phubbing and smartphone

**Table 2** Linear Regression Models

Predictors	Model 1 (Boredom Proneness)		Model 2(SA)		Model 3(SA)		Model 4 (SA)	
	$\beta$	t	$\beta$	t	$\beta$	t	$\beta$	t
Age	0.01	0.07	-0.01	-0.31	-0.01	-0.33	-0.01	-0.06
Gender	-0.14	-5.97	-0.05	-1.15	0.01	0.13	0.04	1.753
Peer phubbing	0.43	18.04***	0.59	27.43***	0.51	21.70***	0.52	22.61***
Boredom proneness					0.19	8.23*	0.25	10.64***
RSE							-0.18	-7.95***
Peer phubbing $\times$ RSE							0.06	2.92**
Boredom proneness $\times$ RSE							-0.05	-2.51
$R^2$	0.20		0.35		0.38		0.41	
F	117.41***		251.23***		214.16***		139.56***	

Notes: N = 1396. Each column is a regression model that predicts the criterion at the top of the column; \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

Abbreviation: SA, smartphone addiction.

addiction as well as boredom proneness and smartphone addiction). Thus, the hypothesized moderated mediating model was supported. The interaction effect is visually plotted in Figure 2. Simple slope tests showed that for college students with low refusal self-efficacy, boredom proneness significantly predicted smartphone addiction,  $b_{simple} = 0.31$ ,  $t = 9.17$ ,  $p < 0.001$ . However, for college students with high refusal self-efficacy, boredom proneness significantly predicted smartphone addiction but much weaker,  $b_{simple} = 0.21$ ,  $t = 7.48$ ,  $p < 0.001$ , indicating a buffering effect of refusal self-efficacy (Figure 2A). Lastly, the interaction effect is visually plotted in Figure 2B. Simple slope tests showed that peer phubbing significantly predicted smartphone addiction in high-level refusal self-efficacy and low-level refusal self-efficacy, but the predictive function of peer phubbing on smartphone addiction was stronger for college students with high levels of refusal self-efficacy ( $b_{simple} = 0.58$ ,  $t = 19.17$ ,  $p < 0.001$ ) than for college students with low levels of refusal self-efficacy ( $b_{simple} = 0.46$ ,  $t = 14.84$ ,  $p < 0.001$ ), indicating a reverse buffering effect of refusal self-efficacy (Figure 2B).

The bias-corrected percentile bootstrap analysis further indicated that the indirect effect of peer phubbing on smartphone addiction through boredom proneness was moderated by refusal self-efficacy. Particularly, for college students low in refusal self-efficacy, the indirect effect of peer phubbing on smartphone addiction via boredom proneness was significant,  $\beta = 0.13$ ,  $SE = 0.02$ , 95% CI [0.08, 0.18]. The indirect effect was also significant for college

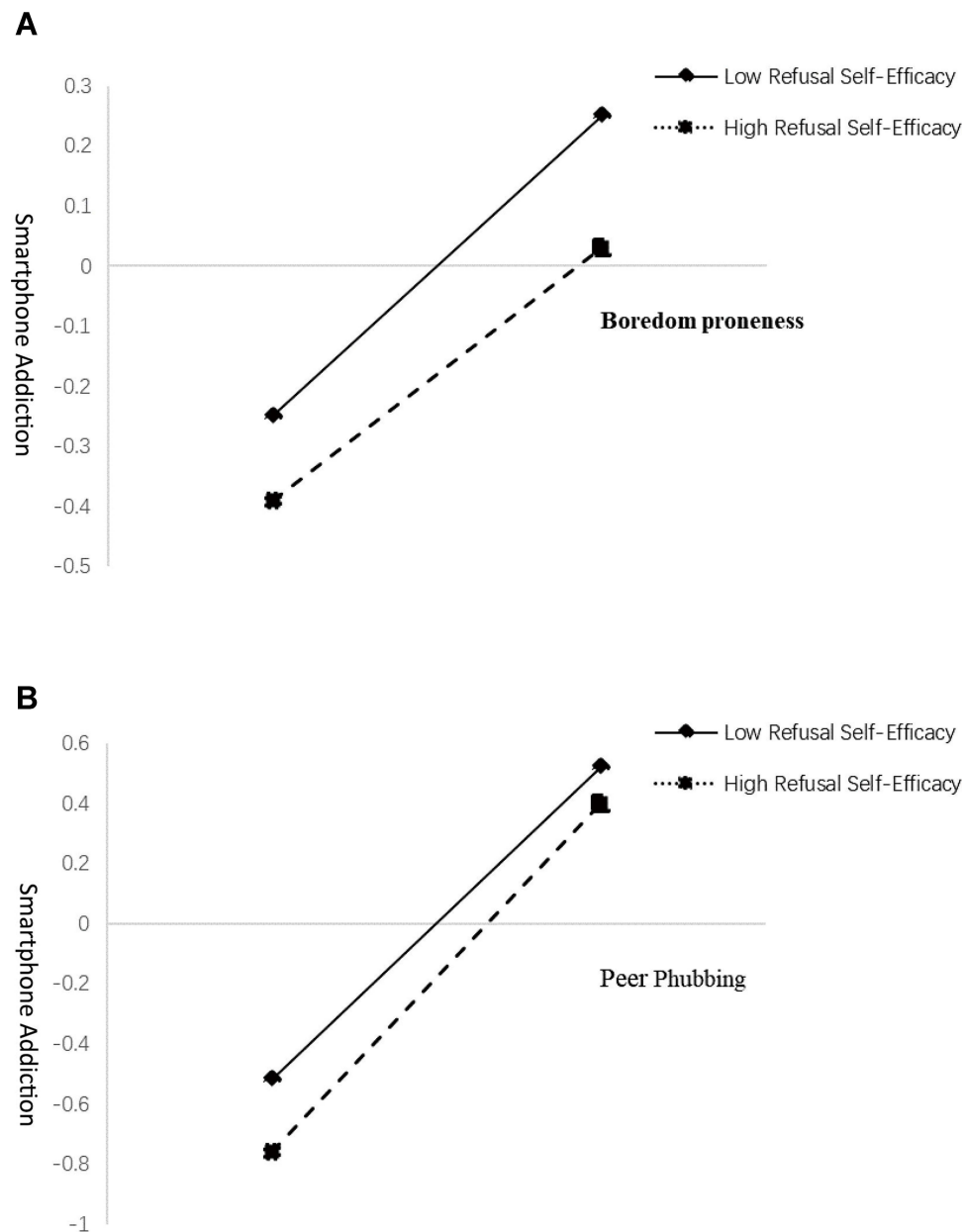
students with high refusal self-efficacy, but weaker,  $\beta = 0.09$ ,  $SE = 0.02$ , 95% CI [0.05, 0.13]. Therefore, Hypothesis 3 was supported.

## Discussion

According to our current knowledge, few studies have found that peer phubbing affects smartphone addiction. Meanwhile, how the underlying mediating and moderating mechanisms are still unclear. Thus, this study proposed a moderated mediation model to examine the effect of peer phubbing on smartphone addiction during COVID-19 pandemic, supplemented with existing literature. This finding showed that peer phubbing was significantly and positively associated with smartphone addiction among Chinese college students during COVID-19 pandemic, and boredom proneness partially mediated the relationship between peer phubbing and smartphone addiction. Furthermore, the relationships between peer phubbing and smartphone addiction as well as boredom proneness and smartphone addiction were partially moderated by refusal self-efficacy.

## The Relationship Between Peer Phubbing and Smartphone Addiction

Results partially supported the hypothesis that peer phubbing would be positively associated with smartphone addiction. Prior researches have mainly focused on the roles of family environmental factors (ie, parent phubbing)



**Figure 2** Association between boredom proneness and smartphone addiction at higher and lower levels of refusal self-efficacy (A); Association between peer phubbing and smartphone addiction at higher and lower levels of refusal self-efficacy (B). (A) Boredom Proneness × Refusal Self-Efficacy. (B) Peer Phubbing × Refusal Self-Efficacy.

in influencing smartphone addiction. After entering puberty, the communication between individuals and their parents becomes less and less, and the interaction with peers becomes more and more frequent.<sup>24</sup> During COVID-19 pandemic, due to the closed management of the college, there is an important interaction between college students and their peers. At the same time, the influence of peers on college students gradually increases. This finding extends prior studies by demonstrating the influence of peer factors on smartphone addiction. The

effect of peer phubbing on college students' smartphone addiction also coincides with the social compensation theory.<sup>59</sup> Peer phubbing can make others feel negative emotions and low-value perceptions.<sup>60,61</sup> College students will release their pressure by using smartphones more frequently. Literature has shown that individual negative experiences can be compensated by using smartphones.<sup>62,63</sup> Thus, as an environmental factor, peer phubbing is closely related to smartphone addiction among college students during COVID-19 pandemic.

## The Mediating Role of Boredom Proneness

To the best of our knowledge, the present study is the first to demonstrate the mediating effect of boredom proneness in the association between peer phubbing and smartphone addiction during COVID-19 pandemic. For the first stage of the mediation process (ie, peer phubbing → boredom proneness), peer phubbing has a positive predictive effect on college students' boredom proneness, that is, the more peer phubbing, the higher level of boredom proneness will be. When peers appear phubbing, their effective communication is interrupted, thinking that they are not important, and damage the peer relationship. During the epidemic, the government asked the public to keep a social distancing, as a result, the interaction between peers is reduced. With the reduction of external stimuli, it is easy to form a sense of boredom,<sup>25,64,65</sup> which is congruent with the arousal theory.<sup>27,66</sup> For the second stage of our mediation model (ie, boredom proneness → smartphone addiction), the present study found that boredom proneness has a positive predictive effect on college students' smartphone addiction, that is, the more boredom proneness, the higher level of smartphone addiction will be. According to the theory of sensation seeking,<sup>67</sup> people must maintain a certain amount of stimulus input in life. In this sense, people with high boredom proneness prefer to seek meaningful stimulation from smartphones to maintain a level of excitement.<sup>32,68</sup> They will actively choose some original stimuli to improve their arousal level when they are boring.<sup>65,69</sup> It's hard to get more stimulation from the outside during COVID-19 pandemic. Because of the portability and functionality of smartphones, it is an important tool for college students to get rid of boredom, and it also raises the risk of smartphone addiction.<sup>32,70</sup> Then, the exposure of college students to an adverse context (eg, peer phubbing) increases their likelihood of facing other adverse contexts (eg, boredom proneness), which increases their likelihood of problematic behavior (eg, smartphone addiction) during COVID-19 pandemic.

## The Moderating Role of Refusal Self-Efficacy

The results indicated that refusal self-efficacy moderated the relationship between peer phubbing and smartphone addiction as well as boredom proneness and smartphone addiction during COVID-19 pandemic. Two specific patterns of protection emerged: reverse risk-buffering and risk-buffering.

Specifically, the adverse effect of peer phubbing on smartphone addiction is stronger for college students with high than low refusal self-efficacy. That is to say, although refusal self-efficacy is an important protective factor in low levels of peer phubbing, its advantages are erased in high levels of peer phubbing. There are two possible explanations. Firstly, according to the theory of normative social behavior,<sup>71</sup> some factors, such as group identity, peer communication, behavioral identity, influenced the behavior. When college students think that peer phubbing is a recognized norm, they will get more psychological satisfaction when using the smartphone,<sup>14</sup> and satisfaction makes individuals feel more self-efficacy.<sup>72</sup> Therefore, even if college students have high levels of refusal self-efficacy, the mutual influence between peers could prevent refusal self-efficacy from playing a protective role during the epidemic. Secondly, co-rumination is common among adolescents,<sup>73</sup> it refers to the repeated discussion and exploration of the problems or troubles faced by one or both sides in an intimate relationship, and mainly focuses on negative emotions. Excessive co-rumination may enlarge the problem itself, leading to the internalization problem.<sup>74</sup> However, individuals can feel understanding and empathy in the process of peer rumination,<sup>75</sup> so as to increase relationship satisfaction,<sup>74</sup> and satisfaction makes individuals feel more self-efficacy.<sup>72</sup> Therefore, when college students who have experienced peer phubbing have high levels of refusal self-efficacy, college students may have more common rumination, which aggravates the negative impact of peer phubbing on college students' smartphone addiction during the epidemic. Consistent with protective-limiting (水车薪) hypothesis,<sup>76</sup> which proposes that the protective factor may lose its ability to counteract risk once risk factors reach a certain level (the protective effects of factor are dampened in the face of the high-risk factor). The protective-limiting hypothesis has been used to explain the moderating effect and is supported adequately by researches.<sup>77–80</sup>

In contrast, refusal self-efficacy served as a buffer factor in the effect of boredom proneness on college students' smartphone addiction. As a result, refusal self-efficacy counteracts the negative impact of boredom proneness on smartphone addiction. College students with a high level of refusal self-efficacy can effectively control their emotions even when they are with a high level of boredom proneness, thus they are less likely to turn to smartphone addiction for psychological fulfillment during the epidemic. The college students who have a high level of refusal self-efficacy also are more likely to understand the destructive impact of smartphone addiction and therefore are less likely to engage in that activity when

they are with negative boredom proneness. In conclusion, this finding confirms the significance of examining the risk-buffering hypothesis<sup>37</sup> to better understand peer phubbing effect on college students' smartphone addiction during COVID-19 pandemic.

## Limitations

There are also some limitations in the present investigation that need to be noted. First, we used a cross-sectional design, which does not allow us to infer causality. To better explain causal direction, future research should utilize experimental and longitudinal designs. Second, there's a possibility that, like any study using only self-reported results for data collection, response biases and social desirability effects may have impacted the findings. Replication of the results with other, more comprehensive, or even more representative samples is needed for even more generalizable conclusions. Third, considering the present study was conducted among Chinese college students, it has limited generalizability and indicates that similar studies should be conducted in more diverse samples.

Despite these limitations, contributions from the current study are both theoretical and practical. From a theoretical point of view, this study extends previous studies by emphasizing the mediating role of boredom proneness, as well as the moderating role of refusal self-efficacy during COVID-19 pandemic. Before COVID-19 epidemic, there was no literature on the relationship between peer phubbing and college students' smartphone addiction. Nonetheless, previous relevant study has found that the correlation analysis showed peer phubbing was significantly positive to high school students' smartphone addiction.<sup>43</sup> Our study contributes to the research understanding of the association between peer phubbing and smartphone addiction among Chinese college students during COVID-19 pandemic.

As well as providing empirical evidence for theories such as the social bonding theory, the arousal theory, social-cognitive theory, the theory of normative social behavior. From a practical point of view, this study has important implications for preventing and intervening with smartphone addiction in college students during COVID-19 pandemic. First, the findings illustrate the importance of peer phubbing in the influence of smartphone addiction. It suggests that educators and parents can help college students avoid spending too much time with their peers who overuse smartphones during the epidemic. Second, we found that boredom proneness was a significant factor linking peer phubbing to smartphone addiction, and our study sheds light on how peer phubbing is related

to smartphone addiction. Thus, it might be good to encourage educators and parents to pay much more attention to college students' peer contexts and take active measures to reduce negative boredom proneness to decrease the level of smartphone addiction. As a final point, the indirect association between the high level of boredom proneness and smartphone addiction is weaker in college students with a high level of refusal self-efficacy than in those with a low level of refusal self-efficacy. Targeted interventions should be developed and conducted, including decreased peer phubbing, especially for a low level of refusal self-efficacy college students. The indirect association between the high level of peer phubbing and smartphone addiction is stronger in college students with a high level of refusal self-efficacy than in those with low refusal self-efficacy. In this study, compared with college students who experienced a higher level of peer phubbing, a lower level of refusal self-efficacy can provide more protection for college students who experienced a higher level of peer phubbing. The reason may be that peer phubbing, a risk factor in life, has an excessive strong negative impact on college students, weakening the protective effect of refusal self-efficacy during COVID-19 pandemic.

## Conclusion

In summary, this study is important in investigating how peer phubbing is related to the smartphone addiction of Chinese college students during COVID-19 pandemic, even if further replication and extension are needed. Boredom proneness is shown to serve as one mechanism by which peer phubbing is associated with more smartphone addiction. The focus on boredom proneness provides additional nuances in linking peer phubbing to smartphone addiction in college students. Furthermore, this mediation mechanism is moderated by refusal self-efficacy. The results suggest that college students' boredom proneness and refusal self-efficacy may be prime targets for prevention and intervention programs. Thus, this study explored "how" and "when" peer phubbing may enhance college students' smartphone addiction during COVID-19 pandemic.

## Highlights

Peer phubbing was associated with Chinese college students' smartphone addiction during COVID-19 pandemic.

Boredom proneness mediated between peer phubbing and Chinese college students' smartphone addiction during COVID-19 pandemic.

Refusal self-efficacy moderated the relationship between peer phubbing and smartphone addiction as well

as boredom proneness and smartphone addiction among Chinese college students during COVID-19 pandemic.

## Data Sharing Statement

The datasets used in this study are available upon request to the corresponding author.

## Ethics Statement

This study was conducted in accordance with the Declaration of Helsinki, and the study protocol was reviewed and approved by the institutional review board of school of Psychology, Jiangxi Normal University. All participants reviewed the consent form before they participated in the study.

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## Disclosure

The authors declare that they have no competing interests.

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