



## Anxiety and stress severity are related to greater fear of missing out on rewarding experiences: A latent profile analysis

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**Abstract:** The fear of missing out on rewarding social experiences (FOMO) is an increasingly studied psychological construct, related to negative affectivity and increased online social engagement. Yet the heterogeneity of FOMO across individuals is not known. We conducted a latent profile analysis (LPA) of FOMO self-report ratings to determine sample heterogeneity and uncover underlying subgroups (profiles) of participants. We recruited 920 undergraduate participants through a Chinese university for an online survey, administering the FOMO Scale and the Depression Anxiety Stress Scale-21. Results demonstrated support for a four-profile LPA model based on FOMO ratings. Using multinomial logistic regression, more severe latent profiles (i.e., those with the greatest amount of FOMO endorsed) were associated with female sex, and higher stress and anxiety severity. Results suggest four distinct latent profiles based on FOMO ratings; findings are discussed in the context of self-determination theory.

**Keywords:** anxiety; depression; fear of missing out; latent profile analysis; stress

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The fear of missing out on rewarding social experiences (FOMO) is a more recently studied psychological construct. FOMO is related to greater psychopathology symptoms and decreased psychological well-being. FOMO is also associated with increased and excessive use of the Internet and social networking sites (SNSs), used as a means of satisfying FOMO through online social engagement. Yet, it is unclear whether FOMO demonstrates heterogeneous symptom presentations or subprofiles, and whether such subprofiles relate to other relevant psychopathology symptoms.

“FOMO” is defined as significant worry of being absent from others’ rewarding experiences, and the desire to

persistently keep up with others’ activities (Przybylski, Murayama, DeHaan, & Gladwell, 2013). Although FOMO likely has been experienced throughout history, in the digital age through SNS one can instantly learn of rewarding experiences being missed (Montag, Lachmann, Herrlich, & Zweig, 2019). As such, FOMO may pose a clinical concern to some individuals, resulting in excessive Internet communication to satisfy FOMO (Elhai et al., 2018), and even disrupted daily activities from phone-checking behavior (Rozgonjuk, Elhai, Ryan, & Scott, 2019). In fact, recent research (reviewed in Elhai, Yang, & Montag, 2020) demonstrates that FOMO is related to greater severity of excessive Internet (Wegmann, Oberst, Stodt, & Brand, 2017;

Yuan, Elhai, & Hall, 2021), smartphone (Elhai et al., 2018; Elhai, Yang, Rozgonjuk, & Montag, 2020; Sha, Sariyska, Riedl, Lachmann, & Montag, 2019; Wolniewicz, Tiamiyu, Weeks, & Elhai, 2018), and SNS use (Dempsey, O'Brien, Tiamiyu, & Elhai, 2019; Fang, Wang, Wen, & Zhou, 2020; Sha et al., 2019).

Our interest was in FOMO's relationship with psychopathology symptom severity. FOMO has revealed small-to-moderate inverse relations with subjective quality of life (Sette, Lima, Queluz, Ferrari, & Hauck, 2020; Sha et al., 2019), small-to-moderate positive relations with negative affect (Elhai, Rozgonjuk, Liu, & Yang, 2020; Wolniewicz, Rozgonjuk, & Elhai, 2020), and moderate associations with neuroticism (Rozgonjuk, Sindermann, Elhai, & Montag, 2021). Furthermore, FOMO has shown small-to-medium positive associations with depression symptom severity and medium-to-large relationships with anxiety severity (Dempsey et al., 2019; Dhir, Yossatorn, Kaur, & Chen, 2018; Elhai et al., 2018; Elhai, Yang, Fang, Bai, & Hall, 2020). Additionally, FOMO demonstrates large positive correlations with perceived stress (Adams, Murdock, Daly-Cano, & Rose, 2020; Elhai et al., 2018). These findings have been revealed in studies spanning numerous parts of the world, including North and South America, Europe, and Asia (Elhai, Yang, & Montag, 2020). Because of these relationships found for FOMO with depression, anxiety, and stress severity, we investigated depression, anxiety and stress as correlates of FOMO in this paper.

The scientific literature on FOMO has only used variable-centered analyses to examine this construct and its relations with other psychological variables. Variable-centered analysis explores relations between levels of one variable and levels of another variable within an overall sample of participants, such as using correlation or regression (Masyn, 2013; McLachlan, Lee, & Rathnayake, 2019). However, an alternative analytic approach involves person-centered analysis, or mixture modeling. Person-centered analysis explores similarities and differences among participants on a set of variables, potentially revealing latent subgroups or clusters of participants, and examines how subgroup membership correlates with other variables of interest (Masyn, 2013; McLachlan et al., 2019). Thus, rather than treating a sample of participants as a homogeneous, single dataset, person-centered analysis can explore how sample heterogeneity relates to other variables. Person-centered analysis for cross-sectional data is typically

conducted using latent class analysis (LCA) for categorical data or latent profile analysis (LPA) for continuous data.

## Aims

Our aim was to use LPA with continuous-scaled FOMO ratings. We explored relations between resulting latent profile membership and severity of depression, anxiety, and stress symptoms. We also included sex as a covariate/predictor of FOMO, given FOMO's positive relationship with female sex in several studies (reviewed in Elhai, Yang, & Montag, 2020). Prior work has not investigated the heterogeneity of FOMO using person-centered analysis.

## Theory

We first used self-determination theory (SDT; Deci & Ryan, 2017; Ryan & Deci, 2000) to conceptualize our research model of psychopathology covariates in relation to FOMO's latent profile membership. SDT attempts to understand how psychological needs and motivation form personality. According to SDT, intrinsic (rather than extrinsic) motivation is an important protective factor for psychological health. Intrinsic motivation involves experience seeking, curiosity, and learning without extrinsic incentives. Furthermore, intrinsic motivation is fostered through socialization and having one's social relatedness needs satisfied. Therefore, social connectedness can influence intrinsic motivation, in turn enhancing psychological health (Koole, Schlinkert, Maldei, & Baumann, 2019).

FOMO has been conceptualized, from the perspective of SDT, as a negative emotional state caused by unmet social relatedness needs (Przybylski et al., 2013). Therefore, people with satisfied social needs should consequently experience less FOMO, but those with unsatisfied social needs should experience greater FOMO (Elhai, Yang, & Montag, 2020; Tandon, Dhir, Almgren, AlNemer, & Mäntymäki, 2021). Negative affectivity, such as depression, anxiety, and stress, play a role in social need fulfillment and FOMO. On one hand, unmet social needs inherent in FOMO can influence negative affectivity (Milyavskaya, Saffran, Hope, & Koestner, 2018; Rozgonjuk, Sindermann, Elhai, & Montag, 2020), a view that fits with SDT, and with research on impaired social functioning causing depression (Kawachi & Berkman, 2001; Santini, Koyanagi, Tyrovolas, Mason, & Haro, 2015).

On the other hand, it is possible that FOMO is a dysfunctional cognitive response to negative affective psychopathology, as previously conceptualized (Elhai, Yang, &

Montag, 2019; Wegmann et al., 2017). The Interaction of Person-Affect-Cognition-Execution (I-PACE) theoretical model of excessive Internet use (Brand et al., 2019; Brand, Young, Laier, Wolfling, & Potenza, 2016) can explain the role of FOMO as a consequence of psychopathology, as well as an influence on excessive Internet communications use. I-PACE proposes that background, predispositional characteristics are important influences on excessive Internet use, and these characteristics involve personality, psychopathology, cognition, and biology, including genetics. I-PACE also discusses psychological variables that are responses to and consequences of predispositional characteristics, including cognitive bias (such as FOMO; Elhai et al., 2019; Wegmann et al., 2017), coping processes, disinhibited behavior, expectancies about Internet use, and craving. Such response variables are also conceptualized in I-PACE as important influences of excessive Internet use. Furthermore, in I-PACE, these response variables are conceptualized as mechanisms that account for how predispositional variables may influence excessive Internet use (Brand et al., 2016, 2019). Thus, I-PACE can account for negative affectivity, such as depression, anxiety, and stress, influencing FOMO (as conceptualized in the present paper), and for FOMO influencing excessive Internet use (not tested here).

Clearly, FOMO is related to negative affectivity; though, there is debate on whether FOMO is the cause or effect. Finally, we should also note that a growing body of research proposes that social media platforms are designed to elicit FOMO-related processes, likely prolonging online time on platforms, such as Facebook (Alutaybi, McAlaney, Stefanidis, Phalp, & Ali, 2018; Montag et al., 2019). Thus, not only are predispositional characteristics responsible for greater levels of FOMO and excessive Internet use, but multiple SNS platforms (Rozgonjuk et al., 2020) that we use may contribute to the problem.

## Hypotheses

Previous research has not used person-centered analyses to examine FOMO ratings. As such, we do not know how many latent profiles to expect in analyzing FOMO ratings, and thus our LPA is exploratory. However, we have specific hypotheses about correlates of FOMO-based latent profile membership, measured by severity of the FOMO profiles (with more severe profiles suggesting greater amounts of FOMO severity), as follows:

*Hypothesis 1 (H1):* Depression symptom severity would be positively related to membership in more severe FOMO-based latent profiles.

Recent studies demonstrate associations between depression and FOMO severity (Dempsey et al., 2019; Dhir et al., 2018; Elhai et al., 2018; Elhai, Yang, Fang, et al., 2020). Such relationship is consistent with SDT (Koole et al., 2019) given FOMO's unmet social connectedness needs related to negative affectivity (Elhai, Yang, & Montag, 2020), and the conceptualization that FOMO is a dysfunctional cognitive response to negative affectivity (Elhai et al., 2019; Wegmann et al., 2017), fitting with the I-PACE model (Brand et al., 2016, 2019).

*Hypothesis 2 (H2):* Anxiety severity would be positively related to more severe FOMO profiles.

Recent work reveals that FOMO is related to anxiety symptoms (Dempsey et al., 2019; Dhir et al., 2018; Elhai et al., 2018; Elhai, Yang, Fang et al., 2020). As with H1, the FOMO–anxiety relationship is consistent with SDT, and with FOMO's conceptualization as a response to negative affectivity within I-PACE. Given that FOMO is conceptualized as more of an anxiety-related than depression-related construct (Elhai, Yang, Fang et al., 2020; Przybylski et al., 2013), FOMO may be more related to anxiety than depression severity in the present study.

*Hypothesis 3 (H3):* Stress severity would be positively related to more severe FOMO latent profiles.

Recent studies show that FOMO is related to perceived stress (Adams et al., 2020; Elhai et al., 2018). The FOMO–stress relationship is also consistent with SDT, and with FOMO as a response to negative affectivity, which fits within I-PACE.

## Research model

Our research model is depicted in Figure 1. We modeled FOMO items with LPA. Psychopathology covariates include depression, anxiety, and stress severity. For reasons stated above, we also included sex as a covariate (Elhai, Yang, & Montag, 2020). Because of the truncated age range (18–25 years), we did not covary for age in the analyses.

## Method

### Participants and procedures

In fall 2018, we recruited student participants for an online survey from a large university (Tianjin Normal University)

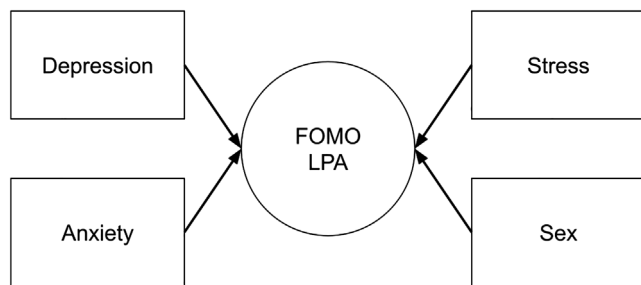


Figure 1. Hypothesized model. Note. FOMO = fear of missing out; LPA = latent profile analysis. The circle represents a latent profile variable, while rectangles indicate observed variables.

in a large, metropolitan city in northeastern China. With assistance from university psychology faculty members, student participants were invited through local online messaging boards and SNS accounts. Interested participants were presented an online informed consent statement, approved by Tianjin Normal University's Department of Psychology ethics review board (in accordance with the Declaration of Helsinki), and if consenting they were routed to an anonymous (non-identifying) online survey on the Chinese platform wjx.cn. We administered all survey instruments in Chinese. Of 1,035 participants, we removed one participant claiming to be 15 years old. We also removed 114 participants for careless/insufficiently effortful responding (Curran, 2016), with at least one string of 20+ consecutive identical item responses. The resulting effective sample included 920 participants.

In the effective sample, average age was 19.42 years ( $SD = 1.65$ ). Most participants were women ( $n = 636$ , 69.1%). A majority were of Chinese Han ethnicity ( $n = 829$ , 90.1%). Most were not in a romantic relationship ( $n = 675$ , 73.4%). The majority were majoring in science ( $n = 534$ , 58.0%), liberal arts ( $n = 227$ , 24.7%), or engineering ( $n = 101$ , 11.1%).

## Instruments

After inquiring about demographic variables, we administered the following surveys. We include internal consistency values in Table 1.

**Depression Anxiety Stress Scale-21.** The Depression Anxiety Stress Scale-21 (DASS-21; Lovibond & Lovibond, 1995) is a self-report measure including 21 items on depression, anxiety, and stress (seven items each). Items are rated over the previous week, from 0 (*Did not apply to me at all*) to 3 (*Applied to me very much or most of the time*). The DASS-21 is reliable and valid (Scholten, Velten,

Bieda, Zhang, & Margraf, 2017), and we used summed scale scores for depression, anxiety, and stress in analyses. We incorporated the Chinese version of the scale, previously supported for its psychometrics (Wang et al., 2016).

**FOMO Scale.** The FOMO Scale (Przybylski et al., 2013) is a self-report measure including 10 items measuring the FOMO construct, such as "I get anxious when I don't know what my friends are up to," and "When I miss out on a planned get-together it bothers me." Items are rated based on current experience, from 1 (*Not at all true of me*) to 5 (*Extremely true of me*). The measure's psychometric properties have been supported (Elhai et al., 2018). We used the 10 FOMO Scale items in analyses. Using exploratory and confirmatory factor analyses, most research on this scale has found one latent factor (Can & Satici, 2019; Elhai et al., 2018; Servidio, 2019), or two factors involving fear of missing out on others' experiences, and ruminative thoughts/strategies to control one's social experiences (Casale & Fioravanti, 2020). We used the Chinese scale version, which has been previously validated (Xie, Wang, Wang, Zhao, & Lei, 2018).

## Analyses

We implemented Version 3.6.1 of the R software (R Core Team, 2020) for data management, and descriptive and correlational analyses. We used R packages *fmsb* (internal reliability), *pastecs* (normality and descriptives), *corrplot* (bivariate correlations), *careless* (insufficient effort), and *sjstats* (ANOVA effects). We did not have missing data, as our web survey required participants to input responses for missed items. FOMO items and psychological scale scores were normally distributed; the largest skewness and kurtosis values were for depression (1.47 and 1.78, respectively).

We used version 8.3 of the Mplus software (Muthén & Muthén, 1998-2019) for LPA of FOMO items. We treated FOMO items as continuously scaled, using maximum likelihood estimation with robust standard errors (Maydeu-Olivares, 2017). We first tested unconditional models (i.e., no covariates) ranging from one profile and higher until fit indices suggested no significant fit increase. We compared models using the Lo-Mendell-Rubin likelihood ratio test (LMR) and its adjusted version (aLMR); a statistically significant LMR/aLMR test would support a model with  $k$  over  $k-1$  profiles (Tein, Coxe, & Cham, 2013). We also considered the Bayesian information criterion (BIC) and sample-size adjusted version (aBIC), with lower values

**Table 1**  
Internal Consistency, Means, and Standard Deviations for the Primary Variables, and Differences Across Sexes

Variable	Alpha	Sample <i>M</i>	Sample <i>SD</i>	Men <i>M</i>	Men <i>SD</i>	Women <i>M</i>	Women <i>SD</i>	<i>F</i> (1, 918)	<i>p</i>	$\eta^2_p$
1. FOMO	.90	26.25	4.90	25.48	6.28	26.59	4.09	10.17	.001	.01
2. Depression	.88	3.44	3.98	3.85	4.21	3.26	3.86	4.20	.04	.01
3. Anxiety	.82	4.59	3.81	4.67	4.08	4.56	3.68	0.18	.68	<.001
4. Stress	.85	5.29	4.16	5.10	4.28	5.38	4.11	0.90	.34	.001

Note. FOMO, fear of missing out.

indicating better fit. Finally, we report entropy, depicting correct classification accuracy (Tein et al., 2013).

After selecting the best fitting but parsimonious LPA model, we added the covariates pictured in Figure 1. We used the Vermunt three-step method in Mplus to regress latent profile membership on covariates using multinomial logistic regression, with posterior probability estimation to account for misclassification (Collier & Leite, 2017).

## Results

We present bivariate intercorrelations between summed scores for the psychological scales in Figure 2, finding that all scales were significantly related ( $ps < .001$ ). Scale descriptive scores and sex differences are displayed in Table 1. Men scored higher on depression severity, while women scored higher on FOMO severity, but effect sizes were very small. We also analyzed scale scores in relation to age using Pearson correlations, but correlations were small in magnitude (highest  $r = .14$ ,  $p < .001$ , for stress).

Table 2 displays the unconditional LPA models compared. Based on LMR and aLMR values, no significant enhancement in fit was found for more than four latent profiles. The four-profile model had the most favorable BIC and aBIC values compared to models with fewer profiles; however, these values were more favorable in the five-profile model. Nonetheless, because LMR and aLMR are the most objective fit indices, we used them to select the four-profile model as best fitting. The four-profile model correctly classified 97% of Profile 1 participants, 86% of Profile 2, 86% of Profile 3, and 96% of Profile 4.

Figure 3 depicts standardized mean FOMO item scores for the four-profile model. Profile 1 is primarily the mildest profile based on FOMO ratings. Profile 2 is about equally mild (compared to Profile 1) on items primarily involving apprehension of missed fun or rewarding activities experienced by friends, but high on remaining items.

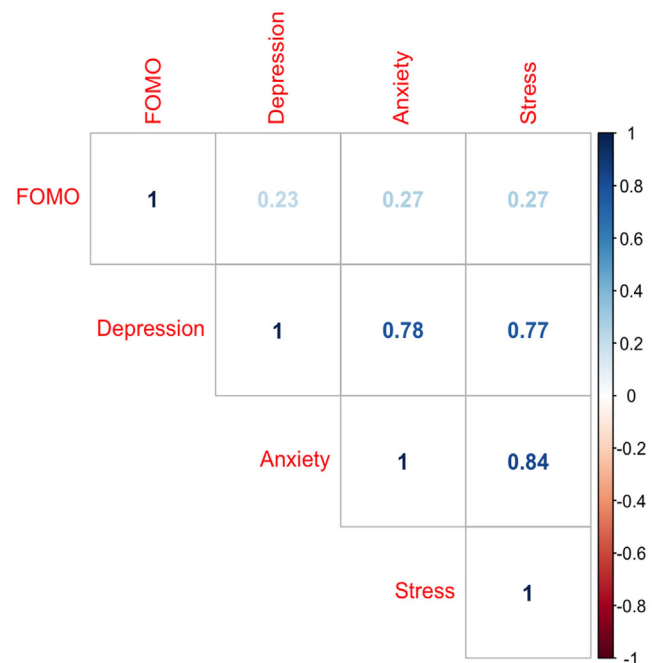


Figure 2. Pearson correlation matrix heat map of primary variables. Note. FOMO = fear of missing out. All correlations were positive in sign. Correlations with a darker shade indicate stronger correlations. All correlations were significant at  $p < .001$ .

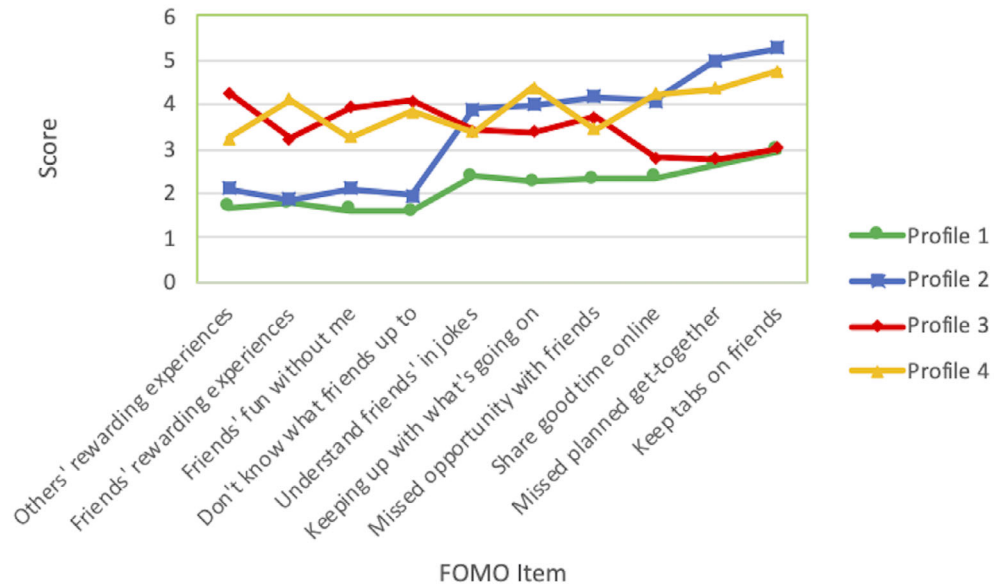
Profiles 3 and 4 are comparatively similar to each other, but diverge for the last three items, with Profile 4 scoring higher on items involving importance of online sharing, being bothered by missing get-togethers, and keeping tabs on friends.

Table 3 presents unstandardized logistic regression coefficients and odds ratios (ORs) for the covariates' associations with FOMO latent profile membership, using the mildest profile (1) as the reference profile. Adjusting for other covariates, female sex and higher stress ratings (H3) were associated with membership in more severe profiles (Profiles 2, 3, and 4, compared to Profile 1); additionally, anxiety severity (H2) was higher in Profile 4 than Profile 1. We also examined other parameterizations, modifying which profile we used as the reference profile. The

**Table 2**  
FOMO Item Latent Profile Analysis Model Comparisons

# of profiles	BIC	aBIC	Entropy	LMR	<i>p</i>	aLMR	<i>p</i>
1	24299.95	24236.44	NA	NA	NA	NA	NA
2	23309.20	23210.74	.94	1065.83	<.001	1051.81	<.001
3	22701.07	22567.69	.87	683.19	<.001	674.21	<.001
<b>4</b>	<b>22367.75</b>	<b>22199.43</b>	<b>.87</b>	<b>408.39</b>	<b>&lt;.001</b>	<b>403.02</b>	<b>&lt;.001</b>
5	22100.99	21897.74	.89	341.83	.08	337.33	.09

Note. FOMO = fear of missing out; BIC = Bayesian information criterion; aBIC = adjusted Bayesian information criterion; LMR = Lo-Mendell-Rubin likelihood ratio test value; aLMR = adjusted LMR; NA = not applicable (not possible to estimate for a one-profile model).



**Figure 3.** The four-profile fear of missing out (FOMO) latent profile analysis model with standardized mean item scores. Note. Profile 1 *n* = 93, Profile 2 *n* = 85, Profile 3 *n* = 175, Profile 4 *n* = 567.

**Table 3**  
FOMO Latent Profile Membership and Relations with Covariates Using Multinomial Logistic Regression and The Vermunt Three-Step Method

Covariate	<i>B</i>	<i>SE</i> of <i>B</i>	<i>z</i>	<i>p</i>	Odds ratio
profile 2 (compared to reference Profile 1)					
Depression	-0.05	0.10	-0.51	.61	0.95
Anxiety	0.06	0.10	0.55	.59	1.06
Stress	0.21	0.08	2.68	.01	1.24
Sex	0.98	0.35	2.79	.01	2.66
profile 3 (compared to reference profile 1)					
Depression	0.06	0.07	0.81	.42	1.06
Anxiety	0.12	0.08	1.45	.15	1.13
Stress	0.17	0.07	2.35	.02	1.19
Sex	1.93	0.32	6.11	<.001	6.91
profile 4 (compared to reference profile 1)					
Depression	0.04	0.07	0.53	.60	1.04
Anxiety	0.16	0.07	2.30	.02	1.18
Stress	0.17	0.06	2.65	.01	1.18
Sex	1.64	0.26	6.33	<.001	5.13

Note. FOMO = fear of missing out. For sex, men = 1, and women = 2 (i.e., a significant positive regression coefficient would indicate that the higher profile is associated with female sex).

only covariate differing between Profiles 2 through 4 was female sex, with women more likely in Profile 4 than 2, *B* = .66, *SE* = .29, *z* = 2.26, *p* = .02, OR = 1.93, and

more likely in Profile 3 than 2, *B* = .96, *SE* = .33, *z* = 2.88, *p* < .01, OR = 2.60 (full parameterization results available upon request).

## Discussion

We found four latent profiles of college participants based on FOMO ratings, distinguished based on severity but also by qualitative differences. Three of the profiles had some diversity in scores across items, while Profile 4 represented relatively flat, high scores across the board, making this profile unique among the others. More severe latent profiles were associated with higher stress severity (H3), as well as female sex. Additionally, the most severe profile scored higher on anxiety symptoms than the least severe profile (H2). Results demonstrate heterogeneity in the experiences of FOMO among Chinese college students, and that distinct profiles based on FOMO had differential associations with anxiety and stress severity.

We did not find support for H1, in that depression severity was not related to more severe FOMO-based latent profiles. Bivariate correlations demonstrated a significant depression–FOMO–severity relationship, which would support SDT's emphasis on unmet social relatedness needs in connection with worse psychological health (Koole et al., 2019), and fits with I-PACE's focus on negative affectivity contributing to cognitive response variables (Brand et al., 2016; Brand et al., 2019), such as FOMO (Elhai et al., 2019; Wegmann et al., 2017). However, this finding did not extend to logistic regression results when modeling FOMO as a latent profile variable. Perhaps the previously found relationship between levels of depression and FOMO (Dempsey et al., 2019; Dhir et al., 2018; Elhai et al., 2018; Elhai, Yang, Fang, et al., 2020) emerge when studying these variables on a continuum, but do not emerge nonlinearly or categorically in person-centered analysis.

We found some support for H2, in that anxiety severity was significantly higher in the most severe profile (4) than the mildest profile (1). This finding fits with SDT and the conceptualization of FOMO involving unmet social connectedness needs associated with negative emotion (Przybylski et al., 2013), and fits with I-PACE's conceptualization that negative affectivity drives cognitive response variables, such as FOMO. Thus, in our study, college students with greater FOMO seemed to have greater anxiety. This finding is also relevant to prior work (albeit using variable-centered analysis) finding that anxiety symptom severity correlated with greater levels of FOMO (Dempsey et al., 2019; Dhir et al., 2018; Elhai et al., 2018; Elhai, Yang, Fang, et al., 2020). Our observation that anxiety severity was significantly higher in the

most severe profile (4) than the mildest profile (1) is in line with our expectations, because the concept of FOMO itself logically should be more closely related to anxiety than depression (Elhai, Yang, Fang, et al., 2020; Przybylski et al., 2013).

We found support for H3, in that stress severity was positively related to more severe FOMO latent profiles among the study's college sample. As with H2, this finding supports FOMO's conceptualization with SDT, and with I-PACE. This result is also relevant to prior (variable-centered) studies revealing a FOMO–stress–severity relationship (Adams et al., 2020; Elhai et al., 2018).

We controlled for sex as a covariate of FOMO latent profile membership, finding that female sex related to more severe latent profiles. Prior work using variable-centered analyses found that female sex associated with higher FOMO ratings (Elhai, Yang, & Montag, 2020). In fact, using measurement invariance testing, Elhai et al. (2018) discovered that the factor structure of FOMO differed across men and women in factor loadings, with sex-based differences in the meaning of the FOMO construct. Perhaps the greater focus on relationship maintenance found in women than men, both off-line (Kawachi & Berkman, 2001) and on-line (Kimbrough, Guadagno, Muscanell, & Dill, 2013; Muscanell & Guadagno, 2012), drives higher FOMO scores to satisfy relationship needs. Such online relationship maintenance is important in college students for building social capital (Vanden Abeele et al., 2018).

Our study had several limitations. First, we used a college student sample, based in a single country (China), and thus results may not generalize to the larger general population in other countries. Second, our research design was cross-sectional, and correlational results cannot confirm causation. Additionally, we used self-report measures of depression, anxiety, and stress severity, rather than clinical diagnostic interviews to assess mental disorders. Nonetheless, this study is unique in conducting person-centered analyses of FOMO, with results suggesting heterogeneity in the construct and relations with psychopathology scores and sex.

## Disclosure of conflict of interest

The authors report no conflicts of interest with this paper's study. Outside the scope of the present paper, Dr. Elhai

notes that he receives royalties for several books published on posttraumatic stress disorder (PTSD); is a paid, full-time faculty member at University of Toledo; is a paid, visiting scientist at Tianjin Normal University; occasionally serves as a paid, expert witness on PTSD legal cases; and receives grant research funding from the U.S. National Institutes of Health. Dr. Montag mentions that he has received (to Ulm University and earlier University of Bonn) grants from agencies such as the German Research Foundation (DFG). Dr. Montag has also performed grant reviews for several agencies; has edited journal sections and articles; has given academic lectures in clinical or scientific venues or companies; and has generated books or book chapters for publishers of mental health texts. For some of these activities, he has received royalties, but not from the gaming or social media industry. Dr. Montag mentions that he is part of a discussion circle (Digitalität und Verantwortung: <https://about.fb.com/de/news/h/gespraechskreis-digitalitaet-und-verantwortung/>) debating ethical questions linked to social media, digitalization, and society/democracy at Facebook. In this context, he receives no salary for his activities. Finally, he mentions that he currently functions as an independent scientist on the scientific advisory board of the Nymphenburg Group. This activity is financially compensated.

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