Psychology Research and Behavior Management

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ORIGINAL RESEARCH

Loneliness and Mobile Phone Addiction Among Chinese College Students: The Mediating Roles of Boredom Proneness and Self-Control

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Introduction: Mobile phones bring convenience to people's lives, but also affect their physical and mental health (especially in college students). Previous studies have revealed that mobile phone addiction is positively related to loneliness. This study further explored the mediating effects of boredom proneness and self-control on the relationship between loneliness and mobile phone addiction.

Methods: A cross-sectional design was conducted in the present study. The investigation employed the Chinese version of the UCLA Loneliness Self-report Scale, Boredom Proneness Scale-Short Form, the Chinese version of the Self-control scale, and the Mobile Phone Addiction Index. Out of 1122 college students, 1078 completed the questionnaire survey and became our final subjects. PROCESS macro of SPSS 21 was used to conduct explore the mediating roles of boredom proneness and self-control in the relationship between loneliness and mobile phone addiction.

Results: Loneliness, boredom proneness, and mobile phone addiction were significantly and positively correlated with each other, as well as significantly negatively correlated with self-control. Boredom proneness and self-control, when operating in parallel, partially mediated the relationship between loneliness and mobile phone addiction. By contrast, when occurring sequentially, they fully mediated the relationship between loneliness and mobile phone addiction.

Conclusion: Mobile phone addiction among lonely college students can be eliminated by exercising self-control and alleviating boredom proneness.

Keywords: loneliness, boredom proneness, self-control, mobile phone addiction, college students

Introduction

Mobile phones are among the greatest inventions in modern society, improving our lives in different ways. However, mobile phone can also have adverse side effects. The most severe problem related to using mobile phones is that people are likely to develop an addiction to them.[1] Research has shown that overuse of mobile phones can adversely affect individuals' physical (sleep problems[2]) and mental health (anxiety and depression[3]). According to a China Internet Network Information Center survey, there are 695 million mobile phone users in China. Among them, students constitute the highest proportion of users, at 25% as of December 2016.[4] Compared to other groups, college students have ample leisure time, and their mobile phone usage is less constrained by the external environment. Thus, they are

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Received: 21 April 2021
Accepted: 20 May 2021
Published: 11 June 2021

more vulnerable to mobile phone addiction.[5] Given the negative consequences of mobile phone addiction, it is necessary to explore the potential mechanisms underlying mobile phone addiction and provide a theoretical basis for the effective addiction prevention among college students.

Loneliness and Mobile Phone Addiction

Loneliness can be associated with mobile phone addiction. Loneliness occurs when there are discrepancies between individuals' present social relationships and their desired social relationships.[6] Research has shown that mobile phone addiction among college students can be predicted by students' level of loneliness.[7–9] For example, Bian and Leung found that the higher one scored in loneliness, the higher was the likelihood they would be addicted to a -smartphone.[7] Previous studies have found that lonely people are more likely to be relationally incompetent, spend less time on social activities, and have difficulties maintaining stable relationships.[10,11] According to the Compensatory Internet Use theory,[12] when individuals are maladjusted in the real world, they may use mobile phones (virtual networks) to escape negative feelings (loneliness). Based on the theory and empirical evidence, the present study hypothesized that mobile phone addiction among college students is predicted by loneliness.

Loneliness, Boredom Proneness, and Mobile Phone Addiction

The relationship between loneliness and mobile phone addiction may be mediated by boredom proneness. Boredom is an aversive state in which individuals are unable to engage with internal or external information, and therefore fail to find satisfaction in any activity.[13] Some previous studies have found that both loneliness[13,14] and mobile phone addiction[15,16] are positively correlated with boredom. Some studies have also found casual relationships between these variables.[13,17,18] For instance, Harris indicated that loneliness is one of the leading causes of boredom.[17] Further, Lin and Yu found that boredom is a crucial motivator for Internet addiction.[18] Hence, the relationship between loneliness and mobile phone addiction may be mediated by boredom proneness.

Loneliness, Self-Control, and Mobile Phone Addiction

The relationship between loneliness and mobile phone addiction may also be mediated by self-control. Self-control is defined as the ability to regulate one's own behavior to achieve personal value and meet social expectations.[19] The limited resource model of self-control[20] posits that successful self-control requires mental energy and cognitive resources, both of which are limited. Resource-consuming activities such as emotional control and impulsivity regulation may lead to failures in self-control, which in turn leads to problematic behaviors.[21] Some previous studies have indicated that psychological problems (loneliness and depression) are negatively related to self-control,[22,23] and that negative feelings weaken self-control.[24] Meanwhile, research has also shown that self-control can negatively predict mobile phone addiction.[25,26] Hence, the present study hypothesized that the relationship between loneliness and mobile phone addiction is mediated by self-control.

Loneliness, Boredom Proneness, Self-Control, and Mobile Phone Addiction

Furthermore, the present study proposes that the relationship between loneliness and mobile phone addiction is mediated by boredom proneness and self-control. Under the sequential mediation model, loneliness leads to a higher propensity for boredom, reducing self-control. Thus, it can be used as a predictor of mobile phone addiction. Some indirect evidence supports sequential mediation models. For example, Zhou and Leung found that loneliness is positively related with boredom proneness.[27] Kılıç et al found that boredom impairs individuals' self-control.[28] Meanwhile, some previous studies have indicated that self-control negatively predicts mobile phone addiction.[25,26] Thus, the relationship between loneliness and mobile phone addiction may be sequentially mediated by boredom proneness and self-control.

The Present Study

Based on these theories and empirical evidence, the present study included both boredom proneness and self-control in the mediation model to investigate their individual and combined effects on the relationship between loneliness and mobile phone addiction. The following hypotheses were tested:

H1: Mobile phone addiction among college students is positively predicted by loneliness.

H2: The relationship between loneliness and mobile phone addiction is mediated by boredom proneness.

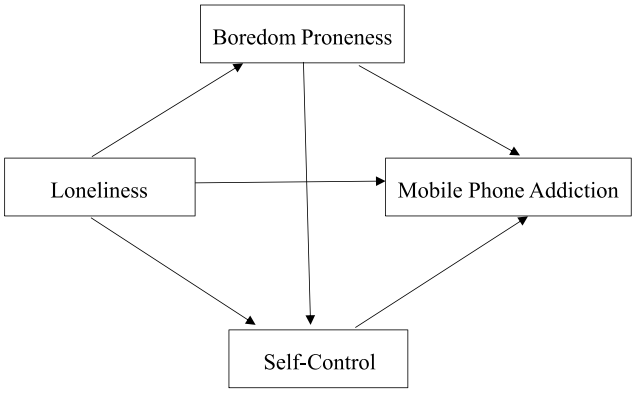

Figure 1 Conceptual model.

H3: The relationship between loneliness and mobile phone addiction is mediated by self-control.

H4: The relationship between loneliness and mobile phone addiction is sequentially mediated by boredom proneness and self-control.

The hypothesized model is shown in Figure 1.

Materials and Methods

Procedures and Participants

The ethics committee of Zhejiang Normal University approved the study, which was conducted per the Declaration of Helsinki. A web-based survey was used to collect data. The survey was conducted in class. Before the survey, all participants were told that the study was conducted anonymously and that their information would be kept confidential. And then the informed consent was provided to them. These participants were introduced to the survey guidelines by trained research. Then, the questionnaire link was sent to participants through the SO JUMP platform, which was used to collect responses and store data. Finally, all data were imported into SPSS for further analysis.

The sample initially consisted of 1122 college students. However, 44 participants who had provided incomplete responses were excluded, resulting in 1078 valid samples for analysis (response rate: 96%). The sample consisted of 772 male (72%) and 306 female respondents (28%), with an average age of 20 years (SD=1.10). A total of 797 (74%) participants were from rural areas, while 281 (26%) were from urban areas. Furthermore, 315 (29%) participants were from a one-child family, while 763 (71%) had siblings. Participants had been using smartphones for an average of six years.

Measures

Loneliness

Loneliness was measured using the Chinese version of the UCLA Loneliness Self-reporting Scale,[29] compiled by Russell (1996).[30] This tool consists 20 items (eg, "How often do you feel unhappy doing so many things alone?"). All items were scored on a five-point Likert scale (1=never, 5=always). Cronbach's alpha for the scale was 0.90 in the present study.

Boredom Proneness

Boredom proneness was measured using the Boredom Proneness Scale-Short Form (BPS-SF-12), as revised by Li et al.[31] The BPS-SF is a 12-item scale ("In most situations, it is hard for me to find something to do or see to keep me interested") designed to assess boredom proneness. Responses to questions ranged from 1(strongly disagree) to 7 (strongly agree). This measure had good internal consistency ($\alpha = 0.76$).

Self-Control

Self-control was measured using the Chinese version of the Self-control Scale (SCS) complied by Tangney et al.[32] The SCS consists of 13 items ("I am good at resisting temptation"). All items were scored on a five-point Likert scale (1=not at all, 5=very much). The Cronbach's alpha of the scale was 0.81 in the present study.

Mobile Phone Addiction

The MPAI is a 17-item scale ("You find it difficult to switch off your mobile phone") designed by Leung[33] to measure mobile phone addiction. The response options ranged from 1 (not at all) to 5 (always), with higher scores indicating a higher level of mobile phone addiction. The Cronbach's alpha coefficient for the scale was 0.91.

Data Analysis

Data analyses were performed using SPSS 21.0 and the PROCESS macro.[34] First, descriptive statistics and correlational analyses were performed for the main variables. Second, the PROCESS macro in SPSS (Model 4) was used to examine the mediating effects of boredom proneness and self-control on the relationship between loneliness and mobile phone addiction. Third, Model 6 of the PROCESS macro was used to investigate the sequential mediating effects of boredom proneness and self-control on the relationship between loneliness and mobile phone addiction. The bootstrapping method was used to examine whether

the mediating effects of boredom proneness and self-control were significant, based on 5000 bootstrap samples.

Results

Preliminary Analysis

The results of the descriptive statistics and correlations among the main variables are shown in Table 1. There was a positive correlation between loneliness and mobile phone addiction, whereas loneliness was negatively correlated with self-control. Similarly, boredom proneness was positively correlated with mobile phone addiction and negatively correlated with self-control, whereas self-control was negatively correlated with mobile phone addiction.

The Mediating Role of Boredom Proneness

The present study used Model 4 of the PROCESS macro[34] to test H2 and ascertain whether boredom proneness mediates the link between loneliness and mobile phone addiction. The results showed a positive correlation between loneliness and boredom proneness ($b = 0.53$, $p<0.001$), which, in turn, was related to mobile phone addiction ($b = 0.33$, $p<0.001$). The residual direct effect was also significant ($b = 0.15$, $p<0.001$). These results indicated that the relationship between loneliness and mobile phone addiction was partially mediated by boredom proneness (indirect effect = 0.17, 95% CI = 0.13 to 0.22). Overall, this model accounted for 53.0% of the variance in mobile phone addiction, supporting H2.

The Mediating Role of Self-Control

We tested H3 to ascertain whether the link between loneliness and mobile phone addiction was mediated by self-control. We found that loneliness was negatively related to self-control ($b = -0.42$, $p<0.001$), which, in turn, was significantly correlated with mobile phone addiction ($b = -0.39$, $p<0.001$). Moreover, the residual direct effect was significant ($b = 0.16$, $p<0.001$). This implied that self-control partially mediated the association between loneliness and mobile phone addiction (indirect effect = 0.16, 95% CI = 0.13 to 0.21). This model accounted for 50.0% of the variance in mobile phone addiction, supporting H3.

Table 1 Means, and Standard Deviations, Bivariate Correlations Among Variables

Variables	*M*	*SD*	1	2	3	4	5
Age	19.86	1.10	–				
Loneliness	2.20	0.43	−0.01	–			
BP	3.60	0.64	−0.06	0.53**	–		
SC	2.94	0.51	0.06	−0.42**	−0.41**	–	
MPA	2.84	0.67	−0.05	0.32**	0.41**	−0.46**	–

Notes: **$p<0.01$.
Abbreviations: BP, boredom proneness; SC, self-control; MPA, mobile phone addiction.

The Multiple Mediation Models

The Model 6 of the PROCESS macro was adopted to test the multiple mediation model. Results showed that the pathways for "loneliness → boredom proneness → mobile phone addiction" (indirect effect = 0.13, 95% CI = 0.09 to 0.17), and "loneliness → self-control → mobile phone addiction" (indirect effect = 0.09, 95% CI = 0.07 to 0.13) were significant. This indicated that boredom proneness and self-control mediated the relationship between loneliness and mobile phone addiction. Similarly, the sequential pathway for "loneliness → boredom proneness → self-control → mobile phone addiction" was significant (indirect effect = 0.05, 95% CI = 0.03 to 0.07), implying that more loneliness was serially associated with higher boredom proneness ($b = 0.53$, $p<0.001$), lower self-control ($b = -0.26$, $p<0.001$), and higher mobile phone addiction ($b = -0.34$, $p<0.001$). However, the residual direct pathway for "loneliness → mobile phone addiction" was not significant ($b = 0.06$, $p>0.05$). Thus, boredom proneness and self-control mediated the relationship between loneliness and mobile phone addiction, both in parallel and sequentially. Overall, this multiple mediation model accounted for significant variance in Chinese college students' mobile phone addiction ($R^2 = 0.27$). The results of the mediation analyses are shown in Table 2.

Discussion

This study proposed that boredom proneness, followed by self-control, would serially mediate the relationship between loneliness and mobile phone addiction. As hypothesized, loneliness predicted mobile phone addiction, and this relation was explained by the serial indirect effect of boredom proneness and self-control. Specifically, increased loneliness was correlated with increased boredom proneness, which was related to decreased self-control and, in turn, more significant mobile phone addiction. Boredom proneness and self-control independently accounted for part of the association between loneliness and mobile phone addiction. After accounting for the indirect effects, loneliness had no significant direct impact on mobile phone addiction. These results underscore the importance of boredom proneness and self-control as

Table 2 Testing the Pathways of the Multiple Mediation Model

Effect	*b*	*SE*	95% CI (Lower-Upper)	
Direct effects				
Loneliness → boredom proneness	0.53***	0.03	0.48	0.59
Loneliness → self-control	−0.28***	0.03	−0.34	−0.21
Boredom proneness → self-control	−0.26***	0.03	−0.32	−0.20
Loneliness → mobile phone addiction	0.06	0.05	−0.01	0.12
Boredom proneness → mobile phone addiction	0.24***	0.03	0.17	0.30
Self-control → mobile phone addiction	−0.34***	0.03	−0.40	−0.28
Indirect effects				
Loneliness → boredom proneness → mobile phone addiction	0.13	0.02	0.09	0.17
Loneliness → self-control → mobile phone addiction	0.09	0.02	0.07	0.13
Loneliness → boredom proneness → self-control → mobile phone addiction	0.05	0.01	0.03	0.07

Note: ***$p<0.001$.

potential factors in explaining the relationship between loneliness and mobile phone addiction among Chinese college students. The present study is the first to suggest that boredom proneness and self-control together play a role in this connection.

Relationship Between Loneliness and Mobile Phone Addiction

The present study found that loneliness was significantly and positively correlated with mobile phone addiction, supporting H1. The results are consistent with previous findings.[35,36] For example, Kardefelt-Winther found that lonely teenagers can meet their social needs through social connections on the Internet.[12] Additionally, our results validated the I-PACE model,[37,38] suggesting that loneliness may influence a person's decision to use the Internet for pleasure, which exacerbates the degree of mobile phone addiction.

The Mediating Role of Boredom Proneness

The present study found that the relationship between loneliness and mobile phone addiction was partially mediated by boredom proneness. That is, college students who are lonely are more likely to experience a greater tendency toward boredom, which indirectly leads to mobile phone addiction. This result is similar to previous findings that loneliness is positively related to boredom proneness, and problematic behaviors are positively correlated with boredom proneness.[39–41] This result can be explained as follows. Existing causal theories of boredom emphasize that situational factors and personality characteristics are key critical causes of boredom.[42] Research has shown that loneliness (personality characteristic) is one of leading causes of boredom.[17] Furthermore, some researchers posit that boredom results from a lack of engaging activity (social interaction[43]). Lonely individuals are characterized by a lack of social networks, including a lack of social relations, both in terms of quantity and quality. Hence, lonely individuals are more likely to be bored. College students who are prone to experiencing boredom tend to use mobile phones to seek out more stimulating and satisfying activities, leading to problematic mobile phone use patterns. Hence, the relationship between loneliness and mobile phone addiction may be mediated by boredom proneness.

The Mediating Role of Self-Control

The present study found that the relationship between loneliness and mobile phone addiction was partially mediated by self-control. This result is similar to previous findings.[19,25,36] For example, Liu et al investigated the relationship between stress, self-control and mobile phone addiction among Chinese adolescents, and the results showed that self-control partially mediated the association between perceived stress and mobile phone addiction.[36] One possible explanation for the mediation effect of self-control is that negative emotions consume limited self-control resources. The finite resource model of self-control[20] posits that the resources available for self-control are limited, and negative emotions might weaken the strength of self-control. Loneliness is a negative emotion. When individuals feel lonely, they tend to focus more

on their emotional state, manage emotions, control thoughts, and make choices, which can trigger a loss of self-control.[36,44] Meanwhile, the consumption of self-control resources may cause individuals to succumb to the temptation of mobile phones; they cannot control either their use of mobile phones or the phones' addictive potential.[45]

Sequential Mediating Effect of Boredom Proneness and Self-Control

One interesting result of the present study was that the relationship between loneliness and mobile phone addiction is fully mediated by boredom proneness and self-control when they operate sequentially, thereby supporting H4. These results suggest that lonely individuals tend to experience a high level of boredom proneness, which consumes cognitive and attentional resources, lowers self-control levels,[20] and ultimately increases the risk of mobile phone addiction among Chinese college students.[36] Therefore, the multiple mediation model supports two important explanatory mechanisms, a higher boredom tendency (emotional factor) and worse self-control (cognitive factor). Among them, the emotional factor of boredom proneness is intrinsically related to the cognitive factor of self-control.

Although research on the sequential mediating role of boredom proneness and self-control in the relationship between loneliness and mobile phone addiction is limited, the results of such research indirectly support the analysis of the present study. The sequential mediation model shows that boredom proneness is negatively correlated with self-control, which is consistent with the findings of previous studies.[46] A possible explanation is that boredom aggravates individuals' sensation-seeking, which leads to impaired self-control. Boredom is commonly defined as an affective state characterized by unpleasant feelings, lack of stimulation, and low physiological arousal in which the level of stimulation is perceived as unsatisfactorily low.[47] When lonely individuals experience boredom, they are more likely to engage in novel experiences and sensation seeking to maintain psychological arousal, which impairs self-control.

Limitations and Implications

This study has several limitations. First, the cross-sectional survey design we used cannot confirm the causal relationship. Future research may adopt longitudinal or experimental research to determine the causal relationships. Second, the representativeness of the sample may limit the generalizability of our results because the participants we recruited were from the same university. Future studies should explore the proposed model in different populations.

Despite these above limitations, this study is the first to reveal the mediating role of boredom proneness and self-control in the relationship between loneliness and mobile phone addiction. These results deepen previous studies by clarifying the mediating factors in the relationship between loneliness and mobile phone addiction. In addition, the present study has significant practical implications. Since boredom proneness plays a vital role in the relationship between loneliness and mobile phone addiction, interventions addressing boredom should include behavioral activation to facilitate valued and enjoyable activities,[48] as well as engagement in challenging activities.[49] Moreover, since loneliness can be strongly associated with low self-control, which is significantly associated with mobile phone addiction, improving self-control may effectively reduce the desire for mobile phones. According to the strength model of self-control, regular practice can strengthen self-control, just as muscles can be maintained by regular exercise.[49]

Conclusion

This study found that the relationship between loneliness and mobile phone addiction was mediated by boredom proneness and self-control in a parallel and sequential manner. When they operate sequentially, the relationship between loneliness and mobile phone addiction is fully mediated by boredom proneness and self-control. Our study suggests that reducing boredom and strengthening self-control may effectively help lonely individuals recover from mobile phone addiction.

Ethics Statement

This study was conducted in accordance with the Declaration of Helsinki. The local Ethics Committee approved the study.

Acknowledgments

The authors thank the subjects who participated in the study.

Author Contributions

Xinwei Li and Xuechao Feng should both be considered as the first author.All authors made a significant contribution to the work reported, whether that is in the conception,

study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

Project supported by Open Research Fund of College of Teacher Education, Zhejiang Normal University(No. jykf21020).

Disclosure

All authors declare that they have no conflicts of interest.

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