Self-control and problematic smartphone use among Italian University students: The mediating role of the fear of missing out and of smartphone use patterns

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Abstract

The aim of the study was to investigate the mediating role of the fear of missing out (FoMO) and of smartphone use patterns (SUP) on self-control and problematic smartphone use (PSU) among Italian university students. This study involved 405 students (mean age 22.11 years). The data were collected by using a paper-pencil method. The hypotheses of the study were tested by using the Person correlation analysis and a structural equation model (SEM). The results of the study showed that females exhibited higher scores in PSU, self-control, and socializing patterns in smartphone use, whereas males scored higher in information-seeking and entertainment. No significant differences emerged between gender and FoMO. We found a partial mediation only by FoMO on the relationship between self-control and PSU and none by SUP. A significant indirect effect, however, emerged when SUP was related to FoMO. The current findings not only confirm the previous results but also provide new evidence regarding the association between self-control and PSU.

Keywords Problematic smartphone use · Self-control · Fear of missing out · Smartphone use patterns · University students

Introduction

Over the last 10 years, smartphones have become so ubiquitous that a society without them is almost unimaginable. The smartphone is not only a constant "friend" for many people, but it has become the primary tool for knowing the world. Although smartphones offer several benefits in terms of communication and access to information, there is growing amount of evidence that they can have negative effects and that their overuse can become problematic (Oberst et al. 2017; Yang et al. 2018).

Problematic Smartphone Use

With the widespread phenomenon of smartphone availability, especially among adolescents, researchers have started exploring whether its excessive use could lead to addiction (Billieux et al. 2015a, b; Carbonell et al. 2018; Lopez-Fernandez et al. 2017). Moreover, some scholars suggest that we should differentiate between habitual smartphone use and smartphone overuse (van Deursen et al. 2015). Habitual smartphone use is driven by an acquired habit to engage in smartphone interactions, such as checking for notifications (Oulasvirta et al. 2012). In contrast, it has been suggested that the risk of smartphone overuse is a detrimental behaviour typically carried out to relieve pain or escape from negative emotional states (Billieux et al. 2015a, 2015b). Excessive smartphone use, on the other hand, has been described using different terms such as smartphone addiction, proneness to smartphone addiction, and smartphone overuse (Rozgonjuk and Elhai 2019). Thus, the current debate on the terminology used to depict this social phenomenon is ongoing, and recently the expression "problematic smartphone use" (PSU) has been proposed to explain the detrimental effects of excessive smartphone use (Panova and Carbonell 2018; Rozgonjuk and Elhai 2019). A prior study found that the daily application most used by females, more than males, is WhatsApp, a smartphone communication app that facilitates the exchange of instant messages and multimedia contents (Montag et al. 2015). However, the general idea is that people are not dependent on the smartphone itself, but rather on one or more activities that can

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be performed through the device (e.g., gaming, social networking, chatting). For example, individuals characterized by an insecure attachment style are more prone to use the smartphone to call people close to them if this is the only way for them to maintain effective relationships (Billieux et al. 2015a, b).

The relationship between gender differences and PSU is still ambiguous. Some evidence suggest that gender plays a crucial role in influencing the risk of PSU (Chen et al. 2017; Jiang and Zhao 2016) and recently a similar result has been recorded in connection with social media users (Andreassen et al. 2017). Despite these outcomes, researchers have found no substantial differences in terms of gender when it comes to PSU (Güzeller and Coşguner 2012). It is reasonable to investigate gender differences in PSU mainly to develop healthcare strategies to prevent the negative impacts of the new communication devices.

Results from recent studies suggest that PSU negatively impacts on individuals' well-being as well as on academic performance and interpersonal relationships (Elhai et al. 2017a, b; Yang et al. 2018). Daily interruptions, for example, moderated the relationship between smartphone overuse and negative impacts on work productivity (Duke and Montag 2017). Participants who scored higher in smartphone overuse reported decreased productivity due to the time spent on the smartphone during work hours. Other previous studies have demonstrated that psychological factors (e.g., stress, self-esteem, self-control, anxiety, and depression) (Cho et al. 2017; Gökçearslan et al. 2018) and recently nomophobia, defined as the discomfort or anxiety caused by not having a smartphone connection, are related to PSU (Yildiz Durak 2018).

Self-Control

Self-control can be defined as a dispositional capacity of the self to operate appropriate adjustments to adapt to the surrounding environment (Tangney et al. 2004). It refers to the individual's ability to override thoughts and emotions, as well as to interrupt undesired behavioural trends that could be in contrast with the predominant objective (Mao et al. 2018). Individuals who have limited self-control are more prone to drug addiction and recent studies have found an association with increased PSU, resulting in an impulse to check the status of one's device (Cho et al. 2017; Jiang and Zhao 2016; Yang et al. 2018). Yet, it has been demonstrated that the procrastination trait, essentially a disposition for failure in self-control, is related to PSU and social media use (Rozgonjuk et al. 2018). In contrast, good self-control is associated with well-being and adaptive behaviour, as demonstrated by a recent review (De Ridder and Gillebaart 2017).

For example, Jiang and Zhao (2016) have argued that self-control is a predictor of PSU because it is related to impulsiveness, which is a factor that contributes to self-control, but also of smartphone use patterns (SUP). Another recent research tested the role of self-control between stress and PSU (Cho et al. 2017). The results indicated that self-control mediated this relationship: as stress increased, self-control decreased, demonstrating that self-control can be considered a protective factor. People who use a smartphone with a permanent Internet connection often face a cognitive self-control dilemma: whether to use their smartphone to check social media or communication applications or to pursue other personal goals.

As regards the relationship between self-control and SUP, a prior study showed that people with a low level of self-control are more likely to answer smartphone notifications immediately after they receive them, suggesting that people frequently fail to regulate their behaviour when it comes to technological habits (Berger et al. 2018). Further studies, however, are needed to investigate the possible pathway of how self-control can affect both SUP and PSU.

Smartphone Use Patterns and Problematic Smartphone Use

Negative results in relation to PSU and SUP have led researchers to explore the addictive effects of smartphone use (Jiang and Zhao 2016). However, to better investigate the association between PSU and SUP, some scholars suggest making a distinction between process smartphone use and social smartphone use (Rozgonjuk and Elhai 2019; Rozgonjuk et al. 2019). While process smartphone use is related to the gratifying effects of consuming media (e.g., watching videos, online gaming, etc.), social smartphone use (e.g., calling and texting friends, social media networking, etc.) leads to pleasurable experiences through socially mediated interaction (Rozgonjuk and Elhai 2019). From this perspective, results from a recent study demonstrate that anxiety is related to process smartphone use, but not social smartphone use (Elhai et al. 2017a, b). Anxious individuals probably feel more comfortable when they are involved in online social interaction, presumably because this modality is less anxiety-provoking. Conversely, participants with severe depression engage in less socially-related smartphone use. Depressed individuals tend to avoid social interaction, but not the process connected with the use of technology. From these results, however, remains unclear, which between social or process usage is more related to PSU, and future studies should examine these mechanisms.

The Mediating Role of Fear of Missing out and Smartphone Use Patterns

Fear of Missing Out (FoMO) is a psychological construct defined as "a pervasive apprehension that others might be having rewarding experiences from which one is absent. It is characterized by the desire to stay continually connected with

what others are doing" (Przybylski et al. 2013, p. 1841). Evidence of the effects of FoMO has also come from college students. Specifically, students who experienced a higher level of FoMO obtained negative outcomes in daily life and over the course of the semester, including increasing negative affect, fatigue, stress, physical symptoms, and decreased sleeping time (Milyavskaya et al. 2018).

FoMO appears to be an important variable that can drive the severity of PSU. A recent study found that FoMO and the need for touch were critical mechanisms to explain the relationship between anxiety, depression and PSU (Elhai et al. 2016). Another study demonstrated that FoMO was most strongly related to both PSU and social smartphone use in relation to negative affect and fears of negative and positive evaluation (Wolniewicz et al. 2018). Additionally, the results of a literature review indicated that FoMO appears to drive overuse of social media and smartphones (Elhai et al. 2017a, b). Furthermore, FoMO has been proposed as a mediator between well-being (e.g., the need to belong and life satisfaction) and social media engagement—insofar as people with low levels of life satisfaction, autonomy and competence report a higher level of FoMO (Oberst et al. 2017)—and between depression, anxiety and PSU severity (Elhai et al. 2018). Despite the increasing interest in FoMO, no studies have yet investigated the effect of self-control on FoMO in relation to PSU and SUP.

Focusing on SUP could increase our understanding of why smartphone overuse leads people to developing addiction. In some cases, people may spend a lot of time on their smartphone for work and study, but this behaviour may not necessarily indicate addiction. Previous studies have found that people who use their smartphone for information-seeking purposes (e.g., to read the news, watch videos or surf the Net) are not as prone to PSU as users who mainly play video-games or pursue other forms of social amusement on their smartphones (Lin et al. 2017; Wei 2008). On the other hand, since smartphones practically function like a desktop computer connected to the Internet (many times exceeding the functionality of the latter), other studies have investigated the mediational effects of smartphone use patterns (e.g., socializing, entertainment and information-seeking) on PSU (Bian and Leung 2015; Hao et al. 2019; Jiang and Zhao 2016). Consequently – and because SUP is similar to PSU – it is reasonable to argue that FoMO could be related to SUP. Previously cited empirical evidence support this assumption (Wolniewicz et al. 2018).

Theory

The theoretical foundation of this study is the Interaction of Person – Affect – Cognition – Execution (I-PACE) model (Brand et al. 2016). This model suggests categories of variables that can influence the use and overuse of Internet

communication and smartphone use. Personal determinants include genetic and biological influences, psychopathology, personality, cognition, and use motives. Responses to such personal determinants involve mechanisms that may be risk or resilience variables for Internet use, among which include cognitive bias, coping style, inhibitory control, craving, and attention bias. Such responses may lead to the decision to use specific types of Internet features and/or applications (e.g., Facebook), which may lead to personal gratification or excessive Internet and smartphone use. Previous studies support the I-PACE conceptual model insofar as it explains excessive Internet use and PSU as by-products of evident personality and other behavioural factors (Duke and Montag 2017; Oberst et al. 2017; Rozgonjuk and Elhai 2019; Wegmann et al. 2017).

Research Aims and Hypotheses

The aim of the study was to examine the effects of both FoMO and SUP as multiple mediators in the relationship between self-control and PSU, as well as to explore the influence of gender differences. Figure 1 shows the research model of the study. Self-control is conceptualized to predict PSU (dependent variable), then FoMO and SUP mediate this relationship. Therefore, we have formulated the following hypotheses.

- H1: self-control is negatively related to PSU (H1a), FoMO (H1b), and SUP (H1c). Previous studies have indicated that self-control is connected to PSU (Rozgonjuk et al. 2018), and FoMO (Chotpitayasunondh and Douglas 2016), and that it is also linked to SUP (Jiang and Zhao 2016). Hence, it is reasonable to hypothesize that decreased levels of self-control are associated with higher levels of FoMO, smartphone use patterns and problematic smartphone use.
- H2: fear of missing out is positively linked to PSU (H2a) and SUP (H2b). Prior studies found a positive relationship between FoMO and PSU (Elhai et al. 2018; Oberst et al. 2017; Wolniewicz et al. 2018). Regarding the relationship between FoMO and SUP, we expected a positive association since SUP is related to smartphone use. Prior studies reached similar conclusions (Elhai et al. 2018; Wolniewicz et al. 2018).
- H3: smartphone use patterns are positively related to PSU. A study carried out by Jiang and Zhao (2016) supported this association.
- H4: smartphone use patterns and FoMO mediate the relationship between self-control and PSU. These hypotheses are based on prior research findings. Specifically, Jiang and Zhao (2016) found that SUP mediated the relationship between self-control and PSU. Fear of missing out has demonstrated robust mediating effects in explaining detrimental behaviours with at least three categories of
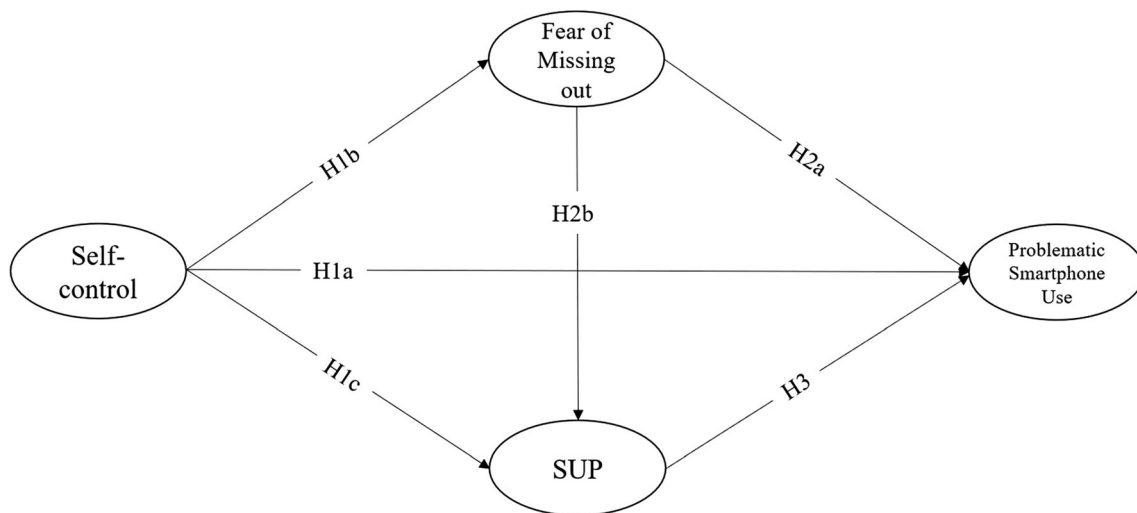
Fig. 1 Hypothesized research model. *Notes.* Circles represent latent variables. SUP = smartphone use patterns

variables: negative affectivity, social engagement, and PSU (Elhai et al. 2018; Oberst et al. 2017). By considering the I-PACE model (Brand et al. 2016), FoMO would be a cognitive bias. As FoMO involves apprehension of missing pleasurable and rewarding experiences, these individuals would be prone to using Internet and smartphone applications to satisfy their personal needs.

Method

Participants and Procedure

Study participants were recruited during regular university activities (e.g., lecture breaks, at the library, etc.). After we obtained their consent, all participants were informed of the study's objectives and were guaranteed strict confidentiality in their answers to the questionnaire. Completing the questionnaire took approximately 25 min. All the research material and procedures were designed according to the guidelines laid out by Ethics in Human Research and the Italian Association of Psychology.

We recruited 405 Italian youths attending several university degrees courses. The sample consisted of 114 males (28.15%) and 288 females (71.11%). Three students did not report their gender (.74%) and were excluded from the multi-group analysis. The participants' ages ranged from 19 to 43 (M = 22.11, SD = 3.80). Most participants were attending psychological and educational courses (60.48%); the rest were enrolled in various courses such as economics (10.86%), engineering (5.18%), mathematics (8.39%) and computer science (11.85%). The remaining students (3.21%) did not indicate their degree course.

Measures

The participants completed a battery of Italian self-report scales. Additionally, they were asked to provide demographic information about their gender, age, and degree course. We also asked participants about the time they spent daily and weekly on social media sites (e.g., Facebook, Twitter, etc.) and smartphone applications (e.g., WhatsApp, Instagram, etc.).

The short Italian version of the *Smartphone Addiction Scale* (SAS) was used to assess smartphone risk (De Pasquale et al. 2017; Kwon et al. 2013). It consists of 10 items (e.g., *Missing planned work due to smartphone use*; *Won't be able to stand not having a smartphone*) pertaining to daily-life disturbance, positive anticipation, withdrawal, cyberspace-oriented relationships, overuse and tolerance. A previous validation study has suggested a single factor structure for the short version of SAS (Luk et al. 2018). Each item is rated on a six-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree). The scale showed a good internal reliability (Cronbach's alpha).80 (M = 2.68, SD = .60, 95% IC [.77, .83].

The Italian version of the *Fear of Missing Out* (FoMO) scale was used to measure the adolescents' disposition towards the fear of missing out (Lai et al. 2016; Przybylski et al. 2013). The 10 items loaded on a single factor solution (e.g., *I fear others have more rewarding experiences than me*; *It is important that I understand my friends' "in jokes"*), measured on a five-point Likert type (1 = not at all true to 5 = extremely true). For the present study, the Cronbach alpha of the scale was of .73 (M = 2.16, SD = .62, 95% IC [.69, .77]).

The *Brief Self-Control Scale* (BSCS) was used to assess self-control processes and failures (Tangney et al. 2004). The scale was translated from English into Italian according to the recommendations of the International Test Commission (2005). The overall process of translation, however, was carried out under the supervision of the author of the scale. BSCS

is applied as a unidimensional self-report measure which contains 13 items (e.g., *I say inappropriate things; I have trouble concentrating*) and the participants reported the extent to which each statement described them, using a five-point Likert scale ranging from 1 (Not at all) to 5 (Very much). The scale revealed a good internal reliability (Cronbach's alpha) α = .77 (M = 3.47, SD = .29, 95% IC [.73, .80]). Finally, confirmatory factor analysis showed that all the items loaded on the scale, indicating that the construct validity of the instrument was good RMSEA = .046, p = .576, SRMR = .035, CFI = .970, TLI = .950.

With the *Smartphone Use Patterns* (SUP), based on previous studies, we adapted a self-report short list of items to collect information about smartphone use during the last six months (Bian and Leung 2015; Elhai et al. 2016; Jiang and Zhao 2016). It comprised 10 items and the participants reported the extent to which each statement described their smartphone habit, using a five-point Likert scale ranging from 1 (Not at all) to 5 (Very much).

Statistical Analyses

Before performing the data analyses, cleaning of the dataset was conducted by inspecting cases with missing values. Overall, only in 19 cases (4.69%) were a few data missing. As a result, no cases were removed, except the three cases of the variable gender which was used to run the multigroup analysis for exploring gender differences. All the statistical analyses were carried out with the support of the SPSS (version 25) and *R - lavaan (version 0.6–3)* package (Rosseel 2012). Descriptive statistics as well as Pearson's r correlations were computed to explore the properties of the variables and to determine their relationships, respectively. In addition, a t-test analysis was performed to explore possible gender differences. To assess the factorial structure of SUP, an exploratory factorial analysis (EFA) with the Principal Axis Factoring method of extraction was conducted using a Promax rotation method to allow the extracted factors to correlate (Fabrigar and Wegener 2012). The factorial structure was tested by performing a Confirmatory Factor Analysis (CFA).

Since Brief Self-Control Scale (BSCS), Fear of Missing Out (FoMO), and the short version of Smartphone Addiction Scale (SAS) are commonly considered unidimensional measures, solutions based on item parcels rather than on individual items may reduce the risk of convergence problems, improving the fit of the model (Sterba and Rights 2016). In this study, the item-parcelling strategy used was to aggregate items with similar standardized factor loadings (Marcoulides and Schumacker 2001).

To test the hypotheses of the study, as well as to explore the mediating effects of FoMO and SUP, a Structural Equation Model (SEM) was used with maximum likelihood parameter estimates with standard errors and a mean-adjusted chi-square

test statistic that were robust to non-normality (MLM). The MLM chi-square test statistic is also referred to as the Satorra-Bentler (S-B) chi-square. Following Kline (2016), multiple indices were used to evaluate model fit (adopted cut-offs in parentheses): the chi-square (χ^2) test value with the associated p value (p > .05), comparative fit index (CFI $\geq$ .95), Tucker-Lewis Index (TLI $\geq$ .95), root-mean-squared error of approximation (RMSEA $\leq$ .06) and its 90% confidence interval, and standardized root mean square residual (SRMR < .08).

Results

Descriptive and Correlations

We asked about the time spent daily and weekly on social media sites, smartphone applications, and the Internet for study and relaxation purposes. We found that daily, the average time spent on Facebook was 2 h; on Instagram, 2.75 h; and on WhatsApp, 5.46 h. For study purposes, students surfed the Internet for only 2.61 h, and to relax, 2.78 h. On the other hand, weekly, the average time spent on Facebook was 12.73 h; on WhatsApp, 31.80 h; on Instagram, 17.46 h. They surfed the Internet for study purposes for 15.53 h and 17.39 h for relaxation.

Descriptive for all variables, including the means, standard deviations and Pearson's bivariate correlations between the variables of the study, are presented in Table 1.

The relationships between the variables are statistically significant (see Table 1). People who show a high level of PSU have a higher level of FoMO and a low level of self-control. Moreover, entertainment and socializing variables are positively correlated with PSU as well as FoMO. We have also found that people who use their smartphone for entertainment have low levels of self-control, while those who use it for information-seeking have higher levels of self-control.

In the next step, we drew a comparison between men and women in relation to the variables of the study. As shown in Table 2, we found that men scored higher on information-seeking and entertainment, and women on socializing.

Factor Structure of Smartphone Use Patterns Scale

Regarding Smartphone Use Patterns (SUP), an exploratory factor analysis (EFA) with Principal Axis Factoring and Promax rotation indicated three factors with eigenvalues greater than 1.00 and cumulatively accounting for 40.26% of the total variance. The main factors were: 1) information-seeking (4 items, α = .69; M = 2.78, SD = .68, 95% IC [.64, .74], i.e. "online reading, sending e-mails, etc."); 2) entertainment (4 items, α = .67; M = 3.58, SD = .45, 95% IC [.61, .72], i.e. "downloading, watching videos, etc."); 3) socializing (2 items, α = .66; M = 4.38, SD = .32, 95% IC [.55, .69], i.e.

Table 1 Descriptive statistics and correlations between the study variables

	M	SD	1	2	3	4	5	6
1. PSU	26.79	8.53	–					
2. FoMO	21.62	5.89	$.35^{**}$	–				
3. BSCS	44.98	7.78	$-.32^{**}$	$-.23^{**}$	–			
4. Information-seeking	2.79	.81	$-.05$	$-.05$	$.15^{**}$	–		
5. Entertainment	3.58	.81	$.15^{**}$	$.11^{*}$	$-.14^{**}$	$.24^{**}$	–	
6. Socializing	4.38	.76	$.21^{**}$	$.15^{**}$	$-.02$	$.16^{**}$	$.25^{**}$	–

PSU problematic smartphone use; *FoMO* fear of missing out; *BSCS* brief self-control scale

$^{*}p < .05.$ $^{**}p < .001$

"online chatting, and sending messages by WhatsApp, Viber, etc."). The Kaiser-Meyer-Olkin measure of sampling adequacy was .705 indicating that the current data were suitable for the EFA. Similarly, Bartlett's test of sphericity was significant $\chi^2(45) = 737.29$, $p < .001$ indicating sufficient correlation between the variables to perform the analysis.

The results of the confirmatory factor analysis fit the data well $\chi^2_{S-B}(44) = 63.16$, $p = .031$, CFI = .976, TLI = .964, RMSEA = .033 (90% CI: .011, .051), SRMR = .038.

Structural Equation Model and Mediation Analysis

The results of the SEM measurement model showed an adequate fit $\chi^2_{S-B}(44) = 78.96$, $p = .001$, CFI = .949, TLI = .924, RMSEA = .044 (90% CI: .028, .060), SRMR = .039. The model explains 57% of the variance in PSU. The standardized coefficients for this model are presented in Fig. 2. Thus, the results showed that self-control was directly related to PSU $\beta = -.318$, $SE = .110$, $p = .004$ (H1a). Self-control was negatively correlated with FoMO $\beta = -.513$, $SE = .082$, $p = .023$ (H1b) and SUP $\beta = -.273$, $SE = .120$, $p = .023$ (H1c). Fear of missing out was positively associated with PSU $\beta = .394$, $SE = .100$, $p < .001$ (H2a) but not with SUP $\beta = .201$, $SE = .117$, $p = .085$ (H2b). Finally, SUP was positively correlated with PSU $\beta = .244$, $SE = .103$, $p = .018$ (H3).

Table 2 Differences between men and women across variables

	Men		Women		
	M	SD	M	SD	$t(400)$
1. PSU	25.19	7.89	27.42	8.74	-2.36^{*}
2. FoMO	22.17	5.94	21.41	5.88	1.16
3. BSCS	43.26	8.29	45.66	7.50	-2.80^{*}
4. Information-seeking	2.94	.87	2.73	.78	2.37^{*}
5. Entertainment	3.75	.77	3.51	.81	2.67^{*}
6. Socializing	4.24	.82	4.44	.72	-2.35^{*}

PSU problematic smartphone use; *FoMO* fear of missing out; BSCS = brief self-control scale

$^{*}p < .05$

Table 3 presents the results of the mediation analysis and the indirect effects for PSU and its predictor and mediator variables.

The relationship between self-control and PSU was partially mediated by FoMO but not by SUP (H4). Regarding the indirect effects (see Table 3), only FoMO indirectly affected the relationship between self-control and PSU. A significant indirect effect, however, emerged when SUP was related to FoMO.

Because the number of women participants was higher than that of men, and because women scored higher on PSU and self-control, the proposed model was tested separately for both genders by using mean structure analysis. The results of the multi-group analysis fit well, $\chi^2_{S-B}(103) = 148.20$, $p = .002$, CFI = .937, TLI = .920, RMSEA = .047 (90% CI: .029, .063), SRMR = .059. Overall, we obtained similar results as with the general model. In the male subsample, only FoMO, $\beta = .417$, $SE = .197$, $p = .034$, was correlated with PSU. Fear of missing out was associated with self-control, $\beta = -.348$, $SE = .160$, $p = .034$. Smartphone use patterns was associated only with FoMO, $\beta = .354$, $SE = .175$, $p = .044$. No significant associations emerged between PSU, self-control, and SUP.

In the female subsample, self-control, $\beta = -.456$, $SE = .129$, $p < .001$, FoMO, $\beta = .396$, $SE = .115$, $p = .001$, and SUP, $\beta = .229$, $SE = .102$, $p = .024$, were related to PSU. Fear of missing out was correlated with self-control, $\beta = -.552$, $SE = .092$, $p < .001$. In turn, self-control was related to SUP, $\beta = -.279$, $SE = .121$, $p = .021$. No significant association emerged between SUP and FoMO. As far as indirect effects are concerned, a significant mediational relationship was only found in the female subsample, specifically: FoMO, $\beta = -.219$, $SE = .072$, $p = .003$ mediated the relationship between self-control and PSU.

Discussion

The purpose of the study was to examine the levels of FoMO and SUP as mediators between self-control (as the predictor)
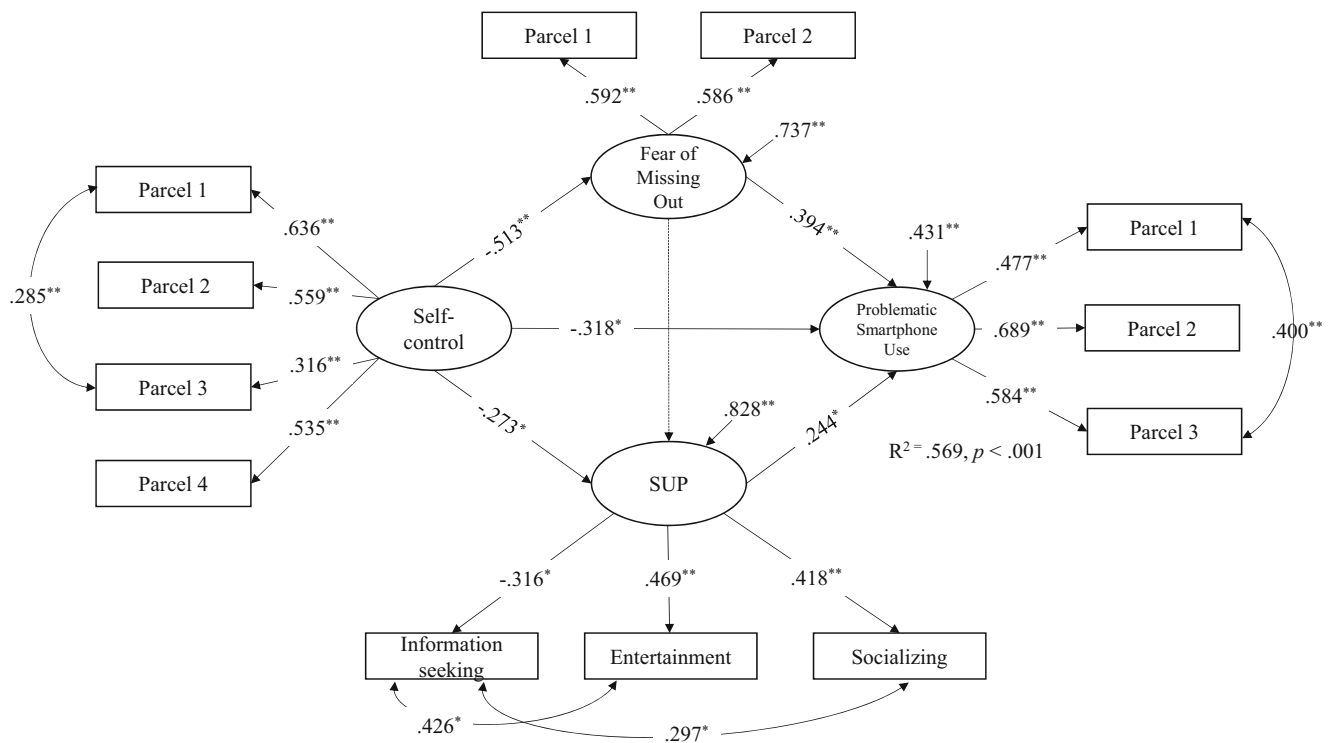
Fig. 2 Results of the SEM model with standardized estimates among the key study variables. *Notes.* Circles represent latent variables; rectangles represent manifest variables. The dashed line represents a non-significant relationship. SUP = smartphone use patterns. *p < .05. **p < .001

and the risk of PSU (as the outcome variable) in a sample of Italian university students.

The results of the *t*-test indicated that females exhibited higher scores in PSU, self-control, and socializing patterns of smartphone use, whereas males scored higher in information-seeking and entertainment. No significant differences emerged between gender and FoMO. Consistent with previous studies, the current results indicate that females are more likely to be dependent on smartphone use (Beranuy et al. 2009; Duke and Montag 2017; Montag et al. 2015). Our results show that women, more than men, use the smartphone mainly to establish and maintain social connections. Females display higher scores in socializing, indicating

that they use their smartphone to communicate. This result is in line with the recent findings of a European cross-cultural survey (Lopez-Fernandez et al. 2017). Why college students easily embrace different new technologies is understandable, and the need to establish and maintain social relationships could be related to the development of their sense of personal and social identity.

Self-control was positively correlated with information-seeking and negatively correlated with entertainment, but no association emerged with the socializing factor. Socializing and entertainment, however, correlated positively with PSU, and the latter showed no association with information-seeking. Taken together, these results are consistent with previous

Table 3 Mediation and indirect effects with standardized estimate of FoMO and SUP for the relationship between self-control and PSU

Pathway	Estimate	S.E.	z	p	95% CI	
					LL	UL
BSCS -- > FoMO -- > PSU						
Total	−.612	.070	−8.680	.000	−.728	−.496
Direct effect	−.318	.110	−2.879	.004	−.500	−.136
Specific indirect effect	−.202	.065	−3.090	.002	−.309	−.094
BSCS -- > SUP -- > PSU						
Specific indirect effect	−.067	.046	−1.460	.144	−.142	.008
BSCS -- > FoMO -- > SUP -- > PSU						
Specific indirect effect	−.025	.110	−2.879	.004	−.056	−.006

CI confidence interval; *LL* lower limit; *UL* upper limit; *S.E.* standard error; *BSCS* brief self-control scale; *FoMO* fear of missing out; *PSU* problematic smartphone use; *SUP* smartphone use patterns

studies and both socializing and entertainment can be regarded as predictors of smartphone overuse (Elhai et al. 2017a, b; Jiang and Zhao 2016; Rozgonjuk and Elhai 2019; Wolniewicz et al. 2018). The current findings suggest that non-social smartphone use is also related to problematic/addictive behaviour. This result is consistent with the idea that the process use of smartphones leads to rewards and pleasure experiences through the consumption of media content, such as watching videos, playing games, and browsing online contents (Rozgonjuk et al. 2019). In any case, based on the technological features that smartphones offer, they may cause over-attachment and even addictive behaviour.

Main Findings

According to our H1a hypothesis, we expected levels of PSU to correlate with self-control. Our findings provide support for this hypothesis: as self-control decreased, PSU increased. People with low levels of self-control are more inclined to use their smartphone for activities which directly relate to the rewarding underlying tendency to pursue short-term goals and immediate pleasure (Billieux et al. 2015a, b; Rozgonjuk et al. 2018). These constructs could be described as dysfunctional and maladaptive, and smartphone restrictions may cause "withdrawal symptoms" in people who have a higher reliance on smartphone use, triggering negative emotions that may also reduce their level of self-control, activating compulsive smartphone use (Rozgonjuk and Elhai 2019). Self-control, therefore, may act as a critical factor in protecting people against the risk of problematic smartphone use. This result could be explained by the I-PACE model (Brand et al. 2016), since poor self-regulation behaviour (a predisposing factor) may lead to compulsive behaviour (higher engagement in habitual checking for smartphone notifications), potentially developing into PSU.

We expected FoMO to be negatively correlated with self-control (H1b). This hypothesis was supported by the data. The present findings suggest that FoMO could play an active role and increase an individual's desire to use his or her smartphone; in turn, this is likely to reduce his or her level of self-control, increasing the risk of addiction. The effect of FoMO, which is in line with previous studies, might orientate people's attention towards the need to belong, as well as the need to avoid negative emotional states, thus inducing a series of maladaptive psychological responses when people use their smartphone (Elhai et al. 2017a, b; Wolniewicz et al. 2018).

We found a support for the hypothesis H1c: smartphone use patterns were negatively associated with self-control – a result consistent with previous findings (Jiang and Zhao 2016). This relationship could be associated with people's preference for rewarding activities such as information seeking, entertainment, and socializing. At an initial stage, people involved in these mediated technological activities may experience positive emotions. Thus, people with low self-control

would be attracted to these social and personal functions. Hence, devices of this kind would induce pleasure, which in turn would contribute to increasing the risk of smartphone misuse. This result is also consistent with a prior study suggesting that people with low levels of self-control are more likely to respond to smartphone notifications immediately after receiving them (Berger et al. 2018).

We set out from the assumption that FoMO was positively related to PSU (H2a), and SUP (H2b). Regarding the hypothesis H2a, which was supported by the current data, it seems that people who experience FoMO could be going through aversive emotional states. People who have similar negative experiences would engage in smartphone and social media use in order to acquire socialization skills and intensify their social connections (Elhai et al. 2018; Przybylski et al. 2013). Fear of missing out would explain the tendency of people experiencing deficits in psychological need satisfaction to engage in PSU, even in situations otherwise requiring full attention (e.g., while driving, during learning activities, attending classes) (Alt and Boniel-Nissim 2018; Jiang and Zhao 2016).

Hypothesis H2b, however, was surprisingly not supported by the present data. We expected to find a significant association between FoMO and SUP because the former is related to smartphone use, but there was none. According to Rozgonjuk and Elhai (2019), a potential explanation for this finding is that this study mainly asked participants to provide information about specific social activities (e.g., *I use my smartphone for online chatting*). Social media platforms may not necessarily require an active social engagement and support passive interaction. People can use Facebook, for example, without need of creating content or answering a friend's messages with comments. A similar description can be applied to items measuring non-social smartphone use (e.g., reading online, watching videos, etc.). We can reflect on this relationship by underlining how non-social smartphone use could suggest that people engaged in social isolation or behavioural avoidance don't feel any kind of social need to know what their friends are doing online. This relationship, however, requires additional studies.

The current outcomes show that SUP is related to PSU, supporting hypothesis H3. The present findings suggest that frequent SUP is associated with an increased level of PSU (Jiang and Zhao 2016). Thus, SUP might contribute to increasing the time a person spends on his or her smartphone. These findings are in line with the idea that since smartphones are multi-purpose devices, it is important to distinguish between process smartphone use and social smartphone use (Rozgonjuk and Elhai 2019). Previous evidence indicates that people who use their smartphone for non-social purposes are more prone to be affected by high levels of PSU. Specifically, one study demonstrated that people who internalize their emotions tend to spend more time on their smartphone for process functionalities and that such behaviour might lead to an increased risk of PSU (Rozgonjuk and Elhai 2019). By contrast, social smartphone

use is more closely connected with rewards effects and pleasurable social experiences through active interaction.

Finally, we expected FoMo and SUP to mediate the relationship between self-control and PSU (H4). This hypothesis was partially confirmed. Only FoMO partially mediated the relationship between self-control and PSU. Indeed, it has been found that FoMO is not only an important predictor of social media addiction, but also serves as a mediator between several variables, such as psychological needs (Przybylski et al. 2013), psychopathological symptoms and negative experience of smartphone use (Oberst et al. 2017), and psychological well-being (Reer et al. 2019). In this study, self-control was a predictor of FoMO. People with low levels of self-control could have higher risks of PSU because they compulsively use their smartphone to check their messages, social networking profile and WhatsApp group, and to engage in other Internet-related habits. Furthermore, we found a partial mediation in the connection between self-control and PSU. This might suggest that those with lower self-control experience higher levels of PSU not only because they are driven to use smartphone applications (direct path), but probably also because they experience stronger feelings of FoMO (indirect path). Our findings can be discussed in the framework of the I-PACE model (Brand et al. 2016) in which FoMO could represent a cognitive bias by mediating the relationship between self-control and PSU. The results of the present study go beyond the previous findings by demonstrating that FoMO partially mediates the relationship between self-control and PSU.

Additionally, PSU has been shown not to mediate the relationship between self-control and PSU. This result is consistent with another study (Wolniewicz et al. 2018). Further studies should explore the actual role of SUP in relation to self-control and PSU. Perhaps, variables such as satisfaction with life, coping strategies or self-esteem should be examined to better understand the role of FoMO in relation to PSU.

Theoretical and Practical Implications

The findings from this study contribute to existing literature in particular with regard to the I-PACE model, which reveals the development and maintenance of an addictive use of technological applications such as the Internet and PSU. We believe that the study's most important contribution is that of providing empirical evidence regarding the mediating effects of FoMO in the relationship between self-control and PSU, but not for SUP. Also, this study contributed in increasing the actual level of knowledge regarding the relationship between process smartphone use and social smartphone use. According to our findings, non-social smartphone use is also related to PSU.

The present results can have important practical implications for psychologists and clinicians interested in designing intervention programs that reduce the risk of PSU. The results of the study suggest that to reduce the risk of PSU, people

should increase their own level of self-control. It should be noted, however, that more research is needed to better understand the nature of PSU as a social problem and to corroborate the current results, especially in the Italian context, where few studies have been conducted so far.

Limitations

This study is not without limitations. Firstly, the sample included only university students, who are likely to use smartphones for various academic purposes and hence are not representative of how other young people engage with the same technological tool. Future studies should extend the current research design by focusing on a more representative sample of participants. Secondly, our study was based on a cross-sectional design and it is hard to confirm the causal relationship between the predictor and PSU. One way of overcoming this limitation is to design and conduct longitudinal studies. Thirdly, the present study did not consider the role of moderating effects in relation to self-control, FoMO, SUP, and PSU. To learn more about how PSU reduces self-control, it would be interesting to include some moderating variables such as sleeping hours. Fourth, another limitation is related to the self-report format. It is possible that participants gave socially desirable answers to the questionnaires. In addition, because we asked participants to report how much time they spent on social applications, it is also possible that they provided unreliable information or gave a poor estimate of the actual duration of their usage. However, most modern smartphone devices include specific functionalities such as screen time, which enable users to know how much time they spend weekly on apps, websites, and so on. The information from these functionalities could provide a more a more accurate picture of actual usage.

Future Studies

Future studies should address the limitations mentioned and in particular should adopt objectively measured smartphone use information, as recent results have demonstrated that the relationship with psychological constructs may depend on smartphone use patterns (Rozgonjuk and Elhai 2019; Rozgonjuk et al. 2019). Additionally, these results should be tested to see if they are replicable across different areas related to Internet use (e.g., social networking addiction, Internet gaming addiction). Finally, we are aware that the current results need to be treated with caution owing to the higher percentage of females in this sample.

Conclusions

We investigated how FoMO and SUP could mediate the relationship between self-control and PSU. The results indicated a

partial mediated effect only for FoMO but not for SUP. Taken together, the results of the current study provide a reliable starting point in exploring the risk of addiction associated with excessive smartphone use. As such, they might help better understand this phenomenon in the Italian context. These findings suggest that self-control could be related to FoMO and SUP, which in turn would drive PSU.

Compliance with Ethical Standards

Ethical Approval   All procedures involving human participants in this study were performed in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent   Informed consent was obtained from all individual participants included in the study.

Conflict of Interest   The Author declares that they have no conflicts of interest.

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