



A multidimensional view of fear of missing out as a mediator between the need to belong and problematic smartphone use

Shong Po Ng^{a,*}, Jia Yuin Fam^b

^a Department of Psychology, Level 3, Block B, HELP University, Subang 2, Persiaran Cakerawala, 40150, Shah Alam, Selangor, Malaysia

^b Department of Psychology, School of Medical and Life Sciences, Sunway University, 5, Jalan Universiti, Bandar Sunway, 47500, Petaling Jaya, Selangor, Malaysia

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ABSTRACT

Previous research has supported a multidimensional structure to conceptualize the fear of missing out. The present study investigates how does FOMO, conceptualized using a two-factor structure, mediate the relationship between the need to belong and problematic smartphone use. Malaysian undergraduates ($N = 149$) aged between 18 and 25 years old completed questionnaires on the need to belong, fear of missing out components, and problematic smartphone use. Confirmatory factor analysis assessed the validity of the two-factor fear of missing out structure, and a structural model was developed. The findings supported the applicability of the two-factor structure. Next, findings revealed that the need to belong positively predicted one's fears about missing out on rewarding experiences, followed by predicting one's ruminative thoughts about missing out and control strategies to avoid missing out, thus influencing the decision to avoid missing out. However, having a higher need to belong, stronger fears about missing out on rewarding experiences, and a stronger decision to avoid missing out did not predict problematic smartphone use. Future studies should consider investigating the intermediary role of FOMO using a multidimensional conceptualization to explain problematic smartphone use, and consider objective smartphone use measures when assessing smartphone use behaviors.

1. Introduction

Problematic smartphone use is defined as the non-regulated use of smartphones that negatively influences the users' lifestyle (Lopez-Fernandez et al., 2018). An estimated 80% of Malaysian young adults would feel anxious when they are away from their smartphones according to the Malaysian Communications and Multimedia Commission (MCMC, 2017). Problematic smartphone use has been associated with negative outcomes across various areas including mental well-being, academic performance, and productivity (Al-Furaih & Al-Awidi, 2021; Elhai, Sapci, et al., 2021; Gugushvili et al., 2020).

Although numerous studies have investigated the adversity of problematic smartphone use in everyday life, the current literature also encourages researchers to examine how specific predispositions and usage motivations contribute to problematic smartphone use (Panova & Carbonell, 2018; Stanciu & Calugar, 2022). As smartphones are largely neutral tools without an inherently negative connotation (Seo, Kim, & David, 2015), it insinuates the importance of also considering the specific motivations behind why only some smartphone users struggle with problematic usage (Ellis, Davidson, Shaw, & Geyer, 2019; Panova &

Carbonell, 2018). To this end, the current study seeks to review existing empirical evidence and frameworks about the development of problematic smartphone use. The current study is particularly focused on understanding problematic smartphone use from a psychosocial perspective as specific social needs are important usage motivations behind smartphone usage (Chen, 2020; van Deursen, Bolle, Hegner, & Kommers, 2015).

The current literature on the antecedents of problematic smartphone use is heavily inferred from a psychopathological perspective. Specifically, various studies have supported psychopathological conditions as key antecedents of problematic smartphone use among young adults (Elhai, Yang, Fang, Bai, & Hall, 2020; Wolniewicz, Tiamy, Weeks, & Elhai, 2018; Yang, Liu, & Fang, 2021). However, there is limited evidence about the development of problematic smartphone use from a psychosocial perspective. The current study is particularly focused on understanding problematic smartphone use from a psychosocial perspective as specific social needs are important usage motivations behind smartphone usage (Chen, 2020; van Deursen et al., 2015). As social needs are largely neutral and do not hold a negative disposition for problematic usage (Seo et al., 2015), our study is interested in

* Corresponding author. Department of Psychology, Level 3, Block B, HELP University, Subang 2, Persiaran Cakerawala, 40150 Shah Alam, Selangor, Malaysia.
E-mail address: B2000859@helplive.edu.my (S.P. Ng).

understanding how such neutral social needs are specifically linked to problematic smartphone use.

2. Literature review

2.1. Theoretical framework

Various theoretical frameworks have been used to explain how problematic smartphone use develops. The current study draws upon two theoretical frameworks which are the compensatory Internet use theory (CIUT; Kardefelt-Winther, 2014), and the Interaction of Person-Affect-Cognition-Execution (I-PACE) model (Brand et al., 2019). Firstly, the CIUT posits that excessive technological usage reflects a maladaptive coping strategy to compensate for negative real-life experiences (Kardefelt-Winther, 2014). Within the broader literature, empirical evidence has supported the CIUT's application to explain how specific negative experiences precipitate problematic smartphone use (Rozgonjuk, Levine, Hall, & Elhai, 2018; Wolniewicz et al., 2018; Yang et al., 2021). For example, the CIUT has been used to explain that Malaysian undergraduates with poor in-person social experiences are motivated to compensate for such experiences by excessively using smartphones for online social activity (as an alternative approach to social fulfilment; Thanzami, 2022).

Although the CIUT does clarify how specific negative experiences precipitate excessive smartphone use, an additional theoretical framework is needed to explain how individual-level factors are associated with problematic smartphone use. This is primarily because personal social needs are stable and do not necessarily serve as state-like, negative experiences that precipitate problematic smartphone use (Baumeister & Leary, 1995). However, we also believe that such social needs can first predispose one to feel specific negative experiences that the smartphone user seeks to compensate against (Büttner & Rudert, 2022; Leary, Kelly, Cottrell, & Schreindorfer, 2013). For example, an individual with a strong predisposition for social fulfilment is likely to first feel unsatisfied with their current social experiences (Büttner & Rudert, 2022), thus becoming more likely to compensate for their poor social satisfaction through smartphone-based social activity.

In this case, Brand et al. (2019)'s I-PACE model comprehensively explains how such predisposing needs influence one's likelihood of problematic smartphone use. The I-PACE model frames problematic smartphone usage as a result of a collective interaction between one's predisposing core characteristics and their underlying cognitive and affective processes and executive functioning (Brand et al., 2019). Specifically, one's core characteristics are theorized to predispose one towards problematic smartphone use which can include personality traits, psychopathological characteristics, and genetic influence (Brand et al., 2019; Stanciu & Calugar, 2022). These core characteristics interact with one's cognitive and affective processes that arise upon perceiving specific cues (Brand et al., 2019). Some examples of cognitive and affective include cognitive biases about smartphone use, usage expectancies, and craving urges to use smartphones (Brand et al., 2019). When considering the CIUT here, these cognitive and affective processes can emerge as usage expectancies whereby the user is likely to believe that using smartphones can compensate for negative real-life experiences (Wegmann, Oberst, Stodt, & Brand, 2017). Accordingly, such cognitive and affective processes would likely lead to a decision to behave in a specific manner about their smartphone use (for example, deciding to use smartphones socially to specifically meet one's desire for social fulfilment). The I-PACE model has been referenced within the literature to explain how individual factors interact with one's cognitive and affective processes that lead to problematic smartphone use (Elhai et al., 2020; Wegmann, Brandtner, & Brand, 2021). In our study, the I-PACE model offers a comprehensive perspective on the interaction between one's predisposing social needs and problematic smartphone use by also examining the underlying processes that are relevant to one's social well-being.

2.2. Need to belong as a predisposing social need

Existing empirical evidence supports the significance of an individuals' personal social needs behind the development of problematic smartphone use (Su, Larsen, Cousijn, Wiers, & Van den Eijnden, 2022; Wegmann et al., 2021). With smartphones conveniently offering digital social opportunities to users (Chen, 2020), previous studies have tested how perceived social needs are related to problematic smartphone use. A relevant social need to explain problematic smartphone use is the need to belong. The need to belong is defined as the basic human need for social belonging and meaningful relationships with others according to the belongingness hypothesis (Baumeister & Leary, 1995; Leary et al., 2013). As smartphones allow one to access online social networks (Al-Furaih & Al-Awidi, 2021; Panova & Carbonell, 2018), users with a higher need to belong are more motivated to capitalize on smartphones to improve their feeling of belongingness with others (Panek, Khang, Liu, & Chae, 2018; Thanzami, 2022; Çetin, Paliszkievicz, Güler, Köksal, & Cieciora, 2021). Accordingly, smartphone use has become particularly attractive for users with a stronger need to belong as they are likely to perceive unmet social needs (Baumeister & Leary, 1995). Existing evidence generally supports a positive association between the need to belong and problematic smartphone use (Alabri, 2022; Panek et al., 2018; Seo et al., 2015).

Additionally, it is likely that belonging satisfaction needs are more closely associated with smartphone-related activity than general Internet use (Rozgonjuk, Davis, & Montag, 2021). Given that smartphones offer handheld communication features that are easily accessible (Montag, Wegmann, Sariyska, Demetrovics, & Brand, 2021; Rozgonjuk, Davis, & Montag, 2021), it is expected that users with stronger social motivations are more likely to use smartphones than to use non-mobile devices. However, this reasoning also implies that problematic smartphone use would technically refer more closely to problematic Internet use rather than problematic smartphone use given that smartphones are viewed more as tools to access Internet-powered communication (Panova & Carbonell, 2018). While it could be argued that testing for problematic Internet use would then be more appropriate, we should reiterate the study's focus on examining smartphone-based activity over Internet use primarily due to the smartphones' significance for handheld everyday use (Montag et al., 2021; Panova & Carbonell, 2018; Rozgonjuk, Davis, & Montag, 2021). As we conceptualized problematic smartphone use in terms of its adversity in everyday life, it is likely that smartphone use patterns have a more pervasive influence on one's livelihood. Additionally, given that smartphones are primarily used for everyday social purposes among Malaysian smartphone users (MCMC, 2017), our study was particularly interested in examining how predisposing social needs are relevant to problematic usage behaviors that can have implications for everyday livelihood (since problematic smartphone use is "predominantly mobile" compared to problematic Internet use; Montag et al., 2021).

Our study selected the need to belong as the psychosocial need primarily because the need to belong is a basic human motivation that is shared across all humans and differentiated mostly by individual differences (Baumeister & Leary, 1995). The innate nature of the need to belong was an important consideration as it implies that smartphone-related activity among all human smartphone users can be influenced by the need to belong to some degree. This is in line with Baumeister and Leary (1995)'s belongingness hypothesis which iterates that the need to belong shapes one's cognitive and behavioral pattern to focus on fulfilling one's social needs (Alabri, 2022; Baumeister & Leary, 1995). For example, an undergraduate with a higher need to belong is more likely to use smartphones as convenient tools for social fulfilment (Çetin et al., 2021). This is also relevant to the I-PACE model as it primarily postulates that one's core characteristic (in this case, the need to belong) can predispose one towards technological usage behaviors to achieve specific needs (Brand et al., 2019). Investigating the need to belong allows the current study to investigate how a basic social need

predisposes one towards a problematic smartphone use pattern, and how the need to belong interacts with specific cognitive and affective processes that are oriented to fulfil one's desire for social belonging. Hence, we hypothesized that:

H1. The need to belong will positively predict problematic smartphone use.

2.3. Fear of missing out

Within the I-PACE model, specific cognitive and affective processes serve as intermediary variables that link predisposing core characteristics to problematic smartphone use (Brand et al., 2019). A cognitive process that has been observed as an intermediary variable towards problematic smartphone use is the fear of missing out (FOMO; Elhai et al., 2020; Wegmann et al., 2021). FOMO is defined as the “pervasive apprehension that others might be having rewarding experiences from which one is absent” (Przybylski, Murayama, DeHaan, & Gladwell, 2013). Individuals with higher FOMO are highly characterized by their desire to remain connected with others' activity (Przybylski et al., 2013). Current research generally supports FOMO as a driving factor behind both non-problematic and problematic smartphone use behaviors (Roberts & David, 2020; Song & Kim, 2022; Thanzami, 2022; Yang et al., 2021). Although having higher FOMO has also been linked to increased smartphone use that is not inherently problematic (Harrigan et al., 2021; Roberts & David, 2020), there is a stronger agreement that FOMO is more closely linked to the problematic use pathway. Empirical evidence has shown stronger associations between FOMO and problematic smartphone use than with non-problematic smartphone use (Elhai, Sapci, et al., 2021; Servidio, 2021; Yang et al., 2021). Thus, it is expected that having higher FOMO is more closely associated with problematic smartphone use.

Although FOMO was originally conceptualized as a unidimensional construct (Przybylski et al., 2013), the conceptualization insinuates both a cognitive and a cognitive-behavioral facet to FOMO. Specifically, the cognitive facet refers specifically to the individuals' perceived apprehension and worries about others having rewarding experiences when one is absent (“pervasive apprehension that others might be having rewarding experiences from which one is absent”; Przybylski et al., 2013). In contrast, the cognitive-behavioral facet refers to the individuals' characterizing desire to behave in a manner that allows them to avoid missing out (“desire to stay continually connected with what others are doing”; Przybylski et al., 2013). This differentiation was clarified in later studies that offered a different perspective on FOMO's factor structure (Casale & Fioravanti, 2020; Stanciu & Calugar, 2022). For example, Casale and Fioravanti (2020)'s findings indicated a two-factor structure in FOMO when applying Przybylski et al. (2013)'s Fear of Missing Out (FoMO) scale to Italian youth users. Specifically, their conceptualization referred to two factors that referred to: 1) their fear and concerns that others are having rewarding experiences or fun without the respondent (FOMO-Fear), and 2) the control-related thoughts and strategies that aim to achieve a sense of control over one's contextual ongoing (FOMO-Control; Casale & Fioravanti, 2020).

Across the broader literature, other FOMO conceptualizations that extend from Przybylski et al. (2013)'s unidimensional conceptualization have also been observed (Elhai, Yang, & Montag, 2021). For example, FOMO has been conceptualized in terms of its relative stability (Wegmann et al., 2017). Specifically, Wegmann et al. (2017) proposed that FOMO can be construed as both a: 1) stable trait that one is generally worried about missing out on rewarding experiences named “trait-FOMO”, and 2) a less stable cognition bias that arises when one is missing out from online-specific activity named “state-FOMO”. While this factor structure has been tested to predict problematic technological use behaviours (Li, Niu, Mei, & Griffiths, 2022; Wegmann et al., 2017, 2021), their findings suggest that state-FOMO is likely the more relevant concept to explain the significance of FOMO to problematic

technological use. Other empirical evidence also shows that FOMO can be conceptualized in terms of the types of experiences that one is missing out on (Alt, 2015; Li, Huang, & Dou, 2021). For example, Alt (2015)'s findings indicated three specific FOMO types in terms of missing out on online social activity, news-related information, and digital sales information. Similarly, FOMO has also been conceptualized in terms of missing out on social opportunities and anticipated novel information (Li et al., 2021). Meanwhile, two-factor structures have also been observed in translated versions of Przybylski et al. (2013)'s FoMO scale (for example, Zhang, Jiménez, & Cicala, 2020), although it should also be noted that other translated versions instead corroborated Przybylski et al. (2013)'s unidimensional FOMO conceptualization (Can & Satici, 2019; Núñez, García, Cartagena, & Martín, 2022) potentially due to unique cultural differences in FOMO experiences across different groups.

Although the current psychosocial literature has associated FOMO with problematic smartphone use (Elhai et al., 2020; Song & Kim, 2022; Wolniewicz et al., 2018), numerous studies tend to define FOMO experiences using Przybylski et al. (2013)'s unidimensional FOMO conceptualization. While studies using the unidimensional FOMO structure to examine problematic smartphone use have generally supported the significance of FOMO (for example, Elhai et al., 2020), interpretations about FOMO were thus kept only within the theoretically suggested unidimensional FOMO structure (Stanciu & Calugar, 2022). Other empirical evidence supporting the application of a multidimensional over a unidimensional FOMO structure in terms of improved model fit (Li et al., 2021; Zhang et al., 2020) and predicting problematic technological use behaviors (Lo Coco et al., 2020; Stanciu & Calugar, 2022), which urges future researchers to reconsider using a multidimensional FOMO conceptualization (Alt, 2015; Stanciu & Calugar, 2022; Wegmann et al., 2017). Using a multidimensional FOMO conceptualization is meaningful to the existing literature about psychosocial factors of problematic smartphone use because it allows researchers to further clarify the significance of intermediary cognitive and affective processes between neutral social needs and problematic smartphone use. This is important given that other empirical evidence did not show a direct association between psychosocial experiences and problematic smartphone use when underlying cognitions were later considered (Alabri, 2022; Thanzami, 2022; Wegmann et al., 2021). Accordingly, this further emphasizes the relevance of underlying cognitions as a key factor (in addition to predisposing core characteristics) to explain why some smartphone users are guided towards a problematic use pathway.

2.4. Current study design

As the I-PACE framework suggests that an interaction between both a predisposing core characteristic and specific cognitive and affective processes precipitates problematic smartphone use (Brand et al., 2019), our study selected the need to belong as the core psychosocial characteristic. To test how the need to belong is indirectly associated with problematic smartphone use, we chose Casale and Fioravanti (2020)'s two-factor structure as our multidimensional FOMO structure. This is primarily because the FOMO-Fear component closely reflects a cognitive facet of Przybylski et al. (2013)'s FOMO conceptualization as one's fear and worries about missing out on rewarding experiences (Lo Coco et al., 2020; Stanciu & Calugar, 2022). Within the I-PACE model, the FOMO-Fear component reflects one's perceptions about one's social livelihood as individuals only become apprehended about missing out when they find out about an ongoing rewarding experience that they are absent from (Przybylski et al., 2013). Next, the FOMO-Control component (ruminative thoughts and strategies to maintain control over ongoing events; Casale & Fioravanti, 2020) reflects a cognitive-behavioral facet of Przybylski et al. (2013)'s FOMO conceptualization as one's behavior to remain continuously connected with others to avoid missing out. As this cognitive-behavioral facet reflects an

interplay between one's underlying cognition about missing out on rewarding experiences and their decision to avoid missing out, this reflects the I-PACE models' specific cognitive and affective processes (one's ruminative thoughts and strategies about missing out) that relates to a decision to behave in a specific manner (in this case, to behave in a manner to avoid missing out; Brand et al., 2019). Casale and Fioravanti (2020)'s two-factor structure has been applied and explained cross-sectional associations between FOMO and problematic smartphone use (Lo Coco et al., 2020). We conceptualize FOMO-Fear as the fears and worries that one is missing out on rewarding experiences that one is absent from, and FOMO-Control as the ruminative thoughts and control strategies that aim to control ongoing experiences to avoid missing out (Casale & Fioravanti, 2020). Thus, the study hypothesized that:

H2. FOMO-Fear will positively predict problematic smartphone use.

H3. FOMO-Control will positively predict problematic smartphone use.

In this study, the I-PACE model was used to explain how FOMO-Fear and FOMO-Control mediate the relationship between one's need to belong and problematic smartphone use. As the need to belong is a predisposing social motivation (Baumeister & Leary, 1995), we hypothesized that having a higher need to belong increased one's likelihood to believe that one is missing out (FOMO-Fear). Specifically, individuals with a higher need to belong have been suggested to be more strongly predisposed to negative beliefs about their social connectedness with others (Büttner & Rudert, 2022; Leary et al., 2013). Such individuals would be more likely to believe that they are isolated from social experiences that they are missing out on (Alabri, 2022), leading to stronger beliefs that one may be missing out on social experiences. We also hypothesized that having a higher need to belong will predispose one to higher FOMO-Control as individuals with a higher need to belong are more likely to develop thoughts and behave in a manner focused on belongingness (Baumeister & Leary, 1995). In turn, having a higher FOMO-Control is hypothesized to predict problematic smartphone use. While FOMO has been associated with both non-problematic and problematic smartphone use, empirical evidence suggests that FOMO is more likely to predict a problematic than non-problematic use pattern (Elhai, Sapci, et al., 2021; Servidio, 2021). Hence, we hypothesized that:

H4. FOMO-Fear will positively mediate between the need to belong and problematic smartphone use.

H5. FOMO-Control will positively mediate between the need to belong and problematic smartphone use.

Although Casale and Fioravanti (2020)'s study did not originally frame FOMO-Fear as a preceding component to FOMO-Control, our study hypothesized FOMO-Fear precedes FOMO-Control. This is because the I-PACE model postulates that perceptions about one's livelihood precipitate specific cognitive processes that are linked to a decision to behave in a specific manner (Brand et al., 2019). In FOMO-Fear, the fears and worries about missing out from rewarding experiences reflect the cognitive thoughts that arise upon perceiving that one is missing out, corresponding to the cognitive aspect of Przybylski et al. (2013)'s FOMO conceptualization ("pervasive apprehension that others might be having rewarding experiences from which one is absent"; Przybylski et al., 2013; Stanciu & Calugar, 2022). The fears and worries about missing out divert one's focus to ruminate about what could happen in their absence, and "characterize" one to respond by strategizing ways to control ongoing experiences to ensure that they do not miss out (Przybylski et al., 2013). Through this logic, it can be inferred that one's fears and worries about missing out (FOMO-Fear) precipitate thoughts about the social consequences of missing out and the desire to avoid missing out (FOMO-Control), resulting in a decision to engage in behaviors to avoid missing out. With FOMO-Control (ruminative thoughts and control strategies to avoid missing out) reflecting a cognitive-behavioral aspect

of FOMO (Casale & Fioravanti, 2020), it is reasonable to assume that the cognitive aspect of FOMO (fears and worries about missing out from rewarding experiences; Przybylski et al., 2013; Stanciu & Calugar, 2022) is followed by a cognitive-behavioral phase in response (ruminative thoughts and control strategies; Casale & Fioravanti, 2020; Stanciu & Calugar, 2022). Our study thus hypothesized that both FOMO-Fear and FOMO-Control will serially mediate between the need to belong and problematic smartphone use. Hence, we hypothesized that:

H6. The need to belong will positively predict FOMO-Fear, in turn positively predicting FOMO-Control, in turn positively predicting problematic smartphone use.

2.5. Research aim

The present study aimed to investigate how the fear of missing out, conceptualized using Casale and Fioravanti (2020)'s two-dimensional FOMO conceptualization, mediates the relationship between the need to belong and problematic smartphone use among Malaysian undergraduates within the I-PACE model.

3. Methods

3.1. Participants

A non-experimental, cross-sectional questionnaire study was conducted among Malaysian undergraduates aged between 18 and 25 years old who owned a smartphone. Ethical approval was received from the corresponding researchers' institution. Participants were recruited through two sampling methods which were convenience and snowball sampling. Convenience sampling involves recruiting Malaysian undergraduates through the researchers' social media platforms since social media is heavily populated with young adult users (MCMC, 2017). For snowball sampling, participants were encouraged to share the questionnaires with others whom they believed also met the study inclusion criteria upon their completion. The finalized sample consisted of 149 Malaysian undergraduates of which 80.8% were female, and aged from 18 to 25 years old ($M_{\text{age}} = 22.09$, $SD = 1.64$). A total of 166 responses were initially received before data cleaning. A total of 16 responses were removed as they were from participants who did not meet the inclusion criteria while one response was omitted as it was identified as an outlier. The finalized sample consisted of 149 Malaysian undergraduates.

3.2. Measures

3.2.1. Need to belong

Need to belong was assessed using the Need to Belong Scale (NTBS; Leary et al., 2013) which contains 10 items rated on a five-point Likert scale (1 = *Not at all*, 5 = *Extremely*; see Appendix A for Need to Belong Scale). NTBS items 1, 3, and 7 are reverse-scored. An example item is "I try hard not to do things that will make other people avoid or reject me." (Leary et al., 2013). The total NTBS score indicates the participants' need to belong, with higher NTBS scores indicating a higher need to belong. The NTBS showed satisfactory reliability in this study ($\alpha = 0.77$).

3.2.2. Fear of missing out

Przybylski et al. (2013)'s Fear of Missing Out scale was used to assess FOMO experiences in the study which originally contains 10 items rated on a five-point Likert scale (1 = *Not at all true of me*, 5 = *Extremely true of me*). No items were reverse-scored. The full scale showed satisfactory reliability ($\alpha = 0.87$; see Appendix B for the full FOMO scale). To assess for FOMO-Fear and FOMO-Control, the scale items were organized based on Casale and Fioravanti, (2020)'s two-factor structure.

Fear of Missing Out – Fear (FOMO-Fear). FOMO-Fear was assessed using items 1 to 4 from Przybylski et al. (2013)'s Fear of Missing Out

scale (see [Appendix C](#) for FOMO-Fear factor scale). An example item is “I fear others have more rewarding experiences than me.” ([Przybylski et al., 2013](#)). The total score across Items 1, 2, 3, and 4 on the Fear of Missing Out scale indicates the participants’ FOMO-Fear, with a higher total score showing higher FOMO-Fear. The composite reliability of the items used to assess FOMO-Fear showed satisfactory reliability ($\alpha = 0.84$).

Fear of Missing Out – Control (FOMO-Control). FOMO-Control was assessed using items 5 to 10 from [Przybylski et al. \(2013\)](#)’s Fear of Missing Out scale (see [Appendix D](#) for FOMO-Control factor scale). An example item is “Sometimes, I wonder if I spend too much time keeping up with what is going on.” ([Przybylski et al., 2013](#)). The total score across Items 5 to 10 indicates the participants’ FOMO-Control, with a higher total score indicating higher FOMO-Control. The composite reliability of the items used to assess FOMO-Control was satisfactory ($\alpha = 0.80$).

3.2.3. Problematic smartphone use

Problematic smartphone use was assessed with the Problematic Mobile Phone Use Questionnaire – Short Version (PMPUQ-SV; [Lopez-Fernandez et al., 2018](#)). The PMPUQ-SV scale contains 15 items rated on a four-point Likert scale (1 = *Strongly agree*, 4 = *Strongly disagree*; see [Appendix E](#) for the full PMPUQ-SV scale). The PMPUQ-SV contains three subscales which are the “Dependent use” subscale containing five items (Items 1, 4, 7, 10, and 13; see [Appendix F](#) for “Dependent use” sub-factor scale), “Dangerous use” subscale containing five items (Items 2, 5, 8, 11, and 14; see [Appendix G](#) for “Dangerous use” sub-factor scale), and the “Prohibited use” subscale containing five items (Items 3, 6, 9, 12, 15; see [Appendix H](#) for “Prohibited use” sub-factor scale). The total PMPUQ-SV score indicates the participants’ problematic smartphone use, with higher PMPUQ-SV scores indicating a higher problematic smartphone use. The full PMPUQ-SV showed unsatisfactory reliability ($\alpha = 0.68$); the “Dependent use” subscale showed satisfactory reliability ($\alpha = 0.77$) while the “Dangerous use” ($\alpha = 0.68$) and “Prohibited use” ($\alpha = 0.51$) subscales showed unsatisfactory reliability.

3.3. Procedure

The researcher developed an online questionnaire form that consolidates an informed consent form, a socio-demographic form, the NTBS, the Fear of Missing Out scale, and the PMPUQ-SV. All questionnaires were digitally distributed through social media platforms and presented in English. Participation was voluntary and required informed consent. No compensation was provided for the completion of all questionnaires. The online questionnaire outlined the study purpose, the nature of the tasks, the inclusion criteria, and their rights during participation.

Users who were interested in participating were required to digitally indicate informed consent and were then taken to the questionnaires. During the study, participants provided socio-demographic responses on their age, gender, ethnicity, smartphone ownership, and if they were enrolled at a university during the time of participation. Next, participants provided responses on their need to belong, FOMO-Fear, FOMO-Control, and problematic smartphone use. Once the questionnaires had been completed, participants were thanked for their participation and were also encouraged to share the questionnaire with others who they believed also met the inclusion criteria for the study.

3.4. Data analysis

Descriptive statistics and correlational analyses were conducted using IBM SPSS Statistics (Ver. 26.0), while confirmatory factor analysis (CFA) and structural equation modelling (SEM) analysis were conducted with AMOS 22. After data cleaning was conducted to exclude responses that either did not meet the inclusion criteria or were identified as an outlier, a finalized sample of 149 Malaysian undergraduates was

yielded. Descriptive statistics were calculated along with the means and standard deviation of the need to belong, FOMO-Fear, FOMO-Control, and problematic smartphone use. Pearson’s correlation was conducted to examine whether the need to belong, FOMO-Fear, FOMO-Control, and problematic smartphone use were correlated together. Excluding the socio-demographic form, Cronbach’s alpha (α) was tested for each questionnaire to indicate their respective reliability, with $\alpha > 0.70$ indicating satisfactory reliability ([Tavakol & Dennick, 2011](#)).

To test the applicability of [Casale and Fioravanti \(2020\)](#)’s two-factor FOMO structure to the observed data on FOMO-Fear and FOMO-Control, a CFA was conducted with maximum likelihood parameter estimation. This analysis framed both FOMO-Fear and FOMO-Control as latent variables and evaluated the standardized factor loadings of each observed indicator onto each latent variable. Any model modifications were included based on the interpretation of modification indices. Next, a SEM analysis with maximum likelihood estimation tested a measurement model that adequately fits the data. For both CFA and SEM analyses, goodness-of-fit tests were interpreted based on [Hu and Bentler \(1999\)](#)’s recommendations for satisfactory model fit. Model fit was interpreted based on the ratio of chi-square (X^2) to the degree of freedom (df) and its significance at the 0.05 level, the comparative fit index (CFI ≥ 0.90), Tucker-Lewis index (TLI ≥ 0.90), and root mean square error of approximation (RMSEA ≤ 0.80).

The measurement model structure was based on [Brand et al. \(2019\)](#)’s I-PACE model, with the need to belong set as an exogenous latent variable, while FOMO-Fear, FOMO-Control, and problematic smartphone use served as endogenous latent variables. Any model modifications were made based on the interpretation of modification indices and standardized residual covariance. Upon showing adequate fit to the data, a measurement model was selected and ran as a structural model to test how both FOMO-Fear and FOMO-Control mediated the relationship between the need to belong and problematic smartphone use. Mediation effects were tested using bootstrap mediation analysis with 1000 bootstrapped samples at a 95% confidence interval.

4. Results

4.1. Correlational analysis

Pearson’s correlation analyses revealed that the need to belong, FOMO-Fear, and FOMO-Control positively associated with problematic smartphone use. The need to belong positively associated with both FOMO-Fear and FOMO-Control, and FOMO-Fear positively associated with FOMO-Control (see [Table 1](#)).

4.2. Confirmatory factor analysis of two-factor FOMO structure

A CFA model using [Casale and Fioravanti \(2020\)](#)’s two-factor FOMO structure was tested. The model initially yielded a poor fit to the data ($X^2/df = 2.97$, $p < .001$; CFI = 0.89, TLI = 0.85, RMSEA = 0.12). Upon adding residual covariances between Items 1 and 2 in FOMO-Fear, and between Items 7 and 9 along with Items 8 and 10 in FOMO-Control, the two-factor FOMO CFA model yielded a satisfactory model fit ($X^2/df = 1.39$, $p = .081$; CFI = 0.98, TLI = 0.97, RMSEA = 0.05). Standardized factor loadings ranged from 0.54 to 0.81 (see [Fig. 1](#) for two-factor FOMO confirmatory factor analysis model and standardized factor loading estimates). The composite reliability of both FOMO-Fear ($\alpha = 0.84$) and FOMO-Control ($\alpha = 0.80$) were both satisfactory (see [Table 2](#)).

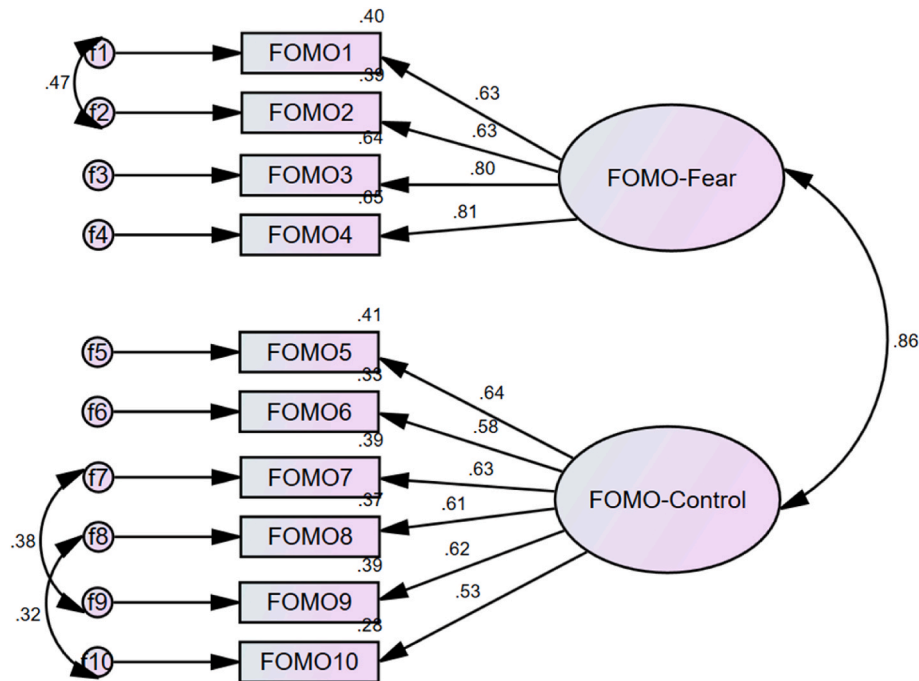
4.3. Measurement model fit

To test the study hypotheses, we tested an initial measurement model that used [Casale and Fioravanti \(FOMO\)](#)’s two-factor structure and the full PMPUQ-SV factor structure labelled as Model 1. Model 1 yielded poor fit to the data ($X^2/df = 1.93$, $p < .001$; CFI = 0.71, TLI = 0.68, RMSEA = 0.08). Although model modifications were made to improve

Table 1

Means, standard deviation, and correlation for the need to belong, FOMO-Fear, FOMO-Control, and problematic smartphone use.

Variables	M	SD	1	2	3	4	5
Need to belong	30.17	6.33	1				
Unidimensional FOMO	24.98	8.07	.65***	1			
FOMO-Fear	9.91	3.97	.61***	.87***	1		
FOMO-Control	15.07	5.00	.57***	.92***	.61**	1	
Problematic smartphone use	33.09	5.46	.22**	.329***	.26**	.32***	1

Note. ** $p < .01$, *** $p < .001$.**Fig. 1.** Confirmatory Factor Analysis Model – Two-Factor FOMO model

Note. Circular shapes labelled “FOMO-Fear” and “FOMO-Control” indicates latent factor of Casale and Fioravanti (2020)’s two-factor FOMO structure. Rectangular shapes indicate observed indicators. Curved double-headed arrows indicate covariance. Only standardized estimates are shown.

the model fit, this model did not reach acceptable model fit to the data ($X^2/df = 1.65$, $p < .001$; CFI = 0.79, TLI = 0.77, RMSEA = 0.07; see Appendix I for unidimensional PMPUQ-SV measurement model labelled as Model 1). Due to poor model fit despite modifications made, we proceeded to use an alternative measurement model that conceptualized problematic smartphone use using Lopez-Fernandez et al. (2018)’s underlying PMPUQ-SV three-factor structure.

The next measurement model, labelled as Model 2, introduced three latent factors based on the PMPUQ-SV’s three-factor structure for “Dependent use”, “Dangerous use”, and “Prohibited use”, whereby each PMPUQ-SV item was loaded based on their respective sub-factor. This model initially yielded poor fit ($X^2/df = 1.77$, $p < .001$; CFI = 0.76, TLI = 0.74, RMSEA = 0.07). However, indicators on the “Prohibited use” latent factor showed poor standardized factor loadings ranging from -0.04 to 0.47 (see Appendix J for three-factor PMPUQ-SV measurement model labelled as Model 2). Furthermore, the “Dangerous use” latent factor did not show a significant correlation with problematic smartphone use ($p = .813$). Notably, the three-factor PMPUQ-SV measurement model showed negative variance which we inferred as a Heywood’s case resulting from the standardized factor loading between “Dependent use” and problematic smartphone use exceeding 1.00. We believed that this measurement model was inappropriate to explain the current data due to: 1) poor standardized factor loadings of “Prohibited use” items relative to “Dependent use” items, 2) overfitting of latent factors in the model to the data, and 3) relatively small sample size

(Farooq, 2022), thus no modifications were made to Model 2 as a re-specified measurement model was needed.

The next measurement model, labelled as Model 3, used the “Dependent use” factor to indicate problematic smartphone use because only the “Dependent use” subscale indicated satisfactory reliability to assess problematic smartphone use ($\alpha = 0.77$). The initial measurement model did not fully yield an adequate fit to the data ($X^2/df = 1.51$, $p < .001$; CFI = 0.90, TLI = 0.89, RMSEA = 0.06). Additional model modifications were made to improve the model fit: 1) removal of Need to Belong Scale (NTBS) item 3, 2) residual covariance between NTBS items 4 and 5, and 3) residual covariance between PMPUQ-SV items 1 and 7. No cross-factor covariances were included. As shown in Table 3, an acceptable model fit was yielded after the model modifications were made ($X^2/df = 1.47$, $p < .001$; CFI = 0.92, TLI = 0.91, RMSEA = 0.06; see Appendix K for “Dependent use” PMPUQ-SV measurement model labelled as Model 3).

4.4. Structural model testing

4.4.1. Two-factor FOMO conceptualization

To test the hypotheses, Model 3 was selected as the structural model for SEM analyses. The model tested for direct effects of the need to belong, FOMO-Fear, and FOMO-Control on problematic smartphone use, and for both independent and serial mediation effects by FOMO-Fear and FOMO-Control on the relationship between the need to

Table 2

Standardized factor loadings and composite reliability of Casale and Fioravanti (2020)'s two-factor FOMO structure.

Factors	1	2
FOMO-Fear (C.R. = .84)		
Item 1: I fear that others have more rewarding experiences than me.		.64
Item 2: I fear that my friends have more rewarding experiences than me.		.63
Item 3: I get worried when I find out my friends are having fun without me.		.81
Item 4: I get anxious when I don't know what my friends are up to.		.80
FOMO-Control (C.R. = .80)		
Item 5: It is important that I understand my friends "in jokes".		.65
Item 6: Sometimes I wonder if I spend too much time keeping up with what is going on.		.59
Item 7: It bothers me when I miss an opportunity to meet up with friends.		.64
Item 8: When I have a good time it is important for me to share the details online (e.g. updating status).		.62
Item 9: When I miss out on a planned get-together it bothers me.		.64
Item 10: When I go on vacation, I continue to keep tabs on what my friends are doing.		.54

Note. The confirmatory model analysis model fit statistics are as follows: $\chi^2 = 43.20$, $df = 31$, $\chi^2/df = 1.39$, $p > .05$; CFI = 0.98, TLI = 0.97, RMSEA = 0.05. C. R. = composite reliability.

Table 3

Model fit of tested measurement models.

Measurement model	Goodness-of-fit indices						
	χ^2	df	χ^2/df	p	CFI	TLI	RMSEA
Model 1	900.452	546	1.649	.000	.788	.769	.067
Model 2	967.261	548	1.765	.000	.762	.741	.072
Model 3	374.029	264	1.417	.000	.919	.908	.053

Note. Model 1 refers to the measurement model using a unidimensional problematic smartphone use factor structure. Model 2 refers to the measurement model using Lopez-Fernandez et al. (2018)'s three-factor problematic smartphone use structure to test problematic smartphone use. Model 3 refers to the measurement model using only the "Dependent use" factor to indicate problematic smartphone use. Model fit indices shown were estimated after model modifications were made and interpreted using Hu and Bentler (1999)'s model fit recommendations.

Table 4

Mediation paths and effects.

Mediation paths	B	SE	95% CI		p-value
			Lower	Upper	
Need to belong → FOMO-Fear → Problematic smartphone use	-.55	1.14	-4.31	0.54	.246
Need to belong → FOMO-Control → Problematic smartphone use	0.22	0.62	-0.12	3.04	.155
Need to belong → FOMO-Fear → FOMO-Control	1.47	1.37	0.47	4.84	.003
Need to belong → FOMO-Fear → FOMO-Control → Problematic smartphone use	0.45	1.12	-0.21	4.51	.127

Note. B = Unstandardized estimate, SE = standard error, CI = confidence interval.

belong and problematic smartphone use (see Table 4).

Firstly, direct effects testing showed that the need to belong did not predict problematic smartphone use ($\beta = .40$, $SE = 0.45$, $p = .129$), thus Hypothesis H1 was unmet. Next, both FOMO-Fear ($\beta = -0.39$, $SE = 0.18$, $p = .226$) and FOMO-Control ($\beta = 0.50$, $SE = 0.19$, $p = .115$) did not directly predict problematic smartphone use, thus Hypotheses H2 and H3 were unmet.

For independent mediation effects, FOMO-Fear did not mediate between the need to belong and problematic smartphone use ($B = -0.55$, $SE = 1.14$, 95% CI [-4.31, 0.54], $p = .246$), thus Hypothesis H4 was unmet. Similarly, FOMO-Control did not mediate between the need to belong and problematic smartphone use ($B = 0.22$, $SE = 0.62$, 95% CI [-0.12, 3.04], $p = .155$), thus Hypothesis H5 was unmet.

For serial mediation effects, FOMO-Fear and FOMO-Control did not serially mediate between the need to belong and problematic smartphone use ($B = 0.45$, $SE = 1.12$, 95% CI [-0.21, 4.51], $p = .127$). However, FOMO-Fear had a significant independent mediation effect between the need to belong and FOMO-Control ($B = 1.47$, $SE = 1.37$, 95% CI [0.47, 4.84], $p = .003$), thus Hypothesis H6 was partially met. The structural model explained 28.2% of the variance in problematic smartphone use among Malaysian undergraduates ($R^2 = 0.282$) as illustrated in Fig. 2.

4.4.2. Additional analyses

A CFA model using Przybylski et al. (2013)'s FOMO structure was also tested to compare against Casale and Fioravanti (2020)'s two-factor FOMO conceptualization. This factor structure initially yielded poor fit to the data ($\chi^2/df = 4.11$, $p < .001$; CFI = 0.81, TLI = 0.76, RMSEA = 0.15). The following model modifications were made: 1) Covariance between FOMO Items 1 and 2, 2) covariance between FOMO Items 7 and 9, and 3) covariance between FOMO Items 8 and 10. Upon these modifications, Przybylski et al. (2013)'s FOMO structure showed acceptable fit to the data ($\chi^2/df = 1.70$, $p = .008$; CFI = 0.96, TLI = 0.95, RMSEA = 0.07). Standardized factor loadings onto FOMO ranged from 0.50 to 0.79 (see Table 5 for standardized factor loadings of unidimensional FOMO model; see Fig. 3 for unidimensional FOMO confirmatory factor analysis model). The unidimensional FOMO structure showed satisfactory reliability ($\alpha = 0.87$).

With the unidimensional FOMO CFA model showing acceptable model fit, we tested a measurement model using unidimensional FOMO conceptualization and the "Dependent use" factor from Lopez-Fernandez et al. (2018)'s PMPUQ-SV scale. This model did not show acceptable model fit initially ($\chi^2/df = 1.55$, $p < .001$; CFI = 0.89, TLI = 0.88, RMSEA = 0.06). Upon removing NTBS item 3, adding a covariance between PMPUQ-SV items 1 and 7, between PMPUQ-SV items 7 and 10, and adding a covariance between NTBS items 4 and 5, an acceptable model fit was yielded ($\chi^2/df = 1.49$, $p < .001$; CFI = 0.91, TLI = 0.90, RMSEA = 0.06; see Table 6). No cross-factor covariances were added. This model was used to test for the mediation effect of unidimensional FOMO between the need to belong and problematic smartphone use (see Appendix L for unidimensional FOMO and "Dependent use" factor measurement model).

With the measurement model showing acceptable model fit, we tested how unidimensional FOMO mediated between the need to belong and problematic smartphone use (see Fig. 4). Results suggested that the need to belong did not predict problematic smartphone use ($\beta = 0.39$, $SE = 0.45$, $p = .134$). Next, unidimensional FOMO did not predict problematic smartphone use ($\beta = 0.11$, $SE = 0.13$, $p = .601$). When testing for mediation effects, unidimensional FOMO did not mediate between the need to belong and problematic smartphone use ($B = 0.16$, $SE = 0.52$, 95%CI [-0.61, 1.48], $p = .577$). The unidimensional FOMO structural model accounted for 23.2% of the variance in problematic smartphone use ($R^2 = 0.232$).

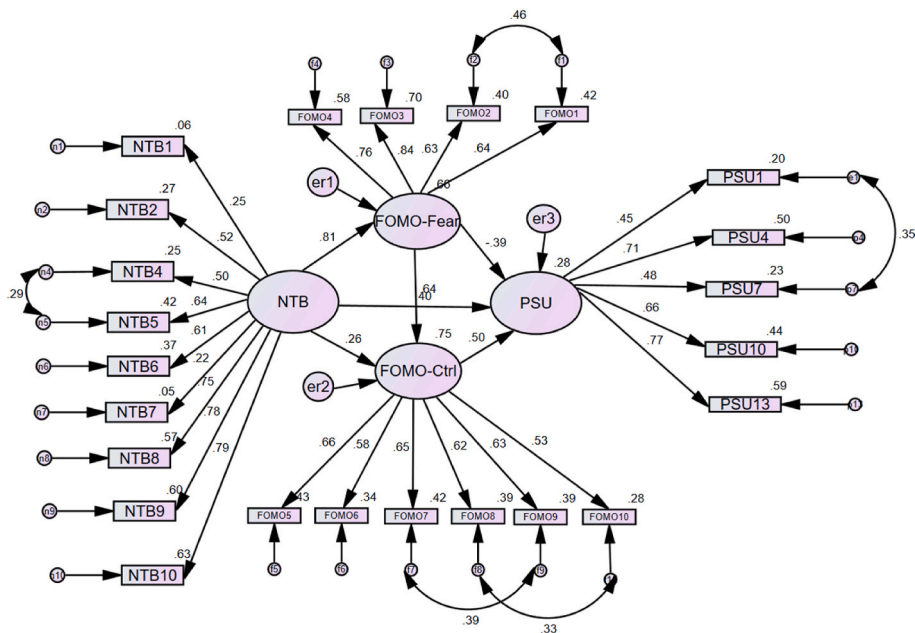


Fig. 2. Structural Model with Standardized Path Estimates
Note. Circles represent latent variables; rectangular shapes indicate observed indicators. NTB indicates need to belong, FOMO-Ctrl indicates FOMO-Control, PSU indicates problematic smartphone use. Curved double-headed arrows indicate covariance between observed indicators. Circles indicating “er” refer to the measurement error of endogenous variables. Standardized path estimate of effect of need to belong on problematic smartphone use is 0.40 ($p = .127$). Standardized path estimate of FOMO-Fear on FOMO-Control is 0.64 ($p < .001$).

Table 5
Confirmatory factor analysis model - unidimensional FOMO standardized factor loadings.

Unidimensional FOMO Factor	Standardized Factor Loadings
Item 1: I fear that others have more rewarding experiences than me.	.61
Item 2: I fear that my friends have more rewarding experiences than me.	.59
Item 3: I get worried when I find out my friends are having fun without me.	.79
Item 4: I get anxious when I don't know what my friends are up to.	.79
Item 5: It is important that I understand my friends “in jokes”.	.63
Item 6: Sometimes I wonder if I spend too much time keeping up with what is going on.	.56
Item 7: It bothers me when I miss an opportunity to meet up with friends.	.59
Item 8: When I have a good time it is important for me to share the details online (e.g. updating status).	.57
Item 9: When I miss out on a planned get-together it bothers me.	.59
Item 10: When I go on vacation, I continue to keep tabs on what my friends are doing.	.50

Note. The factor loadings indicated are shown from testing Przybylski et al. (2013)’s unidimensional FOMO structure.

5. Discussion

5.1. Direct effects of the need to belong and FOMO

With problematic smartphone use becoming an increasingly prevalent issue among Malaysian undergraduates (MCMC, 2017), the current study aimed to investigate how FOMO-Fear and FOMO-Control mediate the relationship between the need to belong and problematic smartphone use. Contrary to the hypotheses, the need to belong did not significantly predict problematic smartphone use. This finding diverges from previous evidence suggesting that the need to belong is associated

with problematic smartphone use (Panek et al., 2018; Wegmann et al., 2021) as users with a higher need to belong are more likely to maximize their perceived belonging through digital communication (Panek et al., 2018). When considering the wider literature about unmet needs satisfaction, having a stronger unmet belonging satisfaction was associated with increased smartphone activity due to the smartphones’ handheld communication features that are accessible to meet one’s social needs (Büttner & Rudert, 2022; Rozgonjuk, Davis, & Montag, 2021).

However, it should also be noted that predisposing social needs similar to the need to belong have also been non-significantly associated with problematic smartphone use when specific underlying cognitions are considered (Thanzami, 2022; Wegmann et al., 2021). We surmised that the non-significant direct effect of the need to belong on problematic smartphone use was likely because our structural model took FOMO into account as an intermediary process linking a predisposing characteristic (need to belong) towards problematic smartphone use (which has been similarly observed in Wegmann et al. (2021)). Alternatively, it is also likely that the need to belong is a largely neutral social motivation that does not inherently lead to problematic behaviors (Seo et al., 2015). Rather, it is also likely that the need to belong is linked to heavier smartphone use that does not have a negative impact on their lives (Chen, 2020; van Deursen et al., 2015; Çetin et al., 2021). As the need to belong has been linked to both non-problematic and problematic smartphone use (for example, Çetin et al. (2021) and Panek et al. (2018) respectively), this aligns with Baumeister and Leary (1995)’s belongingness hypothesis which suggested that individuals with a higher need to belong are more predisposed to improve their perceived belonging such as social smartphone activity. However, it remains unclear behind how having a higher need to belong in itself guides one towards either a non-problematic or problematic use pattern. Future studies should consider further examining the predisposing effect of the need to belong for smartphone users.

Next, neither FOMO-Fear, FOMO-Control nor unidimensional FOMO predicted problematic smartphone use. This was a surprising finding given that the literature suggests that users with higher FOMO would be expected to overuse smartphones as a coping mechanism to avoid

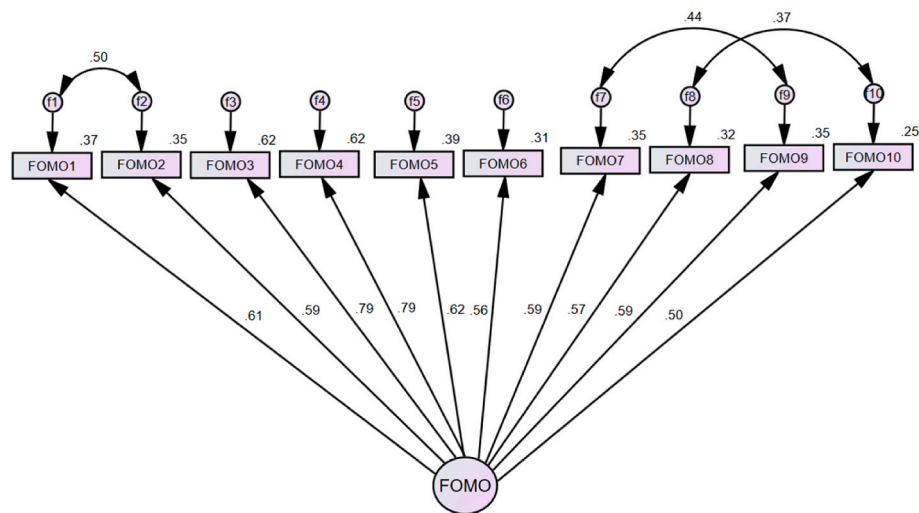


Fig. 3. Confirmatory Factor Analysis Model - Unidimensional FOMO
Note. Circular shape labelled “FOMO” indicates unidimensional FOMO as latent factor. Rectangular shapes indicate observed indicators of FOMO items loaded onto latent factor. Curved double-headed arrows indicate covariance. Only standardized estimates are provided.

Table 6
Unidimensional FOMO and “dependent use” factor measurement model.

Measurement Model	Model Fit Indices						
	X ²	df	X ² /df	p	CFI	TLI	RMSEA
Pre-modification	417.149	269	1.551	.000	.891	.878	.061
Post-modification	360.997	243	1.486	.000	.913	.901	.057

Note. The measurement model uses Przybylski et al. (2013)’s unidimensional FOMO conceptualization and Lopez-Fernandez et al. (2018)’s “Dependent Use” factor to indicate problematic smartphone use. Pre-modification model refers to measurement model prior to covariance addition and item removal. Post-modification refers to measurement model after covariances were added and any items removed. Model fit indices are interpreted with Hu and Bentler (1999)’s model fit recommendations.

missing out (Elhai et al., 2020; Lo Coco et al., 2020; Thanzami, 2022; Wolniewicz et al., 2018). This finding also diverges from Kardefelt-Winther (2014)’s compensatory Internet use theory, which suggests that individuals experiencing negative real-life experiences (such as one’s worries related to missing out on rewarding experiences) are more likely to compensate through technological use behaviors. A possible reason is that Malaysian undergraduates who experience higher FOMO are more likely to turn to in-person relationships instead of using smartphones to avoid missing out (Harrigan et al., 2021). Specifically, Malaysian undergraduates likely rationalize FOMO more closely as a threat to in-person connectedness than to their online connectedness. Consequently, Malaysian undergraduates likely prefer to avoid missing out particularly from in-person interactions than digital social networks to avoid missing out (Seo et al., 2015). Specifically, in-person social opportunities likely offer the acquisition of specific resources that relieve undergraduates’ desire to avoid missing out on which digital platforms may not currently offer, such as physical company (Harrigan et al., 2021; Leary et al., 2013; Roberts & David, 2020). Accordingly, it would be likely that Malaysian undergraduates prefer to remain connected face-to-face to ensure that they do not lose out on their social relationships (Roberts & David, 2020).

However, this explanation may not apply to undergraduates with poor in-person socializing skills as they would be unlikely to engage face-to-face with others to avoid missing out (Seo et al., 2015; Su et al., 2022). In such cases, such students are likely more reliant on smartphones to avoid missing out while also aiming to circumvent in-person social barriers (Chen, 2020). Future theoretical approaches should

consider the significance of one’s in-person social competency to problematic smartphone use given that undergraduates may only choose to use smartphones to avoid missing out, depending on how socially capable one is.

5.2. Mediation effects of two-factor FOMO structure

Next, FOMO-Fear and FOMO-Control did not independently mediate the relationship between the need to belong and problematic smartphone use. However, the need to belong positively predicted FOMO-Fear but did not predict FOMO-Control. The significant association between the need to belong and FOMO-Fear supports previous evidence which suggested that having a higher need to belong increases one’s sensitivity to belongingness threats (Alabri, 2022; Büttner & Rudert, 2022; Leary et al., 2013). In this case, Malaysian undergraduates are more likely to be apprehended by beliefs of missing out on rewarding social experiences (FOMO-Fear) if they have a higher need to belong. Such undergraduates may be more easily apprehended by feelings of missing out as having a higher need to belong reflects a need to be socially included as often as possible (Büttner & Rudert, 2022). In contrast, the need to belong did not predict FOMO-Control, suggesting that having a higher need for belonging may not necessarily encourage one to directly adopt strategies to avoid missing out. It is expected that the need to belong would be more likely to predict FOMO-Fear than FOMO-Control given that the I-PACE model suggests that predisposing characteristics (for example, the need to belong) are more closely proximal to one’s affective and cognitive processes (FOMO-Fear) than to one’s decision to behave in a certain way (for example, the decision to adopt behavioral strategies that allows one to avoid missing out; Brand et al., 2019).

Lastly, the hypothesized serial mediation of FOMO-Fear and FOMO-Control on the relationship between the need to belong and problematic smartphone use was non-significant. However, it should be pointed out that there was a full mediation by FOMO-Fear in the relationship between the need to belong and FOMO-Control, thus this hypothesis was partially supported. When another version of the structural model was run using unidimensional FOMO instead, the findings did not support a mediation effect by unidimensional FOMO between the need to belong and problematic smartphone use. This finding lends partial support to the I-PACE model (Brand et al., 2019) specifically on how predisposing characteristics (the need to belong) precipitate specific cognitive that emerge from perceptions about one’s social livelihood (FOMO-Fear) that lead to decisions to behave in a specific manner to avoid missing out

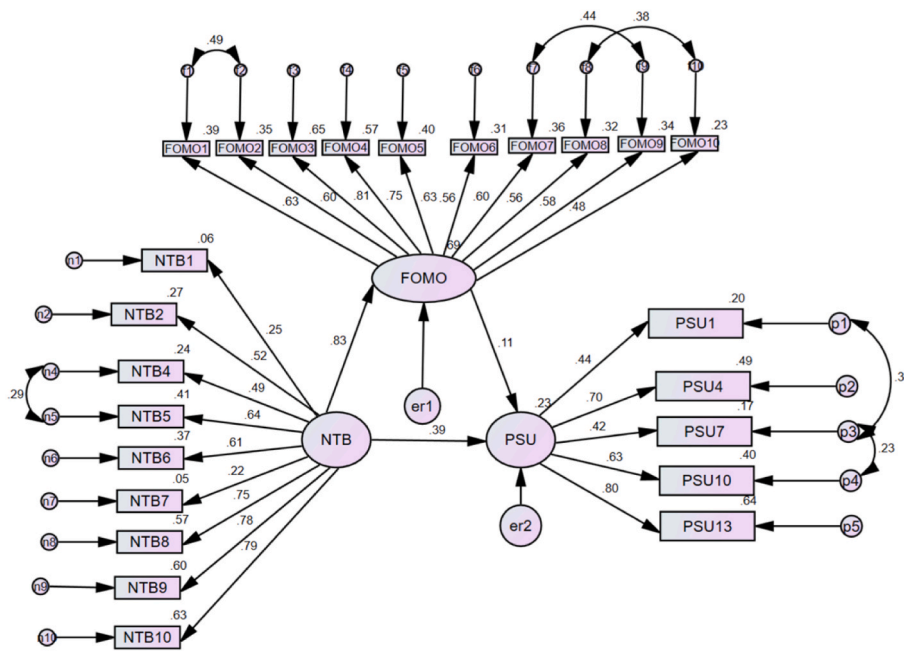


Fig. 4. Unidimensional FOMO Structural Model

Note. Structural model used Przybylski et al. (2013)'s unidimensional FOMO conceptualization. Circular shapes labelled NTB, FOMO, and PSU indicate latent factors, rectangular shapes indicate observed indicators. NTB refers to need to belong, PSU refers to problematic smartphone use. Curved double-headed arrows indicate covariances. Only standardized path estimates are shown. Circles labelled "er" refer to measurement error of the respective endogenous variable.

(FOMO-Control). Within the I-PACE model, core social characteristics (need to belong) predispose one towards specific cognitive processes that arise from one's perceptions about one's social livelihood (FOMO-Fear), which later precipitates cognitive and affective responses about missing out on a rewarding experience (such as ruminative thoughts and planned strategies to avoid missing out; FOMO-Control), thus leading to a decision to behave in a specific manner (Brand et al., 2019). Although the other studies support the I-PACE models' application to explain problematic smartphone use (Elhai et al., 2020; Servidio, 2021), the current findings did not support the I-PACE's premise on how such cognitive and affective responses are thus linked to decisions to behave in a specific manner (problematic smartphone use).

A possible explanation behind why Malaysian undergraduates who intend to avoid missing out may not develop problematic smartphone use is that Malaysian undergraduates perhaps do use smartphones more heavily but not to a problematic extent. Specifically, the I-PACE model suggests that the decision to behave in a specific manner is guided by both an: 1) impulsive (problematic use) system relating to an urge to use smartphones from low inhibitory control, and a 2) deliberative (functional use) system that relates to self-regulated smartphone use (Brand et al., 2019). The deliberative system for self-regulated smartphone use is likely more salient among Malaysian undergraduates, whereby undergraduates are perhaps more likely to use smartphones (to avoid missing out) functionally rather than impulsively (Brand et al., 2019). As a result, Malaysian undergraduates are more likely to habituate their smartphone use to avoid missing out but not towards an impulsive, problematic level (Chen, 2020; Song & Kim, 2022; van Deursen et al., 2015). Alternatively, it is also likely that FOMO-Control would first predict higher smartphone use frequency instead, followed by a greater likelihood of problematic smartphone use (van Deursen et al., 2015). As this certainly suggests an indirect effect of one's impulsive/deliberative system for problematic smartphone use, future research should consider testing for indirect effects of both an impulsive and a deliberative system on problematic smartphone use.

Other considerations on the non-significant effects of the need to belong, FOMO-Fear, and FOMO-Control on problematic smartphone use

should also be discussed. It should be noted that the implemented two-factor FOMO structure was initially developed among Italian youth (Casale & Fioravanti, 2020). Owing to possible cross-cultural differences in FOMO experiences between Malaysian and Italian youth, it is likely that specific FOMO experiences that are unique to Malaysian undergraduates were overlooked by this two-factor structure. As there is little research on FOMO experiences particularly among Malaysian undergraduates (Thanzami, 2022), future exploratory studies should consider exploring how this demographic uniquely internalizes and act upon FOMO experiences. Doing so will allow qualitative inquiry to expand upon Brand et al. (2019)'s I-PACE model on how perceptions about one's social livelihood in specific settings (such as FOMO-Fear) interact with inhibitory/deliberative processing to give rise to specific outcome behaviors (such as problematic and regulated smartphone use behaviors).

5.3. Multidimensionality of FOMO

The study findings showed that the measurement model with: 1) Casale and Fioravanti (2020)'s two-factor structure, and 2) "Dependent use" factor of problematic smartphone use (named Model 3) showed the most improved fit to the data compared to Model 1 and 2. With only the "Dependent use" subscale showing satisfactory reliability and higher standardized factor loadings compared to the "Dangerous use" and "Prohibited use" subscales of the PMPUQ-SV, we surmised that problematic smartphone use among Malaysian undergraduates is likely characterized closely as a dependent-like usage pattern.

Next, the current study supported Casale and Fioravanti (2020)'s two-factor structure when applied. This complements similar literature on using a multidimensional perspective to conceptualize FOMO which has been defined in terms of its stability (Wegmann et al., 2017) and the type of experiences one could miss out on (Alt, 2015; Li et al., 2021). Notably, the intermediary role of FOMO was clarified when comparing the mediation role of FOMO between using a unidimensional and two-factor structure whereby the non-significant mediation of unidimensional FOMO was further clarified to instead show that having a

higher FOMO-Fear was associated with higher FOMO-Control (despite not predicting problematic smartphone use). When we tested FOMO using Przybylski et al. (2013)'s unidimensional FOMO conceptualization, it suggested that having a higher need to belong predisposes one towards a greater apprehension of missing out from rewarding experiences. When using Casale and Fioravanti (2020)'s two-factor perspective instead, it further specifies this mediation by clarifying that having a higher need to belong first predisposes one to a greater apprehension of missing out (FOMO-Fear), followed by stronger ruminative thoughts and likelihood of adopting strategies to avoid missing out (FOMO-Control).

Although much evidence currently supports Przybylski et al. (2013)'s unidimensional conceptualization as a mediator (for example, Elhai et al., 2020; Wolniewicz et al., 2018), applications of multidimensional FOMO structures have not been sufficiently tested to explain technological use behaviors (Stanciu & Calugar, 2022). Despite this, we should also note that our structural model did not predict problematic smartphone use even with an acceptable model fit of the two-factor FOMO structure to the data which was likely due to low statistical robustness. Regardless, the improved fit of Casale and Fioravanti (2020)'s two-factor FOMO structure from using unidimensional FOMO structure hopes to encourage future studies to consider multidimensional FOMO conceptualizations when planning analytical strategies to explain how problematic smartphone use arises.

5.4. Limitations and future implications

There are some limitations to consider in this study. Firstly, the study was conducted using cross-sectional data which limits causality inference. Given that there is limited evidence about the longitudinal effects of underlying cognitions on one's smartphone use behaviour (for example, Lo Coco et al., 2020), future studies should consider testing a cross-lagged model of problematic smartphone use that further clarifies how problematic smartphone use develops over time. Secondly, the study used a relatively small sample size which likely led to statistically underpowered inferences about how the need to belong and FOMO are related to problematic smartphone use. We initially acknowledged that: 1) the wider literature generally supports the link between FOMO and problematic smartphone use (both unidimensional and multidimensional such as Wegmann et al. (2021) and Li et al. (2021) respectively), and 2) the number of indicators loaded on each latent factor was sufficient for model identification, we presumed that the current sample size would be sufficient for interpretation (Wolf, Harrington, Clark, & Miller, 2013). However, a larger sample size would have been required given that the study also tested for both independent and serial mediation effects. We encourage future studies to carefully consider the sample size when testing for mediation using a multidimensional FOMO conceptual model especially if a substantial number of latent variables are being modelled (Wolf et al., 2013). Next, the specified study scope on Malaysian undergraduates limits the generalizability of the findings to other undergraduate groups. Given that there may be potential cross-cultural elements that are unique to Malaysian undergraduates' FOMO experiences, any potential generalization of the current findings to other undergraduates should be made with caution.

Another notable limitation was that the study did not include an objective measure to assess problematic smartphone use. Specifically, differences in the relationship between individual factors and problematic smartphone use have been observed depending on whether a self-report or objective measure was used (Elhai, Yang, & Montag, 2021). For example, evidence suggested that depressive and anxiety symptoms were positively associated with self-reported smartphone use but negatively associated with the users' number of smartphone use pickups and unlocks (Elhai, Sapci, et al., 2021; Rozgonjuk et al., 2018). Additionally, there were relatively weak correlations between self-reported problematic smartphone use and objective smartphone use measures (Rozgonjuk et al., 2018). Similarly, FOMO was associated with self-reported problematic smartphone use but was not associated with

objective smartphone use (Rozgonjuk, Elhai, Sapci, & Montag, 2021). One reason behind this difference is that self-reported scales of problematic smartphone usage are designed to generate responses that likely "validate" the concept of a pathological smartphone use pattern (Ellis et al., 2019).

Given that the concept of a pathological smartphone use pattern remains heavily debated (Panova & Carbonell, 2018; Thanzami, 2022), it is plausible that self-reported problematic smartphone use scales quantify everyday smartphone use more negatively, thus generating responses that are suggestive of a pathological use phenomenon (Elhai, Sapci, et al., 2021; Ellis et al., 2019). This can be undesirable when interpreting self-reported responses about problematic smartphone use as such scales could potentially over-pathologize smartphone use that is not necessarily problematic (for example, heavy smartphone use; Ellis et al., 2019). For example, a user with a high "Dependent use" PMPUQ-SV score heavily uses their smartphones more likely because they have to meet everyday needs through smartphones rather than because they have a genuine problematic smartphone use. With evidence suggesting relatively weak correlations between self-reported scales and objective measures of smartphone use (Rozgonjuk et al., 2018), it suggests that self-reported problematic smartphone use scales likely do not accurately reflect the respondents' actual smartphone use (at least not on their own). Including objective smartphone use measures allows for a more meaningful evaluation of how predisposing core characteristics and underlying cognitions about smartphone use encourage smartphone use in terms of both smartphone use scores and objective smartphone use activity (Elhai, Sapci, et al., 2021). While this should not discredit the relevance of a self-reported scale to assess smartphone use (given that objective smartphone use is not indicative of problematic smartphone use on its own; Rozgonjuk, Elhai, et al., 2021), future researchers should carefully consider various methodological strategies when assessing problematic smartphone use.

The study offers both theoretical and practical implications. Firstly, the non-significant effects of FOMO on problematic smartphone use deviate from previous findings (Elhai et al., 2020; Thanzami, 2022; Wolniewicz et al., 2018). Given that this was a relatively unexpected finding, future research should consider using qualitative inquiry to explore FOMO experiences and the significance of smartphones to such experiences (van Deursen et al., 2015). Secondly, the present confirmatory factor analysis supported Casale and Fioravanti (2020)'s two-factor FOMO structure to frame the FOMO experiences of Malaysian undergraduates. With only a handful of studies testing FOMO using a multidimensional conceptualization to explain problematic technological use behaviors (for example, Stanciu & Calugar, 2022; Zhang et al., 2020), future research should consider further validating multidimensional FOMO conceptualizations when examining how such behaviors such as problematic smartphone use arises. Lastly, the significant mediation by FOMO-Fear on the relationship between the need to belong and FOMO-Control may be insightful for Malaysian higher education institutions. As the findings suggest that Malaysian undergraduates with a higher need to belong are more likely to be apprehended by FOMO perceptions, it has a potential displacement effect on academic pursuits in favor of the desire to avoid missing out (Harrigan et al., 2021). Higher education systems can benefit from this finding by considering how social needs play a role in the development of behaviors that displace academic pursuits.

Our study investigated how the fear of missing out, conceptualized using a two-factor structure, mediates the relationship between the need to belong and problematic smartphone use among Malaysian undergraduates within the I-PACE framework. The findings supported the application of the two-factor FOMO structure to the data. Next, our findings showed that the need to belong predicted one's fears and worries about missing, in turn predicting one's ruminative thoughts about missing out and strategies to avoid missing out, leading to a decision to avoid missing out. However, the findings did not manage to predict problematic smartphone use despite supporting an association

between the need to belong and FOMO components. The study encourages future research to test the significance of FOMO to problematic smartphone use using a multidimensional conceptualization. Our study also encourages future studies to use objective smartphone use measures when investigating how core characteristics and usage motivations predict smartphone use behaviors, and to explore how else and why problematic smartphone use remains a significant behavioral issue among undergraduate groups.

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CRediT authorship contribution statement

Shong Po Ng: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. **Jia Yui Fam:** Conceptualization, Project administration, Supervision, Validation, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Ng, Shong Po (2023), “NTB_Multidimensional_FOMO_PSU dataset”, Mendeley Data, V1, doi: 10.17632/vxmyzz5czj.1

Appendix A. Supplementary data

Supplementary data to this article can be found online here at <https://doi.org/10.1016/j.chbr.2023.100352> and <https://doi.org/10.17632/vxmyzz5czj.1>

References

- Al-Furaih, S. A. A., & Al-Awidi, H. M. (2021). Fear of missing out (FoMO) among undergraduate students in relation to attention distraction and learning disengagement in lectures. *Education and Information Technologies*, 26(2), 2355–2373. <https://doi.org/10.1007/s10639-020-10361-7>
- Alabri, A. (2022). Fear of missing out (FOMO): The effects of the need to belong, perceived centrality, and fear of social exclusion. *Human Behavior and Emerging Technologies*. <https://doi.org/10.1155/2022/4824256>, 2022, Article 4824256.
- Alt, D. (2015). College students' academic motivation, media engagement and fear of missing out. *Computers in Human Behavior*, 49, 111–119. <https://doi.org/10.1016/j.chb.2015.02.057>
- Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, 117(3), 497–529. <https://psycnet.apa.org/doi/10.1037/0033-2909.117.3.497>
- Brand, M., Wegmann, E., Stark, R., Müller, A., Wölfling, K., Robbins, T. W., et al. (2019). The Interaction of Person-Affect-Cognition-Execution (I-PACE) model for addictive behaviors: Update, generalization to addictive behaviors beyond internet-use disorders, and specification of the process character of addictive behaviors. *Neuroscience & Biobehavioral Reviews*, 104, 1–10. <https://doi.org/10.1016/j.neubiorev.2019.06.032>
- Büttner, C. M., & Rudert, S. C. (2022). Why didn't you tag me?!: Social exclusion from Instagram posts hurts, especially those with a high need to belong. *Computers in Human Behavior*, 127, Article 107062. <https://doi.org/10.1016/j.chb.2021.107062>
- Can, G., & Satici, S. A. (2019). Adaptation of fear of missing out scale (FoMOs): Turkish version validity and reliability study. *Psicologia: Reflexão e Crítica*, 32. <https://doi.org/10.1186/s41155-019-0117-4>, Article 3.
- Casale, S., & Fioravanti, G. (2020). Factor structure and psychometric properties of the Italian version of the fear of missing out scale in emerging adults and adolescents. *Addictive Behaviors*, 102. <https://doi.org/10.1016/j.addbeh.2019.106179>, Article 106179.
- Çetin, F., Paliszkievicz, J., Güler, M., Köksal, O., & Cieciora, M. (2021). Exploring relational needs on using social network sites. *Journal of Computer Information Systems*, 62(4), 790–801. <https://doi.org/10.1080/08874417.2021.1919940>
- Chen, C.-Y. (2020). Smartphone addiction: Psychological and social factors predict the use and abuse of a social mobile application. *Information, Communication & Society*, 23(3), 454–467. <https://doi.org/10.1080/1369118X.2018.1518469>
- van Deursen, A. J. A. M., Bolle, C. L., Hegner, S. M., & Kommers, P. A. M. (2015). Modeling habitual and addictive smartphone behavior: The role of smartphone use types, emotional intelligence, social stress, self-regulation, age, and gender. *Computers in Human Behavior*, 45, 411–420. <https://doi.org/10.1016/j.chb.2014.12.039>
- Elhai, J. D., Sapci, O., Yang, H., Amialchuk, A., Rozgonjuk, D., & Montag, C. (2021). Objectively-measured and self-reported smartphone use in relation to surface learning, procrastination, academic productivity, and psychopathology symptoms in college students. *Human Behavior and Emerging Technologies*, 3(5), 912–921. <https://doi.org/10.1002/hbe2.254>
- Elhai, J. D., Yang, H., Fang, J., Bai, X., & Hall, B. J. (2020). Depression and anxiety symptoms are related to problematic smartphone use severity in Chinese young adults: Fear of missing out as a mediator. *Addictive Behaviors*, 101. <https://doi.org/10.1016/j.addbeh.2019.04.020>, Article 105962.
- Elhai, J. D., Yang, H., & Montag, C. (2021). Fear of missing out (FOMO): Overview, theoretical underpinnings, and literature review on relations with severity of negative affectivity and problematic technology use. *Brazilian Journal of Psychiatry*, 43, 203–209. <https://doi.org/10.1590/1516-4446-2020-0870>
- Ellis, D. A., Davidson, B. I., Shaw, H., & Geyer, K. (2019). Do smartphone usage scales predict behavior? *International Journal of Human-Computer Studies*, 130, 86–92. <https://doi.org/10.1016/j.ijhcs.2019.05.004>
- Farooq, R. (2022). Heywood cases: Possible causes and solutions. *International Journal of Data Analysis Techniques and Strategies*, 14(1), 79–88. <https://doi.org/10.1504/IJDATS.2022.121506>
- Gugushvili, N., Täht, K., Rozgonjuk, D., Raudlam, M., Ruiter, R., & Verduyn, P. (2020). Two dimensions of problematic smartphone use mediate the relationship between fear of missing out and emotional well-being. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace*, 14(2). <https://doi.org/10.5817/CP2020-2-3>, Article 3.
- Harrigan, M. M., Benz, I., Hauck, C., LaRocca, E., Renders, R., & Roney, S. (2021). The dialectical experience of the fear of missing out for U.S. American iGen emerging adult college students. *Journal of Applied Communication Research*, 49(4), 424–440. <https://doi.org/10.1080/00909882.2021.1898656>
- Hu, L.-T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, 6(1), 1–55. <https://doi.org/10.1080/10705519909540118>
- Karddefelt-Winther, D. (2014). A conceptual and methodological critique of internet addiction research: Towards a model of compensatory internet use. *Computers in Human Behavior*, 31, 351–354. <https://doi.org/10.1016/j.chb.2013.10.059>
- Leary, M. R., Kelly, K. M., Cottrell, C. A., & Schreindorfer, L. S. (2013). Construct validity of the need to belong scale: Mapping the nomological network. *Journal of Personality Assessment*, 95(6), 610–624. <https://doi.org/10.1080/00223891.2013.819511>
- Li, Y.-Y., Huang, Y.-T., & Dou, K. (2021). Validation and psychometric properties of the Chinese version of the fear of missing out scale. *International Journal of Environmental Research and Public Health*, 18(18). <https://doi.org/10.3390/ijerph18189896>, Article 9896.
- Li, L., Niu, Z., Mei, S., & Griffiths, M. D. (2022). A network analysis approach to the relationship between fear of missing out (FoMO), smartphone addiction, and social networking site use among a sample of Chinese university students. *Computers in Human Behavior*, 128, Article 107086. <https://doi.org/10.1016/j.chb.2021.107086>
- Lo Coco, G., Salerno, L., Franchina, V., La Tona, A., Di Blasi, M., & Giordano, C. (2020). Examining bi-directionality between fear of missing out and problematic smartphone use: A two-wave panel study among adolescents. *Addictive Behaviors*, 106. <https://doi.org/10.1016/j.addbeh.2020.106360>, Article 106360.
- Lopez-Fernandez, O., Kuss, D. J., Pontes, H. M., Griffiths, M. D., Dawes, C., Justice, L. V., et al. (2018). Measurement invariance of the short version of the problematic mobile phone use questionnaire (PMPUQ-SV) across eight languages. *International Journal of Environmental Research and Public Health*, 15(6). <https://doi.org/10.3390/ijerph15061213>, Article 1213.
- Malaysian Communications and Multimedia Commission. (2017). *Handphone users survey (statistical brief number 22)*. <https://www.mcmc.gov.my/skmmgovmy/media/General/pdf/HPUS2017.pdf>
- Montag, C., Wegmann, E., Sariyska, R., Demetrovics, Z., & Brand, M. (2021). How to overcome taxonomical problems in the study of Internet use disorders and what to do with “smartphone addiction”. *Journal of Behavioral Addictions*, 9(4), 908–914. <https://doi.org/10.1556/2006.8.2019.59>
- Núñez, H. Q., García, M. C., Cartagena, D. G., & Martín, R. (2022). Validación de la escala FoMOs (Fear of Missing Out scale) en el contexto colombiano. *Pensamiento Americano*, 15(30), 1–11. <https://doi.org/10.21803/penamer.15.30.490>
- Panek, E., Khang, H., Liu, Y., & Chae, Y.-G. (2018). Profiles of problematic smartphone users: A comparison of South Korean and U.S. College students. *Korea Observer*, 49 (3), 437–464. <https://doi.org/10.29152/KOIKS.2018.49.3.437>
- Panova, T., & Carbonell, X. (2018). Is smartphone addiction really an addiction? *Journal of Behavioral Addictions*, 7(2), 252–259. <https://doi.org/10.1556/2006.7.2018.49>
- Przybylski, A. K., Murayama, K., DeHaan, C. R., & Gladwell, V. (2013). Motivational, emotional, and behavioral correlates of fear of missing out. *Computers in Human Behavior*, 29(4), 1841–1848. <https://doi.org/10.1016/j.chb.2013.02.014>
- Roberts, J. A., & David, M. E. (2020). The social media party: Fear of missing out (FoMO), social media intensity, connection, and well-being. *International Journal of Human-Computer Interaction*, 36(4), 386–392. <https://doi.org/10.1080/10447318.2019.1646517>

- Rozgonjuk, D., Davis, K. L., & Montag, C. (2021). The roles of primary emotional systems and need satisfaction in problematic internet and smartphone use: A network perspective. *Frontiers in Psychology*, 12. <https://doi.org/10.3389/fpsyg.2021.709805>. Article 709805.
- Rozgonjuk, D., Elhai, J. D., Sapci, O., & Montag, C. (2021). Discrepancies between self-reports and behavior: Fear of missing out (FoMO), self-reported problematic smartphone use severity, and objectively measured smartphone use. *Digital Psychology*, 2(2), 3–10. <https://doi.org/10.24989/dp.v2i2.2002>
- Rozgonjuk, D., Levine, J. C., Hall, B. J., & Elhai, J. D. (2018). The association between problematic smartphone use, depression and anxiety symptom severity, and objectively measured smartphone use over one week. *Computers in Human Behavior*, 87, 10–17. <https://doi.org/10.1016/j.chb.2018.05.019>
- Seo, M., Kim, J.-H., & David, P. (2015). Always connected or always distracted? ADHD symptoms and social assurance explain problematic use of mobile phone and multicomputing. *Journal of Computer-Mediated Communication*, 20(6), 667–681. <https://doi.org/10.1111/jcc4.12140>
- Servidio, R. (2021). Self-control and problematic smartphone use among Italian university students: The mediating role of the fear of missing out and of smartphone use patterns. *Current Psychology*, 40(8), 4101–4111. <https://doi.org/10.1007/s12144-019-00373-z>
- Song, H.-Y., & Kim, J.-H. (2022). Smartphone use type, fear of missing out, social support, and smartphone screen time among adolescents in Korea: Interactive effects. *Frontiers in Public Health*, 10. <https://doi.org/10.3389/fpubh.2022.822741>. Article 822741.
- Stanciu, D., & Calugar, A. (2022). What is irrational in fearing to miss out on being online. An application of the I-PACE model regarding the role of maladaptive cognitions in problematic internet use. *Computers in Human Behavior*, 135, Article 107365. <https://doi.org/10.1016/j.chb.2022.107365>
- Su, S., Larsen, H., Cousijn, J., Wiers, R. W., & Van den Eijnden, R. J. J. M. (2022). Problematic smartphone use and the quantity and quality of peer engagement among adolescents: A longitudinal study. *Computers in Human Behavior*, 126, Article 107025. <https://doi.org/10.1016/j.chb.2021.107025>
- Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education*, 2, 53–55.
- Thanzami, V. (2022). Risk factors for smartphone overuse among university students in Malaysia. In S. K. Sia, L. S. Crane, A. K. Jain, & S. Bano (Eds.), *Understanding psychology in the context of relationship, community, workplace and culture*. Springer. https://doi.org/10.1007/978-981-19-2693-8_10.
- Wegmann, E., Brandtner, A., & Brand, M. (2021). Perceived strain due to COVID-19-related restrictions mediates the effect of social needs and fear of missing out on the risk of a problematic use of social networks. *Frontiers in Psychiatry*, 12. <https://doi.org/10.3389/fpsyg.2021.623099>. Article 623099.
- Wegmann, E., Oberst, U., Stodt, B., & Brand, M. (2017). Online-specific fear of missing out and Internet-use expectancies contribute to symptoms of Internet-communication disorder. *Addictive Behaviors Reports*, 5, 33–42. <https://doi.org/10.1016/j.abrep.2017.04.001>
- Wolf, E. J., Harrington, K. M., Clark, S. L., & Miller, M. W. (2013). Sample size requirements for structural equation models: An evaluation of power, bias, and solution propriety. *Educational and Psychological Measurement*, 73(6), 913–934. <https://doi.org/10.1177/0013164413495237>
- Wolniewicz, C. A., Tiamiyu, M. F., Weeks, J. W., & Elhai, J. D. (2018). Problematic smartphone use and relations with negative affect, fear of missing out, and fear of negative and positive evaluation. *Psychiatry Research*, 262, 618–623. <https://doi.org/10.1016/j.psychres.2017.09.058>
- Yang, H., Liu, B., & Fang, J. (2021). Stress and problematic smartphone use severity: Smartphone use frequency and fear of missing out as mediators. *Frontiers in Psychiatry*, 12. <https://doi.org/10.3389/fpsyg.2021.659288>. Article 659288.
- Zhang, Z., Jiménez, F. R., & Cicala, J. E. (2020). Fear of missing out scale: A self-concept perspective. *Psychology and Marketing*, 37(11), 1619–1634. <https://doi.org/10.1002/mar.21406>