# Problematic smartphone use and relations with negative affect, fear of missing out, and fear of negative and positive evaluation

Claire A. Wolniewicz[a], Mojisola F. Tiamiyu[a], Justin W. Weeks[b], Jon D. Elhai[a,c,d,*]

[a] Department of Psychology, University of Toledo, Toledo, OH, USA
[b] Department of Psychology, Nebraska Medicine, Omaha, NE, USA
[c] Department of Psychiatry, University of Toledo, Toledo, OH, USA
[d] Laboratory for Traumatic Stress Studies, CAS Key Laboratory of Mental Health, Institute of Psychology, Chinese Academy of Sciences, Beijing, China

## ARTICLE INFO

## ABSTRACT

For many individuals, excessive smartphone use interferes with everyday life. In the present study, we recruited a non-clinical sample of 296 participants for a cross-sectional survey of problematic smartphone use, social and non-social smartphone use, and psychopathology-related constructs including negative affect, fear of negative and positive evaluation, and fear of missing out (FoMO). Results demonstrated that FoMO was most strongly related to both problematic smartphone use and social smartphone use relative to negative affect and fears of negative and positive evaluation, and these relations held when controlling for age and gender. Furthermore, FoMO (cross-sectionally) mediated relations between both fear of negative and positive evaluation with both problematic and social smartphone use. Theoretical implications are considered with regard to developing problematic smartphone use.

## 1. Introduction

In modern society, many individuals engage in excessive use of their smartphones. Excessive smartphone use is associated with physical health symptoms (Shan et al., 2013; İNal et al., 2015; Xie et al., 2016), as well as mental health problems including depression and anxiety (reviewed in Elhai et al., 2017a). Excessive use is also associated with decreased productivity, and poor academic achievement (Samaha and Hawi, 2016; Duke and Montag, 2017). However, little is known about relations between excessive smartphone use and other contemporary psychopathology-related constructs.

Smartphone access and usage is prevalent in contemporary times. Recent data demonstrate that the average worldwide ownership rate of a smartphone is 43%, with 72% ownership in the United States (Poushter, 2016). Smartphones have the advantage of being used for multiple purposes, including productivity enhancement, information seeking, social interaction, relaxation and entertainment, among other motivations (van Deursen et al., 2015). However, excessive smartphone use is a problem among many individuals currently.

"Problematic smartphone use" (PSU) is a construct often defined by excessive use of one's smartphone with interference in work, school or socially (Billieux et al., 2015). PSU is also accompanied by symptoms found in addictive/substance use disorders, including dependence and withdrawal when not using one's smartphone (Clayton et al., 2015). In recent years, PSU has been studied, with multiple personality-related pathways theorized and found to influence this construct, such as excessive reassurance seeking, impulsivity, and extraversion (Billieux et al., 2015). Models of PSU have often conceptualized psychopathology or personality variables as influencing increase smartphone use, with increased or habitual use influencing PSU (Oulasvirta et al., 2012; van Deursen et al., 2015).

PSU is related to the construct of problematic internet use (Kuss et al., 2014), and both constructs involve symptoms observed in substance use disorders. However, these constructs are statistically distinct (Kiraly et al., 2014). The study of problematic internet use has revealed associations with demographic, psychosocial, psychopathological, and technology use variables (Kuss et al., 2014) that has informed the examination of risk factors for PSU (Elhai et al., 2017a). Importantly, because of the portability and ease of access of one's smartphone, PSU is different from and poses a unique hazard compared to problematic internet use.

Our focus is on PSU, and a particular type of use - social use. Whereas non-social (or "process") smartphone use involves primarily non-social purposes (e.g., entertainment, relaxation), social use involves primarily social purposes (e.g., communication, social networking) (van Deursen et al., 2015).

While extensive research finds associations between PSU and depression and anxiety (reviewed in Elhai et al., 2017a), little consistent support has been found for other mental health variables. We examined additional variables reasonably expected to relate to PSU, despite little empirical scrutiny. These variables include fear of positive and negative evaluation, negative affect, and fear of missing out (FoMO). While FoMO has been recently linked to PSU in a community sample (Elhai et al., 2016), these other three variables have not been examined.

### 1.1. Fears of positive and negative evaluation

The fear of positive evaluation involves feelings of apprehension about others' positive evaluations of oneself, and associated distress (Weeks and Howell, 2012). This construct emerged from the finding that socially anxious individuals worry about their social performance, and that attaining positive evaluation adds pressure to perform positively (Weeks and Howell, 2012). In contrast, fear of negative evaluation involves apprehension that others will negatively evaluative oneself, and associated distress (see Watson and Friend, 1969).

The fear of negative evaluation is a common factor of psychopathology, involving social anxiety and depression; fear of positive evaluation is unique to social anxiety (Wang et al., 2012; Weeks and Howell, 2012). PSU has been linked with depression (Elhai et al., 2017a) and social anxiety (Lu et al., 2011; Hong et al., 2012; Harwood et al., 2014), but has not been assessed in relation to fear of positive or negative evaluation.

### 1.2. Negative affect

Negative affect is an underlying dimension of a broad set of emotional states, including fear, anger, sadness, guilt, and disgust. Watson (2009) found evidence for negative affect as a factor underlying depression and anxiety disorders. Negative affect shares similar physiological correlates with depression and anxiety, including low heart rate variability (Bleil et al., 2008). Because depression and anxiety are related to PSU (Elhai et al., 2017a), negative affect is worth investigating.

### 1.3. FoMO

FoMO is a pervasive apprehension that others might be having rewarding experiences from which one is absent (Przybylski et al., 2013). Using a community sample, Elhai et al. (2016) discovered that FoMO was related to PSU. Additionally, FoMO was associated with increased social smartphone use in college and community participants (Przybylski et al., 2013; Alt, 2015).

## 2. Theory

Uses and Gratifications Theory (UGT) is relevant to electronic media consumption, such as smartphone use. UGT assumes that based on individual differences, people have specific needs that they desire to be fulfilled by mass media. Furthermore, a specific need would drive an individual to consume a very particular type of media to satisfy that need (Blumler and Katz, 1974; Blumler, 1979). In UGT, individual differences driving such media choices can include demographic characteristics, as well as psychological and psychopathological traits. Recent papers have supported individual differences in UGT in explaining PSU (Grellhesl and Punyanunt-Carter, 2012; Park et al., 2013; Elhai et al., 2017b). Individuals with high levels of FoMO should attempt to fulfill their social needs by increased use of social media (e.g., a smartphone).

An additional relevant theory is Compensatory Internet Use Theory (CIUT), developed by Kardefelt-Winther (2014). As with UGT, CIUT also attempts to explain media use – in particular, internet use. CIUT assumes that life stressors and negative events motivate some people to overuse technology as a means of alleviating their negative emotion.

Thus, this theory is grounded in the assumption that excessive internet use is not pathological in and of itself, but rather is a compensatory process for coping with psychopathology. Several studies thus far have found empirical support for this theory as related to the study of PSU (Wang et al., 2015; Long et al., 2016; Zhitomirsky-Geffet and Blau, 2016).

### 2.1. Purpose/aims

Our purpose was to examine psychopathology-related variables in relation to PSU, including *social* use in particular. Specifically, we examined fears of positive and negative evaluation, negative affect, and FoMO for associations with PSU and social smartphone use, of which only FoMO has been explored for relations with PSU (Elhai et al., 2016).

### 2.2. Hypotheses

1) *FoMO would relate positively to PSU, and particularly to social smartphone use*. Based on UGT (Blumler and Katz, 1974; Blumler, 1979) and CIUT (Kardefelt-Winther, 2014), FoMO should be associated with increased social smartphone use, as a means to fulfill and compensate for individuals' social needs. Recent research has found FoMO related to PSU (Elhai et al., 2016). Furthermore, Przybylski et al. (2013) and Alt (2015) found that FoMO related to increased social media use.
2) *Fear of negative and positive evaluation should be positively related to PSU, and social use*. Based on UGT and CIUT, social smartphone use would be expected to relate positively to evaluative fears, because those individuals fearing evaluation should avoid real-life interaction, instead using their smartphones to compensate. Social anxiety is associated with PSU (Lu et al., 2011; Hong et al., 2012; Harwood et al., 2014), and social media use (Hargittai, 2007); and social anxiety is strongly related to fears of positive and negative evaluation (Weeks and Howell, 2012).
3) *Negative affect should be positively related to PSU, including increased social use*. Negative affect should relate to social smartphone use based on UGT and CIUT, as such use would be a means to cope with and compensate for negative affect. Depression relates to increases in PSU (Elhai et al., 2017a), social smartphone use (Elhai et al., 2017b), and social media use in general (Rosen et al., 2013; Andreassen et al., 2016). And depression is similar to negative affect, an underlying part of depressive and anxiety disorders (Watson, 2009).
4) *FoMO will have an additive effect on problematic and social smartphone use, above and beyond the other correlates*. Elhai et al. (2016) found FoMO to be the most potent predictor of PSU in a community sample. We expected to find similar support with the present college sample.
5) *FoMO should (cross-sectionally) mediate relations between fear of evaluation and both problematic and social smartphone use*. Fear of evaluation is related to social anxiety (Weeks and Howell, 2012). And social anxiety is associated with PSU (Lu et al., 2011; Hong et al., 2012; Harwood et al., 2014), and social media use (Hargittai, 2007). Social anxiety is thought to be associated with PSU because online (e.g., smartphone-based) socializing can be a means of compensating for one's real-world social fears (Hong et al., 2012; Kardefelt-Winther, 2014). We propose that FoMO may be a mechanism responsible for why some socially anxious/evaluative fearful individuals engage in increased smartphone use.
   An additional mechanism that can explain relations between psychopathology-related variables and PSU is the extent or type of smartphone use. Increased smartphone use was revealed to be a significant mediator between psychopathology-related variables and PSU in several papers (Oulasvirta et al., 2012; Kim et al., 2015; van Deursen et al., 2015). Furthermore, van Deursen et al. (2015)

discovered that increased social and process smartphone use similarly served as significant mediators. Therefore, we aimed to test an alternative model from that specified in Hypothesis 5.

6) *Social smartphone use should (cross-sectionally) mediate relations between psychopathology-related variables (FoMO, fear of negative and positive evaluation, negative affect) and PSU.* Existing models conceptualize the extent or type of smartphone usage as a mediating variable between psychopathology and PSU (Oulasvirta et al., 2012; Kim et al., 2015; van Deursen et al., 2015).

## 3. Method

### 3.1. Participants

We recruited 299 college students for a web survey, after obtaining approval from a Midwestern university's Institutional Review Board. Excluded were students ($n$ = 3) who did not complete more than 50% of items on each of the primary measures (i.e., effective sample: $n$ = 296).

The average age of our participants was 20 years ($SD$ = 3.02). Women were slightly overrepresented ($n$ = 169, 57.1%), compared to men ($n$ = 127, 42.9%). Most were of Caucasian racial background ($n$ = 220, 74.3%), with some representation from African Americans ($n$ = 38, 12.8%), Asian Americans ($n$ = 18, 6.1%), and Hispanic/Latino individuals ($n$ = 18, 6.1%). A majority were freshmen ($n$ = 143, 48.3%) or sophomores ($n$ = 91, 30.7%). All participants attended a Midwestern U.S. university.

### 3.2. Procedure

We used the Sona Systems website from the university's psychology department to recruit subjects. Those who chose to participate were routed to an online consent statement and web survey (for those consenting), hosted on psychdata.com.

### 3.3. Instruments

#### 3.3.1. Demographics
Demographics that were inquired about included age, gender, race, school and employment.

#### 3.3.2. Smartphone usage
We used the scale developed by Elhai et al. (2016) to inquire about 11 specific smartphone features. We queried about current frequency of using the following features: "video and voice calls (making and receiving)," "text/instant messaging (sending and receiving)," "email (sending and receiving)," "social networking sites," "internet/websites," "games," "music/podcasts/radio," "taking pictures or videos," "watching videos/TV/movies," "reading books/magazines," and "maps/navigation." Response options ranged from "1 = Never" to "6 = Very often." We summed responses from the first four items to generate a *social smartphone use* score, and from the remaining seven items for a *non-social smartphone use score.* Elhai et al. (2016) discovered coefficient alpha of 0.86 for all 11 items, and a correlation of 0.34 with PSU. Coefficient alpha in the present sample was 0.79 for the 11 items, 0.69 for the social smartphone use items, and 0.71 for the non-social items.

#### 3.3.3. Smartphone addiction scale-short version (SAS-SV)
To measure PSU, we administered the SAS-SV (Kwon et al., 2013). This measure queries about current smartphone use-related health and social impairment, withdrawal and tolerance. The SAS-SV includes 10 items using a Likert scale ranging from "1 = Strongly disagree" to "6 = Strongly agree." Coefficient alpha is reported at 0.91, and the scale demonstrates convergent validity (Kwon et al., 2013). Coefficient alpha in our sample was 0.88.

#### 3.3.4. FoMO scale
The FoMO scale, developed by Przybylski et al. (2013) is a 10-item scale, with responses ranging from "1 = Not at all true of me" to "5 = Extremely true of me." This scale measures anxiety that individuals currently experience when they miss out on social events, such as going out with friends. Przybylski et al. (2013) found coefficient alphas ranging from 0.87 to 0.90. FoMO scores correlated positively with social media engagement, and negatively with mood, need and life satisfaction, providing support for convergent validity. Elhai et al. (2016) found moderate correlations with depression/anxiety. Coefficient alpha in our sample was 0.87.

#### 3.3.5. Fear of positive evaluation scale (FPES)
The FPES (Weeks et al., 2008) is a 10-item measure of current fear of positive evaluation, such as in receiving compliments and garnering positive attention. It has response options for describing oneself, ranging from "0 = Not at all true" to "9 = Very true." The scale includes two reversed-scored items, not used in calculating the FPES total score. Weeks et al. (2008) reported coefficient alpha of 0.80, and significant positive relations with social anxiety measures. Our sample's coefficient alpha was 0.77.

#### 3.3.6. The brief fear of negative evaluation scale-straightforward items (BFNES-S)
The BFNES-S (Rodebaugh et al., 2004) is an 8-item measure of current fear of negative evaluation, such as in displaying shortcomings, not making a positive impression, and speaking objectionably. It has response options ranging from "1 = Not at all characteristic of me" to "5 = Extremely characteristic of me" (Weeks and Howell, 2012). Rodebaugh et al. (2004) found internal consistency between 0.91 and 0.93, and positive associations with social anxiety measures. Coefficient alpha in our sample was 0.79.

#### 3.3.7. The positive and negative affect schedules (PANAS)
The PANAS is a combined 20-item scale of affect, measuring positive and negative affect (Watson et al., 1988). We queried items based on the past week. Given our interest in negative (rather than positive) affect, and prior relevant research on depression and PSU (Elhai et al., 2017a), we examined only the negative affect scale in this paper. This negative affect scale contains 10 bi-directional adjectives describing recent negative mood (Watson et al., 1988). Watson et al. (1988) found internal consistency for the negative affect scale between 0.84 to 0.87, and positive relationships with other negative mood and affect scales. Coefficient alpha was 0.86 in our sample.

### 3.4. Analysis

Our dependent variables included summed scores for a) the SAS-SV, b) *social smartphone use*, and c) *non-social smartphone use.* Our predictor variables included summed scores on the FoMO Scale, PANAS Negative Affect Scale, FPES and BFNES-S scales. Variable distributions did not demonstrate non-normality; the largest skewness or kurtosis value in absolute size was 0.91. Therefore, we used parametric, general linear model analyses.

Using bivariate Pearson correlations, we tested relations between age and our study variables (the three dependent variables and four predictor variables from the previous paragraph). We tested relations between gender (main factor, coded men = 1, women = 2) and our study variables as outcomes, using analyses of variance.

We used Pearson correlations to assess bivariate relationships between our predictor variables and the dependent variables, testing Hypotheses 1 through 3. Next we used sequential linear regression analyses to assess multivariate relations between our predictor variables (based on Hypotheses 2 through 4) and each of our dependent variables. Regression analyses statistically adjusted for gender and age in Step 1; PSU is greater in women than men (Wang et al., 2015; Jeong

et al., 2016) and greater in younger than older individuals (Lu et al., 2011; van Deursen et al., 2015). To test Hypothesis 4, we assessed the additive effect of FoMO over the other predictor variables in accounting for SAS-SV and social use.

In testing Hypothesis 5, we used (cross-sectional) mediation testing to examine whether FoMO would mediate relations between two predictor variables - a) fear of positive evaluation and b) fear of negative evaluation - with our two dependent variables - c) PSU and d) *social smartphone use*. Adjusting for age and gender, we tested for mediation using the product of direct effect coefficients, estimating indirect effects using the Delta method, with 1000 bootstrapped samples (MacKinnon, 2008). Model fit was assessed using the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), root mean square error of approximation (RMSEA), and standardized root meant residual (SRMR). Adequate fit can be judged based on CFI and TLI values of 0.90 or higher, RMSEA values of 0.08 or lower, and SRMR values of 0.10 or lower (Hu and Bentler, 1999).

In testing Hypothesis 6, we used (cross-sectional) mediation testing to examine social smartphone use as a mediator between the four psychopathology variables (separately) and PSU, adjusting for age and gender. Thus we conducted four mediation tests, with a different psychopathology variable in each analysis separately (FoMO, fear of negative evaluation, fear of positive evaluation, and negative affect).

## 4. Results

First, we report descriptive statistics for the primary measures in Table 1. PSU was modestly correlated with *social smartphone use* ($r = 0.19$) and *non-social use* ($r = 0.12$). A Bonferroni correction ($0.05/5 = 0.01$) was applied, which controlled for the number of comparisons between each study dependent measure with all 5 remaining study measures. Based on the correlation matrix presented in Table 1, we found that the variables most related to PSU were: fear of missing out ($r = 0.42$), fear of negative evaluation ($r = 0.29$), and negative affect ($r = 0.23$) ($ps < 0.001$). Study variables were only modestly related to *social smartphone use*; only FoMO would be statistically significant ($r = 0.12$, $p = 0.02$) but did not pass with the Bonferroni correction. No study variables were related to *non-social smartphone use*, and consequently, we did not include this variable in subsequent regression analyses.

Next, we examined associations between both age and gender with the study variables. The only significant correlation for age was with negative affect, $r = 0.14$, $p = 0.02$. Gender was only significantly related to PSU, $F(1292) = 4.80$, $p = 0.03$, $\eta^2 = 0.02$, with women scoring higher.

As noted above, linear regression analyses were adjusted for age and gender. First, in predicting PSU, age and gender in Step 1 accounted for only a modest amount of variance, $F(2290) = 2.47$, $p = 0.09$, $R^2 = 0.02$ (Table 2). Step 2's addition of negative affect, fear of positive evaluation and fear of negative contributed significant variance,

**Table 2**
Final linear regression model, predicting SAS-SV scores.

| Predictor variable | β | B | SE B | t | p |
|---|---|---|---|---|---|
| Age | 0.03 | 0.10 | 0.18 | 0.53 | 0.59 |
| Gender | 0.14 | 2.88 | 1.10 | 2.62 | 0.01 |
| Negative affect | 0.08 | 0.10 | 0.08 | 1.29 | 0.20 |
| Fear of negative evaluation | 0.09 | 0.11 | 0.08 | 1.36 | 0.18 |
| Fear of positive evaluation | − 0.01 | − 0.01 | 0.04 | − 0.15 | 0.88 |
| FoMO | 0.36 | 0.49 | 0.08 | 6.06 | < 0.001 |

Note: FoMO = Fear of missing out; SAS-SV = Smartphone Addiction Scale-Short Version. Gender is coded 1 for men, and 2 for women.

**Table 3**
Final linear regression model, predicting social smartphone use scores.

| Predictor variable | β | B | SE B | t | p |
|---|---|---|---|---|---|
| Age | − 0.01 | − 0.01 | 0.08 | − 0.12 | 0.90 |
| Gender | 0.28 | 2.20 | 0.46 | 4.79 | < 0.001 |
| Negative affect | − 0.03 | − 0.01 | 0.03 | − 0.39 | 0.69 |
| Fear of negative evaluation | 0.02 | 0.01 | 0.04 | 0.35 | 0.73 |
| Fear of positive evaluation | − 0.08 | − 0.02 | 0.02 | − 1.37 | 0.17 |
| FoMO | 0.14 | 0.08 | 0.03 | 2.24 | 0.03 |

Note: FoMO = Fear of missing out. Gender is coded 1 for men, and 2 for women.

$F_{\text{change}}(5287) = 4.55$, $p < 0.001$, $R^2_{\text{change}} = 0.09$. In the final step, Step 3, there was an additive effect of fear of missing out, $F_{\text{change}}(6286) = 5.68$, $p < 0.001$, $R^2_{\text{change}} = 0.10$. Step 3 demonstrated that adjusting for the other variables, FoMO was the only significant psychopathology-related predictor ($\beta = 0.36$, $p < 0.001$).

Next, in predicting *social smartphone use*, age and gender in Step 1 accounted for 8% of variance, $F(2289) = 11.77$, $p < 0.001$, $R^2 = 0.08$ (Table 3). Step 2's addition of negative affect, fear of positive evaluation, and fear of negative evaluation contributed a significant but modest amount of variance, $F_{\text{change}}(5286) = 3.40$, $p < 0.001$, $R^2_{\text{change}} = 0.01$. Finally, in Step 3, fear of missing out added significant variance, $F_{\text{change}}(6285) = 5.20$, $p < 0.001$, $R^2_{\text{change}} = 0.02$. In Step 3, adjusting for other variables, FoMO was again the only significant psychopathology-related predictor ($\beta = 0.14$, $p = 0.03$).

Mediation tests from Hypothesis 5 are displayed in Table 4. FoMO scores (cross-sectionally) mediated relations between both fear of positive evaluation and negative evaluation with both PSU and *social smartphone use*. The pattern of findings appears strongest in predicting PSU, and somewhat less strong for *social smartphone use*.

Finally, (cross-sectional) mediation results testing social smartphone use as a mediator between psychopathology variables and PSU were conducted. However, none of these four mediation tests were significant (see Table 5).

**Table 1**
Intercorrelation matrix of study variables, and means and standard deviations.

| Variable | M | SD | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|---|
| 1. SAS-SV | 27.01 | 10.15 | 1 | | | | | | |
| 2. Social Use | 18.56 | 3.99 | 0.19** | 1 | | | | | |
| 3. Non-social Use | 28.73 | 5.76 | 0.12* | 0.52*** | 1 | | | | |
| 4. FoMO | 22.02 | 7.53 | 0.42*** | 0.12* | − 0.01 | 1 | | | |
| 5. Fear of Negative Evaluation | 31.98 | 7.90 | 0.29*** | 0.06 | 0.07 | 0.46*** | 1 | | |
| 6. Fear of Positive Evaluation | 26.69 | 13.65 | 0.12* | − 0.07 | 0.00 | 0.23*** | 0.35*** | 1 | |
| 7. Negative Affect | 23.00 | 7.69 | 0.22*** | 0.02 | 0.05 | 0.30*** | 0.44*** | 0.27*** | 1 |

Note: FoMO = Fear of missing out; SAS-SV = Smartphone Addiction Scale-Short Version.
* p < 0.05.
** p < 0.01.
*** p < 0.001.

**Table 4**
Mediation effects in accounting for relations between fear of evaluation and smartphone use.

| Mediating relationship | β | B | SE | p | $\chi^2(2)$ | CFI | TLI | RMSEA | SRMR |
|---|---|---|---|---|---|---|---|---|---|
| FNE- > FoMO- > SAS-SV | 0.17 | 0.22 | 0.04 | < 0.001 | 2.53 | 0.99 | 0.99 | 0.03 | 0.02 |
| FPE- > FoMO - > SAS-SV | 0.10 | 0.07 | 0.02 | 0.001 | 3.76 | 0.98 | 0.92 | 0.06 | 0.03 |
| FNE- > FoMO - > SSU | 0.06 | 0.03 | 0.01 | 0.02 | 2.53 | 0.99 | 0.98 | 0.03 | 0.02 |
| FPE- > FoMO - > SSU | 0.03 | 0.01 | 0.01 | 0.03 | 3.76 | 0.96 | 0.86 | 0.06 | 0.02 |

Note: FoMO = Fear of missing out; SAS-SV = Smartphone Addiction Scale-Short Version; SSU = Social Smartphone Use; FNE = Fear of Negative Evaluation; FPE = Fear of Positive Evaluation.

## 5. Discussion

In the present study, we went beyond traditional studies focusing on depression and anxiety related to smartphone use in general and PSU, by expanding the domain of psychopathology-related constructs examined. We found support for Hypothesis 1. Specifically, FoMO was significantly related to PSU on a bivariate basis (see Table 1; see also below regarding multivariate relations). FoMO was significantly associated with *social* smartphone use specifically on a bivariate basis (see Table 1; see also below regarding multivariate relations), but did not pass the Bonferroni correction. Findings fit with UGT (Blumler and Katz, 1974; Blumler, 1979) and CIUT (Kardefelt-Winther, 2014) in terms of individuals with social dependency needs gravitating to social forms of technology (Park et al., 2013), in order to compensate for their social needs. Results also support prior research on FoMO's relations with PSU (Przybylski et al., 2013; Alt, 2015; Elhai et al., 2017a).

Results demonstrated partial support for Hypothesis 2 in that fear of negative evaluation was significantly associated with PSU. This was the case for bivariate findings, but not in multivariate analyses. Results support UGT and CIUT at the univariate level, regarding fears pertaining specifically to negative evaluation and PSU (Lu et al., 2011; Hong et al., 2012; Harwood et al., 2014). Findings suggest that fear of negative evaluation, an individual difference variable in UGT, can drive PSU as a means to compensate (in CIUT) for such fear. However, neither fear of positive nor negative evaluation were associated with *social smartphone use* specifically.

Results provided full support for Hypothesis 3. Specifically, negative affect was associated with PSU, though only on a bivariate basis. Negative affect was not associated with *social* smartphone use. Results for associations with PSU support UGT and CIUT, in that those with greater negative affectivity (an individual difference in UGT) over the past week was related to PSU, conceptualized as a means of compensating for their negative affect (Kardefelt-Winther, 2014). Associations between negative affect (a construct which underlies the mood and anxiety disorders) (Watson, 2009) and PSU support prior research on depression and anxiety in relation to PSU (Elhai et al., 2017a).

We also found support for Hypothesis 4, about the potency of the FoMO construct. After adjusting for the other psychopathology-related constructs in multivariate analyses, only FoMO was related to PSU. FoMO was also significant in association with *social* smartphone use, specifically based on multivariate analyses. Thus findings support UGT in that FoMO is an individual difference variable driving problematic and social smartphone use – more specifically in the context of CIUT,

a variable driving compensatory smartphone use as a result. Furthermore, in contrast to the other psychopathology-related constructs examined in the present study, FoMO had the strongest effects in relation to both problematic and social smartphone use, supporting previous work (Elhai et al., 2016). Additionally, in multivariate analyses, FoMO added a significant amount of variance above and beyond the other psychopathology-related constructs in accounting for PSU.

**Hypothesis 5.** was also supported. FoMO (cross-sectionally) mediated relations between both fear of negative and positive evaluation in predicting PSU and social use. Prior studies have found relations between social anxiety variables and PSU (Lu et al., 2011; Hong et al., 2012; Harwood et al., 2014), and social media use (Hargittai, 2007). It is possible that among socially anxious individuals, those who worry about missing out on rewarding experiences are especially likely to excessively use their smartphones to alleviate their FoMO.

We did not find support for Hypothesis 6 as an alternative model to that specified in Hypothesis 5. Thus, we can rule out Hypothesis 6, in favor of Hypothesis 5. Specifically, social smartphone use did not mediate relations between any of the psychopathology-related variables and PSU, adjusting for age and gender. Our findings run counter to existing models which conceptualize increased smartphone use as mediating relations between psychopathology and problematic use (Oulasvirta et al., 2012; van Deursen et al., 2015). However, in a community sample, Elhai et al. (2017b) also found that social smartphone use did not mediate relations between psychopathology and PSU.

Also of note, we discovered several findings regarding age and gender that are consistent with prior research. In bivariate and regression results, we discovered that female gender was associated with PSU and social use, consistent with past work (Wang et al., 2015; Jeong et al., 2016). However, our results did not support age related to smartphone use, despite some research supporting an association (Lu et al., 2011; van Deursen et al., 2015). Of course, given the undergraduate nature of our sample, we had a limited age range for detecting such associations.

Our study had several limitations that should be considered in interpreting the findings. First, we used a college student sample, which is not necessarily representative of the larger U.S. population. Second, we relied exclusively upon self-report measures for assessing our constructs. Importantly, individuals are notorious for inaccurate time perception (Grondin, 2010), and inaccurately estimating time spent on their smartphones (Kobayashi and Boase, 2012; Boase and Ling, 2013; Lin et al., 2015; Montag et al., 2015; Elhai et al., 2017c). Third, we

**Table 5**
Mediation effects for social smartphone use in accounting for relations between psychopathology-related variables and problematic smartphone use.

| Mediating relationship | β | B | SE | p | $\chi^2(3)$ | CFI | TLI | RMSEA | SRMR |
|---|---|---|---|---|---|---|---|---|---|
| FoMO- > SSU - > SAS-SV | 0.02 | 0.03 | 0.02 | 0.15 | 79.81 | 0.13 | 1.00 | 0.29 | 0.11 |
| FNE- > SSU - > SAS-SV | 0.01 | 0.01 | 0.02 | 0.39 | 46.15 | 0.18 | 0.92 | 0.22 | 0.09 |
| FPE- > SSU - > SAS-SV | − 0.01 | − 0.01 | 0.01 | 0.33 | 28.04 | 0.26 | 0.73 | 0.17 | 0.07 |
| NA- > SSU - > SAS-SV | < 0.00 | < 0.00 | 0.01 | 0.79 | 36.59 | 0.20 | 0.88 | 0.20 | 0.08 |

Note: FoMO = Fear of missing out; SAS-SV = Smartphone Addiction Scale-Short Version; SSU = Social Smartphone Use; FNE = Fear of Negative Evaluation; FPE = Fear of Positive Evaluation; NA = Negative Affect.

measured media use only by way of a smartphone rather than from other devices. Additionally, our primary smartphone outcome variables were based on overall use rather than application-specific uses. Future research could focus on problematic use of specific internet-based applications (Oberst et al., 2017; Wegmann et al., 2017). Finally, our study was cross-sectional, and thus we cannot infer causality based on our findings. Nevertheless, this study is innovative in exploring more contemporary constructs of psychopathology-related variables that have not received previous scrutiny. Future research should explore these and other newer psychopathology-related constructs.

## Disclosure section

No competing financial interests exist.

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