

Peer relationship and adolescent smartphone addiction: The mediating role of self-esteem and the moderating role of the need to belong

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Background and aims: Adolescent smartphone addiction has received increased attention in recent years, and peer relationship has been found to be a protective factor in adolescent smartphone. However, little is known about the mediating and moderating mechanisms underlying this relation. The aim of this study was to investigate (a) the mediating role of self-esteem in the association between student–student relationship and smartphone addiction, and (b) the moderating role of the need to belong in the indirect relationship between student–student relationship and adolescent smartphone addiction. *Methods:* This model was examined with 768 Chinese adolescents (mean age = 16.81 years, $SD = 0.73$); the participants completed measurements regarding student–student relationship, self-esteem, the need to belong, and smartphone addiction. *Results:* The correlation analyses indicated that student–student relationship was significantly negatively associated with adolescent smartphone addiction, and the need to belong was significantly positively associated with adolescent smartphone addiction. Mediation analyses revealed that self-esteem partially mediated the link between student–student relationship and adolescent smartphone addiction. Moderated mediation further indicated that the mediated path was weaker for adolescents with lower levels of the need to belong. *Discussion and conclusion:* High self-esteem could be a protective factor against smartphone addiction for adolescents with a strong need to belong as these students appeared to be at elevated risk of developing smartphone addiction.

Keywords: student–student relationship, smartphone addiction, self-esteem, the need to belong, adolescents

INTRODUCTION

Smartphone addiction has emerged as a major concern in the past decade (Bian & Leung, 2015; Lee & Lee, 2017), and it is rapidly increasing among adolescents in Asia (BBC, 2015). Smartphones are based on the Internet and have a large body of functions. Smartphone use is found to be related to a lot of adverse influences, such as physical health problems, emotional problems, sleep disturbances, and academic failures (Kim, Kim, & Jee, 2015; Lemola, Perkinson-Gloor, Brand, Dewald-Kaufmann, & Grob, 2015; Lepp, Barkley, & Karpinski, 2014; Samaha & Hawi, 2016; Seo, Park, Kim, & Park, 2016; Thomee, Harenstam, & Hagberg, 2011). A better understanding of the risk factors and related mechanisms for adolescent smartphone addiction is in need to enlighten prevention and intervention efforts. Although some personal characteristics as risk factors for smartphone addiction have been recognized (Bian & Leung, 2015; Gökçearsan, Mumcu, Haşlamam, & Çevik, 2016; Hong, Chiu, & Huang, 2012; Lee, Chang, Lin, & Cheng, 2014; Roberts, Pullig, & Manolis, 2015), only a handful of studies have explored the roles of peer relationships in the development of adolescent smartphone addiction (Bae, 2015; Lee & Lee, 2017).

Student–student relationship is an important element of peer relationships. Research on mobile addiction was mostly

based on previous investigation of Internet addiction (Bian & Leung, 2015). Theorists and prior empirical research have long argued the importance of peer relations in the development of adolescents. According to the social control theory, an individual's bond to society is important in deterring his/her delinquent activities (Hirschi, 1969). Adolescents' relationships with peers are important in keeping them from conducting a delinquent activity. In line with this theory, several empirical studies find that peer relations are important protective factors in adolescent Internet addiction in general (Liu & Kuo, 2007) and adolescent smartphone addiction in particular (Bae, 2015). For example, Bae (2015) found that friendship satisfaction was negatively associated with adolescent smartphone addiction. These findings indicate that student–student relationship might play an important role in adolescent smartphone addiction.

The previous studies have made valuable contributions, however, the mediating (i.e., how student–student relationship relates to adolescent smartphone addiction) and moderating mechanisms (i.e., when the relation is most

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potent) underlying the association between student–student relationship and adolescent smartphone addiction remain largely unexplored. Confirming its mediating and moderating mechanisms could be critical to advance our understanding of adolescent smartphone addiction, and to develop effective intervention as well. In addition, given that adolescents are found to be at the most risk of being addicted to smartphone, because they have relatively poorer impulse control compared with adults and apply smartphones as devices to manage their social status and emotions (Lopez-Fernandez, Honrubia-Serrano, Freixa-Blanxart, & Gibson, 2014), and given that the majority of the studies about smartphone addiction are about young adults such as college students, more research attention should be focused on adolescents (Lopez-Fernandez et al., 2014).

To address these gaps, this study utilized a sample of Chinese adolescents to examine a conceptual model in which, first, self-esteem mediated the relation between student–student relationship and adolescent smartphone addiction; second, the indirect relations between student–student relationship and adolescent smartphone addiction through self-esteem were moderated by the need to belong.

The mediating role of self-esteem

As Deci and Ryan (2000) argue, relatedness (i.e., the feeling of closeness and connectedness to others) is one of the fundamental and universal psychological human needs, and it is an essential element for individual well-being and thriving. And it is well known that peer relationship is associated with people’s self-esteem (Rosenberg, 1965). In line with this notion, compelling evidence with diverse methodologies and samples have confirmed that peer relations could predict adolescent self-esteem. For example, some cross-sectional studies find a significant positive correlation between peer relations and adolescent self-esteem (McLean & Jennings, 2012; Thompson, Wojciak, & Cooley, 2016; Vanhalst, Luyckx, & Goossens, 2014). In addition, a longitudinal study indicates that peer acceptance is protective for adolescent self-esteem (Birkeland, Breivik, & Wold, 2014). In addition, a meta-analytic study reveals that peer attachment could predict adolescent self-esteem (Gorrese & Ruggieri, 2013). Furthermore, an experimental study indicates that there is a causal association between peer relationship and adolescent self-esteem (Jiang, Zhang, Ke, Hawk, & Qiu, 2015).

According to Davis’s (2001) cognitive-behavioral model of pathological Internet use, low self-esteem is a risk factor for getting addicted to the Internet. Many empirical studies indicate that lower self-esteem could predict adolescent Internet addiction (Błachnio, Przepiórka, Senol-Durak, Durak, & Sherstyuk, 2016; Mei, Yau, Chai, Guo, & Potenza, 2016; Park, Kang, & Kim, 2014; Sariyska et al., 2014; Yen, Chou, Liu, Yang, & Hu, 2014; Zhang, 2015), and the relationship between self-esteem and adolescent Internet addiction is found being consistent for people from different areas and cultural backgrounds (Błachnio et al., 2016; Sariyska et al., 2014). In addition, research regarding the association between self-esteem and mobile phone addiction has found similar results (Ha, Chin, Park, Ryu, & Yu, 2008; Hong et al., 2012; Walsh, White, Cox, & Young, 2011),

although a few studies indicated different findings (Butt & Phillips, 2008; Ehrenberg, Juckes, White, & Walsh, 2008; Phillips, Butt, & Blaszczyński, 2006). The majority of the research is in line with the notion that lower self-esteem could predict adolescent smartphone addiction. To date, no previous studies have directly examined the mediating role of self-esteem in the relation between student–student relationship and adolescent smartphone addiction.

The moderating role of the need to belong

Although student–student relationship may influence adolescent smartphone addiction through the mediating effect of self-esteem, adolescents are differently sensitive to interpersonal relationships. Therefore, it is important and necessary to explore potential moderators of student–student relationship as it affects adolescent smartphone addiction. This study tests a hypothesis that the indirect association between student–student relationship and adolescent smartphone addiction will be moderated by the need to belong.

According to the belongingness hypothesis (Baumeister & Leary, 1995), the need to belong is a powerful, fundamental, and extremely pervasive human motivation, which has multiple influences on people’s emotions, cognitions, and behaviors. Individuals high in the need to belong will work harder to gain satisfying relationships (Pillow, Malone, & Hale, 2015). Given that the basic purpose of mobile phone use is to allow people to communicate with each other (Choi et al., 2015; Townsend, 2000), it is logical to assume that adolescents high in the need to belong will use the smartphone more than adolescents low in the need to belong, which will put them at more risk of getting addicted to smartphone. That is, the need to belong can predict adolescent smartphone addiction. In line with this notion, prior empirical studies indicate that the need to belong can indeed drive people to engage in a series of activities that may enhance their social connections (Hackenbracht & Gasper, 2013; Newman & Smith, 2016; Sicilia, Delgado-Ballester, & Palazon, 2016).

Moreover, the need to belong may moderate the indirect relations between student–student relationship and adolescent smartphone addiction. Efforts to use peer relationship as a single predictor of adolescent smartphone addiction have produced inconsistent results (Bae, 2015; Lee & Lee, 2017). Taken alone, peer relationship as an interpersonal or environmental factor can explain only a small part of the variance in a specific, overt human behavior. Thus, without any other related information about the personality characteristics of an individual, it can be hard to provide a clear statement of whether peer relationship would be a strong predictor of behavior. Therefore, the need to belong as a personality characteristic is involved to better explain the relation between student–student relationship and adolescent smartphone addiction.

The organism–environment interaction model proposes that individuals with diverse personality characteristics will respond to similar environments differently, the dynamics of personality characteristics and environment contexts will contribute to a person’s psychological and social adaptation (Lerner, 2004). That is, the need to belong may exacerbate the relationship between environment factors and adolescent smartphone addiction. In support of the notion, a recent

METHODS

study finds that adolescents' preference for social connections will moderate the relation between the quality of interpersonal relationship and adolescent Internet addiction (Zhou et al., 2017). To date, previous studies have neither examined the need to belong as a predictor of adolescent smartphone addiction nor a moderator of the indirect relations between student–student relationship and adolescent smartphone addiction.

The present study

In this study, we tested a conceptual model of the process by which student–student relationship will be a protective factor for adolescent smartphone addiction. In particular, the purposes of this study were twofold: (a) to test whether adolescents' self-esteem mediates the relation between student–student relationship and adolescent smartphone addiction, and (b) to test whether the indirect association between student–student relationship and adolescent smartphone addiction through self-esteem would be moderated by the need to belong. Altogether, these two research questions constitute a moderated mediation model. This integrated model can address questions about both mediation (i.e., how does student–student relationship relate to adolescent smartphone addiction?) and moderation (i.e., when and for whom is the link least or most potent?) in a single model. Figure 1 illustrates the proposed model. Based on the literature reviewed above, we put forward the following hypotheses:

Hypothesis 1. Student–student relationship will increase adolescent self-esteem, which in turn will decrease adolescent smartphone addiction. That is, self-esteem will mediate the link between student–student relationship and adolescent smartphone addiction.

Hypothesis 2. The need to belong will positively predict adolescent smartphone addiction. Furthermore, the indirect association between student–student relationship and adolescent smartphone addiction through self-esteem will vary as a function of the need to belong. Specially, the indirect relationship between self-esteem and adolescent smartphone addiction will be stronger for adolescents with higher levels of the need to belong.

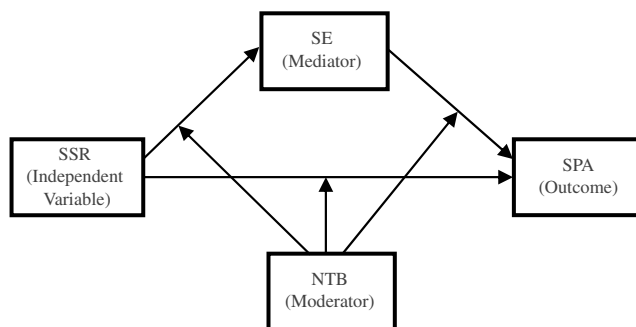


Figure 1. The proposed moderated mediation model. Note. SSR: student–student relationship; SE: self-esteem; NTB: the need to belong; SPA: smartphone addiction

Participants

Data for this study were drawn from the first wave of an ongoing longitudinal project; the project was designed to examine the influence of individual and environmental factors on adolescent smartphone addiction and some other Internet use behavior. Participants were 768 adolescents recruited from two middle schools of Hebei Province, China. The mean age of the participants was 16.81 years ($SD = 0.73$, range = 15–19 years). Forty-four percent of the participants were males. In terms of parents' education level, 17% of the fathers and 21% of the mothers had a primary school education or less, 58% of the fathers and 58% of the mothers had a junior high-school education, 19% of the fathers and 16% of the mothers had a senior high-school education, and 6% of the fathers and 5% of the mothers had a college education or more. In addition, 53% of the fathers and 63% of the mothers had an unskilled or semi-skilled occupation.

Measures

Student–student relationship. The student–student relationship scale was originated from one subscale of *My Class Scale* developed by Jiang (2002). The scale measured the quality of the relationship between adolescents themselves and other students that the participants perceived, which consists of eight items (e.g., “If anyone has concerns, the other students will care for him/her”). The participants rated each item on a 5-point scale ranging from 1 = *completely not true* to 5 = *completely true*, with higher total scores indicating better student–student relationship they perceived. In this study, the measure showed good reliability (Cronbach's $\alpha = .86$).

Smartphone addiction. Adolescent smartphone addiction was measured by the Smartphone Addiction Scale (Kwon, Kim, Cho, & Yang, 2013). The scale consists of 10 items (e.g., “Missing planned work due to smartphone use”). The participants rated each item on a 6-point scale ranging from 1 = *strongly disagree* to 6 = *strongly agree*, with higher scores indicating more addicted to smartphone. For this study, the measure demonstrated good reliability (Cronbach's $\alpha = .86$).

Self-esteem. Adolescent self-esteem was assessed by the Rosenberg Self-Esteem Scale (Rosenberg, 1965). This scale consists of 10 items (e.g., “On the whole, I am satisfied with myself”). The participants rated each item on a 5-point scale ranging from 1 = *not very true of me* to 4 = *very true of me*, with higher scores indicating higher level of self-esteem. For the current, the scale demonstrated good reliability (Cronbach's $\alpha = .76$).

The need to belong. The need to belong was measured by the Single-Item Need to Belong Scale, which has been confirmed to have good reliability and validity (Nichols & Webster, 2013). This scale consists of one item (“I have a strong need to belong”). The participants rated this item on a 5-point scale ranging from 1 = *not at all* to 5 = *extremely*, with higher scores indicating higher levels of the need to belong.

Procedure. The data were collected in middle-school classrooms between March and May 2017. Trained post-graduate students administered the measures using scripts and a manual of procedures to ensure standardization of the data collection process. Participants received a gift as incentives after they completed all questionnaires.

Statistical analyses. First, the descriptive information and correlation matrix were calculated. Second, we followed MacKinnon's (2008) four-step procedure to establish a mediation effect. Third, we examined whether the mediation process was moderated by the need to belong. Moderated mediation is often applied to test whether the magnitude of a mediation effect is conditional on the value of a moderator (Muller, Judd, & Yzerbyt, 2005). The analyses of moderated mediation were constructed using Hayes's (2013) PROCESS macro (Model 59). All continuous variables were standardized and the interaction terms were computed from these standardized scores. In addition, the bootstrapping method was applied to examine the significance of all the effects to obtain robust standard errors for parameter estimation (Hayes, 2013). The bootstrapping method produces 95% bias-corrected confidence intervals of these effects from 1,000 resamples of the data. Confidence intervals that do not include zero indicate effects that are significant.

Ethics

The study was approved by the Research Ethics Committee of the first author's institution. Informed consent was obtained from the participants and school administrator before data collection. Participants were informed that their participation was completely voluntary and they could terminate the participation anytime they want.

RESULTS

The purposes of this study were to explore whether self-esteem would mediate the relation between student–student relationship and adolescent smartphone addiction, and whether the indirect path between student–student relationship and adolescent smartphone addiction would be moderated by the need to belong. These research questions were tested in three steps.

Preliminary analyses

Means, standard deviations, and zero-order correlations for all study variables are presented in Table 1. As expected, adolescents with better student–student relationship were less

likely to get addicted to smartphone, which is also true for adolescents with higher levels of self-esteem. Besides, adolescents with better student–student relationship were more likely to have higher levels of self-esteem. In addition, adolescents with higher levels of need to belong are more likely to get addicted to smartphone; they may have lower levels of self-esteem and worse student–student relationship as well.

Testing for mediation effect

In Hypothesis 1, this study assumed that self-esteem would mediate the link between student–student relationship and adolescent smartphone addiction. To examine this hypothesis, this study followed MacKinnon's (2008) four-step procedure to establish the mediation effect, which requires (a) a significant relation between student–student relationship and adolescent smartphone addiction, (b) a significant association between student–student relationship and self-esteem, (c) a significant association between self-esteem and addiction while controlling for student–student relationship, and (d) a significant coefficient for the indirect path between student–student relationship and adolescent smartphone addiction through self-esteem. The bias-corrected percentile bootstrap method determines whether the last condition is satisfied.

Multiple regression analysis showed that, in the first step, student–student relationship was significantly associated with adolescent smartphone addiction, $b = -0.24$, $p < .001$ (see Model 1 of Table 2). In the second step, student–student relationship was significantly associated with self-esteem, $b = 0.14$, $p < .001$ (see Model 2 of Table 2). In the third step, when this study controlled for student–student relationship, self-esteem was significantly associated with adolescent smartphone addiction, $b = -0.30$, $p < .001$ (see Model 3 of Table 2). Finally, the bias-corrected percentile bootstrap method indicated that the indirect effect of student–student relationship on adolescent smartphone addiction through self-esteem was significantly, $ab = -0.04$, $SE = 0.02$, 95% CI = $[-0.08, -0.02]$. The mediation effect accounted for 18% of the total effect. Overall, the four criteria for establishing mediation effect were totally satisfied. Therefore, Hypothesis 1 was supported.

Testing for moderated mediation

As noted, Hypothesis 2 predicted that the need to belong would moderate the indirect associations between student–student relationship and adolescent smartphone addiction through self-esteem (Figure 1). To examine this moderated mediation hypothesis, we used the PROCESS macro (Model 59) developed by Hayes (2013) to test for moderated

Table 1. Descriptive statistics and correlations of the main study variables

Variables	<i>M</i>	<i>SD</i>	1	2	3	4
1. Student–student relationship	3.40	0.69	1			
2. Self-esteem	2.75	0.40	0.25***	1		
3. The need to belong	3.44	0.92	−0.07*	−0.10**	1	
4. Smartphone addiction	3.40	0.91	−0.18***	−0.17***	0.18***	1

Note. $N = 768$. *SD*: standard deviation.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 2. Testing the mediation effect of student–student relationship on adolescent smartphone addiction

Predictors	Model 1 (SPA)		Model 2 (SE)		Model 3 (SPA)	
	<i>b</i>	<i>t</i>	<i>b</i>	<i>t</i>	<i>b</i>	<i>t</i>
SSR	−0.24	−5.14***	0.14	7.16***	−0.30	−4.12***
SE					−0.30	−3.56***
<i>R</i> ²	.03		.06		.05	
<i>F</i>	26.37***		51.30***		19.74***	

Note. *N* = 768. Each column is a regression model that predicts the criterion at the top of the column. SSR: student–student relationship; SE: self-esteem; SPA: smartphone addiction.

****p* < .001.

mediation. Specially, we estimated parameters for three regression models. In Model 1, we estimated the moderating effect of the need to belong on the relation between student–student relationship and adolescent smartphone addiction. In Model 2, we estimated the moderating effect of the need to belong on the relation between student–student relationship and self-esteem. In Model 3, we estimated the moderating effect of the need to belong on the relation between self-esteem and adolescent smartphone addiction. The specifications of the three models can be seen in Table 3.

Moderated mediation was established if either or both patterns existed (Hayes, 2013; Muller et al., 2005): (a) the path between student–student relationship and self-esteem was moderated by the need to belong (first-stage moderation), and/or (b) the path between self-esteem and adolescent smartphone addiction was moderated by the need to belong (second-stage moderation).

As Table 3 demonstrates, in Model 1, there was a main effect of student–student relationship on adolescent smartphone addiction, *b* = −0.17, *p* < .001, and this effect was not moderated by the need to belong, *b* = 0.02, *p* > .05. Model 2 indicated that the effect of student–student relationship on self-esteem was significant, *b* = 0.25, *p* < .001, and this effect was not moderated by the need to belong, *b* = −0.01, *p* > .05. Finally, Model 3 indicated that there was a significant main effect of self-esteem on adolescent smartphone addiction, *b* = −0.10, *p* < .01, and more importantly, this effect was moderated by the need to belong, *b* = −0.09, *p* < .01. For descriptive purposes, this study plotted predicted adolescent smartphone addiction against student–student relationship,

separately for low and high levels of the need to belong (one *SD* below the mean and one *SD* above the mean, respectively) (Figure 2). Simple slope tests demonstrated that for adolescents with high levels of need to belong, higher levels of self-esteem were associated with lower levels of smartphone addiction, *b*_{simple} = −0.19, *p* < .001. However, for adolescents with low levels of need to belong, self-esteem was not significantly associated with smartphone addiction, *b*_{simple} = −0.01, *p* > .05.

The bias-corrected percentile bootstrap method further indicated that the indirect effect of student–student relationship on adolescent smartphone addiction through self-esteem was moderated by the need to belong. For adolescents high in the need to belong, the indirect effect had a protective impact on adolescent smartphone addiction, *b* = −0.05, *SE* = 0.02, 95% *CI* = [−0.08, −0.02]. For adolescents low in the need to belong, student–student relationship had no effect on adolescent smartphone addiction through self-esteem, *b* = −0.00, *SE* = 0.02, 95% *CI* = [−0.03, 0.03]. Given that the need to belong only moderated the second stage of the mediation process, this study called it a “second stage moderation model,” which is one form of moderated models. Therefore, Hypothesis 2 was partially supported.

DISCUSSION

The influence of peer relationship on adolescent smartphone addiction has begun to gain empirical support (Bae, 2015). However, questions concerning the underlying mediating

Table 3. Testing the moderated mediation effect of student–student relationship on adolescent smartphone addiction

Predictors	Model 1 (SPA)		Model 2 (SE)		Model 3 (SPA)	
	<i>b</i>	<i>t</i>	<i>b</i>	<i>t</i>	<i>b</i>	<i>t</i>
SSR	−0.17	−4.89***	0.25	7.00***	−0.15	−4.1***
NTB	0.17	4.76***	−0.07	−2.10*	0.16	4.60***
SSR × NTB	0.02	0.53	−0.01	−0.34	0.04	1.22
SE					−0.10	−2.77**
SE × NTB					−0.09	−2.67**
<i>R</i> ²	.06		.07		.08	
<i>F</i>	16.73***		18.61***		13.82***	

Note. *N* = 768. Each column is a regression model that predicts the criterion at the top of the column. SSR: student–student relationship; SE: self-esteem; NTB: the need to belong; SPA: smartphone addiction.

p* < .05. *p* < .01. ****p* < .001.

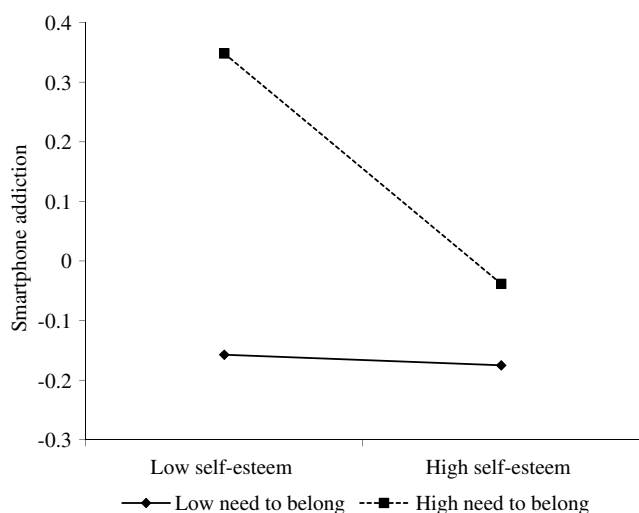


Figure 2. Smartphone addiction among adolescents as a function of self-esteem and the need to belong. Functions are graphed for two levels of the need to belong; one standard deviation above the mean and one standard deviation below the mean. Note that the graph is for descriptive purpose only. All inferential analyses maintained the continuous values of self-esteem and the need to belong

and moderating mechanisms stay largely unknown. This study established a moderated mediation model to test whether student–student relationship would be indirectly associated with adolescent smartphone addiction through self-esteem, and whether this indirect relationship was moderated by the need to belong. The results indicated that the impact of student–student relationship on adolescent smartphone addiction can be partially explained by adolescent self-esteem. That is, student–student relationship would positively predict self-esteem, and in turn, self-esteem could negatively predict adolescent smartphone addiction. Furthermore, this indirect relation was moderated by the need to belong in the second stage of the mediation process, such that the path from self-esteem was stronger in the context of higher need to belong. In other words, high level of self-esteem is a protective factor against smartphone addiction for students with an increased need to belong, whereas the protective role was not found in students with low level of the need to belong. The following sections will discuss each of the research hypotheses in light of this moderated mediation model of student–student relationship and adolescent smartphone addiction.

The mediating role of self-esteem

This study found that student–student relationship increased adolescent self-esteem, which in turn was negatively related to adolescent smartphone addiction. That is, self-esteem mediated the relation between student–student relationship and adolescent smartphone addiction. Therefore, high level of self-esteem can be one of the explanatory mechanisms for why those adolescents with good student–student relationship are less likely to get addicted to smartphone. As far as we know, this is the first study to report such results in the literature. These findings support the social

control theory (Hirschi, 1969), which posits that an individual’s attachment to conventional others is a crucial element in the restriction of delinquent behaviors among adolescents. The relationships that adolescents build with important others will increase their costs of engaging in risk behavior, which in turn will restrict adolescents’ intention toward conducting delinquent actions (Hirschi, 1969). These findings go beyond the prior research by illuminating why good student–student relationship can decrease adolescent smartphone addiction. In the past research about adolescent smartphone addiction, school psychologists pay attention to the influences of peer relationships, whereas developmental psychologists emphasized individual well-being, such as self-esteem and depression. These two research fields have independently developed without the potential association between peer relationship, such as student–student relationship and adolescent self-esteem. This study integrated research from both areas to uncover adolescent smartphone addiction. The integrated model indicates protective factors in the interpersonal context (e.g., student–student relationship) may enhance some protective intrapersonal traits (e.g., self-esteem), which in turn reduce their smartphone addiction tendency.

In addition to the overall mediation result, each of the separate associations in the mediation model is noteworthy. For the first stage of the mediation process (i.e., student–student relationship → self-esteem), our findings support the notion that good peer relationships are related to increased adolescent self-esteem. This finding is consistent with the self-determination theory (Deci & Ryan, 2000), the belongingness hypothesis (Baumeister & Leary, 1995), and the attachment theory (Ainsworth, 1989; Bowlby, 1969/1982), all of which indicate that good interpersonal relationship plays a vital role in people’s well-being. For adolescents with good student–student relationships, they are more likely to be people with good psychological diathesis, which in turn could prevent them from engaging in a series of problem behaviors. For the second stage of the mediation model (i.e., self-esteem → smartphone addiction), this study revealed that self-esteem was negatively associated with adolescent smartphone addiction. This finding is congruent with the cognitive-behavioral model of pathological Internet use (Davis, 2001), which indicates that people with maladaptive cognitions such as low self-esteem are more likely to get addicted to the Internet. Given that smartphones are based on the Internet, and the majority of adolescents use smartphones to connect the Internet in modern society, it is meaningful to apply this model to explain why some adolescents may get addicted to smartphone than the others. In addition, this finding is consistent with previous studies showing that self-esteem is a protective factor for adolescent mobile phone addiction (Ha et al., 2008; Hong et al., 2012; Walsh et al., 2011).

The moderating role of the need to belong

The second goal of this study was to examine whether the need to belong could predict adolescent smartphone addiction, and more importantly, whether the need to belong would moderate the indirect link between student–student

relationship and smartphone addiction. The results revealed that the need to belong could predict adolescent smartphone addiction, for adolescents with higher levels of the need to belong, they are more likely to get addicted to smartphone. This is consistent with the prior research showing that individuals high in the need to belong would engage in activities that may satisfy their need for social connections (Hackenbracht & Gasper, 2013; Newman & Smith, 2016; Sicilia et al., 2016). And given that smartphone is a portable device, people could use it anywhere and anytime they want, which makes it easier for people with high need to belong to get addicted to it.

Moreover, the results revealed that the need to belong only moderated the path between self-esteem and adolescent smartphone addiction (second-stage moderation). The relationship between self-esteem and smartphone addiction was significant for adolescents with high level of the need to belong; however, it was not significant for adolescents with low level of the need to belong. According to the belongingness hypothesis (Baumeister & Leary, 1995), adolescents with high level of the need to belong may make more effects to seek social connections (Hackenbracht & Gasper, 2013; Newman & Smith, 2016; Pillow et al., 2015; Sicilia et al., 2016); thus, they may use the smartphone to make contact with their friends, family members, or other people. In contrast, for adolescents with low level of the need to belong, they have less intention to contact with other people, so the relationship between self-esteem and adolescent smartphone addiction was not significant for them. These findings may explain the inconsistent results about the relationship between self-esteem and mobile phone addiction (Butt & Phillips, 2008; Ehrenberg et al., 2008; Phillips et al., 2006). Therefore, the need to belong can be regarded as a promising indicator to distinguish whether people with maladaptive cognitions, such as low self-esteem, would get addicted to smartphone or other tools that may enhance their social connections.

Contrary to our expectation, the need to belong did not moderate the relation between student–student relationship and adolescent self-esteem (first-stage moderation). This result could be explained by the robust role that social relationships play in people’s lives. According to the self-determination theory (Deci & Ryan, 2000), relatedness is a fundamental and universal human need, people cannot flourish without satisfying this basic psychological need, and if this basic need is fulfilled, people can thrive regardless of whether they have high or low level of the need to belong.

Altogether, by integrating the need to belong as a moderator into the model, this study revealed effects that have been overlooked without the moderation analysis. The moderated mediation model in this study is conceptually more sophisticated and provides greater predictive power than the mediation model alone.

Implications

The findings of this study have important implications. First, these findings highlight the importance of student–student relationship in preventing adolescent smartphone addiction. Middle-school students spend the majority of their time in the school, and they spend a lot of time with their

classmates. Improving student–student relationship can help reduce adolescent smartphone addiction, given the adverse impacts smartphone addiction has on adolescents’ development, such as physical health, emotions, sleep quality, and academic performance (Kim et al., 2015; Lemola et al., 2015; Lepp et al., 2014; Samaha & Hawi, 2016; Seo et al., 2016; Thomee et al., 2011). It is necessary and vital for the school educators to make efforts to improve student–student relationship. For example, a previous study finds that good teacher–student relationship can increase student–student relationship (Xie, Zhao, Xie, & Lei, 2016); teachers should maintain good relationships with their students, which in turn can reduce adolescent smartphone addiction. Second, our findings can help practitioners understand how student–student relationship is linked to adolescent smartphone addiction by establishing the mediation model; it can provide insights for potential interventions. For example, interventions targeting at increasing adolescent self-esteem can reduce adolescent smartphone addiction. Third, although the need to belong is a fundamental and powerful human motivation (Baumeister & Leary, 1995), people’s demands for the need to belong are different (Pillow et al., 2015). It is helpful to realize that people with higher levels of the need to belong are more likely to get addicted to smartphone. We should prioritize preventions and interventions at people with high level of the need to belong. Prevention and intervention efforts aiming to enhance self-esteem in students with a high level of need to belong could possibly contribute to the prevention or reduction of the physical and psychological harms linked to smartphone addiction.

Limitations and future directions

Several limitations must be considered when interpreting the findings of this study. First, this study was cross-sectional and cannot infer causality. Further studies should apply the longitudinal or experimental designs to confirm the causal assumptions in this study. Second, the measures are based on adolescent self-report, future studies should try to collect data from multiple informants (e.g., teacher, peer, or parent) to further replicate our findings. Third, other interpersonal relationships, such as parent–child relationship or teacher–student relationship, may also influence adolescent smartphone addiction; future studies should examine the associations between different kinds of interpersonal relationships and adolescent smartphone addiction. Fourth, the model in this study was tested on a sample of middle-school students rather than a clinical sample. Thus, these results should not be generalized in other samples. Future research can benefit from testing the model in other sample, such as the clinical samples. Finally, we used only one item to assess the need to belong of adolescents. Future studies should use a more sensitive assessment instrument to further explore the associations that we established in this study.

CONCLUSIONS

In summary, this study indicates that student–student relationship can be a protective factor in adolescent smartphone addiction. Furthermore, the mediation analysis

shows that self-esteem can be one possible mechanism underlying this relation. Moreover, high levels of need to belong can be a predictor of adolescent smartphone addiction, and moderated mediation reveals that the need to belong moderates the relationship between self-esteem and adolescent smartphone addiction, with the relation being significant only for adolescents with high level of the need to belong. To be specific, high self-esteem could be a protective factor against smartphone addiction for adolescents with a strong need to belong as these students appeared to be at elevated risk of developing smartphone addiction.

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