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ORIGINAL ARTICLE

Smartphone Addiction and Its Relationship with Indices of Social-Emotional Distress and Personality

Adam M. Volungis[1] · Maria Kalpidou[1] · Colleen Popores[1] · Mark Joyce[1]

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Abstract

We examined the relationships among smartphone addiction, social-emotional distress (e.g., anxiety, depression, sleep quality, and loneliness), and personality traits among 150 undergraduate college students. Participants completed the Smartphone Addiction Scale, the Outcome Questionnaire-45.2, the Pittsburgh Sleep Quality Index, the UCLA Loneliness Scale-3, and the Neuroticism-Extraversion-Openness Five-Factor Inventory-3. Results showed that the more students were addicted to their smartphone, the higher their reported social-emotional distress was. Additionally, logistic analyses supported the predictive nature of smartphone addiction on specific domains of social-emotional distress. Personality did not moderate the relationship between smartphone addiction and social-emotional distress. However, neuroticism had a positive relationship with smartphone addiction, while extraversion, openness, agreeableness, and conscientious all had a negative relationship with smartphone addiction. Overall, these findings can inform assessment and interventions targeted at reducing smartphone use and improving mental health of college students. Research implications are also provided considering the infancy of studying the effects of smartphone use on psychological well-being.

Keywords Smartphone addiction · Depression · Anxiety · Sleep · Loneliness · Personality

The Pew Internet and American Life Project recently reported that the use of technology has become an integral part of daily life for many Americans, especially adolescent and young adult usage of smartphones (Smith 2015). Not only has technology become more readily available across populations but also is easier to use. Preliminarily data show an

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✉ Adam M. Volungis
am.volungis@assumption.edu

[1] Department of Psychology, Assumption College, 500 Salisbury St., Worcester, MA 01609-1296, USA

increasing trend of college-aged students having an excessive reliance on smartphones. In fact, according to a Pew Center survey, 94% of young people between the ages of 18 and 29 own a smartphone (Pew Research Center 2018). Although it is inevitable that smartphones serve a practical purpose for many daily activities, there is some indication that the frequent use and dependency on smartphones show cognitive and behavioral patterns similar to addictive disorders (Griffiths 2005; Lee et al. 2014).

How addiction is conceptualized has been a contested topic for some time (Griffiths 2005). The use of the word "addiction" has often been reserved for those whose use of substances results in clinically significant impairment, often including an inability to control its use (i.e., dependence), tolerance, and withdrawal symptoms. However, the most recent edition of the Diagnostic and Statistical Manual for Mental Disorders (DSM-5; American Psychiatric Association 2013) now formally recognizes gambling disorder as a "non-substance related disorder." Additionally, the DSM-5 also now includes Internet gaming disorder as a possible disorder for future consideration under the section "conditions for further study." Thus, the concept of addiction appears to be expanding beyond the use of substances.

Excessive smartphone use has been associated with difficulty concentrating in school or work (Wilmer et al. 2017), sleep disturbances (Demirci et al. 2015), poor interpersonal relationships (Kim et al. 2015), reduction in academic achievement (Hawi and Samaha 2016), feeling anxious when not holding the phone, spending too much time using the phone, and repeated failed attempts to reduce phone usage (Korea Internet and Security Agency 2013). The consequences of excessive smartphone use and similarities in symptoms to substance use disorders and Internet gaming disorder appear to support the very real notion of "smartphone addiction" (or "smartphone use disorder").

In addition to smartphone use, mental health concerns are also receiving increasing attention in college students. In the 2014 National Survey of College Counseling Centers (Gallagher 2015), 94% of 275 counseling center directors reported an increasing number of students with severe psychological problems over the past year. According to the 2016 survey by the Association for University and College Counseling Center Directors (Reetz et al. 2017), the top three presenting concern for students are anxiety (50.61%), depression (41.23%; suicidal thoughts/behaviors, 20.52%), and relationship issues (34.42%). Alcohol/substance use/dependence was the sixth most common presenting concern (16.99%) for students. The 2016 annual report by the Center for Collegiate Mental Health (2017) reported that depression, generalized anxiety, and social anxiety continue to show increasing rates in students each year for the past 6 years. It is clear that student mental health is a significant increasing concern across colleges and universities in the USA.

Research over the past approximate 5 years has begun to explore possible relationships between smartphone use and a variety of indicators of mental health, especially among traditional college-aged students. One area that has received some attention is the impact on interpersonal relationships, often using loneliness as a primary indicator. For example, Tan et al. (2013) found that increasing daily hourly smartphone use was associated with increasing reports of loneliness in a sample of Turkish university students. Similarly, Bian and Leung (2015) found that the higher Chinese university students scored on loneliness and shyness, the greater the chance was that these students were addicted to their smartphones. Furthermore, Darcin et al. (2016) found both loneliness and social anxiety to be predictors of smartphone addiction in Turkish university students. Overall, there appears to be a relationship between excessive smartphone use and self-reports of significant interpersonal distress.

It is reasonable to also consider possible relationships between smartphone use and other domains of mental health beyond social anxiety. In a population of Singaporean undergraduates, Lin et al. (2015) found mobile dependency symptoms (i.e., frequent voice calls, Internet use, and text messaging) to be positively associated with "feeling anxious and lost" and "withdrawal and escape." Choi et al. (2015) found generalized levels of anxiety as a risk factor for smartphone addiction in Korean college students. Similarly, Mok et al. (2014) reported in another population of Korean university students that anxiety levels increased with addiction severity levels. These studies indicate a trend of students who engage in smartphone addictive behaviors and experience anxious distress beyond the social anxiety that they may typically experience in person-to-person social interactions.

Anxiety and depression are two commonly comorbid conditions, especially with college-aged students (Reetz et al. 2017). Thus, it makes sense to also examine the role of depression and smartphone addiction as well. Babadi-Akashe et al. (2014) found in a population of Iranian university students that the more they were addicted to their smartphone, the more their mental health deteriorated, including depressive and obsessive-compulsive symptoms and interpersonal sensitivity.

Symptoms of depression and anxiety are often associated with poor sleep quality. Thus, a few studies have examined these domains simultaneously in relation to smartphone use and addiction. In a population of 20–24-year-old Swedish adults, Thomee et al. (2011) found high mobile phone use associated with stress, sleep disturbances, and symptoms of depression. Adams and Kisler (2013) found that higher levels of cellphone use after the onset of sleep predicted lower levels of sleep quality, which in turn predicted symptoms of depression and anxiety in American college students. Finally, in a population of Turkish university students, Demirci et al. (2015) found a positive relationship between smartphone addiction scores and symptoms of depression and anxiety and poor sleep quality. Overall, smartphone addiction is a very real concern for college students, which appears to have a significant negative impact on their mental health.

The existing literature supports the connection of social anxiety, loneliness, and sleep quality with smartphone dependency and possibly addiction. Because anxiety, depression, and poor sleep quality tend to be clinically inter-correlated and connected with levels of distress, we consider them as significant indices of social-emotional distress. Therefore, one main goal of the study was to investigate how smartphone addiction is related to social-emotional distress. While previous studies have examined such link, the present study is the first to do so while measuring all indices at the same time and relying on clinical instruments that can reveal clinically significant findings. While previous studies have used instruments measuring specific types of mental health distress, these instruments did not provide clinical cutoff scores. Thus, in this study, we used the Outcome Questionnaire-45.2 (OQ-45.2), which measures overall distress in three domains (i.e., symptom distress, interpersonal relationships, school/work adjustment). The OQ-45.2 also has validated clinical cutoffs for college-aged populations, which allows for clearer indication of the level of social-emotional distress affected by smartphone addiction.

Another goal of this study was to investigate the role of personality in the connection between social-emotional distress and smartphone addiction. Past research has shown relationships between personality and mental health, including addictive behaviors (e.g., Griffiths 2005; Gu et al. 2014; Kotov et al. 2010). In addition, some research has provided evidence about how smartphones or their functions relate to personality. For example, outgoing and agreeable individuals prefer multiple media for communication (Dunaetz et al. 2015) and tend

to use more positive words and personal pronouns while texting (Holtgraves 2010). Moreover, extraverted individuals were more likely to own a smartphone and considered texting to be of primary importance to them (Lane and Manner 2010). Lastly, in a population of Malaysian students, Lee et al. (2013) found that extraversion positively predicted frequency of texting and openness positively predicted frequency of voice calling. When the researchers considered social anxiety and loneliness in the predictive model, individual personality traits lost their predictive value but as a block predicted 7.70% of the variance in number of people called while social anxiety predicted an additional 2.80%. None of the personality traits predicted time spent on text messages and only openness predicted the number of people with whom to exchange text messages. Altogether, it is difficult to discern a pattern of possible personality influences on smartphone use.

Moreover, very little is known about the relationship between personality and smartphone addiction and whether personality may influence the relationship between smartphone addiction and mental health outcomes, specifically the indices of social-emotional distress, which we consider in the present study. In a short research report, Ehrenberg et al. (2008) found that college students who rated higher in neuroticism also rated higher on addictive tendencies, such as withdrawal, and not being able to control the use of the phone. Lastly, in a population of Korean university students, Kim et al. (2014) found that impulsivity had a significant effect on the relationship between smartphone addiction and levels of depression. More specifically, high levels of impulsivity enhanced the positive relationship between smartphone addiction and depression, whereas low levels of impulsivity diminished this relationship. At this point, there is not enough research to make any substantive conclusions about the role personality plays in the relationship between smartphone addiction and social-emotional distress. For this reason, this research question continues to be primarily explorative in nature.

Measuring smartphone addiction has been a multi-approached endeavor. Some researchers constructed their own questions and then reported inter-item reliabilities (e.g., Ehrenberg et al. 2008). However, there are few instruments that are psychometrically sound. Billieux et al. (2008) developed and validated a scale for problematic use of smartphones but their focus was not on addiction as dependency was only one subscale of this instrument. One smartphone addiction instrument that has demonstrated good validity is the Smartphone Addiction Scale (SAS), recently developed by Kwon et al. (2013). All the aforementioned studies that used the SAS in examining smartphone addiction and some form of social-emotional distress have been done with either Korean university students (i.e., Choi et al. 2015; Mok et al. 2014) or Turkish university students (i.e., Darcin et al. 2016; Demirci et al. 2015). Thus, not only have very few studies examined smartphone addiction and social-emotional distress with the SAS but this is also the first known study to examine this relationship in American college students using the SAS.

Overall, the purpose of this study was to examine the relationship between smartphone addiction, social-emotional distress, and personality traits in college students using well-validated instruments. We operationalize smartphone addiction as a clinically significant impairment of daily activities resulting from smartphone use that causes dependence, tolerance, and withdrawal symptoms. Based on the reviewed research, we expected to find a positive correlation between smartphone addiction scores and the indices of social-emotional distress. Specifically, we expected that increased smartphone addiction would correlate with general emotional distress (e.g., symptoms of depression and anxiety), poorer interpersonal (e.g., relations (e.g., conflicts), poorer daily functioning (e.g., role as a student), higher loneliness, and poorer quality of sleep. Furthermore, we expected that this relationship would

be strong enough to indicate clinical levels of distress. Finally, the role-specific personality traits play in the relationship between smartphone addiction and social-emotional distress was also explored. Based on the findings of Ehrenberg et al. (2008), we expected to replicate the positive relationship between neuroticism and addiction. While Ehrenberg et al. (2008) did not find any relationships between other main personality traits and problematic use of smartphones, we explored the relationship of smartphone addiction and the traits of extraversion, agreeableness, conscientiousness, and openness. Because personality traits are also correlated with social-emotional distress, we investigated whether the relationships between smartphone addiction and social-emotional distress were moderated by specific personality traits. This investigation was exploratory in nature.

Method

Participants and Procedure

Data were collected from 150 undergraduate college students from a small liberal arts college in the Northeast ($M_{age} = 19.28$). The majority of the participants were female (83.2%) and White (80.5%; 7.4% African-American, 4.7% Latino, 4.7% Asian, and 2.7% biracial). Family income was reported as 14.6% at 0–$50,000; 36.7% at $51,000–100,000; 28.7% at $101,000–150,000; and 13.4% at $150,000+. Participants were recruited from multidisciplinary undergraduate classes and data were collected during the Spring semester for 5 weeks. College years for participants were 41.3% first-year, 36.0% sophomore, 16.7% junior, and 5.3% senior. Students arrived in waves between 5:00 PM and 7:00 PM in a classroom on campus where they were asked to fill out questionnaires on the website PsychData with provided computers. There were between 5 and 20 students in the room during each wave and they were given as much time as needed to complete all the questions. Participation was voluntary and depending on their instructor, students might have been offered extra course credit. If extra course credit was provided, an alternative assignment was offered in place of participation. Participants in the study were entered in a lottery to win a $25 gift card for every 20 participants (5% chance). This study adhered to all protocols approved by the College's Institutional Review Board.

Measures

In addition to the demographic questionnaire, the following measures were used to assess smartphone use and social-emotional well-being.

Smartphone Frequency and Health Questionnaire A series of 14 questions were developed by the researchers to assess the participants' smartphone use. Examples of questions included "How often do you use your phone when you are in class?" "How often do you check your phone for new messages?" and "How often do you use your phone for social networking (e.g., Facebook, Twitter, Instagram, etc.)?" Each item is rated on a 5-point Likert scale (1 = never, 5 = always). Students were also asked to report daily hours of smartphone use and their degree of attachment to their smartphone (i.e., 1—not connected at all to 9—extremely connected). Additionally, students were asked to report number of doctor visits and number of times they have been sick over the past year, including their current state of health.

Smartphone Addiction Scale The Smartphone Addiction Scale (SAS; Kwon et al. 2013) is a 33-item self-report scale designed to measure an individual's index of smartphone addictive behavior for those 18 years of age and older. The SAS is a relatively new measure based off the K-scale (Kim et al. 2008), a 40-item measure developed for juveniles possibly experiencing Internet addiction. The SAS was developed by altering the items in the K-scale containing the word Internet to the word smartphone and adding several additional items. After revising the scale through factor analysis, concurrent validity of the final version of the SAS was established through comparison with the K-scale, the Young Internet Addiction Test (Y-scale; Young 1998), a visual analog scale, and DSM-IV substance dependence and abuse diagnoses. The SAS was found to have significant concurrent validity with the K-scale and the visual analog scale, while displaying positive relations with the Y-scale and DSM-IV diagnoses (Kwon et al. 2013).

The SAS consists of six subscales: daily life disturbance (e.g., "Having a hard time concentrating in class, while doing assignments, or while working due to smartphone use"), positive anticipation (e.g., "My life would be empty without my smartphone"), withdrawal (e.g., "Feeling impatient and fretful when I am not holding my smartphone"), cyberspace-oriented relationship (e.g., "Not being able to use my smartphone would be as painful as losing a friend"), overuse (e.g., "Feeling the urge to use my smartphone again right after I stopped using it"), and tolerance (e.g., "Always thinking I should shorten my smartphone use time"). Each item is rated on a 6-point Likert scale (1 = strongly disagree, 6 = strongly agree). All six subscale scores can be combined for a total score of overall smartphone addiction. The following were Cronbach's alpha's for this study: daily life disturbance (0.73), positive anticipation (0.78), withdrawal (0.66), cyberspace-oriented relationship (0.74), overuse (0.56), tolerance (0.75), and total score (0.89).

Neuroticism-Extraversion-Openness Five-Factor Inventory-3 The Neuroticism-Extraversion-Openness Five-Factor Inventory-3 (NEO-FFI-3; McCrae and Costa 2010) is a 60-item short version self-report scale of the original NEO-PI for those 12 years of age and older. The NEO-FFI-3 provides scores based on responses to 12 items in each of the five separate domains: neuroticism, extraversion, openness, agreeableness, and conscientiousness. Each item is rated on a 5-point Likert scale (1 = strongly agree, 5 = strongly disagree). Total scores for each domain is converted to a T-score. Equivalence coefficients between the NEO-FFI-3 and NEO-PI-3 scales ranged from 0.87 to 0.95, indicating that the short form NEO-FFI-3 possesses similar strengths to the full domain scales (McCrae and Costa 2010). The following were Cronbach's alpha's for this study: neuroticism (0.80), extraversion (0.82), openness (0.79), agreeableness (0.78), and conscientiousness (0.86).

Indices of Social-Emotional Distress

Outcome Questionnaire-45.2

The Outcome Questionnaire-45.2 (OQ-45.2; Lambert et al. 2011) is a 45-item self-report scale used to estimate an individual's index of mental health functioning for those 18 years of age and older. The OQ-45.2 consists of three subscales: symptom distress (e.g., "I feel no interest in things"), interpersonal relations (e.g., "I feel unhappy in my marriage / significant relationship"), and social role (e.g., "I feel stressed at work/school"). Each item is rated on a 5-point Likert scale (0 = never, 4 = almost always). All three subscale scores can be combined for a total score of overall distress. The total score and each subscale possess a clinical cutoff score indicative of

clinical significance. The following were Cronbach's alpha's for this study: symptom distress (0.90), interpersonal relations (0.80), social role (0.58), and total score (0.92).

Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index (PSQI; Buysse et al. 1989) is a 19-item self-report measure that assesses sleep quality and sleep disturbances over the past month. There are seven components to the PSQI: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction. These component scores add up to a global score as an indicator of overall sleep quality. The global score has a range of 0–21, with scores greater than five indicative of significant sleep disturbance. Cronbach's alpha for the global score in this study was 0.69.

UCLA Loneliness Scale-3

The UCLA Loneliness Scale (version 3; UCLA-LS-3; Russell 1996) is a 20-item self-report scale designed to measure an individual's subjective feelings of loneliness as well as feelings of social isolation and shyness people may experience in specific situations. Examples of questions include: "How often do you feel alone?" "How often do you feel isolated from others?" and "How often do you feel outgoing or friendly?" Each item is rated on a 4-point Likert scale (1 = never, 4 = always). The scale provides a total score with a range from 20 to 80, with higher scores indicating greater degrees of loneliness. Cronbach's alpha in this study was 0.93.

Results

All 150 students (100%) in this study reported to be smartphone users. Students reported using their smartphone for an average of 6.33 ($SD = 4.26$) hours a day. A single 9-point Likert item assessing the degree of attachment to their smartphone (1 = not connected at all, 9 = extremely connected) had an average of 6.13 ($SD = 1.56$). Over the past year, students reported being sick (e.g., cold, flue) an average of 3.25 ($SD = 2.41$) times and visiting the doctor an average of 3.58 ($SD = 5.04$) times. The mean scores and standard deviations for all measures, including subscales, are provided in Table 1. Table 2 shows the Pearson correlation coefficients of the SAS and items from the health questionnaire and smartphone frequency. Doctor visits positively correlated with SAS daily disturbance and reported incidents of being sick positively correlated with SAS daily disturbance, withdrawal, and overuse. It is important to note that SAS total and all the SAS subscales positively correlated with hourly smartphone use, smartphone attachment, and smartphone frequency.

Relationship Between Smartphone Addiction and Social-Emotional Distress

Table 3 shows the Pearson correlation coefficients of the SAS, the OQ-45.2 scales, and the UCLA-LS-3. SAS total was positively correlated with all OQ-45.2 scales: symptom distress, interpersonal relations, social role, and total. Additionally, all the SAS subscales, except for overuse, also positively correlated with at least one or more of the OQ-45.2 scales. Finally, SAS total and all SAS subscales, except for overuse, positively correlated with the UCLA-LS-3.

Table 1 Range and mean scores for all study measures

	Range	Mean (SD)
SAS		
Daily life disturbance	5–26	12.54 (4.65)
Positive anticipation	8–40	23.10 (5.36)
Withdrawal	6–30	16.21 (4.80)
Cyberspace relationship	7–33	17.13 (5.32)
Overuse	4–24	15.15 (3.69)
Tolerance	3–18	9.10 (3.55)
Total	38–148	93.23 (19.00)
OQ-45.2		
Symptom distress	3–68	29.75 (13.17)
Interpersonal relations	0–26	10.15 (6.16)
Social role	3–21	10.75 (3.72)
Total	8–110	50.65 (20.17)
PSQI		
Sleep quality	0–3	1.15 (0.59)
Sleep latency	0–3	1.39 (0.92)
Sleep duration	0–3	0.64 (0.64)
Sleep efficiency	0–3	0.54 (0.79)
Sleep disturbances	0–3	1.31 (0.59)
Sleep medications	0–3	0.35 (0.73)
Daytime dysfunction	0–3	1.11 (0.74)
Global score	0–17	6.46 (2.99)
UCLA-LS-3	20–65	39.01 (10.05)
NEO-FFI-3		
Neuroticism	6–41	22.29 (7.48)
Extraversion	11–45	30.91 (6.56)
Openness	14–48	30.64 (6.84)
Agreeableness	17–48	34.93 (6.27)
Conscientiousness	14–48	31.99 (6.80)
Smartphone frequency	24–60	47.38 (6.03)

Table 4 shows the Pearson correlation coefficients of the SAS and the PSQI. Total SAS was positively correlated with sleep disturbance, daytime disturbance, and the PSQI global score. Additionally, all the SAS subscales correlated with at least one or more PSQI subscales. Of note, the SAS subscale life disturbance was positively correlated with the PSQI global score

Table 2 Pearson correlation coefficients of the SAS with the health questionnaire and smartphone frequency

SAS scales							
	Daily life disturbance	Positive anticipation	Withdrawal	Cyberspace relationship	Overuse	Tolerance	Total
Doctor visits	0.23**	−0.01	0.02	−0.01	0.04	−0.01	0.07
Sick	0.31**	−0.07	0.16*	0.01	0.19*	0.10	0.16
Smartphone use (h)	0.22**	0.37**	0.24**	0.25**	0.29**	0.31**	0.40**
Smartphone attachment	0.20*	0.30**	0.29**	0.30**	0.52**	0.37**	0.46**
Smartphone frequency	0.22**	0.27**	0.30**	0.21**	0.40**	0.26**	0.39**

Note: *$p < 0.05$; **$p < 0.01$

Table 3 Pearson correlation coefficients of the SAS with the OQ-45.2 and UCLA-LS-3

SAS scales							
	Daily life disturbance	Positive anticipation	Withdrawal	Cyberspace relationship	Overuse	Tolerance	Total
OQ symptom distress	0.35**	0.08	0.24**	0.14	0.14	0.27**	0.28**
OQ interpersonal relations	0.23**	0.16	0.21**	0.23**	− 0.06	0.23**	0.25**
OQ social role	0.41**	0.17*	0.18*	0.13	0.12	0.31**	0.31**
OQ total	0.37**	0.13	0.25**	0.19*	0.10	0.30**	0.32**
UCLA loneliness	0.23**	0.19*	0.24**	0.30**	0.08	0.24**	0.31**

Note: *$p < 0.05$; **$p < 0.01$

and all PSQI subscales, except for sleep latency. These results are consistent with our hypothesis.

Smartphone Addiction as a Predictor of Clinical Levels of Social-Emotional Distress

Simple logistic regression analyses were conducted to determine the impact of smartphone addiction on social-emotional distress with all the OQ-45 scales (symptom distress, interpersonal relations, social role, and total), the PSQI global score, and the UCLA-LS-3 score. Separate models were used to determine the potential "direct" effect of SAS on each clinical level of social-emotional distress. The OQ-45 has predetermined clinical cutoff scores (Lambert et al. 2011): symptom distress (range, 0–100; cutoff, 36+), interpersonal relations (range, 0–44; cutoff, 15+), social role (range, 0–36; cutoff, 12+), and total (range, 0–180; cutoff, 63+). For the PSQI global score, research has supported that a score of 6+ (range, 0–21) is an indicator of "abnormal" (i.e., poor) sleep quality (Buysse et al. 1989). There is no formally ascribed clinical cutoff for the UCLA-LA-3 score. Thus, as commonly done with

Table 4 Pearson correlation coefficients of the SAS with the PSQI

SAS scales							
	Daily life disturbance	Positive anticipation	Withdrawal	Cyberspace relationship	Overuse	Tolerance	Total
Sleep quality	0.27**	0.02	0.15	0.01	0.04	0.18*	0.15
Sleep latency	0.15	− 0.20*	− 0.07	− 0.19*	− 0.02	− 0.01	− 0.09
Sleep duration	0.18*	0.04	0.09	− 0.01	− 0.01	0.18*	0.11
Sleep efficiency	0.25**	0.04	0.09	0.06	0.07	0.15	0.15
Sleep distur-bances	0.33**	0.02	0.23**	0.07	0.09	0.19*	0.22**
Sleep medications	0.25**	−0.04	0.09	0.07	0.17*	0.14	0.15
Daytime dysfunction	0.28**	0.09	0.11	0.07	− 0.03	0.18*	0.17*
Global score	0.40**	− 0.02	0.15	0.01	0.08	0.23**	0.19*

Note: *$p < 0.05$; **$p < 0.0$

such instruments, based on the sample mean score, those that fell above were put in the clinical category and those that fell below were put in the non-clinical category.

Table 5 shows each of these models with SAS total as the continuous predictor and the noted clinical cutoffs for social-emotional distress as the dichotomous (0 = no, 1 = yes) criteria. SAS total significantly predicted all OQ-45.2 scales: symptom distress, interpersonal relations, social role, and the UCLA-LS-3. SAS total did not significantly predict PSQI global score. Overall, SAS total explained a range of 6.9–12.3% of the variance. Additionally, SAS total correctly explained a range of 62.7–72.0% of the cases. Altogether, these results support the research hypotheses.

The Relationships Between Smartphone Addiction, Social-Emotional Distress, and Personality

Table 6 shows the Pearson correlation coefficients of the SAS the NEO-FFI-3. SAS total was positively correlated with neuroticism, as expected, and negatively correlated with extraversion, openness, agreeableness, and conscientiousness. Consistent with our hypothesis, all the SAS subscales, except for positive anticipation, also positively correlated with neuroticism. Additionally, all the SAS subscales negatively correlated with at least one or more personality trait.

Stepwise multiple regression moderator analyses were conducted to determine the impact of personality traits on the relationship between smartphone addiction and social-emotional distress as indexed by the OQ-45 total score, the PSQI global score, and the UCLA-LS-3 score. Tables 7, 8, and 9 show each of these models with SAS total as the predictor variable, each personality trait separately treated as moderator, and the noted social-emotional distress variables as the criterion variable. Although most of the models were statistically significant, none of the personality traits showed a moderator effect on social-emotional distress. Post hoc analyses were also done with the OQ-45 subscales, which did not yield any moderator effects.

Discussion

Although most college students use smartphones (Pew Research Center 2018), and there are increasing rates of college students experiencing social-emotional distress (Center for Collegiate Mental Health 2017; Gallagher 2015; Reetz et al. 2017), few studies have examined these two domains concurrently. Furthermore, few studies have examined smartphone addiction using a well-validated measure with American college students. The main finding of this

Table 5 Simple logistic regression analyses of SAS total predicting social-emotional distress

Social-emotional distress	*B*	*OR*	*p*	*R*	X^2	Model *p*	% Correct
OQ symptom distress	0.03	1.03	0.01	0.11	12.14	0.00	65.3
OQ interpersonal relations	0.03	1.03	0.01	0.09	9.74	0.01	72.0
OQ social role	0.04	1.04	0.00	0.12	14.38	0.00	63.3
OQ total	0.03	1.03	0.01	0.07	7.53	0.01	65.3
PSQI global score	0.01	1.01	0.18	0.02	1.84	0.18	57.3
UCLA loneliness	0.03	1.03	0.01	0.07	8.11	0.01	62.7

Note: *OR*, odds ratio; R^2, Nagelkerke *R* square

Table 6 Pearson correlation coefficients of the SAS with the NEO-FFI-3

SAS scales							
	Daily life disturbance	Positive anticipation	Withdrawal	Cyberspace relationship	Overuse	Tolerance	Total
Neuroticism	0.30**	0.13	0.25**	0.26**	0.25**	0.25**	0.34**
Extraversion	− 0.06	− 0.21**	− 0.09	− 0.15	− 0.23**	− 0.08	− 0.20*
Openness	− 0.03	− 0.17*	− 0.27**	− 0.23**	− 0.07	− 0.11	− 0.22**
Agreeableness	0.01	− 0.20*	− 0.22**	− 0.13	0.02	− 0.09	− 0.16*
Conscientiousness	− 0.23**	− 0.06	− 0.20*	− 0.07	− 0.06	− 0.21*	− 0.19*

Note: *$p < 0.05$; **$p < 0.01$

study showed that smartphone addiction symptoms in college students were positively associated with social-emotional distress, including clinical levels that impact interpersonal relationships and daily functioning. Additionally, there also appears to be a relationship between smartphone addiction symptoms and specific personality traits. Overall, the results from this study appear to support a form of smartphone addiction with clinical significance.

As expected, the more students use their phones, the more prone they are to report symptoms of smartphone addiction. Smartphone use and smartphone addiction symptoms are probably reciprocal in nature; frequent use of smartphones increases the chances of developing smartphone addiction, while smartphone addiction symptoms can reinforce smartphone use. Additionally, students who reported higher incidences of sickness and doctor visits were also more likely to experience symptoms of smartphone addiction. This finding does not imply that smartphone addiction causes one to get sick. Rather, particular subscales of the SAS (e.g., daily life disturbance) may be tapping into similar domains that are also affected

Table 7 Personality (NEO-FFI-3) as a moderator between SAS total (IV) and OQ total (DV)

	R^2	F	B	t	p
Model 1	0.54	57.43**			
SAS total			0.08	1.31	0.19
Neuroticism			0.71	11.61	0.00
SAS total × neuroticism			0.01	0.18	0.86
Model 2	0.23	14.88**			
SAS total			0.25	3.32	0.01
Extraversion			− 0.37	− 4.88	0.00
SAS total × extraversion			0.02	0.24	0.81
Model 3	0.15	8.42**			
SAS total			0.37	4.65	0.00
Openness			0.22	2.77	0.01
SAS total × openness			− 0.01	− 0.13	0.89
Model 4	0.11	6.16**			
SAS total			0.30	3.84	0.00
Agreeableness			− 0.09	− 1.16	0.25
SAS total × agreeableness			− 0.06	− 0.82	0.41
Model 5	0.18	10.45**			
SAS total			0.27	3.57	0.00
Conscientiousness			− 0.24	− 3.03	0.01
SAS total × extraversion			0.09	1.15	0.25

Note: **$p < 0.01$

Table 8 Personality (NEO-FFI-3) as a moderator between SAS total (IV) and PSQI total score (DV)

	R^2	F	B	t	p
Model 1	0.10	5.28**			
SAS total			0.10	1.18	0.24
Neuroticism			0.25	2.88	0.01
SAS total × neuroticism			− 0.06	− 0.70	0.48
Model 2	0.04	2.11			
SAS total			0.19	2.29	0.02
Extraversion			− 0.02	− 0.20	0.84
SAS total × extraversion			0.07	0.89	0.38
Model 3	0.06	3.28*			
SAS total			0.21	2.55	0.01
Openness			0.17	2.00	0.05
SAS total × openness			0.07	0.83	0.41
Model 4	0.04	2.20			
SAS total			0.20	2.47	0.02
Agreeableness			0.09	1.05	0.30
SAS total × agreeableness			− 0.02	− 0.21	0.83
Model 5	0.08	4.40**			
SAS total			0.15	1.85	0.00
Conscientiousness			− 0.20	− 2.43	0.00
SAS total × extraversion			0.05	0.57	0.57

Note: *$p < 0.05$; **$p < 0.01$

by medical ailments. Nonetheless, our findings highlight the importance of further exploring the connection between medical health and smartphone addiction.

For specific domains of social-emotional functioning, the SAS positively correlated with all OQ-45.2 scales: symptom distress, interpersonal relations, social role, total, the UCLA-LS-3, and the PSQI global score. Furthermore, many of the SAS subscales also positively correlated

Table 9 Personality (NEO-FFI-3) as a moderator between SAS total (IV) and UCLA-LS-3 total score

	R^2	F	B	t	p
Model 1	0.44	38.75**			
SAS total			0.10	1.55	0.12
Neuroticism			0.63	9.41	0.00
SAS total × neuroticism			0.04	0.61	0.54
Model 2	0.36	27.03**			
SAS total			0.20	2.95	0.00
Extraversion			− 0.53	− 7.67	0.00
SAS total × extraversion			− 0.12	− 1.69	0.09
Model 3	0.12	6.51**			
SAS total			0.35	4.37	0.00
Openness			0.11	1.40	0.16
SAS total × openness			− 0.08	− 0.95	0.34
Model 4	0.11	6.07**			
SAS total			0.30	3.74	0.00
Agreeableness			− 0.11	− 1.35	0.18
SAS total × agreeableness			− 0.05	− 0.68	0.50
Model 5	0.16	9.54**			
SAS total			0.26	3.40	0.00
Conscientiousness			− 0.26	− 3.24	0.00
SAS total × extraversion			0.01	0.10	0.92

Note: **$p < 0.01$

with these measures. There appears to be a pattern where increasing levels of smartphone addictive behaviors are associated with increasing levels of emotional distress (e.g., depression, anxiety), poor interpersonal relationships (e.g., conflicts, loneliness), poor sleep quality, and poor general daily functioning (e.g., role as a student). These findings are consistent with others studies that have examined similar relationships with the SAS (e.g., Choi et al. 2015; Darcin et al. 2016; Demirci et al. 2015; Mok et al. 2014). Furthermore, due to empirically predetermined clinical cutoff scores for the OQ-45.2, analyses were possible to show that the SAS predicted clinical levels of symptom distress, interpersonal relations, social role, and total score. Also, the SAS predicted loneliness with the UCLA-LS-3. With that said, although the SAS correctly predicted a range of 62.7–72.0% of the cases, it only explained a range of 6.9–12.3% of the variance. Thus, there is still much unknown about what is contributing to the relationship between smartphone addiction and social-emotional distress. Nevertheless, smartphone addictive behaviors are having a strong enough impact on student social-emotional distress that warrants concern. For some students, smartphone addictive behaviors are associated with high enough levels of emotional distress and poor interpersonal relationships where they are experiencing an extremely negative impact on their daily functioning to the point that may warrant professional therapeutic assistance. In other words, these relationships are not just statistically significant, but clinically significant as well.

Although personality traits did not play a moderating effect on the relationship between the SAS and social-emotional distress, they were all significantly correlated with the SAS. Probably of most clinical relevance, neuroticism was positively correlated with smartphone addictive behaviors, as expected. This finding is consistent with the relationship we found between the SAS and the OQ-45.2, as neuroticism includes emotional distress features, including depression and anxiety. Students scoring high on neuroticism may already be predisposed to experiencing social-emotional distress, including addictive behaviors. The relationship between smartphone addiction and neuroticism is also in agreement with the findings of Ehrenberg et al. (2008), who too found that neuroticism increased the likelihood to experience withdrawal and to have difficulty controlling phone use. Interestingly, extraversion, openness, agreeableness, and conscientiousness were all negatively correlated with smartphone addictive behaviors. These findings shed light on the conflicting pattern that exists in the literature. Unlike Lee et al. (2013), we found that those who reported to be more socially outgoing and open to trying new things were less likely to become addicted to their smartphones. The trend for conscientiousness seems to be better validated. Lee et al. (2013) also found a negative association between smartphone addictive behaviors (i.e., heavy use) and conscientiousness and Kim et al. (2014) reported that impulsivity was related to smartphone addiction. Considering that conscientiousness signifies the ability to control impulses, it appears that conscientiousness is potentially a protective factor in developing smartphone addiction. With that said, personality in this study did not moderate the relationship between smartphone addiction and mental health. Although there are significant relationships between personality and smartphone addiction, it seems that the symptoms of addiction are strong enough alone to be associated with social-emotional distress.

Limitations

Given the correlational nature of these findings, it is impossible to establish directionality or causality. Anxious, depressed, and socially isolated individuals may engage more in smartphone addictive behaviors. Alternatively, smartphone addiction negatively impacts specific aspects of life, which then may contribute to anxiety, depression, and social isolation. Even so, the predictive

models we tested here allow us with confidence to forecast outcomes for smartphone addiction. While an experimental design may not be feasible to establish causality, future research could employ a longitudinal design that has set temporary relationships between specific types of smartphone use, later addiction, and psychological outcomes. Such a design would allow more powerful predictions. Furthermore, the relationships between the SAS and clinical levels of the OQ only explained a portion of the variance (6.9–12.3%). Thus, there are probably other variables not accounted for in this study such as coping styles and executive functioning (Dickson et al. 2017) that could be contributing to these relationships. Nevertheless, the findings of this study are a significant step towards a better understanding of the relationships between smartphone addictive behaviors and the mental health of college students. In addition, the generalizability of the results is limited to liberal arts college student, who are primarily women, white, and middle class. Lastly, data was collected via self-report measures, which does not accurately reflect actual time spent on the smartphone (i.e., quantity) and specific smartphone activities (e.g., searching the internet, checking email, social applications, video games; i.e., quality). Objective behavioral measures would be required to collect such information.

Research Implications

Research into smartphone addiction and social-emotional distress is still in its infancy. There are many directions to pursue future research, but the following implications deserve serious consideration. First, the inclusion of objective behavioral measures for smartphone use (e.g., tracking applications; Lee et al. 2014) can provide accurate data on actual time spent using the smartphone and what specific applications are used. It is likely that students are gradually becoming addicted to the specific features of their smartphones such as entertainment and social networking applications. Although most of these features are not new, the portable and easy access nature of smartphones provides near-instant gratification for these desires. Such information would be helpful in determining what specific aspects of the smartphone are potentially addictive. Furthermore, studying specific applications would also shed light into smartphone uses that are beneficial to the well-being of the students. Second, using measures for specific disorders, such as anxiety and depression, allows for targeting research questions at specific domains of emotional distress. Third, including additional social-emotional measures and other domains of common daily student functioning might provide predictive models with more explained variance. Finally, there appears to be inconsistent operational definitions and measurement of smartphone addiction across studies examining this construct. It is important that caution is taken in generalizing and comparing the results across studies when different measures are used, as the construct of smartphone addiction is still in its infancy and, consequently, can vary greatly in how it is defined and measured. We suggest that future research continue to use the SAS due to its strong psychometrics and use of six subscales. The SAS encompasses a broad, but clear, operational definition of smartphone addiction that includes clinically significant impairment of daily activities resulting from dependence, tolerance, and withdrawal symptoms.

Clinical Implications

The findings from this study and others can inform assessment and therapeutic interventions targeted at reducing/modifying smartphone use and improving college student mental health. This is a significant contribution given the overwhelming number of college students who own smartphones and the increasing number of college students experiencing significant mental health problems.

Using the SAS, or a modified version, as a screening tool for smartphone addiction may be a prudent option for college counseling centers. Screening for alcohol and substance abuse is already common practice in these settings. Thus, it only makes sense to also screen for smartphone addiction, another common behavior that appears to have deleterious effects on mental health, social well-being, and academic functioning. Information gained from such an assessment may help indicate "warning signs" to follow up on and integrate into the treatment plan. From a preventative approach, psychoeducation of smartphone use can help reduce the risk of students engaging in maladaptive behavior patterns. From an intervention approach, distinguishing what features students may be addicted to can help identify specific facets of their life that may warrant further intervention. In other words, what needs are being met with their smartphones, but not elsewhere in their daily life? Correspondingly, in addition to reducing smartphone use, it is essential to consider what alternative behaviors should take its place. Just like treating other types of maladaptive behavior patterns, there should be a replacement behavior that can also provide some level of gratification in a more adaptive manner. Finally, completely eliminating smartphone use is not a practical option, as it does provide essential features for communication, networking, and accessing information, which can be effective tools for coping with social-emotional distress. However, like many life activities, it is a matter of finding the right balance for each individual. Thus, it is therapeutically prudent to consider what features are most beneficial for each student, including applications that are specifically designed to improve emotional well-being and increase adaptive behaviors.

Conclusion

This is the first study to demonstrate clinical significance of smartphone addiction among college-age students in the USA. Individuals who use their smartphone to the extent that they experience daily dysfunction when separated from their phone, withdrawal symptoms, and difficulty limiting phone use, put themselves at risk of significant social-emotional distress. Given the high prevalence of mental health disorders among undergraduate students, smartphone addiction may aggravate or contribute to poor mental health of young adults. Therefore, a concerted effort to include assessment of smartphone attachment and heavy use in mental and perhaps physical health exams is warranted.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Informed Consent All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (5). Informed consent was obtained from all patients for being included in the study.

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