



The Role of Psychological Dimensions as Mediating Variables in Adolescent Interpersonal Relationships and Smartphone Addiction

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Abstract. Research suggests that smartphone addiction (SA) is associated with interpersonal relationships and psychological factors. Using random samples of 8th-grade students at Taian High School, this paper explores how interpersonal relationships impact the three psychological factors and SA. The data shows that when students' perceived interpersonal relationships worsen, they are more likely to have negative emotions, resulting in a greater susceptibility to SA.

Keywords: Smartphone addiction, Interpersonal relationships, Psychological dimensions, Adolescents.

1 Introduction

With a wide range of mobile applications that cover communication, office work and networking, smartphones have become widely used^[1]. In 2021, the number of 900 million smartphone users in China is hard evidence of the indispensability of smartphones (www.gov.cn, 2021). However, inappropriate usage of smartphones may lead to smartphone addiction (SA) or problematic mobile phone use. For example, high communication costs resulting from excessive use of smartphones, smartphone-induced interpersonal conflicts, disruption of daily life and frequent mood swings are all demonstrations of SA^[2]. According to Ting & Chen^[2], SA could be better understood through the four dimensions of addiction, which is a symptom of compulsive behavior, withdrawal, tolerance and deterioration of function. To some extent, SA could be regarded as an extension of internet addiction since SA is related to extensive engagement in internet activities^[3]. Numerous research proved that SA has a negative impact on students' daily life and academic performance, as they suffer from aprosexia, reduced sense of happiness, lower scores, social anxiety, personality disorder and suicidal thinking^[1,3,4].

Most research focuses on interpersonal relationships, negative emotions and cyberbullying as determinants of SA. Cyberbullying, in this case, is defined as conducting repeated individual or collective hostile attacks on other netizens through telecom equipment^[5]. It was found that individuals tend to use smartphones to vent or circumvent bad feelings as psychological compensation, and the stronger these needs emerge,

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the more susceptible they are to SA. Therefore, individuals highly addicted to smartphones are more likely to demonstrate cyberbullying, and vice versa^[5].

2 Interpersonal Relationship and Smartphone Addiction

Interpersonal relationships developed in different stages of life can have a great influence on one's growth. For instance, during childhood and adolescence, the family is the foremost context for socialization. Meanwhile, the influence of interpersonal relationships developed at school, where adolescents spend most of their time, should not be underestimated. Good student-teacher interactions are important as teachers are those to whom adolescents would have the most exposure.

2.1 Family Functioning, Child-Parent Relationship and Smartphone Addiction

Interaction and relationships within a family are the major manifestations of family functioning in terms of cohesion, adaptability, coordination and communication quality^[6]. Well-functioning family is characterized by clear roles, smooth communication, great cohesion and emotional regulation. In contrast, poor family functioning is prone to conflicts and less effective communication and emotional support. If a teenager is exposed to poor family functioning during most of their formative years, their psychological well-being could be undermined^[6]. The most influential aspect of family functioning is the child-parent relationship. However, during adolescence, parenthood usually experiences a rapid deterioration as parents may not provide adolescents with enough autonomy to support the independence they aspire to. This can lead to conflicts and an increasing number of arguments between children and parents^[7]. Adolescents with poor parent-child bonding may seek support from other sources, such as smartphones or the Internet^[8]. Research has found that families with better parent-child relationships have lower levels of SA. For example, Park et al.^[9] surveyed middle school students with evident outcomes demonstrating that communication quality in the addiction and addiction-prone groups is significantly lower than that in the non-addiction group.

2.2 Teacher-Student Relationship and Smartphone Addiction

Apart from regular educational work, teachers are responsible for providing enough care and emotional support for students^[10]. According to Indeok^[11], a good teacher-student relationship can enhance students' adaptability and reduce the likelihood of seeking support online, thus reducing their dependence on smartphones. Furthermore, research has found that a good teacher-student relationship can help prevent adolescents from becoming addicted to smartphones. For example, through self-reports of 2,798 Korean high school students concerning SA issues, it was found that a good relationship with teachers can effectively reduce the propensity of SA^[11].

2.3 Negative Emotions and Smartphone Addiction

Loneliness, anxiety and depression are three common negative emotions whose relations to addictive behaviors have been studied. Loneliness refers to the feelings of social isolation or disconnection when an individual's need for a sense of belonging remains unmet in the environment^[12]. Anxiety is an enduring personality trait characterized by heightened tension and anxiety in stressful situations^[13]. Depression is a persistent feeling of sadness and loss of interest, which impairs one's ability to engage in normal activities (WHO). Mahapatra^[14] noted that when faced with negative psychological problems, students who are unable to resolve them may turn to the internet on smartphones to escape. Furthermore, individuals with psychosocial problems are often found to lack self-regulation and control abilities, leading to uncontrolled increases in smartphone use and eventually forming a dependency^[14]. Therefore, this study proposed a hypothesis that interpersonal relationship influences SA through psychological dimensions; and cyberbullying is positively correlated with SA.

3 Method

3.1 Participants

534 8th-year students from a high school in Taian, Shandong Province, were randomly selected as participants. Among them, 262 are male and 272 are female.

3.2 Measurement

3.2.1 UCLA Loneliness Scale (ULS-6).

Developed by Zhou et al.^[15], this concise scale quantifies loneliness as the discrepancy between desired and actual social connections. Comprising six items, the scale's scores range from 6 to 24, with ≤ 6 indicating no loneliness, 7-12 slight, 13-18 moderate, and 19-24 severe loneliness. The scale demonstrates high internal consistency, evidenced by a Cronbach's alpha of 0.831. In the current study, the scale maintained robust internal reliability with a Cronbach's alpha of 0.762, affirming its validity in assessing loneliness.

3.2.2 Child-Parent Relationship.

The scale with 18 items measures adolescents' closeness and relatedness with the father and mother. This study adopted a simplified 8-items version that incorporates paternal and maternal dimensions into one and deletes one item that overlaps with an item within family functioning scale.

3.2.3 Family Functioning.

This study employed the Overall Family Assessment Device revised by Zou^[16] to assess the situation of family functioning among high school students. All 6 items within will be measured.

3.2.4 Cyberbullying.

The Chinese version of the cyberbullying questionnaire revised by Chen^[17] was adopted by this study to evaluate the cyberbullying situation of high school students. The questionnaire evolves around two parts: cyberbullying behavior and the situation of being cyberbullied. Since the items of these two parts highly overlap, 5 items that appear most relevant in the later part were adopted.

3.2.5 Anxiety scale.

This study used the Chinese version of the Generalized Anxiety Disorder 7-item scale (GAD-7) to assess the participants' anxiety levels in the past two weeks^[18]. Each of the 7 questions can be rated from 0 (not at all) to 3 (nearly every day) with the total score ranging from 0 to 21. Scores of 0-4 indicate no anxiety, 5-9, 10-14, and 15 or above represent mild, moderate, and severe anxiety, respectively. This scale has been proven to be practical at home and abroad^{[18][19]}. Score 10 acts as the cutoff value for anxiety diagnosis and the α coefficient of the scale was 0.92 in this study.

3.2.6 Smartphone Addiction.

Smartphone Addiction Scale for College Students (SAS-C) developed by Su et al^[20] consists of 22 items, covering six factors, namely withdrawal symptoms (items 7, 11, 13, 14, 15, 19, 21), salience (items 1, 2, 4), social soothing (items 5, 6, 16), negative consequences (items 3, 9, 10, 17), app usage (items 8, 18, 22), and app updates (items 12, 20). This scale adopts the format of Likert scale 5 points with 1 indicates strongly disagree and 5 indicates strongly agree. Higher scores indicate a stronger tendency towards addiction. The scale does not have reverse scoring.

3.2.7 Depression.

The 10-item streamlined version of the Center for Epidemiologic Studies Depression Scale (CES-D-10) proposed by Andresen^[21] is employed in this study. This is a self-report scale designed to investigate the frequency of depressive symptoms experienced by participants in the past two weeks. The scale consists of 10 items, and participants are required to score themselves from 1 (rarely or none of the time) to 4 (most or all of the time) for each item, with items 9 and 10 reverse-scored. Higher total scores indicate higher levels of depression.

3.3 Research Procedure

Data were collected from participants through questionnaires, which took approximately 20 minutes to complete with the guidance of a teacher. The questionnaires were uniformly collected. Participation in this study was entirely voluntary, and participants' data were recorded. Comprehensive information regarding the survey objectives was communicated to the students, their parents, and teachers. Following the exclusion of invalid data and duplicate samples, data curation, statistical computations, and analyses were conducted utilizing SPSS version 21.0 and the SPSS PROCESS macro.

4 Results

Table 1. Descriptive Statistics and Difference Tests for Various Variables

	Gender(mean±SD)		t
	male(n=262)	female(n=272)	
loneliness	1.34±0.55	1.44±0.59	-1.96*
child-parent relationship	3.75±0.95	3.68±0.93	0.95
family functioning	4.29±0.90	4.23±0.87	0.74
student-teacher relationship	3.61±0.90	3.57±0.82	0.47
cyberbully	1.29±0.59	1.27±0.46	0.52
anxiety	1.33±0.61	1.40±0.53	-1.33
depression	1.64±0.42	1.79±0.50	-3.6*
SA	1.41±0.82	1.56±0.93	-1.92*

In this investigation, the relationship between gender and both independent and dependent variables related to smartphone addiction (SA) was examined using an independent samples t-test. The results, as depicted in the preceding Table 1, reveal statistically significant gender differences in loneliness, depression, and SA ($P < 0.05$), indicating that females are more susceptible to experiencing loneliness, depression, and SA than males. Notably, the p-value for SA is 0.06, suggesting that while females tend to exhibit higher levels of SA, this difference is marginally significant, especially when compared to the disparities observed in loneliness and depression. Conversely, the analysis did not uncover significant gender differences in other examined dimensions ($p > 0.05$).

Table 2. Correlation analysis

	loneliness	child-parent relationship	family functioning	student-parent relationship	cyberbully	anxiety	depression	SA
loneliness	-							
child-parent relationship	-.0436	-						
family functioning	-.402**	.686**	-					
student-teacher relationship	-.201**	.273**	.258**	-				
cyberbully	.282**	-.170**	-.191**	-0.07	-			
anxiety	.438**	-.252**	-.231**	-.124**	.311**	-		
depression	.331**	-.158**	-.112*	-0.05	.275**	.397**	-	
SA	.253**	-.197**	-.232**	-.091*	.235**	.242**	.216**	-

** . The correlation is significant at the 0.01 level (two-tailed)

* . The correlation is significant at the 0.05 level (two-tailed)

The Table 2 delineates the results of a correlation analysis conducted between various independent and dependent variables, employing a two-tailed test to ascertain the correlation coefficients. The analysis reveals a positive correlation between SA and psychological factors such as loneliness, anxiety, and depression, indicating that higher levels of these factors are associated with increased SA. Conversely, a negative correlation is observed between interpersonal relationships and SA; specifically, lower scores in parent-child relationships, teacher-student relationships, and family functioning are associated with heightened SA, suggesting that deteriorating interpersonal relationships contribute to increased SA. Additionally, a positive correlation is identified between online bullying and SA, indicating that individuals subjected to higher levels of bullying are more prone to exhibit SA.

Table 3. Regression analysis of variables of SA

	unstandardized coefficient		standardized	t	Significance	Collinearity Statistics	
	B	Standard Error	Beta			Tolerance	VIF
(Constant)	1.335	0.268		4.982	0.000		
loneliness	0.096	0.065	0.070	1.478	0.140	0.779	1.283
unwell child- parent relation- ship	0.023	0.049	0.029	0.476	0.634	0.484	2.068
unwell family functioning	-0.221	0.057	-0.239	-3.916	0.000	0.467	2.140
unwell student- teacher rela- tionship	0.109	0.044	0.106	2.461	0.014	0.944	1.060
being bullied online	0.187	0.070	0.115	2.656	0.008	0.927	1.079
anxiety	0.184	0.057	0.147	3.201	0.001	0.823	1.215
depression	0.012	0.059	0.009	0.198	0.843	0.934	1.070

$r^2=0.148$, $F=12.100^{**}$

A regression analysis, controlling for gender, assessed the efficacy of factors related to emotion and interpersonal relationships in predicting SA. The reliability of various predictors, including loneliness, parent-child relationship quality, family functioning, teacher-student relationship, cyberbullying, anxiety, and depression, were individually evaluated. The results indicated that family functioning, anxiety, teacher-student relationship, and experiences of cyberbullying significantly and positively predicted SA (Table 3).

5 Mediating Effect

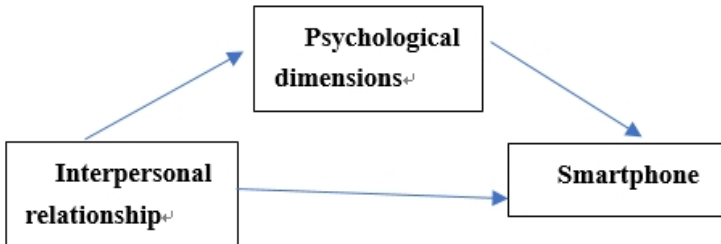


Fig. 1. Mediating effect model

A mediating model with environmental factors (parent-child relationship, family functioning, and teacher-student relationship) as independent variables, emotional constructs (depression, anxiety, and loneliness) as mediating variables and SA as the dependent variable were examined (Figure 1).

With the parent-child relationship as the independent variable, the total sum of indirect effects was -0.09, which includes loneliness (-0.05), anxiety (-0.03), and depression (-0.02). In other words, the negative correlation between the parent-child relationship and SA is mediated by loneliness, anxiety and depression. These indirect effects account for 47.3% of the total effect, indicating that the mediators play a partial role in this model. When individuals have poor parent-child relationships, they experience higher levels of loneliness, anxiety, and depression, which in turn leads to higher levels of SA.

In terms of family functioning, the total sum of indirect effects is -0.08: loneliness (-0.04), anxiety (-0.02), and depression (-0.01). This suggests that family functioning indirectly influences SA through the above-mentioned mediator variables. In other words, when individuals have poor family functioning, their levels of loneliness, anxiety, and depression are higher, leading to an increase in SA. These indirect effects account for 34.8% of the total effect, emphasizing the partial role of mediator variables in the relationship between family functioning and smartphone addiction.

As for the teacher-student relationship, the total sum of indirect effects is -0.05, including loneliness (-0.03), anxiety (-0.01), and depression (0.00). However, with $p=0.27$, this indicates a lack of direct relationship between teacher-student relationship and SA. This suggests that the teacher-student relationship influences the SA by affecting the mediating variables.

6 Conclusion

Based on the above research and analysis, the following observations were concluded. As Pearson correlation analysis demonstrated, interpersonal dimensions, including the quality of parent-child and teacher-student relationships and overall family functioning, negatively correlate with the propensity for SA. Meanwhile, psychological constructs

— depression, loneliness and anxiety — alongside experiences of cyberbullying are positively associated with an increase in SA. Furthermore, the relationships between interpersonal relationships and SA are mediated by these psychological factors, which aligns with our hypothesis.

According to Willems et al. [22], the core of interpersonal relationships is for the individual to acquire a sense of intimacy, fulfillment and trust, and hence form connections with other social communities. Wang et al. [23] found that family functioning is negatively correlated with adolescent internet addiction, with emotional regulation acting as the mediator, which is consistent with our findings. In other words, functional parent-child relationships boost adolescents' emotional regulation abilities, leading to less loneliness, anxiety and depression and hence few addictive behaviors. Meanwhile, as attachment theory suggests, a secure attachment that makes children feel safe enhances their emotional regulation [24]. For students, secure attachment is mainly built through parents and teachers, who can meet students' needs for love, affection and belonging. Without secure attachment, students are reluctant to seek support when facing difficulties, reinforcing a lack of close social connections and a stronger sense of loneliness. Under these circumstances, individuals tend to seek new ways to address psychological issues [25]. Mobile phones or the internet that provide a wealth of information to distract students' attention might be the destination where negative emotions are temporarily eliminated and a psychological sense of insecurity [1].

Furthermore, from the perspective of self-determination theory, individuals' need for autonomy, relatedness and competence shall be met for personal development. If not, students are prone to negative emotions [26]. Chinese teachers and parents often carry high expectations for students in various aspects; when expectations exceed students' abilities, students under significant pressure often suffer from negative emotions [27]. In such cases, the absence of good interpersonal relationships means insufficient support and assistance from teachers and parents. According to Liu [28], faced with less family interaction, lack of communication and a cold family atmosphere, adolescents' communication needs often cannot be fulfilled in real life. Therefore, family members should strive to create a more interactive, harmonious and cohesive atmosphere, allowing adolescents to feel the warmth of the family and focus more on family life.

In addition, this study found a positive correlation between the score of the cyberbully questionnaire. This is in line with previous research conducted by Xu et al. [29], which observed that cyberbullying adds to stress and, hence, more dependence on smartphones to avoid or vent negative emotions.

7 Limitations and Future Direction

However, there are some limitations in this study. Firstly, the data collection was based on self-reports, which may result in biased and inaccurate results. Secondly, as the findings of this study only demonstrate a correlation between the independent and dependent variables, further research is needed to explore and confirm the specific correlation. Lastly, there is much left unexplored regarding gender, particularly how gender may further impact SA through psychological dimensions. Therefore, in future research,

new methods should be used for data collection. With sufficient data support, observations of the relationship between the independent and dependent variables may be gained. Furthermore, researchers can focus on how gender impacts SA.

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