



The Role of Desire Thinking and Craving in Problematic Smartphone Use

Giulia Fioravanti¹ · Marcantonio M. Spada² · Sara Bocci Benucci³

Accepted: 21 February 2024
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Abstract

The Elaborated Intrusion Theory of desire and the metacognitive model of desire thinking posit that the intensification of craving centres on the initiation of a voluntary cognitive process named desire thinking (DT). The role of DT in eliciting craving has been studied extensively in substance use disorders and, more recently, in some behavioral addictions. The main aim of the current study was to test the mediating role of DT and craving in the association between psychological distress, boredom proneness, and problematic Smartphone use (PSU). Six hundred and forty-six participants (mean age = 27.57 ± 9.64; females = 74.8%) took part in the study and completed a battery of self-report measures. As evidenced by path analysis, psychological distress and boredom proneness were linked to PSU through (i) imaginal prefiguration and verbal perseveration components of DT's serial mediation; and (ii) imaginal prefiguration and craving's serial effect. The model accounted for 60% of PSU variance and showed good fit indices. The current findings highlight the role of DT, particularly the imaginal prefiguration, in craving for the Smartphone and provide evidence that DT is associated with PSU directly, supporting the distinction between DT and craving.

Keywords Boredom proneness · Craving · Desire thinking · Problematic smartphone use · Psychological distress

✉ Giulia Fioravanti
giulia.fioravanti@unifi.it

¹ Department of Health Sciences, Psychology Unit, University of Florence, Via San Salvi 12-Padiglione 26, Florence 50135, Italy

² School of Applied Sciences, London South Bank University, London, UK

³ Department of Experimental and Clinical Medicine, University of Florence, Florence, Italy

Introduction

Problematic Smartphone use (PSU) can be described as an escalating, excessive, and unregulated use of the Smartphone that can cause personal, social, educational, and working impairment in a person's life (Billieux et al., 2015). Regarding the prevalence estimation of PSU, recent meta-analyses on the global prevalence characteristic of digital addiction (Meng et al., 2022) found that the worldwide prevalence estimate was 26.9% (95% CI, 22.73–31.73) for PSU and that problematic smartphone use is increasing worldwide (Olson et al., 2022). Concerning PSU conceptualization, although the scientific debate about the possibility of considering PSU as an addictive behavior is still open (Billieux et al., 2015; Kardefelt-Winther et al., 2017; Panova & Carbonell, 2018), some evidence about the fact that PSU shows similarities with substance and behavioral addictions emerged. For example, craving, withdrawal symptoms (when the Smartphone is not available), tolerance (the need to use the Smartphone more frequently), continuing to use the Smartphone despite the negative consequences, trying unsuccessfully to control Smartphone use, and impaired functioning in social life have been evidenced (Billieux et al., 2015; Clayton et al., 2015). Many researchers have explored the psychological and psychopathological correlates of PSU. As evidenced by recent meta-analyses, personality factors related to PSU encompass neuroticism, conscientiousness (Marengo et al., 2020), impulsivity (Carvalho et al., 2018), and low self-esteem (Casale et al., 2022). Furthermore, a predictive role was found for boredom proneness (Casale et al., 2021; Elhai et al., 2018; Lepp et al., 2017; Wolniewicz et al., 2020). Individuals inclined to experience boredom get into PSU to alleviate their boredom and overcome attention deficits and the negative affect associated with boredom (Elhai et al., 2018). Concerning psychopathology, positive associations were found between PSU and depressive symptoms with a medium effect size (Elhai et al., 2017), anxiety with a slight to moderate effect size (Elhai et al., 2019; Vahedi & Saiphoo, 2018), and psychological distress (Casale et al., 2021; Chen et al., 2020).

Among the theoretical models proposed to explain addictive behaviors, cognitive models have emphasized the predominant role of desire in activating craving and sustaining addictive behaviors (May et al., 2004). The Elaborated Intrusion (EI) theory of desire (Kavanagh et al., 2004, 2005, 2009; May et al., 2004) suggests that the conjunction of automatic and voluntary cognitive processes are responsible for the frequency, duration, and intensity of craving. The EI theory of desire postulates that internal (e.g., stress) or external (e.g., viewing a specific image/stimulus related to the desired target) triggers activate the individual thoughts about a desired target or activity (e.g., its positive consequences or sense of deprivation). When the pleasure associated with the desired target/activity or the feeling of deprivation becomes very strong, these associations become conscious, are cognitively elaborated, and provoke the craving experience (Bywaters et al., 2004). The intensification and persistence of craving depend on a cognitive process termed desire thinking (DT; Green et al., 2000; Kavanagh et al., 2009; Tiffany & Drobes, 1990). DT is a voluntary and conscious cognitive process oriented to prefigure images, information, and memories about the positive target-related experience (Caselli & Spada, 2010). According to Caselli and Spada (2010), DT comprises two dimensions: (i) imaginal prefiguration, which refers

to the allocation of attentional resources to the information concerning the desired target/activity, and the multi-sensorial elaboration of positive anticipatory imagery or memories related to the desired target/activity (e.g., the individual imagines themselves doing the desired activity); and (ii) verbal perseveration, which concerns the extended self-talk about the good reasons for engaging and achieving target-related activities (e.g., the individual mentally repeats to themselves that they need to practice the desired activity) (Caselli & Spada, 2011). DT implies a voluntary engagement in elaborating the positive consequences of the desired target/activity, the prolonged self-talk on the good reasons for achieving it, and the mental planning of actions necessary to reach the desired target/activity (Caselli & Spada, 2010, 2015).

Although in the short-term DT may help to cope with negative emotional states (like the sense of deprivation) by shifting the attention to the positive sensations related to the desired target/activity or by generating a virtual sense of pleasure and relief, in the medium to longer term it drives the experience of craving an intensely subjective experience that prompts individuals to seek out and achieve a craved target, or practice a dreamed activity, to reach its desired effects (Marlatt, 1987) as the target is perseveratively thought about, but not achieved. At this point, the desired target begins to be perceived as the only urgent means to relieve the rising sense of deprivation and craving (Caselli & Spada, 2011). Negative consequences of DT include increased craving levels, perception of lack of control, and amplified availability of target-related information (Caselli & Spada, 2015).

The role of desire thinking in eliciting craving has been extensively studied for substance-related addictive behaviors, especially for Alcohol Use Disorder (Caselli et al., 2021) and smoking behavior (Caselli et al., 2012). More recently, research has enlightened the role of desire thinking in behavioral addictions such as gambling (Ferne et al., 2014), problematic Internet use (Spada et al., 2013b), problematic social media use (Sharifi Bastan et al., 2022), problematic Facebook use (Marino et al., 2019), and problematic mobile phone use (Gao et al., 2023). A meta-analysis exploring DT across different addictive behaviors (Mansueto et al., 2019) found that: (a) both dimensions of desire thinking are significantly associated with addictive behaviors (i.e., alcohol use, nicotine use, gambling, and Internet use) in both clinical and community samples; (b) the type of addictive behavior moderates the strength of the relationship between verbal perseveration and addictive behaviors, being more strong for nicotine and alcohol use than Internet use; and (c) the strength of the relationship between imaginal prefiguration and addictive behaviors does not change among different addictive behaviors.

According to the metacognitive model of desire thinking (Caselli & Spada, 2011, 2015; Spada et al., 2012, 2013a), the imaginal prefiguration component predicts verbal perseveration, which, in turn, induces the craving experience. This theoretical tenet has been confirmed among clinical samples presenting with alcohol and tobacco use disorders, problematic Internet use, and gambling disorder and also in a community sample. In the latter, different from what was observed in clinical samples, a direct effect of the imaginal prefiguration component on craving was observed (Caselli & Spada, 2015). This finding revealed that in the community sample, imaginal prefiguration also drives craving without the verbal perseveration component. In contrast, in clinical samples, the activation of verbal perseveration is necessary for inducing

the craving experience. According to the authors, imaginal prefiguration plays a role in activating craving (that in community samples has a transient nature). In contrast, verbal perseveration contributes to the escalation and maintenance of craving and is, therefore, crucial for the ‘cementing’ of addictive behavior. Imaginal prefiguration-induced craving becomes clinically significant once the verbal perseveration component is activated. In support of this view, verbal perseveration is responsible for transitioning from social to problem drinker status and from problematic drinking behavior to alcohol dependence (Caselli et al., 2012).

Recently, Marino et al. (2019), examining the role of desire thinking and craving in problematic Facebook use (PFU), have observed that the imaginal prefiguration component of DT (i.e., creating mental images of oneself using Facebook and anticipating the sensations that one would feel online) predicts craving for Facebook use. Such urge is associated with the verbal perseveration component of DT (i.e., repetitive self-talk regarding the need to use Facebook), which in turn leads the higher levels of PFU. Başer et al. (2022) evidenced that higher scores on DT were associated with higher scores on problematic social networking sites use after controlling for boredom, affect, and impulsivity. Sharifi Bastan et al. (2022) found that negative affect, impulsivity, and thought suppression indirectly predicted craving and problematic social media use through the mediating role of DT. Noteworthy, a recent study (Gao et al., 2023), indicated that desire thinking plays a key role in problematic mobile phone use independent of demographic characteristics, big five personality traits, negative affect, and self-control.

These results are promising because they encourage exploring desire thinking as a potential underlying mechanism linking established variables associated with PSU (like boredom proneness and psychological distress) to craving and PSU.

The Current Study

The purposes of the current study were: (1) to reassess the associations between PSU, psychological distress, boredom proneness, and craving and (2) to test the role of desire thinking and craving as mediators of the associations between psychological distress and boredom proneness and PSU in a general adult sample. Specifically, according to the EI theory of desire (Kavanagh et al., 2004, 2005, 2009; May et al., 2004), internal triggers (e.g., stress) activate thoughts about a desired target or activity; moreover, previous studies (Caselli & Spada, 2015) have shown that imaginal prefiguration is associated with verbal perseveration which in turn is associated with craving as a proximal predictor of addictive behavior. Therefore, it was hypothesized that: (i) psychological distress and boredom proneness would be associated with both DT components which in turn would be associated with PSU through craving; (ii) there is a serial/sequential mediation of imaginal prefiguration, verbal perseveration, and craving in the association between psychological distress and boredom proneness and PSU. Age and gender would be considered as control variables, as previous studies have shown that females report more psychological distress (Matud et al., 2015) and less boredom proneness than males (McIntosh et al., 2006) and younger people report higher levels of PSU (Elhai et al., 2017). The proposed model is displayed in

Fig. 1. Finally, due to the cross-sectional study design, two alternative models (see Supplementary materials Fig. 1S and Fig. 2S), which will be discussed in the statistical analysis section, will be compared with the hypothesized model.

Method

Participants and Procedure

A sample of 646 participants (74.8% females) was involved in this study. The age ranges between 18 and 60 years and the average age of participants was 27.57 years ($SD=9.64$). The most reported occupation was being a student (43.3%), followed by a working student (31.6%), a worker (23.1%) and an unoccupied (2%). Regarding educational qualifications, 56.0% of the sample reported having a high school diploma, 26.2% a bachelor’s degree, 11.8% a master’s degree, 4.8% a higher qualification (e.g., Ph.D.), and the remaining 1.2% a middle school diploma. Considering participants’ relationship status, 39.6% declared having a non-cohabiting partner, 35.8% were single, and 24.6% had a cohabiting partner.

Participants were recruited using advertisements on social network groups such as Facebook, Telegram and WhatsApp; inclusion criteria were: (a) being at least 18 years old and (b) being a SNS user. They were informed that participation was voluntary and anonymous and that confidentiality was guaranteed. A web link directed the participants to the study, and if they consented to participate, they were asked to answer demographic questions and complete the self-report measures. Since it was only possible to submit the form by filling in all the required fields, no data was missing. Data were collected between November 2021 and

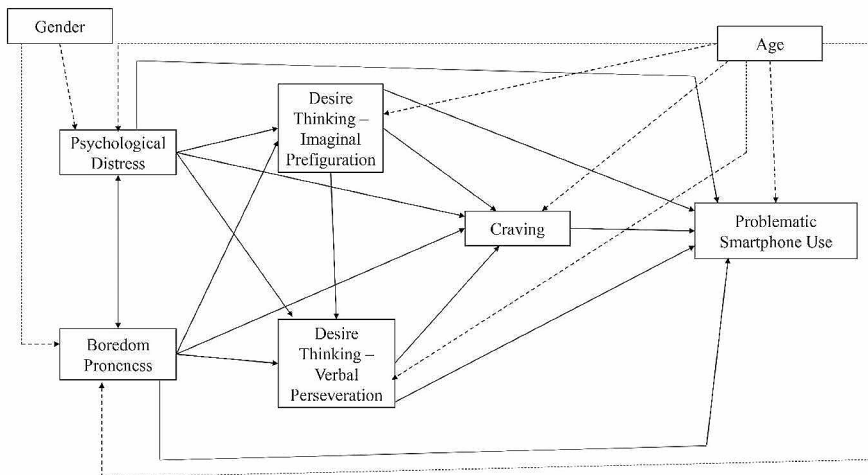


Fig. 1 Proposed theoretical model. *Note* Solid lines indicate the hypothesized pathways between the study variables. Dotted lines indicate the hypothesized pathways from the control variables (age and gender) to the study variables

March 2022, and no remuneration for participation was provided. The study was carried out in accordance with the Declaration of Helsinki. The Ethics Committee of the University of Florence approved the study. Written informed consent was obtained for all participants.

Measures

Boredom Proneness

Boredom proneness was measured using the 8-item Boredom Proneness Scale–Short Form (BPS-SF; Struk et al., 2017). The BPS-SF uses a 7-point Likert scale ranging from 1 (*Highly disagree*) to 7 (*Highly agree*). A sample item is “In most situations, it is hard for me to find something to do or see to keep me interested” and higher scores denote higher boredom proneness. The BPS-SF has shown good internal consistency and construct validity (Struk et al., 2017). Acceptable internal consistency was found for the Italian version of the BPS (Craparo et al., 2013). In the current sample, Cronbach’s alpha was 0.89.

Psychological Distress

Psychological distress was measured using the 21-item Italian version (Bottesi et al., 2015) of the Depression Anxiety Stress Scales-21 (DASS-21; Lovibond & Lovibond, 1995). In the DASS-21, distress is conceptualized along three dimensions of depression, anxiety, and stress. Respondents are asked to indicate on a 4-point Likert scale ranging from 0 (*Did not apply to me at all*) to 3 (*Applied to me very much or most of the time*) how much the item represents their state over the previous week. In the current sample, Cronbach’s alpha was 0.95. Higher scores mean higher levels of psychological distress.

Desire Thinking

Desire thinking about Smartphone use was measured using the Desire Thinking Questionnaire (DTQ; Caselli & Spada, 2011), which is a self-report instrument composed of two factors, each constituted by five items: imaginal prefiguration (DTQ-IP) and verbal perseveration (DTQ-VP). Imaginal prefiguration indicates the tendency to prefigure images about the desire-related experience (a sample item is “I imagine myself using the Smartphone”). In contrast, verbal perseveration refers to self-motivated affirmations and repetitive self-talk about the necessity to achieve the desired target (a sample item is “I repeat mentally to myself that I need to use the Smartphone”). Participants are asked to respond on a 4-point Likert scale from 1 (*Almost never*) to 4 (*Almost always*). Higher scores indicate higher levels of desire thinking. In the current sample, Cronbach’s alpha for the DTQ-IP was 0.77 and for the DTQ-VP 0.78.

Craving for Smartphone Use

Craving related to Smartphone use was measured using the 8-item Mobile Phone Addiction Craving Scale (MPACS; De Sola et al., 2017). The measure was translated from Spanish into Italian using a back-translation procedure, and none of the items raised any concerns. Participants are asked to respond on a 10-point Likert scale from 1 (*Not at all*) to 10 (*A lot/very much*), indicating the degree of concern and anxiety in eight possible situations in which one would not be able to use the Smartphone (e.g., “If I wanted to turn it on right now and could not or would not be allowed to”). Higher scores indicate higher craving related to Smartphone use. In the current sample, Cronbach’s alpha was 0.89.

Problematic Smartphone Use

Problematic Smartphone use was measured using the 10-item Italian version (De Pasquale et al., 2017) of the Smartphone Addiction Scale – Short Version (SAS-SV, Kwon et al., 2013). The SAS-SV utilizes a 6-point Likert scale ranging from 1 (*Strongly disagree*) to 6 (*Strongly agree*) and a sample item is “I have used my Smartphone for longer than I had intended”. The questionnaire comprises a single factor investigating aspects such as daily-life disturbance, positive anticipation, withdrawal, cyberspace-oriented relationships, overuse and tolerance. Higher scores denote higher levels of PSU. In the current sample, Cronbach’s alpha was 0.86.

Statistical Analyses

Descriptive statistics and Pearson’s Product Moment correlations between the study variables were performed. $A p < .001$ was significant (0.05/28, Bonferroni correction). The hypothesized pattern of associations (Fig. 1) was tested through path analysis using the Lavaan package of R software (Version 4.1.3) with the Robust Maximum Likelihood (RML) estimation method. In our model, psychological distress and boredom proneness were the predictors; imaginal prefiguration, verbal perseveration and craving were the mediators; and PSU was the outcome variable. Age was included as a control variable for all the variables in the model, and gender was included as a control variable for psychological distress and boredom proneness. The distribution of product coefficients test (P) was used to test the indirect effects (MacKinnon et al., 2002). Two alternative models with reverse ordering of the variables were also tested as the literature still debates which variable between DT-IP, DT-VP and craving is the antecedent (Caselli & Spada, 2015). Specifically, the first alternative model reverses the order of craving and desire thinking variables as mediators of the association between psychological distress and boredom proneness on the one hand and PSU on the other (see Fig. 1S in Supplementary materials). In line with Marino et al. (2019) study, the second alternative model considers craving as mediator of the association between the imaginal prefiguration and verbal perseveration components of desire thinking (see Fig. 1S in Supplementary materials). To evaluate the models’ goodness of fit the χ^2 (and its degrees of freedom and P-value), the Standardized Root Mean Square Residual (SRMR) ‘close to’ 0.09 or lower, the Comparative Fit Index

(CFI) ‘close to’ 0.95 or higher, and the Root Mean Square Error of Approximation (RMSEA) less than 0.08 were considered (Hu & Bentler, 1999).

Results

Descriptive and Correlational Analyses

Descriptive statistics and Pearson’s Product Moment correlations among the study variables are presented in Table 1. Age was negatively associated with all the study variables. Boredom proneness and psychological distress were positively associated with the imaginal prefiguration and verbal perseveration components of desire thinking, craving and PSU. Moreover, imaginal prefiguration and verbal perseveration were positively associated with craving and PSU. Finally, craving showed a positive association with PSU. Additionally, correlations between all the items assessing PSU and the other study variables were performed to investigate if some items were driving the higher correlations. Results show that the strongest association emerged between item 4 of the SAS-SV (i.e., “Won’t be able to stand not having a smartphone”) and craving ($r = .61, p < .001$) and between item 5 of the SAS-SV (i.e., “Feeling impatient and fretful when I am not holding my smartphone”) and craving (Pearson’s $r = .61, p < .001$) (see Supplementary Materials Table S1).

Table 1 Theoretical ranges (min-max), means, standard deviations, and Pearson’s Product Moment correlations among study variables

	Min-Max	M	SD	1	2	3	4	5	6	7	8
1. Age	18–60	27.58	9.65	-							
2. Gender	-	-	-	-0.19**	-						
3. Boredom Proneness	8–56	25.01	10.69	-0.28**	-0.10	-					
4. Psy- chological Distress	0–63	26.46	14.92	-0.25**	0.10	0.54**	-				
5. Desire Think- ing - Verbal Perseveration	5–20	7.18	2.76	-0.12**	0.05	0.23**	0.27**	-			
6. Desire Thinking - Imaginal Prefiguration	5–20	8.54	3.07	-0.12**	-0.03	0.30**	0.32**	0.58**	-		
7. Craving	8–80	28.52	16.84	-0.18**	0.00	0.28**	0.30**	0.36**	0.52**	-	
8. Prob- lematic Smartphone Use	10–60	25.53	9.96	-0.23**	0.01	0.38**	0.34**	0.48**	0.65**	0.67**	-

Note ** $p < .001$ (with Bonferroni correction)

Path Analysis

The hypothesized model (Fig. 2) accounted for 60% of the variance of PSU and showed good fit indices: $\chi^2=4.906$, $df=4$, $p=.30$; $RMSEA [90\%CI]=0.02[0.00-0.06]$; $CFI=0.99$; $SRMR=0.01$. Both boredom proneness and psychological distress were associated only with the imaginal prefiguration component of desire thinking, which in turn was associated with PSU both directly ($\beta=0.06$, $SE=0.015$, $z=3.576$, $p<.001$; $P=55$ $p<.05$ and $\beta=0.07$ $SE=0.011$, $z=4.587$, $p<.001$; $P=48.84$ $p<.05$ respectively) and indirectly through the craving experience ($\beta=0.029$, $SE=0.008$, $z=3.461$, $p<.001$; $P=509.71$ $p<.05$ and $\beta=0.039$, $SE=0.006$, $z=4.351$, $p<.001$; $P=703.19$, $p<.05$ respectively). The hypothesized serial/sequential mediation of imaginal prefiguration, verbal perseveration and craving in the association between psychological distress and boredom proneness and PSU was not confirmed since verbal perseveration was not associated with craving. However a significant serial/sequential mediation effect of imaginal prefiguration and verbal perseveration on PSU (without the mediation of craving) emerged both for psychological distress ($\beta=0.013$, $SE=0.002$, $z=3.87$, $p<.001$; $P=224.04$, $p<.05$), and boredom proneness ($\beta=0.010$, $SE=0.003$, $z=3.21$, $p=.001$; $P=252.29$, $p<.05$). Finally, a direct effect of boredom proneness on PSU was found, whereas psychological distress was associated with PSU only indirectly through imaginal prefiguration and craving's serial effect, and the craving experience alone ($\beta=0.041$, $SE=0.011$, $z=2.419$, $p=.016$; $P=33.48$, $p<.05$). Regarding control variables, gender (i.e., male) was significantly associated with boredom proneness levels whereas age was negatively associated with psychological distress, boredom proneness, craving and PSU.

The two alternative models yielded the following fit statistics: Model 1 $\chi^2=166.43$; $df=5$; $p=.000$ $RMSEA [90\% CI]=0.22 [0.19-0.25]$; $CFI=0.89$; $SRMR=0.06$. Model

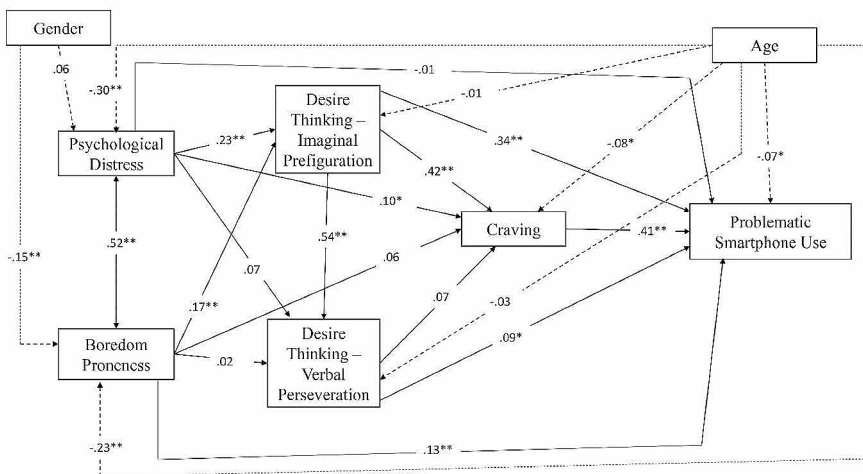


Fig. 2 Results of the path analysis. *Note* Solid lines indicate the pathways between the study variables. Dotted lines indicate the pathways from the control variables (age and gender) to the study variables. *** $p<.001$; * $p<.05$

2 $\chi^2=166.42$; $df=5$; $p=.000$; $RMSEA [90\% CI]=0.22 [0.19-0.25]$; $CFI=0.89$; $SRMR=0.06$. The alternative models had a poorer fit than the hypothesized model.

Discussion

The current study aimed to examine the role of desire thinking in problematic Smartphone use. The first goal was to reassess the associations between psychological distress, boredom proneness, and PSU (Casale et al., 2021) and between craving and PSU (De-Sola et al., 2017). Following previous research (Casale et al., 2021; Elhai et al., 2018; Lepp et al., 2017), the results of the current study indicated a positive association between PSU and psychological distress and boredom proneness on the one hand and an association between craving and PSU on the other hand. The second aim was to understand the function of desire thinking in the association between some psychological correlates of PSU (i.e., psychological distress and boredom proneness) and PSU levels by also evaluating the role of craving. The path analysis of our hypothesized model shows that the model fits the data very well. Extending what was already observed for other behavioral addictions (Mansueto et al., 2019), the current findings provide further evidence of the role of desire thinking in PSU (Gao et al., 2023). In particular, a relevant part of the imaginal prefiguration component as a 'cognitive strategy' to cope with negative emotional states (i.e., psychological distress and boredom proneness) emerged. However, when activated, it might lead to PSU directly and indirectly through the induction of craving. An explanation for the dysfunctionality of desire thinking originates from the triphasic formulation of the Self-Regulatory Executive Function (S-REF) model for addictive behaviors (Spada et al., 2013b; Wells & Matthews, 1996), which posits that in the pre-engagement phase desire thinking can become dysfunctional as it does not assist in downregulating negative thoughts and emotions but instead favors their prolongation by distributing attentional resources to them instead of meditating on the content of such experiences, as well as the experience of craving.

Moreover, our results revealed that imaginal prefiguration is associated with craving independently of verbal perseveration. This finding is in line with a previous study conducted in a community sample where different from clinical samples, a direct effect of the imaginal prefiguration component on craving was found (Caselli & Spada, 2015). It is possible to assume that the elaboration of the positive consequences related to Smartphone use (i.e., the imaginal prefiguration component of desire thinking) has a more substantial relevance in the activation of craving compared to the prolonged self-talk on the good reasons for using it (i.e., the verbal perseveration component of desire thinking). Concurrently, according to the present findings, the verbal perseveration component, which follows the imaginal prefiguration component, is associated with PSU independently of craving. An explanation may lie in the desired target (i.e., the Smartphone) being easily achievable, especially in a sample of young adults, and, consequently, craving being a transient experience.

Finally, in line with previous studies (McIntosh et al., 2006), being men positively predicted boredom proneness, whereas, inconsistently to what was previously reported (Matud et al., 2015), gender did not affect psychological distress levels. This

result could be partially explained by the fact that, in the current study, the sample predominantly comprises women. Age was found to predict PSU negatively, supporting previous evidence that younger people report higher levels of PSU (Elhai et al., 2017). Moreover, in the current study, being younger is associated with high levels of psychological distress and boredom proneness. Prior studies indicate boredom proneness rises early in adolescence (Spaeth et al., 2015) and declines later in adolescence into adulthood (Perone et al., 2023; Schulenberg et al., 2012). This further raises the possibility adolescence is a critical period to help youth acquire healthy responses to situations that induce boredom since adolescents who experience boredom and psychological distress are more likely to engage in unhealthy behaviors (Biolcati et al., 2018).

Limitations and Recommendations

The current study results must be considered in light of some methodological limitations. First, our work's cross-sectional design did not permit us to draw causal inferences. Although the poorer fit of the alternative models tested in the current study supports the contention that desire thinking precedes craving (and not the contrary), future longitudinal studies are needed to verify whether desire thinking dimensions can prospectively predict craving and PSU, even after a phase of interruption from the desired target. Second, data was collected through self-report measures, which may be affected by social desirability and self-report biases. Previous studies showed that PSU does not correlate strongly with actual smartphone use (Rozgonjuk et al., 2018), and although PSU correlates with psychopathology variables, psychopathology variables are not strongly correlated with tracked smartphone use (Rozgonjuk et al., 2021). Future studies should implement mixed methods, including objective measures of smartphone usage (e.g., daily minutes of phone screen time), as well as more robust methodologies such as Ecological Momentary Assessment. Third, the non-probability sampling method (i.e., convenience sampling) and some specific sample characteristics, such as the average age of participants and the fact that the sample was predominantly composed of women, limited the results' generalizability. Future replications among more representative samples and clinical samples are needed.

Finally, it would be helpful to test the proposed model in a sample of adolescents who could not use the Smartphone (for example, when they are at school). Similarly, it would be helpful to test the proposed model in experimental studies, where abstinence from Smartphones can be manipulated.

Conclusions

Regardless of the above limitations, the current study increases our understanding of the role of desire thinking and craving in PSU and has potential theoretical and practical implications. From a theoretical point of view, these results further support the impact of DT (especially in its imaginal prefiguration component) on craving for smartphone use, extending the application of the cognitive models of addictive behaviours (i.e., the Elaborated Intrusion Theory of Desire and the Self-

Regulatory Execution Function model) for the understanding of PSU. If future research validates these results, several practical implications can be drawn. Our findings suggest the importance of assessing and treating desire thinking to reduce the risk of craving and PSU. This could be achieved, for example, by providing information on the role of desire thinking in the activation of craving and in the excessive and uncontrolled use of the Smartphone. Desire thinking as a cognitive response to ‘manage’ negative internal experiences may be detrimental because it maintains attentional resources on the target and enhances the urge to achieve it. The propensity to engage in desire thinking could be attenuated by applying Metacognitive Therapy techniques, like attention training, detached mindfulness, and situational attentional refocusing (Wells, 2000, 2009), which permit the achievement of flexible control over attention and thinking style. In conclusion, this study highlights the potential role of desire thinking components and craving in PSU. Taken together, the current findings: (1) show the role of desire thinking, particularly the imaginal prefiguration component, in generating craving for the Smartphone; and (2) evidence that desire thinking can predict PSU directly, supporting the difference between desire thinking and craving.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s10942-024-00544-3>.

Author Contributions GF: study concept and design, analysis and interpretation of the data, writing the initial draft; MMS: study supervision, revising the final draft; SSB: study concept and design, statistical analysis, revising the final draft.

Funding Open access funding provided by Università degli Studi di Firenze within the CRUI-CARE Agreement. No funds, grants, or other support was received.
Open access funding provided by Università degli Studi di Firenze within the CRUI-CARE Agreement.

Data Availability The dataset analyzed during the current study is available from the corresponding author upon reasonable request.

Declarations

Ethical Approval The study was carried out in accordance with the Declaration of Helsinki. The Ethic Committee of the University of Florence approved the study.

Consent to Participate Informed consent was obtained for all participants.

Conflict of Interest The authors have no conflicts of interest to declare that are relevant to the content of this article.

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