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Depression and anxiety symptoms are related to problematic smartphone use severity in Chinese young adults: Fear of missing out as a mediator



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HIGHLIGHTS

- Fear of missing out (FOMO) related to problematic smartphone use (PSU) severity.
- FOMO mediated relations between anxiety and smartphone use frequency.
- FOMO mediated relations between anxiety and PSU severity.

ARTICLE INFO

Keywords:

Fear of missing out
Problematic smartphone use
Internet addiction

ABSTRACT

Introduction: Recently studies examined mediating psychological constructs accounting for relations between both depression and anxiety with problematic smartphone use (PSU) severity. The aim of the current study was to analyze the fear of missing out (FOMO) as a possible mediator in these relationships.

Method: We recruited 1034 Chinese undergraduate students via a web-based survey that measured smartphone use frequency, PSU, depression, anxiety and FOMO.

Results: Structural equation modeling demonstrated that FOMO was significantly related to smartphone use frequency and PSU severity. FOMO significantly mediated relations between anxiety and both smartphone use frequency and PSU severity. FOMO did not account for relations between depression and smartphone use/PSU.

Conclusion: This is one of the first studies testing FOMO in relation to PSU severity among Asian participants. FOMO may be an important variable accounting for why some types of psychopathology (e.g., anxiety) are associated with PSU.

1. Introduction

Addictive use of a smartphone is associated with mental health problems - in particular, depression and anxiety symptoms (Elhai, Dvorak, Levine, & Hall, 2017; Elhai, Levine, & Hall, 2019). Recently, research has investigated variables accounting for relations between mental health symptoms and addictive smartphone use.

An important conceptualization of internet addiction includes specific types of internet use disorders (Brand, Young, Laier, Wolfling, & Potenza, 2016). For example, internet gaming disorder has received empirical attention (Király, Griffiths, & Demetrovics, 2015), and is included in the proposed ICD-11 (World Health Organization, 2018).

Additionally, addictive social networking site use has also received attention (Seabrook, Kern, & Rickard, 2016; Turel & Qahri-Saremi, 2016).

We focus in this paper on a specific type of internet use disorder - smartphone use disorder (SUD) (Sha, Sariyska, Riedl, Lachmann, and Montag, in press; Lachmann et al., 2018). SUD has synonyms throughout the literature, including “smartphone addiction,” and “problematic smartphone use” (PSU) (Thomee, 2018). Because of controversy over applying the term “addiction” to internet use, and because SUD is not formally classified as a DSM-5 or ICD-11 disorder, we will use the term “PSU” here. PSU is defined by maladaptive smartphone use with functional impairment, involving symptoms

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<https://doi.org/10.1016/j.addbeh.2019.04.020>

Received 20 January 2019; Received in revised form 11 March 2019; Accepted 19 April 2019

Available online 20 April 2019

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observed in substance use disorders, such as tolerance, withdrawal after periods of non-use, continued use despite adverse effects, and difficulty controlling use (Billieux, Maurage, Lopez-Fernandez, Kuss, & Griffiths, 2015; De-Sola Gutierrez, Rodriguez de Fonseca, & Rubio, 2016). A smartphone has the risk of maladaptive use and functional impairment because of the plethora of pleasurable features it has (Brand et al., 2016), releasing chemicals in the brain that reinforce its use (as in drug addiction) (Montag, Sindermann, Becker, & Panksepp, 2016). In fact, PSU may involve different subtypes based on specific smartphone features used (Sha et al., *in press*).

PSU is associated with mental health problems. The predominant conceptualization is that mental health problems can drive PSU, rather than the reverse (Brand et al., 2016; Kardefelt-Winther, 2014). Most research finds PSU related to depression symptom severity with medium effect sizes (Elhai, Dvorak, et al., 2017), and to anxiety symptoms with small to moderate effects (Elhai et al., 2019; Elhai, Dvorak, et al., 2017; Vahedi & Saiphoo, 2018).

Predisposing mental health impairment is not the only factor influencing PSU. Several variables have mediated relations between mental health problems (such as depression and anxiety) and PSU severity - primarily, maladaptive cognitive and emotion processes, and behavioral disinhibition. In particular, rumination (Elhai, Tiamiyu, & Weeks, 2018; Q.-Q. Liu et al., 2017), proneness to boredom (Elhai, Vasquez, Lustgarten, Levine, & Hall, 2018), emotion dysregulation and distress intolerance (Elhai et al., 2018; Elhai, Levine, Dvorak, & Hall, 2016), and impaired self-control (Cho, Kim, & Park, 2017) have mediated relations between depression/anxiety and PSU severity.

Another important variable that can drive PSU severity is FOMO. FOMO involves apprehension of missing pleasurable and rewarding experiences, with the need to constantly stay connected with members of one's social network (Przybylski, Murayama, DeHaan, & Gladwell, 2013). FOMO involves an adverse negative emotional state, and is correlated with depression (Dhir, Yossatorn, Kaur, & Chen, 2018; Elhai et al., 2016; Elhai, Levine, Alghraibeh, Alafnan, et al., 2018; Oberst, Wegmann, Stodt, Brand, & Chamarro, 2017) and anxiety severity (Dhir et al., 2018; Elhai et al., 2016; Elhai, Levine, Alghraibeh, Alafnan, et al., 2018; Oberst et al., 2017; Wolniewicz, Tiamiyu, Weeks, & Elhai, 2018). FOMO is associated with higher levels of PSU severity (Liu and Ma, *in press*; Chotpitayasonondh & Douglas, 2016; Elhai et al., 2016; Elhai, Levine, Alghraibeh, Alafnan, et al., 2018; Fuster, Chamarro, & Oberst, 2017; Oberst et al., 2017; Wolniewicz et al., 2018). Furthermore, FOMO mediated relations between depression/anxiety and PSU severity (Elhai, Levine, Alghraibeh, Alafnan, et al., 2018; Oberst et al., 2017); and between depression/anxiety and increased smartphone use frequency (Elhai, Levine, Alghraibeh, Alafnan, et al., 2018).

Finally, studies often model frequency of smartphone use, as an intermediate variable between psychopathology and PSU (e.g., Elhai & Contractor, 2018; Kim, Seo, & David, 2015; van Deursen, Bolle, Hegner, & Kommers, 2015). This inclusion is important in order to analyze the relative effects of psychopathology on PSU severity, after controlling for smartphone use frequency.

1.1. Aims

Several studies reviewed above revealed associations between FOMO and PSU severity. Furthermore, FOMO has mediated relations between depression/anxiety and PSU severity. However, the FOMO-PSU relationship has been tested almost exclusively with Western samples from Europe and North America, with one exception from Asia (specifically in China; Liu and Ma, *in press*). We assessed FOMO as a mediator between depression/anxiety and PSU severity, a question not been previously tested in Asia.

FOMO may exhibit a different pattern of relations with PSU because of the different set of social rules (online and offline) that govern Chinese culture, emphasizing affective and instrumental social resource exchange (Lisha, Goh, Yifan, & Rasli, 2017). Such social rules mean that

forming social connections is not as easy or relaxed as in Western countries, but rather requires careful thought and consideration. Furthermore, people interact with their smartphones differently in China, as they primarily use an application called "WeChat" that handles most smartphone features and functions of daily life, including social networking, calling, messaging, navigation, mobile payment, and transportation arrangement (Montag, Becker, & Gan, 2018).

1.2. Theory

A relevant, contemporary theory accounting for PSU is Compensatory Internet Use Theory (CIUT) (Kardefelt-Winther, 2014). CIUT conceptualizes excessive internet use (e.g., PSU) as a maladaptive coping strategy used to alleviate negative emotion. CIUT has been empirically supported in studies of PSU (Elhai, Tiamiyu, & Weeks, 2018; Long et al., 2016; Zhitomirsky-Geffet & Blau, 2016). However, CIUT neglects to conceptualize other influences of excessive internet use, beyond psychopathology and negative emotion.

A more comprehensive theoretical model is the Interaction of Person-Affect-Cognition-Execution (I-PACE) model (Brand et al., 2016). I-PACE proposes categories of variables that influence use and excessive use of internet communications. First, personal determinants include genetic, biological, personality, psychopathology, and internet use motive-based influences. Second, I-PACE proposes responses to personal determinants involving risk and resilience variables, including cognitive and attention bias, expectancies about internet use, coping strategies, inhibitory control and craving. These response variables are conceptualized to moderate or mediate relationships between personal determinants and excessive internet use (Brand et al., 2016). Finally, I-PACE assumes that response variables influence decisions to use particular internet features or applications, which may lead to adaptive, or problematic use. Numerous studies find support for I-PACE in modeling excessive internet use (Dempsey, O'Brien, Tiamiyu, and Elhai, *in press*; Lemenager et al., 2018; Oberst et al., 2017).

1.3. Hypotheses

H1. FOMO should be positively related to PSU severity. Several previous studies support FOMO's positive relationship with PSU severity, from Latin America, England, and U.S. (Chotpitayasonondh & Douglas, 2016; Elhai et al., 2016; Elhai, Levine, Alghraibeh, Alafnan, et al., 2018; Fuster et al., 2017; Oberst et al., 2017; Wolniewicz et al., 2018). One recent study with Chinese participants also supported this relationship (Liu and Ma, *in press*). The negative emotion associated with FOMO should correlate with PSU severity, serving as a means of emotion regulation according to CIUT (Kardefelt-Winther, 2014). In I-PACE, FOMO would represent cognitive bias correlating with PSU severity (Brand et al., 2016; Wegmann, Oberst, Stodt, & Brand, 2017) - specifically, that the individual is missing rewarding experiences only fulfilled by persistently using internet communications.

The next hypotheses have not been investigated with an Asian sample.

H2. FOMO should be positively related to smartphone use frequency. Several prior studies found FOMO related to increased smartphone use (Elhai, Levine, Alghraibeh, Alafnan, et al., 2018; Wolniewicz et al., 2018). As with H1, the FOMO-smartphone use frequency hypothesis fits with CIUT's emphasis on internet use to alleviate negative emotion, and I-PACE's focus on specific cognitions driving internet use.

H3. Smartphone use frequency should mediate relations between FOMO and PSU severity. Smartphone use frequency is often modeled as an intermediate variable between psychopathology and PSU severity (Elhai & Contractor, 2018; Kim et al., 2015; van Deursen et al., 2015). And studies support smartphone use frequency mediating between depression/anxiety variables and PSU severity (Elhai, Levine, Dvorak,

& Hall, 2017; Kim et al., 2015).

H4. FOMO should mediate relations between both depression (H4a) and anxiety (H4b) with PSU severity. Prior studies revealed FOMO as a significant mediating variable between both depression and anxiety with PSU severity (Elhai, Levine, Alghraibeh, Alafnan, et al., 2018; Oberst et al., 2017). FOMO would be conceptualized as cognitive bias within the response variable category in I-PACE (see H1 for elaboration). Response variables are conceptualized to mediate relations between psychopathology and excessive internet use (Brand et al., 2016).

H5. FOMO should mediate relations between both depression (H5a) and anxiety (H5b) with smartphone use frequency. A prior study found that FOMO mediated relations between depression and anxiety with smartphone use frequency (Elhai, Levine, Alghraibeh, Alafnan, et al., 2018). As with the previous hypothesis, conceptualizing FOMO as an intermediate, cognitive bias variable between psychopathology and smartphone use frequency would fit with I-PACE.

1.4. Research model

Our research model is shown in Fig. 1. Depression and anxiety severity are conceptualized to predict FOMO. FOMO is conceptualized to predict both smartphone use frequency and PSU severity; smartphone use frequency predicts PSU severity. We also include age and sex as covariates of PSU severity; younger age (Lu et al., 2011; van Deursen et al., 2015) and female sex (Jeong, Kim, Yum, & Hwang, 2016; J.-L. Wang, Wang, Gaskin, & Wang, 2015) are associated with higher PSU severity.

2. Method

2.1. Participants and procedure

In fall 2018, we conducted a web survey at Tianjin Normal University, a large university in Tianjin, China. Institutional Review Board approval was first granted by the university. Student participants were recruited through local online messaging boards and social networking site accounts by university psychology faculty. Those enrolling were routed online to an informed consent statement, and (for those consenting) a web survey, hosted by the Chinese web survey platform:

wjx.cn. All measures were administered in Mandarin Chinese. 1035 individuals participated, but one participant reported being only 15 years old, and was excluded.

Among the 1034 participants, the average age was 19.34 years (SD = 1.61). A slight majority were women (n = 675; 65.3%), with 359 (34.7%) men. Most were of Chinese Han ethnicity (n = 939; 90.8%). A majority were freshman (n = 547, 52.9%) or sophomores (n = 270, 26.1%). Most were majoring in social/natural sciences (n = 609, 58.9%), language/humanities (n = 242, 23.4%), or performing arts/sports (n = 119, 11.5%). A majority reported being single/not in a romantic relationship (n = 762, 73.7%), with 262 (25.3%) participants in a relationship, but not married.

2.2. Instruments

After querying the above-mentioned demographic characteristics, the following psychological scales were administered.

2.2.1. Smartphone use frequency scale (SUF)

The SUF (Elhai et al., 2016) was developed as an 11-item measure querying frequency of using specific smartphone features, with response options from 1 = Never to 6 = Very often. Activities inquired are: (1) video and voice calls (making and receiving), (2) text/instant messaging (sending and receiving), (3) email (sending and receiving), (4) social networking sites, (5) internet/websites, (6) games, (7) music/podcasts/radio, (8) taking pictures or videos, (9) watching videos/TV/movies, (10) reading books/magazines, and (11) maps/navigation. We added a twelfth item tailored to this population: educational learning. We submitted the SUF to a rigorous process of translation and back-translation by Chinese/English speaking experts. Internal reliability for the original, English SUF is adequate, with convergent validity against PSU measures (Elhai et al., 2016). Coefficient alpha for the current sample was 0.82.

2.2.2. Smartphone addiction scale-short version (SAS-SV)

We used the SAS-SV (Kwon, Kim, Cho, & Yang, 2013) to measure PSU severity via self-report, tapping health and social impairment, withdrawal, and tolerance components. The SAS-SV is a shortened version of the original SAS (Kwon et al., 2013). The SAS-SV contains 10 items with response options from 1 = Strongly disagree to 6 = Strongly agree. Studies demonstrate scale reliability (Kwon, Kim, et al., 2013), and scores converge with other measures of PSU and PIU (Kwon, Kim,

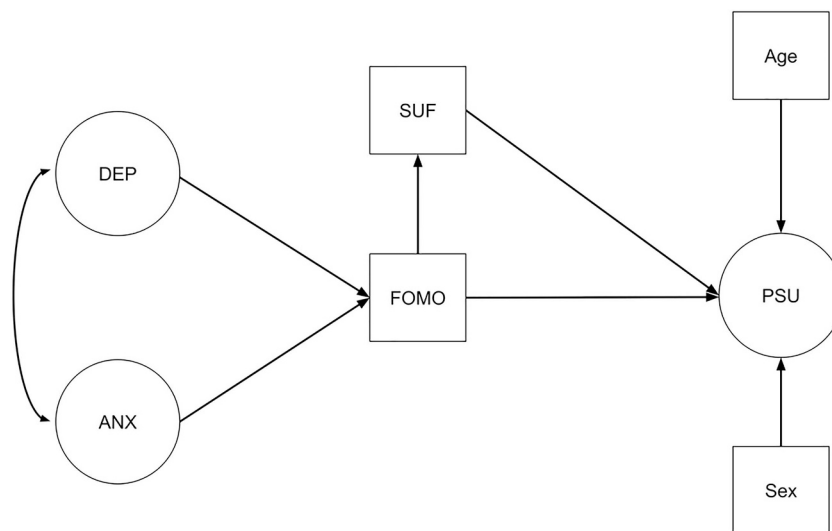


Fig. 1. Hypothesized model.

Notes: Circles represent latent variables; squares represent observed variables. DEP = Depression; ANX = Anxiety; SUF = Smartphone Use Frequency; FOMO = Fear of Missing Out; PSU = Problematic Smartphone Use.

Table 1
Means and standard deviations for the primary variables.

Variable	M	SD
1. Smartphone Use Frequency	50.39	9.31
2. Problematic Smartphone Use	34.92	11.39
3. Fear of Missing Out	25.89	5.71
4. Depression	3.73	4.49
5. Anxiety	4.76	4.32

et al., 2013), and smartphone use frequency (Lopez-Fernandez, 2017). We used the Chinese scale version, translated and validated previously (Chen et al., 2017). Cronbach's alpha in our sample was 0.92.

2.2.3. Depression anxiety stress scale-21 (DASS-21)

The DASS-21 (Lovibond & Lovibond, 1995) consists of 21 items measuring depression, anxiety, and stress symptoms. Each subscale is measured by seven items rated over the past week, with options from 0 = Did not apply to me to 3 = Applied to me very much or most of the time. We analyzed the depression and anxiety subscales, with adequate internal consistency (Lovibond & Lovibond, 1995), and convergent validity against similar scales (Antony, Bieling, Cox, Enns, & Swinson, 1998; Brown, Chorpita, Korotitsch, & Barlow, 1997). We used the Chinese version, translated and validated previously (K. Wang et al., 2016). Coefficient alphas for our sample were 0.91 for depression and 0.87 for anxiety.

2.2.4. Fear of missing out (FOMO) scale

The FOMO scale (Przybylski et al., 2013) is a 10-item survey, with response options ranging from 1 = Not at all true of me to 5 = Extremely true of me, measuring anxiety from missing out on social events (e.g., going out with friends). Internal reliability is adequate, with convergent validity against measures of social media engagement, poor life satisfaction (Przybylski et al., 2013), depression, anxiety and negative affect (Elhai et al., 2016; Wolniewicz et al., 2018). We used the Chinese version, translated and validated previously (Xie, Wang, Wang, Zhao, & Lei, 2018). Coefficient alpha in this study was 0.81.

2.3. Data analysis

We used R software, version 3.5.1 (R Core Team, 2019) for preliminary data analysis, using the following packages: *fmsb* (coefficient alphas), *pastecs* (normality, descriptive statistics), and *corplot* (scale intercorrelations). We had no missing item-level data, as the web survey prompted participants to input responses for skipped items. We summed each scale's items for a total score. Our model's variables were normally distributed; the highest skewness value (in absolute size) was 1.54 (Depression), and for kurtosis was 2.36 (FOMO).

We used Mplus version 8 (Muthén & Muthén, 1998–2019) for confirmatory factor analytic (CFA) and structural equation modeling (SEM) analyses. We first conducted measurement modeling using CFA for each scale in Fig. 1, using item-level data. We treated each scale's items as ordinal, using polychoric covariance matrices, weighted least squares estimation with a mean- and variance-adjusted chi-square (WLSMV), and probit-based factor loadings (DiStefano & Morgan, 2014). Residual covariances were fixed to zero; all factor loadings were freely estimated, with factor variances fixed to a value of 1. We report fit indices including the comparative fit index (CFI) and Tucker-Lewis Index (adequate fit between 0.90 and 0.94; excellent fit > 0.94), and root mean square error of approximation (adequate fit from 0.07 to 0.08; excellent fit < 0.07) (Hu & Bentler, 1999).

We tested the model in Fig. 1. We discuss our use of latent versus observed variables below. The path from FOMO to PSU severity tests H1. The path from FOMO to SUF tests H2.

We tested mediation, computing the cross-product of two direct path coefficients. We estimated standard errors for indirect (mediation)

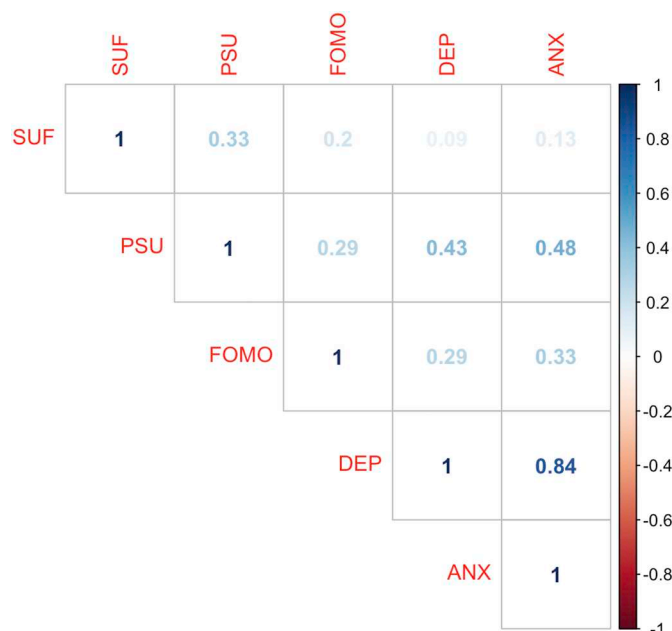


Fig. 2. Correlation Matrix of Primary Variables.

Notes: DEP = Depression; ANX = Anxiety; SUF = Smartphone Use Frequency; FOMO = Fear of Missing Out; PSU = Problematic Smartphone Use. All correlations were positive in sign. All correlations were significant at $p < .001$, except for DEP with SUF ($p = .004$). Correlations with a darker shade indicate stronger correlations.

path coefficients using the Delta method, with 1000 bootstrapped, non-parametric samplings (Hayes, 2017). We tested SUF as a mediator between FOMO and PSU severity (H3). We tested FOMO as a mediator (separately) between both depression (H4a) and anxiety (H4b) with PSU. Finally, we tested FOMO as a mediator (separately) between both depression (H5a) and anxiety (H5b) with SUF.

3. Results

3.1. Descriptive findings

Scale descriptive statistics are displayed in Table 1. Correlations among the primary (observed) variables are displayed in Fig. 2. All scale scores were moderately to largely intercorrelated, except SUF was only mildly correlated with depression, anxiety and FOMO scores.

The SUF comprises social (first four items) and non-social smartphone features (last eight items). To clarify FOMO's relationship with these different types of smartphone use, we estimated Pearson correlations. FOMO correlated 0.20 with social use ($p < .001$), and 0.16 with non-social use ($p < .001$); using a *t*-test for dependent correlations, these values were not significantly different, $t(1031) = 1.16$, $p = .25$.

3.2. SEM results

The FOMO measurement model resulted in poor fit, WLSMV $\chi^2(35, N = 1034) = 2501.26$, $p < .001$, CFI = 0.64, TLI = 0.53, RMSEA = 0.26 (90% CI: 0.25 to 0.27). Additionally, the SUF measurement model yielded poor fit, WLSMV $\chi^2(54, N = 1034) = 825.21$, $p < .001$, CFI = 0.89, TLI = 0.86, RMSEA = 0.12 (90% CI: 0.11 to 0.13).

The PSU measurement model yielded some evidence for adequate fit but some evidence for inadequate fit, WLSMV $\chi^2(35, N = 1034) = 2061.44$, $p < .001$, CFI = 0.91, TLI = 0.88, RMSEA = 0.13 (90% CI: 0.128 to 0.137). Depression showed evidence for good fit, WLSMV $\chi^2(14, N = 1034) = 126.85$, $p < .001$,

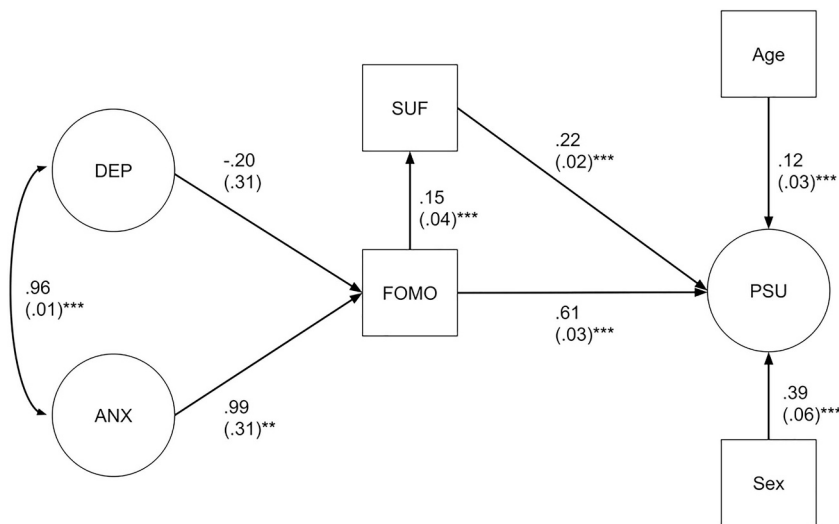


Fig. 3. SEM model with standardized path coefficients. Notes: Circles represent latent variables; squares represent observed variables. DEP = Depression; ANX = Anxiety; SUF = Smartphone Use Frequency; FOMO = Fear of Missing Out; PSU = Problematic Smartphone Use. Standard errors are displayed in parentheses. Factor loadings are not displayed for the latent variables, for simplicity, but are available upon request from the first author. * $p < .05$, ** $p < .01$ *** $p < .001$.

CFI = 0.99, TLI = 0.99, RMSEA = 0.09 (90% CI: 0.08 to 0.10). Anxiety primarily showed evidence for good fit, WLSMV $\chi^2(14, N = 1034) = 189.89, p < .001, CFI = 0.98, TLI = 0.97, RMSEA = 0.11$ (90% CI, 0.10 to 0.12).

We believed that FOMO and SUF yielded too much evidence for poor fit to be modeled as latent variables. Therefore, we modeled them as observed variables in SEM. PSU yielded mixed evidence for good fit, but we retained PSU as a latent variable, given its role as our primary dependent variable.

We tested Fig. 1's model, which fit reasonably well based on most indices, WLSMV $\chi^2(345, N = 1034) = 3196.340, p < .001, CFI = 0.93, TLI = 0.92, RMSEA = 0.09$ (90% CI, 0.09 to 0.09). Fig. 3 displays standardized parameter estimates. FOMO was significantly related to PSU severity (adjusting for age, sex, and SUF covariates; H1), and to SUF (H2). SUF was related to PSU severity (adjusting for covariates). FOMO was related to anxiety, but not to depression severity.

3.3. Mediation results

SUF mediated relations between FOMO and PSU severity, $\beta = 0.03$ (SE = 0.01), $p < .001$ (H3). FOMO mediated relations between anxiety and PSU severity, $\beta = 0.63$ (SE = 0.19), $p < .001$ (H4b), but not between depression and PSU severity, $\beta = -0.12$ (SE = 0.19), $p = .53$ (H4a). Finally, FOMO mediated relations between anxiety and SUF, $\beta = 0.16$ (SE = 0.06), $p = .006$ (H5b), but not between depression and SUF, $\beta = -0.03$ (SE = 0.05), $p = .53$ (H5a).

4. Discussion

Our primary study aim was to examine levels of FOMO as a mediator between both depression and anxiety with PSU severity. Our focus was on a Chinese sample of young adults, as Asian samples have rarely been investigated for relations between FOMO and PSU severity.

We found that FOMO was related to PSU severity, supporting H1. We also found FOMO related to higher levels of smartphone use frequency, supporting H2. These findings fit with CIUT's (Karddefelt-Winther, 2014) proposition that people often attempt to regulate their negative emotion (i.e., found with FOMO) through internet communication use. Findings also fit with I-PACE (Brand et al., 2016), proposing that cognitions influence excessive internet use. The relationship between FOMO and PSU severity (bivariate $r = 0.30$) was similar to that from a recent Chinese sample (Liu and Ma, in press), but slightly lower than that found in samples from other countries (ranging from bivariate r s of 0.40 to 0.60 (Chotpitayasunondh & Douglas, 2016; Elhai et al., 2016; Elhai, Levine, Alghraibeh, Alafnan, et al., 2018; Fuster

et al., 2017; Oberst et al., 2017; Wolniewicz et al., 2018). Perhaps the all-in-one use of WeChat in China (Montag et al., 2018) suggests many other factors besides FOMO account for PSU severity in this culture, such as the need to arrange transportation and paying for daily expenses (e.g., utilities, groceries).

We should note that FOMO was not significantly more related to social than non-social smartphone use, using bivariate correlations. This finding may seem surprising, as FOMO is conceptualized as a construct involving unmet social relatedness needs (Przybylski et al., 2013), linked with increased social networking site use (e.g., Fuster et al., 2017; Oberst et al., 2017). Yet a prior American study also found FOMO not more related to social than non-social smartphone use (Elhai, Levine, Alghraibeh, Alafnan, et al., 2018).

We found support for H3; smartphone use frequency mediated relations between FOMO and PSU severity. Results support increased smartphone use as a mediator between psychopathology symptoms and excessive use (Elhai & Contractor, 2018; Kim et al., 2015; van Deursen et al., 2015). This finding was thus extended to a Chinese sample, in the present study.

For H4 and H5, we tested FOMO as a mediator between psychopathology symptoms and both levels of smartphone use and PSU. We only found support for FOMO mediating between anxiety and smartphone use/PSU variables (H4b and H5b); FOMO was not significant when depression was modeled as the predictor variable (rejecting H4a and H5a). Perhaps these findings can be explained by FOMO being conceptualized as more of an anxiety- than depression-related variable (Przybylski et al., 2013), and FOMO evidences slightly higher relationships with anxiety than depression severity (Dhir et al., 2018; Elhai et al., 2016; Oberst et al., 2017). Nonetheless, our significant findings support prior work, whereby FOMO mediated relations between anxiety severity and a) PSU severity (Elhai, Levine, Alghraibeh, Alafnan, et al., 2018; Oberst et al., 2017) and b) smartphone use frequency (Elhai, Levine, Alghraibeh, Alafnan, et al., 2018). It is interesting that our mediation effect for FOMO between anxiety and PSU severity ($\beta = 0.63$) was notably higher than found in Western samples (β s = 0.20 to 0.28) (Elhai, Levine, Alghraibeh, Alafnan, et al., 2018; Oberst et al., 2017). Perhaps because of more formal social resource exchange rules in China, regarding online and offline interaction (Lisha et al., 2017), FOMO played a greater role in accounting for relations between anxiety and PSU severity in our study. Whereas in Western cultures that do not have such an extent of social exchange rules, FOMO may not serve as such a strong mechanism explaining the link between psychopathology (such as anxiety) and PSU. Our findings also support theoretical frameworks such as I-PACE, proposing cognitive bias variables such as FOMO as mediating between psychopathology and

excessive internet use (Brand et al., 2016; Wegmann et al., 2017).

Limitations include the use of college students, a sample which may not generalize to the larger Chinese population. Furthermore, our data were cross-sectional, and thus we cannot infer causality based on the relationships revealed. Additionally, we relied on self-report measures, and self-reported smartphone use does not validate well against objective smartphone logs (Elhai et al., 2018; Rozgonjuk, Levine, Hall, & Elhai, 2018). And we modeled PSU as a latent construct, despite mixed evidence for goodness of fit. Furthermore, self-selection may be another source of bias. Finally, we did not have access to other important predisposing or response variables from the I-PACE theory.

FOMO is a newer personality construct that is important to study in relation to internet communications use. This study provides initial data on how FOMO is related to PSU severity in an Asian sample - specifically Chinese participants. Results further research on understanding variables that account for relationships between psychopathology and PSU.

Funding

This work was supported by Tianjin Philosophy and Social Science Project (TJJX15-002). The authors do not have competing interests to disclose for this paper.

Conflict of interest

All authors declare that they have no conflicts of interest with this study.

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