Linking Loneliness, Shyness, Smartphone Addiction Symptoms, and Patterns of Smartphone Use to Social Capital

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Abstract

The purpose of this study is to explore the roles of psychological attributes (such as shyness and loneliness) and smartphone usage patterns in predicting smartphone addiction symptoms and social capital. Data were gathered from a sample of 414 university students using online survey in Mainland China. Results from exploratory factor analysis identified five smartphone addiction symptoms: disregard of harmful consequences, preoccupation, inability to control craving, productivity loss, and feeling anxious and lost, which formed the Smartphone Addiction Scale. Results show that the higher one scored in loneliness and shyness, the higher the likelihood one would be addicted to smartphone. Furthermore, this study shows the most powerful predictor inversely affecting both bonding and bridging social capital was loneliness. Moreover, this study presents clear evidence that the use of smartphones for different purposes (especially for information seeking, sociability, and utility) and the exhibition of different addiction symptoms (such as preoccupation and feeling anxious and lost) significantly impacted social capital building. The significant links between smartphone addiction and smartphone usage, loneliness, and shyness have clear implications for treatment and intervention for parents, educators, and policy makers. Suggestions for future research are discussed.

Keywords

loneliness, Mainland China, shyness, social capital, smartphone addiction

Introduction

The increase in the demand for mobile, mediated interpersonal, and mass communication technologies boosted the powerful evolution of mobile phone devices during the last decade. Smartphones, distinct from standard mobile phone in operating system and equipped with more advanced 3G or 4G features and capabilities (e.g., socializing on Facebook and viewing/posting video on YouTube),

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are rapidly gaining popularity worldwide. In 2012, the number of smartphones sold in the world market reached 700 million and accounted for 40% of the total sales of all mobile phones, an increase of 43% over a year ago (Rivera, 2013; Strategy Analytics, 2013). In urban China, the smartphone penetration rate skyrocketed to 66% last year, exceeding developed economies such as the United States and the United Kingdom (Gao, 2013). According to a report released from Analysys International, the penetration rate of smartphones in China, among those aged 21 to 30 years old, was 68.4%, which is the largest in the smartphone market (Xinhua Net, 2011).

Although the widespread adoption and use of smartphones presents attractive statistics for the industry, for social scientists, it also provides a new area for research into some social problems, especially in the overuse of the device. Past research has focused on mobile phone addiction and its impact on face-to-face communication (Leung, 2008). People are now less attentive to whom they are with in person and indulge themselves in their smartphones, not only for connecting with other people but also for features and functions like reading e-books, answering e-mails, texting short messages, or engaging in online games. Some users even put the mobile phone on the table for all to see, implying that if the interaction is not interesting enough, they have alternatives. Furthermore, the culture of using mobile phones in inappropriate places with little respect for others has made some users appear invasive, impolite, and disruptive (Rosen, 2004; Wei & Leung, 1999).

Although previous studies have paid much attention to mobile phone addiction and Internet addiction (Leung, 2008; Young, 1998), little research has specifically explored smartphone addiction. Thus, the purpose of this study is to investigate the degree to which smartphone addiction exists among university students in Mainland China (henceforth ''Chinese students'' in the remainder of this study to represent ''university students in mainland China'') and develop and test Smartphone Addiction Scale (SPAS) to better measure smartphone addiction. Besides, past research was aware of the importance of social capital in technology development (Fountain, 1997; Riemer, 2004; Syrjanen & Kuutti, 2004), but few focused on the impact of mobile technologies on social capital. In addition, past research has demonstrated that psychological attributes such as loneliness and shyness have a significant effect on people's addiction to different substances (Brook & Newcomb, 1995; Dobkin, Tremblay, Masse, & Vitaro, 1995; Engelberg & Sjoberg, 2004; Ensminger, Juon, & Fothergill, 2002; Gaev, 1976; Weiss, 1973). Following this line of research, this study also examines whether loneliness and shyness can explain symptoms of smartphone addiction and investigates the roles of the smartphone usage patterns and smartphone addiction on social capital.

Literature Review

Smartphone addiction. Addictive mobile phone use can be regarded as an impulse control disorder that does not involve an intoxicant and is similar to pathological gambling (Park & Lee, 2011). Previous mobile phone addiction research was mostly based on past investigation of Internet addiction (Beard, 2002; Beard & Wolf, 2001; Chak & Leung, 2004; Leung, 2004; Scherer, 1997; Young, 1998), which assumed that behavioral addiction, especially people who are addicted to Internet, is similar to people who are addicted to gambling, drugs, and alcohol (Young, 1996). Researchers in mobile phone addiction in Nordic countries also found positive relationships between mobile phone use and health-compromising behaviors (Leenaa, Tomib, & Arjab, 2005). In particular, Thomée, Härenstam, and Hagberg (2011) found that high mobile phone use was associated with sleep disturbances and symptoms of depression in Sweden.

To clinically define addictive use of the smartphone, it is necessary to compare it against criteria for other established addictions. The American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders* (known as *DSM*) has established objective and measurable criteria for assessing ''substance dependence'' (American Psychiatric Association, 1994). The main diagnostic criterion is a maladaptive pattern of substance use, leading to significant psychological impairment.

This impairment is manifested by symptoms. Bianchi and Phillips (2005) developed the Mobile Phone Problem Use Scale (MPPUS), which identified several symptoms mobile phone addicts exhibit. They found that addicts of mobile phones hide their actual use from family and friends; face financial crises[1] because of excessive use of mobile phones; feel preoccupied, anxious, or depressed when out of reception range for some time; continuously fail to control or cut back mobile phone use; and use mobile phones to escape from problems and emergencies.

Past research has investigated mobile phone addiction from the perspectives of leisure, boredom, sensation seeking, and self-esteem (Leung, 2008). This study explores predictors from other psychological perspectives such as loneliness and shyness, in order to differentiate addicts from nonaddicts of smartphones among Chinese students. More importantly, this study seeks to explain the effects of smartphone usage and smartphone addiction specifically on social capital. Before reviewing the psychological literature, this study asks two research questions:

Research Question 1: What smartphone addiction symptoms can be identified among a group of Chinese students?

Research Question 2: To what extent are Chinese students addicted to smartphone use?

Loneliness. Loneliness is defined as perceived deficiencies in one's ongoing relationships in both number and quality (Peplau, Russell, & Heim, 1979). Such deficiencies occur when ''a person's network of relationships is either smaller or less satisfying than the person desires'' (Peplau et al., 1979, p. 55). Past studies have found a significant relationship between loneliness and deficits in social interaction, especially when talking to others (Jones, 1982; Spitzberg & Canary, 1985). Lonely people tend to talk less, have lower levels of involvement and attention, and inappropriate levels of self-disclosure (Sloan & Solano, 1984; Solano, Batten, & Parish, 1982). In addition, lonely people are more likely to be relationally incompetent, and as a result, they spend less time on social activities but more time being alone (Spitzberg & Canary, 1985). According to Woodward and Frank (1988), adolescence is usually labeled as a time of loneliness, distress, alienation, and solitude. Research also concluded that loneliness is related to deviant drug and alcohol use, overeating, and even suicide (Gaev, 1976; Weiss, 1973; Wenz, 1977). Loneliness has also been found to be significantly associated with Internet addiction. Engelberg and Sjoberg (2004) found that lonely people with poorer social skills tend to have more frequent use of the Internet.

When it comes to mobile communication, the basic purpose of the mobile phone is to allow people in two different places to communicate instantly, eliminating the primary human anxiety about loneliness (Townsend, 2000). Thus, it is reasonable to believe that lonely people might tend to use a mobile phone more to get rid of this kind of anxiety. In Korea, Park (2005) also found that loneliness is positively correlated with mobile phone addiction among college students. In line with these, this study expects lonely people would be more likely to be addicted to smartphones and would have heavier use of smartphones. Since lonely people are reluctant to talk to others in face-to-face communication, they would tend to interact with people by texting or other social networking applications on smartphones.

Shyness. Shyness is understood as a lack of confidence in meeting people and feeling uncomfortable in the presence of others. The key to shyness is anxiety over being assessed by others (Pilkonis, 1977). Cheek and Buss (1981) defined shyness as ''one's reaction to being with strangers or casual acquaintances including tension, concern, feelings of awkwardness and discomfort, and both gaze aversion and inhibition of normally expected social behavior'' (p. 330).

Shy people tend to regard their networks as less supportive and less satisfying and are happy and more comfortable being by themselves (Parrott, 2000). Shyness is associated with problematic drug

and alcohol use both in adolescence and in adulthood (Brook & Newcomb, 1995; Dobkin et al., 1995; Ensminger et al., 2002; Hawkins, Catalano, & Miller, 1992; Kellam, Simon, & Ensminger, 1983). Research has also shown that the computer-mediated medium provides shy people a perfect environment to perceive control over the communication process (Carducci & Zimbardo, 1995). Past research has found that deviant Internet use is significantly correlated to shyness (Caplan, 2002; Ofosu, 1999). However, Wei and Lo (2006) found that shyness was negatively associated with motivation to use mobile phones and with the amount of mobile phone use.

Smartphone use, on the other hand, provides a similar environment to what the Internet provides. This is because smartphones not only have functions and features like verbal communication but also have other applications such as texting (e.g., WhatsApp, WeChat), which provide functions for social networking. These functions let people avoid communicating with others face-to-face or even by voice; thus, this may be a preferred way for shy people to communicate with others. In addition, other functions of smartphones, which give people access to entertainment like games or allow people to get information by surfing on the Internet, help shy people to escape from uncomfortable situations while in public and indulge in a virtual, private mobile computing environment. As a result, it seems that shy people would rely more on smartphones, which may lead to heavier smartphone use. Thus, the study proposes the following research question:

> **Research Question 3:** How can smartphone addiction symptoms be predicted by demographics, loneliness, shyness, and smartphone usage?

Social capital. Bourdieu and Wacquant (1992) defined social capital as "the sum of the resources, actual or virtual, that accrue to an individual or a group by virtue of possessing a durable network of more or less institutionalized relationships of mutual acquaintance and recognition" (p. 14). Putnam (2000) conceptualized social capital as bridging and bonding social capital and distinguished between the two with the former being what network researchers refer to as *weak ties* and the latter as *social capital* found between individuals in tightly knit, emotionally close relationships, such as family and close friends.

Meanwhile, the relationship between social capital and information and communication technologies (ICTs) seems to be not quite clear in the research literature. High levels of social capital were shown to be a success factor for establishing electronic-based social networks (Fukuyama, 2001), while ICTs with sophisticated networking infrastructure encourage the formation of social capital (Calabrese & Borchert, 1996). Thus, the relationship between social capital and ICTs seems to be mutual. Since social capital is about connections among people, people who are addicted to smartphones or use a smartphone heavily may also generate more social capital. Conversely, less social capital may result since the smartphone occupies the time that could be used to bridge or bond with others. Therefore, we propose the following research question:

> **Research Question 4:** To what extent can demographics, loneliness, shyness, smartphone usage, and smartphone addiction symptoms predict (a) bonding social capital and (b) bridging social capital?

Method

Setting and Sampling

As an exploratory study, this research targets Chinese students, as they are the most likely subjects in China to be early adopters of smartphones. First, to guide the questionnaire design, an online focus group was conducted among a group of 20 university students in order to assess their motivations and usage patterns of smartphones. Questionnaire was initially designed in Chinese and later

translated into English.[2] The results showed that two most common social media apps were Weibo and WeChat; they played various games: adventure, card, puzzle, racing, strategy, and so on; and the most common e-commence app was Taobao. Data were later collected by an online Chinese questionnaire on sojump.com, one of the most professional website for online survey in China, which allows users to post their own survey for free which is especially popular among university students (sojump.com also provide paid survey service), with a snowball sampling of 565 Chinese students from March 13–28, 2012. Among the 565 completed questionnaires, only 478 were smartphone users. In addition, 64 were excluded as repeated submissions or questionable questionnaires. Thus, the total valid sample size was 414.

The sample consisted of 61.6% females and 38.4% males. Nearly 2% of the respondents were aged under 18, 35.5% were aged from 19 to 22, 60.1% were aged from 23 to 26, and 2.4% of respondents were aged from 27 to 30. As for education, of the 414 respondents, 4.1% were in Year 1; 7.2% were in Year 2; 5.8% were in Year 3; 37.4% were in Year 4; 44% were master's students; and 1.4% were PhD students. In terms of household monthly income, 15% of respondents reported less than Renminbi (RMB) 3,000; 31.2% were in the range of RMB 3,001–6,000; 29.5% were RMB 6,001–10,000; 14.3% were RMB 10,001–20,000; and 10.1% reported more than RMB 20,000. Current U.S. dollar exchange rate with RMB is US\$1 = RMB 6.16522 at the time of the study.

Measurement

Mobile phone addiction. The MPPUS developed by Bianchi and Phillips (2005), the Internet Addiction Test (Young, 1998), and the Television Addiction Scale (Horvath, 2004) were adapted to measure smartphone addiction in this study. All measures were based on *DSM* (Fourth edition; DSM-IV) criteria, which are in line with the assumption that behavioral addiction shows symptoms that are similar to addiction to other substances (e.g., alcohol). Young's Internet Addiction Scale was used in the study, as smartphone today provides an environment to let people access Internet anytime anyplace which may lead to symptoms caused by Internet addiction. This study also adopted items from Horvath's Television Addiction Scales (2004), as it was prudent to include additional *DSM-IV* criteria that were not included in Young's scale since smartphone can also be used as a remote TV. However, only 19 items from the three scales mentioned earlier were adopted. Using Young's (1996) classic definition of assessing Internet addiction with 8 revised items similar to those used in *DSM-IV* for screening gambling problems, 8 items embedded in the original 19 items were used to create the composite smartphone addiction index (SPAI). Sample items included "You have tried to hide from others how much time you spend on your smartphone" and "You find yourself engaged on the smartphone for longer periods of time than intended." These 8 items were also used by Young (1996) to develop her screening instrument for addictive Internet use and by Leung (2008) for addictive mobile phone use. A 5-point Likert-type scale was used for the 19-item SPAI scale with 1 = *not true at all* to 5 = *extremely true*. The Cronbach's α was high at .92.

Loneliness. To assess loneliness, a short form of the Revised UCLA Loneliness Scale, version 3, was adopted (Russell, 1996). Respondents were asked to express how they feel about eight statements (e.g., "You can find companionship when you want it" and "People are around you but not with you") using a 4-point Likert-type scale, ranging from 1 = *never* to 4 = *always*. The Cronbach's α was .71.

Shyness. A short version of Cheek and Buss's (1981) Shyness Scale was used to evaluate shyness. Respondents were asked to rank their agreement with six statements (e.g., "You are socially somewhat awkward" and "You don't find it hard to talk to strangers") using a 5-point Likert-type scale, from 1 = *strongly disagree* to 5 = *strongly agree*. The Cronbach's α was .73.

Table 1. Factor Analysis of Smartphone Usage (Smartphone Users Only).

How Often Do You Use the Smartphone for …?	Factors				Mean	SD
	1	2	3	4		
Information seeking						
1. Surfing on the Internet	.85				3.77	.98
2. Using search engine	.68				3.59	1.05
3. Checking information about daily life	.64				3.33	1.05
4. Viewing news	.63				3.26	1.14
5. Using instant message	.62				3.84	1.01
6. Using social networking services	.48	.45			3.85	1.02
Utility						
7. Functions related to efficiency		.72			3.06	1.05
8. Dictionary		.71			3.23	1.06
9. E-mail		.64			2.66	1.22
10.Taking photos and videos		.61			3.53	.86
Fun seeking						
11. Watching videos			.78		2.54	1.07
12. Listening to music			.75		3.29	1.15
13. E-book			.64		2.82	1.19
14. Game			.60		2.98	1.09
Sociability						
15. Making phone call				.84	4.15	.78
16. Texting				.83	3.96	.92
Eigenvalue	2.80	2.30	2.16	1.55		
Variance explained (%)	17.52	14.40	13.47	9.70		
Cronbach's α	.79	.68	.68	.64		

Note. N = 414. SD = standard deviation. Scale used: 1 = *almost never*, 2 = *seldom*, 3 = *sometimes*, 4 = *often*, and 5 = *very often*.

Smartphone usage. To assess the pattern of smartphone usage, respondents were asked how often they used 16 different functions of the smartphones such as texting, calling, and gaming, using a 5-point Likert-type scale ranging from 1 = *almost never* to 5 = *very often*. As shown in Table 1, a principal components factor analysis with Varimax rotation identified four major functions with Eigenvalues greater than 1, explaining 55.09% of the variance including information seeking (6 items; α = .79), utility (4 items; α = .68), fun seeking (4 items; α = .68), and sociability (2 items; α = .64).

Social capital. To measure social capital, a short version of bridging and bonding social capital measures constructed by Williams (2006) was employed. Respondents were asked to rank their agreement with four statements for bonding and four statements for bridging social capital (e.g., ''There is someone online/offline you can turn to for advice about making very important decisions'' and ''There are several people online/offline you trust to solve your problems'') using a 5-point Likert-type scale with 1 = *strongly disagree* to 5 = *strongly agree*. The Cronbach's α for bonding social capital was .72 and for bridging social capital was .70. Descriptive results and the bivariate relationships for all main variables are presented in Tables 2 and 3.

Findings

Smartphone addiction symptoms. The 19-item SPAS was developed to collect responses from 414 Chinese students to identify smartphone addiction symptoms and to assess their overall level of smartphone addiction. The mean score for the 19-item SPAS was 48.48 and standard deviation equaled 12.75 (with possible scores ranged from 0 to 95; see Table 2). As shown in Table 4, principal

Table 2. Descriptive Results on Main Measures.

	Loneliness	Shyness	SPAS	Bonding Social Capital	Bridging Social Capital
Mean score	2.14	2.33	48.48	3.00	2.82
SD	0.43	0.45	12.74	0.51	0.46
Min	1.00	1.00	19.00	1.50	1.50
Max	3.25	3.67	89.00	4.00	4.00

Note. Max = maximum; Min = minimum; SD = standard deviation.

components factor analysis (with Varimax rotation, Eigenvalue greater than 1, and factor loading greater than .50) yielded a five-factor smartphone addiction symptoms structure and accounted for 70.09% of the total variance. The first factor was "disregard of harmful consequences" (5 items; $\alpha = .88$), indicating that Chinese students suffered from being late for appointments, school, or work as a result of too much time spent on smartphones and got in trouble because their smartphone went off during a meeting, lecture, or in a theater. "Preoccupation" ($\alpha = .82$) was the second factor. It included 5 items characterizing that Chinese students feel preoccupied with smartphones when they were not using it or fantasized about using it, found themselves engaged on smartphones for longer periods of time than intended, and anticipated using their smartphone again. "Inability to control craving" ($\alpha = .82$) was the third factor. It contained 4 items illustrating the inabilities of Chinese students to avoid complaints they received from friends and family about their obsessive smartphone use, to stop using a smartphone, and to cut down on the amount of smartphone use. "Productivity loss" ($\alpha = .86$) was the fourth factor. It consisted of 3 items indicating that Chinese students found that excessive use of the smartphone has caused problems in their lives, decreased productivity, occupied time for other things, and diverted attention from pressing issues that they should be facing. The fifth factor, "feeling anxious and lost" ($\alpha = .79$), contained 2 items reflecting that Chinese students felt anxious or preoccupied when out of reception range for some time.

As a whole, this study identified five smartphone addiction symptoms, which were conceptually consistent with the diagnostic criteria of pathological gambling described in *DSM-IV*. The original *DSM* measurement for pathological gambling was based on 8 items; however, this study employed 19.

Extent of smartphone addiction. To assess the extent to which university students were addicted to smartphones, the 8 items from the original 19 that are most conceptually equivalent to Young's (1996) screening instrument in Internet addiction were employed. First, the 5-point Likert-type scale for these 8 items was dichotomized with "1" to "3" recoded to "0" and "4" and "5" recoded to "1." These 8 items were summed, which yielded a value ranging from "0" to "8." Students with a score of 5 or above were classified as addicts. According to this classic measurement, 13.5% in the sample were addicted to smartphones. However, we recognize that such magnitude is small and addictions are developed from regular habit-formation processes over time and some users develop them into addictions (i.e., meeting the criteria similar to *DSM-IV* in assessing substance addiction) and some don't (Oulasvirta, Rattenbury, Ma, & Raita, 2012).

Predicting smartphone addiction. Regression results in Table 5 show loneliness ($\beta = .22, p \leq .001$) was one of the strongest predictors in influencing smartphone addiction (as shown in SPAI) followed by shyness ($\beta = .21, p \leq .001$). This means that Chinese students who are most vulnerable or easily become addicted to smartphones are generally those who scored high in loneliness and shyness. In examining the predictive power of the two psychological variables on the five dimensions of smartphone addiction symptoms, data show that shyness was more influential than loneliness. Specifically, shyness was a predictor of preoccupation ($\beta = .14, p \leq .01$), inability to control craving

Table 3. Zero-Order Pearson Correlation Matrix for Observed Variables.

	2	3	4	5	6	7	8	9	10	11	12	13	14
Psychological attributes													
1. Loneliness	.40***	−.09	−.02	.08	−.22***	.31***	.31***	.09	.05	.18***	.04	−.37***	−.27***
2. Shyness		.05	.02	.01	−.06	.30***	.11*	.15**	.14**	.18***	.12*	−.17***	−.21***
Smartphone usage													
3. For information seeking			—	—	—	.13**	−.11*	.11*	.17***	.06	.11*	.23***	.20***
4. For utility				—	—	.11*	−.06	.15**	.11*	−.02	.08	.13**	.16***
5. For fun seeking					—	.20***	.24***	.14**	.12*	.003	−.13**	−.10*	−.06
6. For sociability						−.11*	−.13**	.05	−.09	−.10*	.06	.24***	.12*
Smartphone addiction													
7. Smartphone addiction index (SPAI)							.52***	.46***	.49***	.44***	.31***	−.06	−.03
8. Disregard of harmful consequences								—	—	—	—	−.28***	−.15**
9. Preoccupation									—	—	—	.20***	.19***
10. Inability to control craving										—	—	−.05	−.04
11. Productivity loss											—	−.10*	−.12*
12. Feeling anxious and lost												.17***	.12*
Social capital													
13. Bonding													.52***
14. Bridging													

Note. $N = 414$.
*$p \leq .05$; **$p \leq .01$; ***$p \leq .001$.

Table 4. Factor Analysis of Smartphone Addiction.

How true do the following statements describe you?	Factors					M	SD
	1	2	3	4	5		
Disregard of harmful consequences							
1. You are often late for appointments because you are engaged on the smartphone when you shouldn't be. (mobile)	.87					1.92	.95
2. Your grades or schoolwork suffer because of the amount of time you spend on smartphone. (Internet)	.80					2.04	.90
3. More than once you have been in trouble because your smartphone has gone off during a meeting, lecture, or in a theatre. (mobile)	.75					2.15	.98
4. You have tried to hide from others how much time you spend on your smartphone. (mobile) (7)*	.66					2.13	.98
5. You have attempted to spend less time on your smartphone but are unable to. (mobile) (3)*	.61					2.26	1.01
Preoccupation							
6. You find yourself anticipating when you will use smartphone again. (Internet)		.83				2.91	1.02
7. You feel preoccupied with smartphone when you are not use it, or fantasize about using it. (Internet)		.76				2.46	1.06
8. When you are unable to use smartphone, you miss it so much that you could call it "withdrawal". (TV)		.69				3.10	1.06
9. You have used your smartphone to make yourself feel better when you were feeling down. (mobile) (8)*		.55	.47			3.00	1.00
10. You find yourself engaged on the smartphone for longer periods of time than intended. (mobile) (5)*		.52	.44			3.25	1.08
Inability to control craving							
11. You have been told that you spend too much time on your smartphone. (mobile)			.73			2.43	1.12
12. You can never spend enough time on your smartphone. (mobile) (2)*			.70			2.61	1.15
13. You often think that you should cut down on the amount of smartphone that you use. (TV)			.61			2.91	1.00
14. Your friends and family complain about your use of the smartphone. (mobile)			.56			2.54	1.07
Productivity loss							
15. Your productivity has decreased as a direct result of the time you spend on the smartphone. (mobile)				.83		2.42	1.05
16. You find yourself occupied on your smartphone when you should be doing other things, and it causes a problem. (mobile) (6)*				.82		2.32	0.97
17. There are times when you would rather use the smartphone than deal with other more pressing issues. (mobile)				.65		2.41	1.09
Feeling anxious and lost							
18. When out of range for some time, you become preoccupied with the thought of missing a call. (mobile) (1)*					.86	2.82	1.09
19. You feel anxious if you have not checked for messages or switched on your smartphone for some time. (mobile) (4)*					.86	2.81	1.10
Eigenvalue	3.65	2.74	2.65	2.53	1.76		
Variance explained (%)	19.19	14.39	13.96	13.31	9.24		
Cronbach's α	.88	.82	.82	.86	.79		

Note. N = 414. SD = standard deviation; TV = television. Scale used: 1 = *not true at all*; 2 = *not true*; 3 = *ordinary*; 4 = *true*; 5 = *extremely true*. *Items resemble or are equivalent to the 8-item Young's Internet addiction diagnostic scale.

Table 5. Hierarchical Regression Analysis of Smartphone Addiction Using Demographics, Shyness, Loneliness, and Smartphone Usage as Predictors.

| | Smartphone Addiction Index (SPAI)[a] | | Smartphone Addiction Symptoms | | | | | | | | | |
| | | | Disregard of Harmful Consequences | | Preoccupation | | Inability to Control Craving | | Productivity Loss | | Feeling Anxious and Lost | |
Predictors	β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2
Demographics												
Age	.06		−.07		.03		.02		−.04		−.02	
Gender (male = 1)	−.01		.21***		−.13**		−.12*		.06		−.01	
Grade	−.13**		−.17***		−.01		−.10*		−.06		.15**	
Family Monthly Income	−.03	.01	−.09	.07	−.05	.01	−.02	.02	−.02	.00	.07	.02
Psychological attributes												
Shyness	.21***		.00		.14**		.13**		.13*		.12*	
Loneliness	.22***	.13	.26***	.07	.05	.02	−.00	.01	.12*	.04	.02	.01
Smartphone usage												
Information seeking	.15***		−.09		.11*		.18***		.07		.09	
Utility	.13**		−.00		.13**		.10*		−.02		.06	
Fun seeking	.17***		.19***		.15***		.11*		−.01		−.12*	
Sociability	−.05	.06	−.05	.03	.05	.04	−.09	.06	−.07	.00	.06	.02
R^2	.21		.19		.09		.10		.06		.06	
Adjusted R^2	.20		.17		.07		.09		.04		.05	

Note. $N = 414$. Figures are standardized β coefficients. R^2 is expressed in percentage of variance accounted for. [a]This is a composite measure of all 19 smartphone addiction symptom items; the higher the score, the higher the tendency of one to have the symptoms.
*$p \leq .05$; **$p \leq .01$; ***$p \leq .001$.

(beta; = .13, $p \leq$ .01), productivity loss (β = .13, $p \leq$ .05), and feeling anxious and lost (β = .12, $p \leq$ .05), while loneliness was significantly linked to the symptom of disregarding harmful consequences (β = .26, $p \leq$ .001) and productivity loss (β = .12, $p \leq$ .05). In addition to psychological variables, three of the four functions of smartphone use and SPAI were linked; the more they used smartphones for information seeking (β = .15, $p \leq$ .001), utility (β = .13, $p \leq$ .01), and fun seeking (β = .17, $p \leq$ .001), the higher the likelihood that they would become addicted. With respect to addiction symptoms, regression analyses show that the more they used smartphones for information seeking, the higher the likelihood that they would exhibit addiction symptoms—such as preoccupation (β = .11, $p \leq$ .05) and inability to control cravings (β = .18, $p \leq$ .001). Moreover, results in Table 5 show that the more they used smartphone for utility, the higher the likelihood that they would exhibit addiction symptoms like preoccupation (β = .13, $p \leq$ 0.01) and inability to control cravings (β = .10, $p \leq$ .05). Furthermore, as shown in Table 5, the more Chinese students used smartphones for fun seeking, the higher the likelihood that they would exhibit addiction symptoms like disregard of harmful consequences (β = .19, $p \leq$ .001), preoccupation (β = .15, $p \leq$ .01), inability to control cravings (β = .11, $p \leq$ .05), and the less they would exhibit feeling anxious and lost (β = −.12, $p \leq$ .05). Demographically, being male seemed to indicate having more vulnerability to exhibiting the symptom of disregard of harmful consequences (β = .21, $p \leq$ .001), while being female seemed to indicate having more vulnerability to exhibiting symptoms like preoccupation (β = −.13, $p \leq$ .01) and inability to control cravings (β = −.12, $p \leq$ .05). Results in Table 5 also indicate that the lower the grade students were in, the higher the likelihood that they would become addicted to smartphones (β = −.13, $p \leq$ .01). The amount of variance explained ranged from 4% to 20%.

Predicting social capital. Finally, to compare the relative influence of shyness, loneliness, use of smartphone functions, and smartphone addiction symptoms on bonding and bridging social capital, a pair of hierarchical regression analyses was run. Results in Table 6 show that gender (β = −.24, $p \leq$ .001) and grade (β = .21, $p \leq$ .001) were two significant predictors of bonding social capital under the demographics block. It shows that females and students in the higher grades perceived higher levels of bonding social capital. The first block accounted for 10% of the variance.

Psychological variables were entered into the next equation. Results showed that loneliness (β = −.33, $p \leq$ .001) was the only significant predictor of bonding social capital. Subjects who scored high on the level of loneliness would perceive that they had lower levels of bonding social capital. This variable contributed 10% of the variance.

The four functions of smartphone use were entered next in the equation. Using smartphones for information seeking (β = .20, $p \leq$ .001) and sociability (β = .15, $p \leq$ .001) contributed significantly to the regression equation, which explained a total of 6% of the variance. This reveals that the more one used smartphones for information seeking and sociability, the higher the level of bonding social capital they would perceive.

Five variables from the smartphone addiction symptoms block were entered last. Disregard of harmful consequences (β = −.10, $p \leq$ .05), preoccupation (β = .19, $p \leq$ .001), and feeling anxious and lost (β = .14, $p \leq$ .001) were three significant predictors that accounted for another 6% of the variance. These results indicate that a greater amount of smartphone addiction symptoms of preoccupation and feeling anxious and lost predicted higher levels of perception of bonding social capital. However, the negative link between disregard of harmful consequences and bonding social capital reveals that a greater amount of smartphone addiction symptoms, as in disregard of harmful consequences, predicted lower levels of perceived bonding social capital.

The equation explained 32% of the variance in total. Demographic and psychological blocks were both the strongest predictors, but use of smartphone for information seeking and sociability or exhibiting addiction symptoms does have an impact on bonding social capital.

Table 6. Hierarchical Regression Analysis of Social Capital Using Demographics, Shyness, Loneliness, Smartphone Usage, and Addiction Symptoms as Predictors.

	Social Capital			
	Bonding		Bridging	
Predictors	β	ΔR^2	β	ΔR^2
Demographics				
Age	−.06		−.08	
Gender (male = 1)	−.24***		−.04	
Grade	.21***		.17***	
Family monthly income	.04	.10***	.05	.03***
Psychological attributes				
Shyness	−.05		−.12*	
Loneliness	−.33***	.10***	−.20***	.06*
Smartphone usage				
Information seeking	.20***		.18***	
Utility	.06		.14**	
Fun seeking	−.04		−.03	
Sociability	.15***	.06***	.07	.05**
Smartphone addiction symptoms				
Disregard of harmful consequences	−.10*		−.04	
Preoccupation	.19***		.20***	
Inability to control craving	−.06		−.04	
Productivity loss	−.03		−.06	
Feeling anxious and lost	.14***	.06*	.12*	.04*
R^2		.34		.21
Adjusted R^2		.32		.18

Note. N = 414. Figures are standardized β coefficients. R^2 is expressed in percentage of variance accounted for.
*$p \leq .05$; **$p \leq .01$; *** $p \leq .001$.

    Likewise, results in Table 6 show that grade (β = .17, $p \leq .001$) was the only significant predictor of bridging social capital under the demographics block. It shows that the higher grade the students were in, the higher level of bridging social capital they would feel. The first block accounted for 3% of the variance.

    After psychological variables were entered into the equation, loneliness (β = −.20, $p \leq .001$) and shyness (β = −.12, $p \leq .05$) were both significant predictors of bridging social capital. The negative link reveals that subjects who scored high on the level of loneliness and shyness would have lower levels of bridging social capital. This variable contributed 6% of the variance.

    The four functions of smartphone use were the next entries in the equation. Using smartphones for information seeking (β = .18, $p \leq .001$) and utility (β = .14, $p \leq .01$) contributed significantly to the regression equation and explained 5% of the variance. This reveals that the more one used smartphones for information seeking and utility, the higher the level of bridging social capital they would have.

    Five variables from the smartphone addiction symptoms block were entered last. Preoccupation (β = .20, $p \leq .001$) and feeling anxious and lost (β = .12, $p \leq .05$) were the only two significant predictors and they accounted for another 4% of the variance. This indicates that the greater the smartphone addiction symptoms of preoccupation and feeling anxious and lost students exhibited, the higher the level of bridging social capital they would report. The equation explained 18% of the variance in total.

Conclusions and Discussions

SPAS

One of the major aims of this research was to identify the underlying structure of smartphone addiction symptoms among Chinese students. Specifically, our data yielded five clearly identifiable symptoms: disregard of harmful consequences, preoccupation, inability to control craving, productivity loss, and feeling anxious and lost. The results of principal components factor analysis appeared to present construct validity of the SPAS and accounted for 70.09% of the variance. Moreover, not only was the 19-item SPAS able to provide a wealth of contextual information relating to smartphone addiction, but the data also yielded clear evidence for the multifactorial nature of smartphone addiction symptoms—five distinct factors representing a series of Chinese university students' behavioral consequences from smartphone addiction. As a whole, SPAS (both the index SPAI and five symptom subscales) correlated mostly in the hypothesized manner with measures of psychologically meaningful constructs such as shyness and loneliness and smartphone usage. These constructs contain a wide series of theoretically and practically important factors for influencing smartphone addiction in general.

Moreover, SPAS distinctly differentiated from the Mobile Phone Addiction Scale (Leung, 2008) for two different addiction symptoms—disregard of harmful consequences and preoccupation. This may be because that Leung's research was focused on adolescents, while this study was on university students. Since university students have more free time and less supervision by parents than adolescents, these may lead to development of those two different addiction symptoms. Moreover, past research found preoccupation and disregard of harmful consequences as Internet addiction symptoms (Leung, 2004; Tao et al., 2010). With additional functions and capabilities a 3G network provide (such as doing e-mail, surfing the Internet, using search engines, watching video, posting photos, and playing multiuser online games), smartphones let users connect to the Internet to engage in a wide range of activities anytime and anywhere. Thus, such advanced functions might have increased the chances of getting addicted and developing other smartphone addiction symptoms such as preoccupation and disregard of harmful consequences, beyond those levels noted for a standard mobile phone.

Effects of Psychological Attributes on Smartphone Addiction

In line with the hypotheses, SPAI and addiction symptom subscales were directly related to shyness and loneliness. This means the higher one scored in shyness and loneliness, the higher the likelihood one would be addicted to smartphones. These results are in line with past research that lonely people tend to use mobile phones more, and loneliness is positively related to mobile phone addiction among college students in Korea (Park, 2005). However, the results also run contrary to the results from Wei and Lo (2006) who found that shyness was negatively linked to motivation and amount of mobile phone use. This may be explained by noting that smartphones, unlike regular mobile phones, provide shy people a mobile device that gives them a perfect environment to alleviate loneliness and shyness. Lonely and shy people may engage in different activities, like playing online games, taking photos and videos, searching for news, texting a friend, and reading a book on a smartphone. Such finding is also supported by cues-filtering theory in computer-mediated communication studies. Interaction via smartphone reduces social cues, such as ''nonverbal cues'' (e.g., facial expression and gestures), as it involves less control of the disclosure and interpretation of social cues. Thus, lonely and shy people may get easily addicted.

With regard to specific addiction symptoms, this study found that shyness was the only predictor for inability to control craving, productivity loss, and feeling anxious and lost. This suggests that these symptoms may be more likely to be present in shy people. As for disregard of harmful

consequences, only loneliness had a significant effect. This may mean that lonely individuals over-use the smartphone to a point that they begin to show little concern for the harmful consequences on their schoolwork and being late to appointments and classes. Similarly, shy individuals are particularly apt to lose control of the time spent on smartphones, despite any negative effects their excessive use has already had on their productivity, and shy individuals also get increasingly anxious and feel lost if their smartphones are out of reception range or they have been unable to use the device for some time.

Although psychological factors played large roles in smartphone addiction, smartphone usage habits were also powerful predictors. Specifically, excessive use of smartphones for information seeking, utility, and fun seeking were predictive of symptoms such as preoccupation and inability to control cravings. This indicates that these often-used functions are most likely to be the causes for being preoccupied and the feeling of never spending enough time on the smartphone.

It is interesting to note that using smartphones for fun seeking was significantly but negatively related to feeling anxious and lost. This may be explained by noting that using smartphones for fun seeking may distract people and get them involved in the fun seeking functions like online games, which may help university students reduce anxiety or feeling lost. Likewise, using smartphones for fun seeking was also significantly and positively related to disregard of harmful consequences. This may be because with diverse entertainment applications and functions such as online games and social networking services accessible through the smartphone, it is inevitable to see university students get addicted despite any harmful outcomes.

Predicting Social Capital

The most powerful predictor affecting both bonding and bridging social capital was loneliness. As expected, subjects who scored high on loneliness did report lower levels of social capital. This makes sense and it is in line with past studies, which have indicated that lonely people tend to have a deficiency in ongoing relationships, have a lower level of involvement in social activities, self-disclose less, and spend less time with friends and more time alone (Sloan & Solano, 1984). Thus, they are likely to be relationally incompetent in maintaining or building social capital (Spitzberg & Canary, 1985). However, shyness only significantly and negatively predicted bridging social capital. This may be because shy people, who lack the confidence to meet people and who feel uncomfortable in the presence of others, regard their social network as less supportive and less satisfying (Pilkonis, 1977); thus, shy people are more happy and more comfortable being by themselves instead of taking active action to build new ties. Previous studies also confirmed that shy people struggle to maintain intimacy in close relationships (Weaver, 1987) and have poor social networks (Nelson et al., 2008).

Past research has demonstrated that ICTs have positive impacts on social capital building by facilitating online social connections and/or enhancing physical (off-line) interactions (Hampton & Wellman, 2003; Norris, 1996, 2003; Rheingold, 2002; Srivastrva, 2005; Wellman, 2001). This study yielded similar results regarding the impact of smartphone use on expanding social capital, especially when using smartphones for seeking information. Such a finding suggests that Chinese students often use smartphones for sending tweets and instant messages through social networking services (such as WhatsApp, WeChat, Weibo, or Twitter) to share information with others, bond with close ties like family and friends, and to bridge with weak ties or new acquaintances. Use of the smartphone for utility functions (e.g., doing e-mail and taking photos and videos) and use of smartphone for sociability (e.g., making phone calls and texting) were also significant predictors for bridging and bonding social capital, respectively. These findings may mean that university students prefer to use the smartphone to bond with close ties by making calls and texting their family and friends and to bridge with weaker ties by e-mailing them in formal correspondence to cultivate relationships.

It is worth noting that having symptoms such as preoccupation and feeling anxious and lost were significantly and positively related to both bonding and bridging social capital. One possible explanation is that when Chinese students exhibit symptoms (specifically using the smartphone to make themselves feel better when they are feeling down, feeling withdrawn when they are unable to use the smartphone, and fantasizing or thinking about using it when their smartphone is not available), such addictive behavior inadvertently boosts their smartphone use, resulting in better social capital. Similarly, when Chinese students exhibit symptoms (specifically feeling anxious and lost, and being preoccupied with the thought of missing a call when out of reception range for some time), they would also unintentionally increase their use of smartphone, resulting in strengthening their strong ties and weak ties.

By contrast, this study also found that the more harmful consequences the university students suffered from smartphone addiction (such as being late for appointments, classes, and meetings and lowered academic performance), the lower the level of bonding social capital they would report. This is logical as the less the harmful and negative consequences resulting from addictive use of smartphones, the more positive outcomes they will experience from proper use of the smartphone to foster social capital.

This study presents clear evidence that the use of smartphones for different purposes and the exhibition of different addiction symptoms significantly impacted social capital building. Of all the predictors—after controlling for demographics—psychological variables and smartphone usage accounted for most of the variance. The significant links between smartphone addiction and smartphone usage, loneliness, and shyness have clear implications for treatment and intervention for parents, educators, and policy makers. Intervention strategies should be focused on helping addicts with more physical activities, so that they can have better self-discipline in the use of their smartphones. Treatment also should assist lonely and shy addicts in improving their communication skills to make them feel comfortable when talking with others, which may lead to less addiction tendency.

Limitations and Suggestions for Future Research

First, it is important to note that since the addiction questionnaire contained some questions that may make respondents feel embarrassed, the overall results may have been affected. Second, due to the nonprobability sample, the skewed gender and grade distribution may not reflect the actual distribution at a typical university in mainland China. Such data, with over 81% being senior's or master's degree students in the sample, may lead to biased results in the severity of smartphone addiction and usage pattern as compared to junior students. Future research efforts should try to select samples randomly in order to eliminate these methodological limitations. Third, the reliability αs for the four smartphone usage pattern, deduced from the 16 smartphone activities, were low ranging from .64 to .79. Such reliability scores were marginal and the overall results may have been affected. Finally, younger individuals suffering from depression of anxiety disorders are more prone in developing addictions which is especially true for game, Internet, and mobile phone addictions (Kratzer & Hegerl, 2008; Robin-Marie Shepherd & Edelmann, 2005). Thus, depression of anxiety disorder could be a possible control variable in future studies. Despite these limitations, this study provides an exploratory framework for further research of addictive smartphone use. Future research should also compare results of different age groups and broaden the geographical background in relation to other behavioral and intoxicant addictions and other mental health problems.

Declaration of Conflicting Interests

Funding

Notes

1. In Mainland China, the telecommunications companies provide various plans for making phone calls, text messages, and general packet radio service (GPRS). Both phone call and text message costs renminbi (RMB) 0.1 per min phone call or per text message within one province/city. Monthly GPRS plan starts from RMB 5/30/M to RMB 200/5G. If the monthly usage has exceeded 5G or what you have preselected, they will charge RMB 1/M afterward which may cause financial crises for Chinese students based on the normal monthly allowance of RMB 1,000 (about US$162).
2. Original items in Chinese are available upon request at author's e-mail address: bianmengwei@gmail.com

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