

Adolescents' Friendship Maintenance via Smartphones: The Interactive Relationship between Psychological Factors and Friendship Network Size

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ABSTRACT

This study investigates how adolescents' smartphone attachment, social anxiety, and offline and smartphone network sizes are related to their friendship in regards to maintaining either a strong or weak bond. Based on an online survey involving 402 adolescent smartphone users in South Korea, this study found that smartphone attachment was positively related to a strong ties friendship maintenance and negatively related to weak ties friendships. Similarly, social anxiety was found to be negatively associated with friendship maintenance for both strong and weak - tie relationships. More importantly, this study revealed that the types and size of social networks moderated the relationships among adolescents with smartphone attachment, social anxiety, and friendship maintenance through smartphones.

Key words: Adolescent, Smartphone Attachment, Social Anxiety, Network Size, Strong and Weak Ties, Friendship Maintenance via Smartphone.

1. INTRODUCTION

Adolescents' social networks and contacts with friends are paramount to their social development [1]. In the digital era, scholars contend that adolescents' social connectedness is closely associated with communication technologies, such as the Internet and mobile phones [2]. These technologies offer a means for adolescents to maintain and immerse themselves in friendship networks. In particular, mobile phones provide a direct communicative channel between teenagers and peer groups; therefore the devices enhance social interactions and bonding with peers.

Another significant predictor associated with peer relations and smartphone use is social anxiety, which explains the fear of being judged and evaluated negatively by others. Adolescents who are socially anxious exhibit significantly poor social skills [3] so that feelings of social anxiety may limit their offline interactions with peers [4]. Therefore, a common assumption is that socially anxious individuals often prefer

text-based communication through email, chat rooms, or instant messaging to avoid face-to-face social situations they fear [5].

The types and size of an individual's social networks are recognized as significant factors for evaluating a person's social relationships [6], particularly among adolescents, whose types (offline and online) and sizes (small and large) of friendship networks frequently change during their school years [7]-[9]. Based on previous research, the current study examines how the size of adolescents' friendship networks moderates the relationships among smartphone use, social anxiety, and friendship maintenance.

An online survey was conducted among 402 adolescent smartphone users in South Korea, which is one of the most highly digitalized societies in the world. Smartphone ownership among South Korean adolescents has consistently increased [10]. Furthermore, recent national statistics suggest that 74% of South Korean adolescents use smartphones to communicate with others [11]. Thus, results of this study on adolescent smartphone users are expected to offer insights into how smartphone usage is related to friendship maintenance among that age group. In view of adolescents' social relationships, the construct of those variables is especially critical to examine the role of adolescents' feelings of social anxiety, smartphone use, and peer networks. A better understanding of psychological factors, social networks, and smartphone use during

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adolescence can contribute to development of knowledge on this topic.

Based on the significance of peer relationships during adolescence, this study explores the predictors of peer relations related to adolescents' feelings of social anxiety, network size, and smartphone use. Those variables have been significantly addressed in previous studies to examine the determinants of adolescents' social interactions with peers. Social anxiety prompts some adolescents to minimize social interactions with peers in everyday life [12]. In addition, adolescents' friendship network size is an important factor to determine social relations with peers [6]. With respect to the relationships between mobile technology use and friendship maintenance, adolescents rely on mobile communication to maintain and create social ties [13]. Based on this framework of literature, this study incorporates the variables into the research model. A number of sources have been referenced in examining predictors of adolescents' peer relations, in terms of social anxiety, social networks, and smartphone use. As far as we know, in literature on adolescents' peer relationships, this is the first study to jointly consider all constructs of the variables in one model.

2. LITERATURE REVIEW

2.1 Smartphone attachment for peer relationships and social ties

Over the past several decades, innovations in technologies that support peer communication have become increasingly important in the lives of adolescents who are heavy users of text-based communication forms, such as instant and text messaging [14]. Moreover, the period between childhood and adulthood is recognized as critical for young people to expand their peer networks as the development of close friendships becomes increasingly important [12]. Many adolescents consciously rely on communication technologies to strengthen their existing relationships and reach out to new friends [13]. In particular, much of adolescents' mobile phone use involves the simple pleasure of being in permanent contact with others by sending "chain messages" as a popular pastime [15].

Smartphones, distinct from regular mobile phone, offer multiple methods for users to contact friends. In addition to the instant and text messaging available on previous mobile devices, smartphones facilitate access to social network sites (hereafter SNS), and more than 80% of SNS users connect to mobile media through smartphones [16]. Due to features such as portability and constant connectivity, smartphones provide a platform for ongoing access to SNS. Based on these characteristics, teenagers in particular access SNS on smartphones to strengthen their social ties [16].

Another important factor in adolescents' lives is smartphone attachment, which refers to a strong emotional connection between individual users and their smartphones [17]. Research that has examined users' emotional attachment to their smartphones explains adolescents' heavy integration of mobile phones in terms of social factors [17], particularly their extensive use of mobile phones as communication devices [6], [7], [18]. Those studies emphasize the dynamic nature of social networks during adolescence and consider how mobile

technology facilitates social linkages. Other social network studies have found that during adolescence, social networks are typically fluid, especially with respect to weak ties (acquaintances) [7] yet more stable with regard to their strong ties (friends) while, relationships are formed and dissolved with less-close friends [9], [19].

Thus, adolescents are known to experience both consistency and change in friendship networks as they add and lose peers. While previous research has demonstrated that the use of mobile phones enables adolescents to manage their friendships, previous studies have also shown contrasting results depending on types of social ties. For example, while adolescents use mobile phones to strengthen relationships with strong ties [8], mobile phones work better for maintaining relationships with weak ties [7]. To better understand how smartphone use for peer communication influences strong and weak ties among adolescents, the following question is posed:

RQ1: How does smartphone attachment relate to smartphone-mediated friendship maintenance among users with strong versus weak ties?

2.2 Social Anxiety and Social Ties

Adolescents' relationships with friends play a critical role in the development of their social skills, feelings of personal competence, and their sense of personal identity and independence from family influences [20]. From the opposite perspective, other scholars who have directed attention to factors that inhibit adolescents' interpersonal functioning to maintain social ties [4], have examined social anxiety as an important factor for understanding social functioning and friendship. Social anxiety is defined as "a state of anxiety resulting from the prospect or presence of interpersonal evaluation in real or imagined social settings" [21]. Symptoms of social anxiety include an uncomfortable feeling that influences one's ability to interact in social situations. Previous research reveals that adolescents with higher levels of social anxiety show poorer social relationships with peers [4].

The connection between social anxiety and social relationships has been discussed in connection with adolescents' use of the Internet and mobile phones [22], [23]; findings show that individuals are often motivated by a need to feel a sense of belonging [24]. However, among those with social anxiety, it may be difficult to fulfill their social needs because of their fear of face-to-face interactions, a fear that encourages them to turn to the Internet [21] or to text-based communication [23]. For socially anxious individuals, communicating with others in a text-based manner (i.e., email, chat rooms, or instant messaging) may allow them to avoid aspects of social situations they fear [5]. Therefore, social anxiety may be positively associated with maintenance of strong and weak social ties that are mediated through smartphone use, especially among adolescents. Based on those observations, the following hypotheses are posed:

H1: Social anxiety will be positively related to smartphone-mediated friendship maintenance among users with strong ties.

H2: Social anxiety will be positively related to smartphone-mediated friendship maintenance among users with weak ties.

2.3 Friendship network size as a moderator

Smartphones are used to maintain friendships in various ways depending on the size of the friendship network because friendship networks, by their very nature, include diverse social groups; some that involve close friends (strong ties) and others with casual friends (weak ties). Due to the distinct characteristics of social environments that adolescents generally experience, the size of offline and online social networks to which adolescents belong frequently change during their school years. By definition, network size refers to the number of people an adolescent is connected to through his or her offline and online social networks. Network size plays an important role in friendship maintenance by facilitating communication among social connections [25]. Specifically, people who have larger networks tend to use SNS more intensively [6] and reveal more of their personal information [26] in communicating with their social connections in comparison to people with smaller-size networks. Furthermore, as people maintain friendships via Facebook, those with fewer actual friends on Facebook are found to perceive more benefits from weak ties that offer non-redundant information than with others who are actual friends or close ties [27]. Smaller friendship groups are more stable because the larger the friendship groups that adolescents belong to, the less likely they are to continuously maintain their friendships [10]. In sum, research on the size of users' networks serves as an indicator of the intensity of individuals' social connectedness and as well as the ways that communication technologies are used to manage relationships. However, studies have not confirmed whether a large or small network size has more advantages in maintaining social relations [10], [26].

Moreover, while network size is known to be an important condition that determines the intensity of social connections, whether network size also plays a role in keeping in touch with both strong and weak ties has not gained much attention. In other words, previous studies have not determined whether adolescents who have a large number of friends use smartphones more for staying in touch with others compared to adolescents who have a small number of friends and tend to bond more closely with intimate friends; or, alternatively, if adolescents with a large number of friends use smartphones to develop friendships with those with whom they have not yet established strong bonds.

Further, although previous research has recognized smartphone attachment, social anxiety, and network size as significant predictors of friendship maintenance, no research to date has considered their combined relations with friendship maintenance. Thus, given that smartphone attachment and social anxiety are significantly related to friendship maintenance [5], [16], [23], this study investigates how these relationships depend on the friendship network size.

In particular, this study categorized adolescents' friendship networks into two types: offline and smartphone. Since adolescents communicate with their friends face-to-face, and with smartphones, it is worth examining these two types of networks. Therefore, the following research questions are proposed:

RQ2: How do offline and smartphone friendship network sizes

relate to smartphone-mediated friendship maintenance by users with strong versus weak ties?

RQ3: How do offline and smartphone friendship network sizes moderate the relationships among smartphone attachment, social anxiety, and smartphone-mediated friendship maintenance by users with strong versus weak ties?

3. METHOD

3.1 Data collection

A web-based survey that targeted adolescent smartphone users was conducted in a Macromill Embrain Ltd. online pool in South Korean in August 2015. The survey participants were selected by using quota sampling of gender and age group to include more diverse sub-groups of the sample. The subjects were all students, ages 13 to 18, who attended either middle school or high school. There were a total of 402 valid responses. All of the question items were measured on a 5-point Likert scale (1 = *strongly disagree*, 5 = *strongly agree*). Men accounted for 168 (41.8 %) and women 234 (58.2 %) of the respondents. The score for average age of the respondents was 16.56 ($SD = 1.31$). The average smartphone use was 4.37 which indicated frequency of use responses between "often" and "very often" ($SD = 0.82$). The measurement models were analyzed using SPSS 21.

3.2 Measurements

3.2.1 Smartphone attachment: Smartphone attachment ($M = 2.96$; $SD = 0.86$; Cronbach's $\alpha = 0.78$) was adopted from constructs used to measure online communication attitudes for the social connection as developed by [28]. Four items were included to measure adolescents' smartphone attachment for maintaining peer relationships.

3.2.2 Social anxiety: Social anxiety ($M = 2.67$; $SD = 0.85$; Cronbach's $\alpha = 0.80$) was composed of five items from the adolescents' social anxiety scale [29] to measure the fear of negative evaluation by peers and social avoidance and distress when getting together face-to-face with peers.

3.2.3 Smartphone-mediated friendship maintenance: Smartphone-mediated friendship maintenance was measured by asking participants about the extent to which they use smartphones to manage both strong ties with friends, such as "to have strong relationships with close friends" or "to keep in touch with friends near me" ($M = 3.61$, $SD = 0.76$, Cronbach's $\alpha = 0.84$) and weak ties with friends, such as "to get in touch with friends to whom I am not very close" or "to have relationships with friends who I do not get along with frequently" ($M = 3.47$, $SD = 0.79$, Cronbach's $\alpha = 0.72$) [7]. To measure strong and weak ties with friends, four and three items were used, respectively.

3.2.4 Friendship network size: Friendship network is categorized into the two types of networks: offline and smartphone, and then was measured its size, respectively. Offline network refers to friendship network to share offline

connection. Offline network size was measured by asking the participants the number of school friends and outside of school friends they hung out with offline ($M = 62.17$, $SD = 99.95$). Smartphone network refers to the network of friends they communicate with on smartphone. Smartphone network size was measured by asking participants the number of friends they sent text messages to (through IM, SMS, or SNS) or had phone conversations with at least once in a week using their phonebook ($M = 6.77$, $SD = 13.79$). Both offline and smartphone friendship network sizes were subjected to a logarithmic transformation because of their highly skewed distribution.

4. RESULTS

Two hierarchical regression analyses were used to examine the relationships among smartphone attachment, social anxiety, network size, and each of the two friendship ties (i.e., strong ties, weak ties). Gender and smartphone use were entered as controls in the first block, and main effects (i.e., smartphone attachment, social anxiety, and network size) were entered in the second and third blocks. In the fourth block, the interaction term was entered to investigate how smartphone attachment and social anxiety interact with network size in affecting each of the two types of friendship ties. The interaction term was formed by mean-centering the main effect first, to avoid multicollinearity, and then multiplying the three main effects.

In response to RQ1, this study found that smartphone attachment was positively related to strong friendship ties ($\beta = 0.44$, $p < 0.001$), as shown in Table 1. H1 was not supported as social anxiety was negatively related to maintenance with strong ties ($\beta = -0.14$, $p < 0.01$). In other words, the respondents' smartphone attachment and social anxiety were both found to play significant roles, but in different ways in

terms of maintaining friendships with their strong ties. In response to RQ2 and RQ3, network sizes and interaction terms were entered in Models 3 and 4, respectively. Although the incremental R^2 was not found to be significant, the offline network size was positively related to friendship maintenance with strong ties via smartphones ($\beta = 0.09$, $p < 0.05$). However, smartphone network size was not significantly related to friendship maintenance with strong ties. No interaction effects were found among smartphone attachment, social anxiety, and network sizes.

Another hierarchical regression analysis was employed to examine the relationship among smartphone attachment, social anxiety, network size, and smartphone-mediated maintenance of friendships with weak ties. In response to RQ1, this study found that smartphone attachment was negatively related to friendship maintenance with weak ties ($\beta = -0.28$, $p < 0.001$; see Table 2). Social anxiety was also found to be negatively related to friendship maintenance with weak ties ($\beta = -0.11$, $p < 0.05$). Thus, H2 was not supported. In response to RQ2, neither offline nor smartphone network sizes were significantly related to maintenance of friendships with weak ties (see Model 4). However, the interaction effects of smartphone attachment ($\beta = 0.17$, $p < 0.01$), social anxiety ($\beta = -0.16$, $p < 0.01$), and offline network size on maintenance of friendships with weak ties via use of smartphones (RQ3) were found (see Model 4). As shown in Fig. 1, participants with a high degree of smartphone attachment were less likely to use smartphones to maintain friendships with their weak ties than those who had a low degree of smartphone attachment. However, this relationship was more significant among those who had a small offline friendship network. Fig. 2 shows that participants with a low level of social anxiety were more likely to use smartphones to maintain friendships with their weak ties than those who had a high level of social anxiety. However, this relationship was more significant among those who had a large offline network of friendships.

Table 1. Regression analysis of smartphone-mediated friendship maintenance with strong-ties

Variables	Model	Model	Model	Model
	1	2	3	4
β				
Block 1: Control variables				
Gender (male)	0.06	0.06	0.06	0.06
Smartphone use	0.26***	0.16***	0.16**	0.17***
R^2 (Percent)	7.0***			
Block 2: Smartphone attachment and Social anxiety				
Smartphone attachment		0.45***	0.45***	0.44***
Social anxiety		-0.16**	-0.14**	-0.14**
Incremental R^2 (Percent)		17.0***		
Block 3: Friendship network size				
Offline			0.10*	0.09*
Smartphone			-0.04	-0.05
Incremental R^2 (Percent)			1.0	

Block 4: Interaction	
Smartphone attachment x Offline network size	0.06
Smartphone attachment x Smartphone network size	-0.10
Social anxiety x Offline network size	-0.03
Social anxiety x Smartphone network size	0.02
Incremental R^2 (Percent)	1.0
Total R^2 (Percent)	25.0***

* N = 402
 * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2. Regression analysis of smartphone-mediated friendship maintenance with weak-ties

Variables	Model	Model	Model	Model
	1	2	3	4
β				
Block 1: Control variables				
Gender (male)	-0.02	-0.03	-0.03	-0.01
Smartphone use	0.01	0.07	0.07	0.07
R^2 (percent)	0			
Block 2: Smartphone attachment and Social anxiety				
Smartphone attachment		-0.25***	-0.26***	-0.28***
Social anxiety		-0.15**	-0.13*	-0.11*
Incremental R^2 (percent)		11.0***		
Block 3: Friendship network size				
Offline			0.09	0.08
Smartphone			-0.05	-0.05
Incremental R^2 (percent)			1.0	
Block 4: Interaction				
Smartphone attachment x Offline network size				0.17**
Smartphone attachment x Smartphone network size				-0.02
Social anxiety x Offline network size				-0.16**
Social anxiety x Smartphone network size				0.02
Incremental R^2 (percent)				3.0**
Total R^2 (percent)				15.0***

* N = 402
 * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

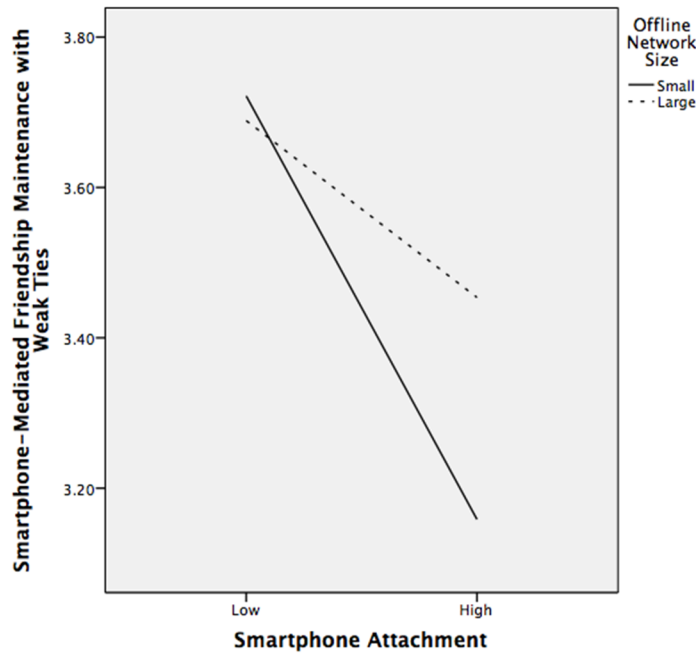


Fig. 1. An interaction effect of smartphone attachment and offline network size on smartphone-mediated friendship maintenance with weak ties.

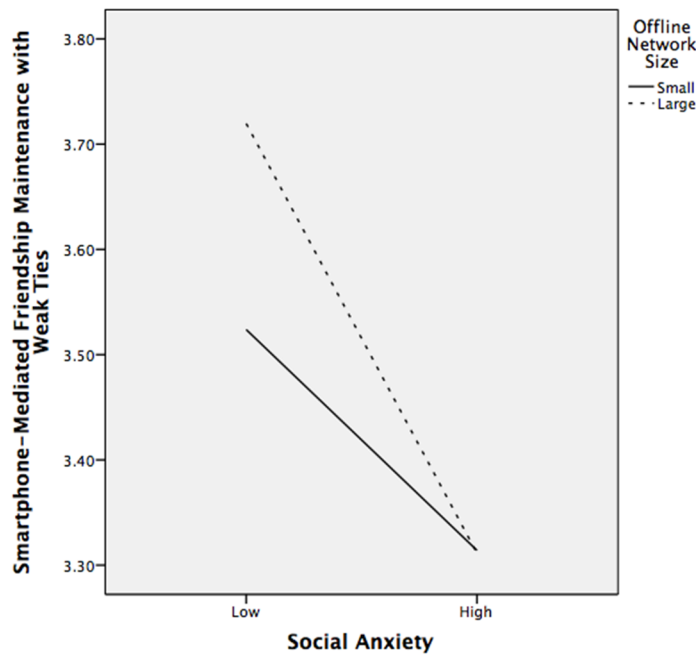


Fig. 2. An interaction effect of social anxiety and offline network size on smartphone-mediated friendship maintenance with weak ties.

5. DISCUSSION

Smartphones are a crucial channel for modern adolescents to maintain their friendships [7], [8], [22], [23]. Smartphone-mediated maintenance of friendships can be implemented by calling, text messaging, and SNS. The social

connections mediated by smartphones are more prominent among adolescents, especially those who have already developed various types and sizes of friendship networks as they gain and lose friends during their school years [7]-[9]. Previous research shows that adolescents' interactions with their peers are closely related to various psychological factors such as attachment [12], [13] and social anxiety [4], [22], [23]. Therefore, this study examined how those psychological

traits and types (offline and smartphone) and sizes (large and small) of social networks relate to the use of smartphones in maintaining friendships (strong and weak ties). The results of the current study highlight three main findings.

First, smartphone attachment is positively related to smartphone-mediated friendships maintained among friends with strong ties. However, smartphone attachment is negatively related to smartphone-mediated friendships among those with weak ties (RQ1). By demonstrating that smartphone attachment plays different roles in maintaining friendships for those with strong ties and weak ties, these results expand on earlier research findings about the relationship between smartphone attachment and friendship maintenance. These results also build on conflicting findings from previous studies showing that mobile phones work better than smartphone for building adolescent relationships regardless of whether the ties are strong [8] or weak [7]. Taken together, when it comes to friendship maintenance through smartphones, smartphone attachment tends to lead to greater bonding with close ties and less frequent interactions with weak ties. In other words, the more emotionally invested adolescents are in using smartphones to connect with intimate friends, the less effort they may put into maintaining connections with friends who are more socially distant. Although previous studies found that adolescents who experience the dynamic nature of social networks during their school years intensively use various communication technologies to manage relationships with both close and less close friends [13], results of the current study found that adolescents' smartphone use is more positively oriented toward strengthening close friendships.

The second major finding of this study is that social anxiety is negatively related to the maintenance of smartphone-mediated friendships among those with both strong (H1) and weak ties (H2). These results contradict previous studies that have shown people who feel social anxiety in face-to-face interactions tend to rely more on Internet [22] or text-based communication to connect socially [5], [23]. By contrast, findings of this study indicate that social anxiety hinders the maintenance of friendship networks regardless of the medium of interaction. Adolescents who feel socially anxious tend to avoid interactions with those they are connected with—by strong or weak ties—even when using smartphones.

The third finding of this study represents a consideration of the critical situation that adolescents experience when their friendship networks expand [12], focusing on the size of their friendship networks relative to friendship maintenance. In contrast to findings from previous research [6], [19], this study found that the size of networks—both smartphone and offline—does not function independently for maintaining relationships via smartphones with strong and weak ties (RQ2). Prior studies demonstrated that larger friendship networks are less likely to be stable than smaller ones because larger friendship networks impede people's ability to continuously maintain their friendships [19]. It is plausible that adolescents with a large number of friends are more likely to use smartphones to keep in contact with their many friends. However, based on findings from the present study, it

is worth noting that psychological factors—smartphone attachment and social anxiety—are better indicators for understanding adolescents' use of smartphones to maintain friendships.

Rather, the issue of network size moderates smartphone relationships with regard to the factors of attachment, social anxiety, and smartphone-mediated relationship maintenance relative to weak ties (RQ3). More importantly, offline network size was found to have different relationships with smartphone attachment and social anxiety regarding interactions among friends with weak ties. Smartphone attachment hinders maintaining friendships with weak ties; this was found to be more prominent among adolescents with a small number of offline friends. The reason may be that smartphone attachment decreases the need for relationships with friends who are not close. By the same logic, heavy use of smartphones to maintain a large number of friendships may lead adolescents to neglect interactions with those they are not close to while strengthening their desire to interact more frequently offline with those with whom they share closer relationships. Thus, smartphone relationships with their weak-tie friends eventually disappear.

Among adolescents with low levels of social anxiety, the current study found that those with small networks of offline friendships were less likely to interact via smartphones with weak-tie friendships compared to smartphone usage among those with large networks of offline friendships. These results expand the findings of previous studies that focused exclusively on interactions with close friends to show how positive and negative interactions with close friends are associated with levels of social anxiety [4]. Overall, the current study showed that social anxiety is a more significant factor with regard to interactions among friends in larger offline networks when they interact with weak ties, possibly because adolescents with more offline friends may experience different degrees of social anxiety, which may give rise to their having greater or lesser fear of connecting with less-close friends.

While the findings of this research have a number of implications, the limitations need to be acknowledged. First, the primary limitation relates to a measuring bias. This study utilized a self-report measure to assess smartphone attachment, social anxiety, and smartphone-mediated friendship maintenance. Such self-reported data inherently has a response bias. Thus, future research may use a behavioral measure to examine those relationships in a stricter manner or conduct an in-depth interview of adolescents to validate the findings from a survey using self-reported data. Second, the sample of this study included a much larger proportion of women (58.2%) than men (41.8%), thus results may have a sampling bias by overrepresenting female respondents. Future research may give greater attention to sampling bias when it comes to data collection. Last, the cross-sectional data used in this study cannot clarify causal relationship among the study variables, possibly limiting the generalizability of the findings. Therefore, future research might use longitudinal data to provide a better explanation for the effects of adolescents' smartphone

attachment, social anxiety, and friendship network size on smartphone-mediated friendship maintenance.

Despite the limitations, this study makes significant contributions to research on how adolescents use smartphones to maintain friendships and how several of their psychological factors relate to their social connectedness via use of a popular computer-mediated technology.

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