Depressive Symptomatology Is Associated With Problematic Smartphone Use Severity in Adolescents: The Mediating Role of Cognitive Emotion Regulation Strategies

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Abstract

Problematic smartphone use (PSU) has been widely studied, and recent research has examined the affective and cognitive process risk factors that underlie its development and maintenance. Based on the Interaction of Person–Affect–Cognition–Execution model for problematic internet use, the present study analyzed the mediating role of cognitive emotion regulation strategies in the link between depressive symptomatology and PSU severity in adolescents. The sample consisted of 2,197 adolescents aged 12 to 19 years from southern Spain, who completed self-report questionnaires of depressive symptoms (Depression Anxiety Stress Scale–21), cognitive emotion regulation strategies (Cognitive Emotion Regulation Strategies Questionnaire), and PSU severity (Smartphone Addiction Scale–Short Version). We used the SPSS PROCESS macro to conduct parallel mediation analyses. The results demonstrated significant indirect/mediation effects from depressive symptoms to PSU severity through cognitive emotion regulation strategies, including other-blame, catastrophizing, rumination (i.e., maladaptive), and refocus on planning (i.e., adaptive). The implications of this study include that specific teaching about these strategies may help reduce PSU severity in adolescents.

Introduction

Because the internet is an essential part of daily life, in recent years there has been a plethora of research on its psychosocial impact (Khan & Khan, 2022). Despite being largely beneficial for information access, time management, and communication (Castellacci & Tveito, 2018), digital technologies and internet usage may become problematic, or even addictive, for about one-quarter of individuals (Meng et al., 2022; Pan et al., 2020). With regard to internet-related negative behaviors, only gaming disorder and gambling disorder (in a „predominantly online" classification) have been included (or considered for inclusion) as mental disorders in the *International Classification of Diseases* (11th ed.; World Health Organization, 2019) and the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; American Psychiatric Association, 2013). Nonetheless, some researchers argue that other disorders due to addictive behaviors should also be considered for inclusion, such as pornography use

disorder, buying-shopping disorder, social network use disorder, and disordered smartphone use (Elhai et al., 2020; Wegmann et al., 2022). In this study, we focused on the latter, conceptualizing it as *problematic smartphone use* (PSU; Elhai et al., 2019b). The term *smartphone addiction* can be found in the literature as well (e.g., Meng et al., 2022; Ratan et al., 2021), but *PSU* is less controversial because *addiction* usually refers to a substance addiction framework and specific criteria that may not be present in the same way when considering smartphone-related behaviors (e.g., tolerance, withdrawal, and relapse; Panova & Carbonell, 2018). Furthermore, usage motives and context should be considered when determining whether a specific criterion is problematic (Panova & Carbonell, 2018). In addition, the term *PSU* acknowledges that people may experience maladaptive consequences due to high smartphone use frequency, although these might not be as severe as with other addictions (Elhai et al., 2020; Panova & Carbonell, 2018). Several scholars consider that more PSU research, in particular that which focuses on risk factors and underlying mechanisms, is still needed to determine whether PSU should be considered a disorder in the future (Elhai et al., 2020; Montag et al., 2020; Wegmann et al., 2022).

To this end, a theoretical approach that guides current research about risk factors and underlying mechanisms of internet-related disorders is the Interaction of Person–Affect–Cognition–Execution (I-PACE) model (Brand et al., 2016, 2019). The I-PACE model states that problematic internet use results from the interaction between specific personal core characteristics (P component), affective and cognitive responses to triggers (A and C components), and executive functioning that influences the decision to engage in certain internet-related behaviors (E component). Brand et al. (2016) asserted that variables such as an individual's biopsychological constitution, psychopathological features, personality, social cognitions, and use motives fall within the P component and are therefore predisposing or risk factors. Furthermore, coping styles, internet-related cognitive biases, cue reactivity, craving, an urge for mood regulation, and attentional biases are among the variables proposed as A and C components. Finally, executive functioning, inhibitory control, and decision making comprise the E component. In this study, we focused on variables related to the P, A, and C components because research suggests that these mechanisms have been most widely studied in relation to PSU (Busch & McCarthy, 2021), although not necessarily within the I-PACE framework. Therefore, our study aimed at providing much-needed empirical evidence regarding particular factors and processes within this contemporary internet-related specific theoretical model (Elhai et al., 2019a; Wegmann & Brand, 2021), as previous studies have done (e.g., Arrivillaga et al., 2022a; Hallauer et al., 2022; Servidio et al., 2022).

First, with regard to risk factors, compared with other portions of the I-PACE model there is considerably more evidence about psychopathology, such as stress, anxiety, and depression, as antecedents of PSU severity (Busch & McCarthy, 2021). For instance, the link between depression symptoms and PSU severity is well established in the scientific literature (Augner et al., 2023; Elhai et al., 2017; Yang et al., 2020). Nevertheless, the direction of this association is not clear, because some longitudinal studies have found evidence suggesting that depression symptoms lead to increased PSU severity (Yuan et al., 2021; Zhou et al., 2021), others have indicated effects in the opposite direction (Coyne et al., 2019; Lapierre et al., 2019), and there is also evidence for a reciprocal relation (Jun, 2016). Still, most theories, such as the I-PACE model (Brand et al., 2019), Compensatory Internet Use Theory (Kardefelt-Winther, 2014), and the pathways model (Pivetta et al., 2019), posit that PSU is a maladaptive response to negative affectivity, such as depressive symptoms, and do not suggest that excessive internet or smartphone use causes psychopathology in people who previously have not displayed psychopathological tendencies (Brand et al., 2019; Kardefelt-Winther, 2014; Pivetta et al., 2019). Consequently, in our study depressive symptomatology was analyzed as an antecedent of PSU severity.

Second, there is current scientific interest in the affective and cognitive processes that might explain the link between risk factors and PSU severity (Elhai, Yang, & Montag, 2019; Wegmann & Brand, 2021). As previously noted, coping styles are among these processes. Brand et al. (2016) suggested that, among individuals with a predisposing vulnerability to negative affect/psychopathology, the use of dysfunctional coping strategies can cause problematic internet use. In addition, some studies have found that depression can affect the selection of certain dysfunctional coping strategies (Domaradzka & Fajkowska, 2018; Fajkowska et al., 2018), and the use of these strategies can help maintain existing depressive symptoms (Visted et al., 2018). Coping processes fall within the umbrella term of *affect regulation*, which also includes mood and emotion regulation (Gross, 2015b). Although there is a slight difference in the type of affect regulated, there is considerable overlap among the types of affect regulation, a realization that has led some theorists to suggest that the terms could be used interchangeably (Gross, 2015b; Kraaij & Garnefski, 2019).

There are various approaches to conceptualizing emotion regulation; some focus on particular deficits (e.g., Gratz & Roemer, 2004), and others specify strategies (e.g., Garnefski et al., 2001; Gross, 2015b). In essence, *emotion*

regulation refers to attempts an individual makes to influence which emotions they have, when they have them, and how they are experienced or expressed (Gross, 2015a). Emotion regulation involves a wide array of biological, social, and behavioral cognitive processes that may be conscious or unconscious (Garnefski et al., 2001). Consequently, one major focus in the field of emotion regulation is finding ways to organize the different strategies people use to regulate emotions and then assessing whether different strategies are associated with specific outcomes (Gross, 2015a). Some studies have found significant associations between emotion dysregulation and PSU severity. For instance, Yildiz (2017) found that greater use of external (e.g., taking one's feelings out on someone else, either verbally or physically) and internal dysfunctional (e.g., harming or punishing oneself) strategies, as well as decreased use of internal functional strategies (e.g., putting things into perspective), were associated with greater PSU severity (Phillips & Power, 2007). Moreover, Sun et al. (2019) found an inverse association between PSU and problem-focused coping strategies and a positive link with emotion-focused strategies. Extremera et al. (2019) found positive associations for PSU severity with self-blame, other-blame, rumination, and catastrophizing and an inverse association with positive reappraisal. In addition, Elhai and collaborators have analyzed the mediating role of specific emotion regulation strategies in several studies and found that greater emotional suppression (Elhai et al., 2016) and rumination (Elhai, Tiamiyu, & Weeks, 2018; Vally et al., 2021), as well as decreased mindfulness (Elhai, Levine, et al., 2018), are mechanisms that mediate the link between depression symptoms and PSU severity. In essence, PSU has been related to emotion regulation strategies known to be maladaptive—that is, those associated with worse long-term mental and physical health outcomes (McRae & Gross, 2020)—while being inversely related to those considered adaptive. In addition, the research discussed earlier indicates that such strategies mediate the associations between depression and PSU severity.

Most previous research has analyzed emotion regulation strategies in relation to PSU severity either from broad (e.g., problem-focused or emotion-focused strategies) or specific (e.g., one or two strategies) frameworks. The present study builds on the research conducted so far and contributes by analyzing emotion regulation using the model of Garnefski et al. (2001), which proposes that there are individual differences in how people regulate negative emotions by using adaptive and maladaptive cognitive emotion regulation strategies. In this framework, adaptive strategies include *acceptance* (i.e., thoughts about accepting a situation and resigning oneself to what has happened), *positive refocusing* (i.e., thinking about other joyful and pleasant events instead of focusing on negative ones), *refocus on planning* (i.e., thoughts about which steps to take to handle the negative event), *positive reappraisal* (i.e., attaching a positive meaning to the negative event so it is perceived as personal growth), and *putting things into perspective* (i.e., thinking about reducing the seriousness of the event or comparing it with more important matters). Maladaptive strategies are *self-blame* (i.e., thoughts of blaming oneself for a negative event experienced), *other-blame* (i.e., thinking that other people are to blame for one's negative experience), *catastrophizing* (i.e., thoughts about emphasizing the terror of the negative event), and *rumination* (i.e., thinking about the emotions and thoughts associated with the negative event; Garnefski et al., 2001; Garnefski & Kraaij, 2018). In general, research shows that more frequent use of maladaptive strategies and less frequent use of adaptive strategies are associated with increased depression (Schäfer et al., 2017; Young et al., 2019). Prior studies that have tested the nine cognitive emotion regulation strategies discussed here suggest that depressive symptomatology in adolescents is associated with greater rumination, self-blame, and catastrophizing and lower positive reappraisal and positive refocusing (Garnefski & Kraaij, 2006, 2018). Analyzing distinct strategies is relevant because it could help determine different pathways that should be avoided or promoted in adolescents suffering from depression to prevent the development of PSU.

Finally, adolescence is a stage in which several biopsychosocial changes take place, some of which are responsible for increases in risk-taking behavior and difficulties controlling impulses shown by this population (Berman, 2018; Valkenburg & Piotrowski, 2017). With regard to internet and smartphone use, these changes influence adolescents' preference for fast, complex, humor-based, and risky content and a need to stay connected to peers to develop their identities, learn about intimacy and sexuality, and search for autonomy (Valkenburg & Piotrowski, 2017). Consequently, studies that have compared different age groups have found that adolescents and youth are at increased risk for PSU (Csibi et al., 2021; Kuss et al., 2018), showing prevalence rates between 10% and 30% (Field, 2020; Sohn et al., 2019). Finally, Liu et al. (2022) found that symptoms of problematic internet use, which is closely related to PSU, differ depending on the stage of adolescence: An early stage is characterized by the need to increase usage time to achieve previous level of satisfaction and the experience of an empty life; a middle stage is differentiated by less sleep, failure to stop, and feeling depressed; and in a late stage the latter is considered the core symptom. Thus, analyzing emotion regulation strategies that could mediate the relationship between

depressive symptoms and PSU in adolescents is relevant to further understanding the specifics of PSU development in this population.

To the best of our knowledge, no study has analyzed the mediating role of these nine cognitive emotion regulation strategies jointly in regard to the association between depressive symptomatology and PSU severity in adolescents using a theoretically supported problematic internet use model (Brand et al., 2019).

The Present Study

In the present study, we analyzed the mediating role of nine cognitive emotion regulation strategies in the link between depressive symptomatology and PSU severity in a sample of Spanish adolescents. On the basis of previous research, we posed the following hypotheses:

H1: We expected that depressive symptomatology would be positively associated with PSU severity (Augner et al., 2023; Elhai et al., 2017; Yang et al., 2020).

H2: On the basis of general findings regarding maladaptive and adaptive strategies (Schäfer et al., 2017; Young et al., 2019), we expected a positive association between depression severity and maladaptive strategies: self-blame, other-blame, catastrophizing, and rumination (**H2a**) and an inverse association with adaptive strategies: acceptance, positive refocusing, refocus on planning, positive reappraisal, and putting things into perspective (**H2b**).

H3: On the basis of general findings about maladaptive and adaptive strategies (Extremera et al., 2019; Sun et al., 2019; Yildiz, 2017), we expected a positive association between maladaptive strategies (i.e., self-blame, other-blame, catastrophizing, and rumination) and PSU severity (**H3a**) and an inverse association with adaptive strategies (i.e., acceptance, positive refocusing, refocus on planning, positive reappraisal and putting things into perspective) and PSU severity (**H3b**).

H4: On the basis of general findings on the mediating role of emotion regulation (Elhai et al., 2016; Elhai, Levine, et al., 2018; Elhai, Tiamiyu, Weeks, et al., 2018; Vally et al., 2021), we expected to find a significant positive indirect effect from depressive symptomatology to PSU severity that is mediated by the maladaptive cognitive emotion regulation strategies and significant negative indirect effects mediated by the adaptive cognitive emotion regulation strategies.

Our research model is presented in Figure 1. The parallel mediation model indicates that depression is expected to have a direct effect on PSU, with nine precise indirect effects specified through each of the cognitive emotion regulation strategies. We tested a parallel mediation model in which each specific indirect path is estimated while holding the remaining mediators constant (Hayes, 2022). This model also allows for pairwise comparisons between indirect effects (Hayes, 2022).

Figure 1. *Parallel Mediation Research Model.*
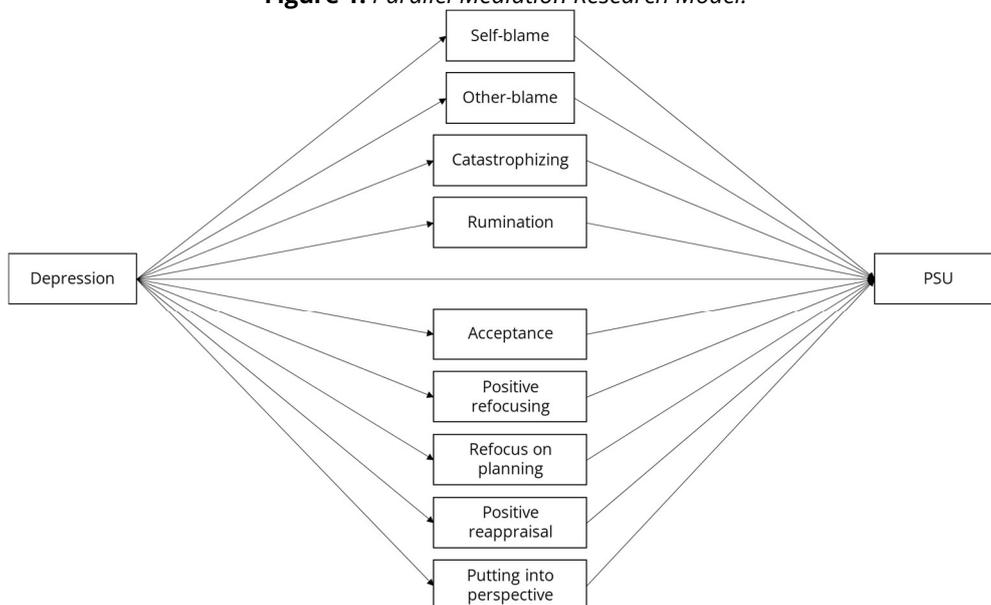
Note. PSU = problematic smartphone use. Representation of the parallel mediation research model, in which the relation between depression and PSU is hypothesized to be mediated by nine cognitive-emotion regulation strategies.

Methods

Procedure

Fourteen urban and rural high schools in the Province of Malaga (southern Spain) were contacted and informed of the research aims and protocol, following a convenience sampling method. Ten schools agreed to participate. The participating schools provided their agreement by signing a consent form and notifying the students' parents about the study. Adolescents whose parents provided implied or informed consent completed the questionnaires (part of a larger battery) during a one-hour tutorial class. One teacher and research assistant were present during this time. Adolescents were informed of the study objectives, the voluntary nature of their participation, and the anonymity and confidentiality of the information they provided. The data was collected from March 2018 to May 2019. The research protocol was approved by the ethics committee of the University of Malaga, and data collection was done in accordance with current ethical principles (World Medical Association, 2013).

Participants

Participants in this study were 2,197 adolescents aged 12 to 19 years (M = 14.57, SD = 1.62). The majority were girls (53.4%). They were students at one of 10 high schools in southern Spain. About one-third were attending the third year of compulsory secondary education (roughly equivalent to American high school ninth grade; 34.3%), 26.8% were in their fourth year, 19.2% were in the first year of high school baccalaureate (roughly equivalent to American high school 11th grade), 18.6% were in their second year, and 1% were in professional/vocational training. With regard to smartphone use habits, on weekdays the majority of participants used their smartphones for more than 6 hours (44.9%), 23.1% between 3 and 5 hours, 15.9% between 2 and 3 hours, 10.7% for less than 2 hours, and 4.9% did not use their smartphones. On weekends, 45.8% indicated that they used their smartphones for more than 6 hours, 27.1% between 3 and 5 hours, 16% between 2 and 3 hours, 8.4% less than 2 hours, and 2.1% did not use their smartphones. Finally, the percentages of adolescents who were at high risk for PSU were 32.1% female and 22.9% male (see *Instruments* for details about this criterion).

Instruments

Depressive Symptomatology

We used the Depression subscale of the Depression Anxiety Stress Scale (DASS–21: Bados et al., 2005; Lovibond & Lovibond, 1995). The Depression subscale is composed of seven items that are rated on a scale ranging from 0 (*did not apply to me at all*) to 3 (*applied to me very much or most of the time*). Higher scores suggest increased depressive symptomatology. An example item is *I felt I wasn't worth much as a person*. The DASS–21 is valid and reliable in Spanish samples (Bados et al., 2005). In our study, internal consistency values were Cronbach's α = .89 and McDonald's ω = .90.

Cognitive Emotion Regulation Strategies

We used the Cognitive Emotion Regulation Strategies Questionnaire (CERQ; Chamizo-Nieto et al., 2020; Garnefski et al., 2001). The CERQ is composed of nine subscales: (a) Self-Blame (e.g., *I think that it's my own fault*), (b) Other-Blame (e.g., *I think that it's all caused by others*), (c) Catastrophizing (e.g., *I often think that it's much worse than what happens to others*), (d) Rumination (e.g., *Again and again, I think of how I feel about it*), (e) Acceptance (e.g., *I think that I have to accept it*), (f) Positive Refocusing (e.g., *I think of nicer things that have nothing to do with it*), (f) Refocus on Planning (e.g., *I think about what would be the best for me to do*), (g) Positive Reappraisal (e.g., *I think that I can learn from it*), and (h) Putting Into Perspective (e.g., *I think that worse things can happen*). Each subscale contains four items, answered on a scale ranging from 1 (*almost never*) to 5 (*almost always*). There is evidence supporting the CERQ's validity and reliability in Spanish populations (Chamizo-Nieto et al., 2020). In our sample, the internal consistency of each subscale was as follows: Self-Blame, α = .63, ω = .65; Other-Blame, α = .72, ω = .73; Catastrophizing, α = .65, ω = .66; Rumination, α = .72, ω = .72; Acceptance, α = .62, ω = .64; Positive Refocusing, α = .83, ω = .85; Refocus on Planning, α = .77, ω = .77; Positive Reappraisal, α = .75, ω = .75; and Putting Into Perspective, α = .71, ω = .71.

PSU Severity

We used the Smartphone Addiction Scale–Short Version (SAS–SV: Kwon et al., 2013; Lopez-Fernandez, 2017) to measure PSU. The SAS–SV is composed of 10 items that are rated on a scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). Higher scores indicate greater PSU severity. The cut-off values to determine high-risk PSU severity are 31 for males and 33 for females (Kwon et al., 2013). An example item is *Having my smartphone in my mind even when I am not using it*. The Spanish version of the SAS–SV is a reliable and valid measure of PSU (Lopez-Fernandez, 2017). The Internal consistencies in our sample were α = .86, ω = .86.

Data Analyses

We used SPSS (v23; SPSS Inc., Chicago) to conduct the analyses. Initially, missing values of items were imputed by using the expectation–maximization imputation algorithm. This is a fitting and extensively used method (Liang & Bentler, 2004). Next, we tested linear regression assumptions (i.e., normality, homoscedasticity, multicollinearity, and independence of errors; Hayes, 2022). Afterward, we calculated descriptive statistics and reliability indices. We then used Kendall's τ, a nonparametric test, to assess bivariate correlations because, according to Newson (2002), in the presence of nonnormality it is more robust than Pearson's ρ (i.e., a parametric test) and more reliable and interpretable than Spearman's ρ (i.e., a different nonparametric test).

Next, we conducted a parallel mediation analysis using Model 4 of the PROCESS macro (Hayes, 2022). Depression was the antecedent variable, PSU was the outcome variable, and the nine CERQ strategies were mediators. Because some studies have indicated that there are differences in PSU between men and women (i.e., women tend to show higher PSU severity) and among age groups (i.e., older adolescents tend to have higher PSU scores; Busch & McCarthy, 2021; Sohn et al., 2019), age and gender were added as covariates of PSU severity. We used bootstrapping with 5,000 simulations to test for indirect/mediating effects from depression to PSU through the CERQ strategies. We conducted pairwise comparisons between significant indirect effects to determine relative importance. An effect was considered significant if the 95% confidence interval (CI) did not include 0.

Results

Preliminary Results

We found that statistical assumptions were met, except for normality and homoscedasticity. Thus, we used nonparametric tests for correlations and heteroscedasticity-consistent standard errors in the mediation analyses.

Table 1 presents descriptive statistics and correlations between the study variables. As shown, depression and PSU severity had a significant and positive correlation. Moreover, depression significantly correlated with all CERQ strategies, showing positive associations with Self-blame, Other-blame, Catastrophizing, Rumination, and Acceptance, and inverse associations with Positive refocusing, Refocus on planning, Positive reappraisal, and Putting things into perspective. The same pattern was observed between PSU and the CERQ strategies, except for Putting things into perspective, which did not have a significant correlation with PSU severity.

Multiple Mediation Results

Results from the parallel mediation analysis are presented in Figure 2 and Table 2. As shown in Figure 2, depression had a significant positive direct effect on PSU severity ($p < .001$). Moreover, all direct effects from depression to the CERQ strategies were statistically significant ($p < .001$). Positive associations were found for self-blame, other-blame, catastrophizing, rumination, and acceptance, and inverse associations were found for positive refocusing, refocus on planning, positive reappraisal, and putting into perspective. Furthermore, significant positive effects were found from other-blame ($p < .001$), catastrophizing ($p = .020$), and rumination ($p < .001$) to PSU severity, and a significant negative effect was found from refocus on planning to PSU ($p = .039$).

Table 1. *Descriptive Statistics and Correlations.*

Variables	M	SD	2	3	4	5	6	7	8	9	10	11
1. Depression	0.75	0.78	.24**	.10**	.29**	.25**	.10**	−.11**	−.08**	−.13**	−.04**	.23**
2. Self-blame	2.81	0.83		.04**	.25**	.39**	.30**	.03*	.19**	.11**	.15**	.07**
3. Other-blame	2.20	0.83			.26**	.10**	.03*	.14**	.08**	.08**	.10**	.10**
4. Catastrophizing	2.51	0.88				.31**	.18**	.06**	.03*	.01	.06**	.15**
5. Rumination	3.18	0.93					.36**	.11**	.26**	.16**	.18**	.16**
6. Acceptance	3.39	0.84						.15**	.25**	.23**	.25**	.03*
7. Positive refocusing	2.94	1.10							.34**	.35**	.29**	−.05**
8. Refocus on planning	3.57	0.94								.47**	.33**	−.03*
9. Positive reappraisal	3.40	0.97									.43**	−.04**
10. Putting into perspective	3.40	0.94										.01
11. PSU	26.48	10.43										

Note. PSU = problematic smartphone use severity. Kendall's tau coefficients are presented for correlations. **$p < .01$, *$p < .05$ (two-tailed).

In addition, the upper section of Table 2 shows that the total effect from depression to PSU was significant and positive. With regard to the covariates, significant and positive total effects were found on PSU severity, indicating that being female and older was associated with increased PSU. The model explained 21% of the variance in PSU, $R^2 = .21$, $F(12, 2,061) = 44.79$, $p < .001$. The lower part of Table 2 presents indirect effects from depression to PSU through the CERQ strategies. Because the bootstrapped 95% CIs did not include 0, significant indirect effects were found through other-blame, catastrophizing, rumination, and refocus on planning.

Finally, pairwise contrasts between significant indirect effects indicated that the path through rumination was significantly larger than the one through other-blame, $B = −0.35$, $SE = 0.14$, 95% CI [−0.62, −0.07], and through refocus on planning, $B = 0.49$, $SE = 0.13$, 95% CI [0.24, 0.74]. The CIs indicate that the remaining differences were not significant.

Figure 2. *Results From the Direct Effects in the Parallel Mediation Model.*
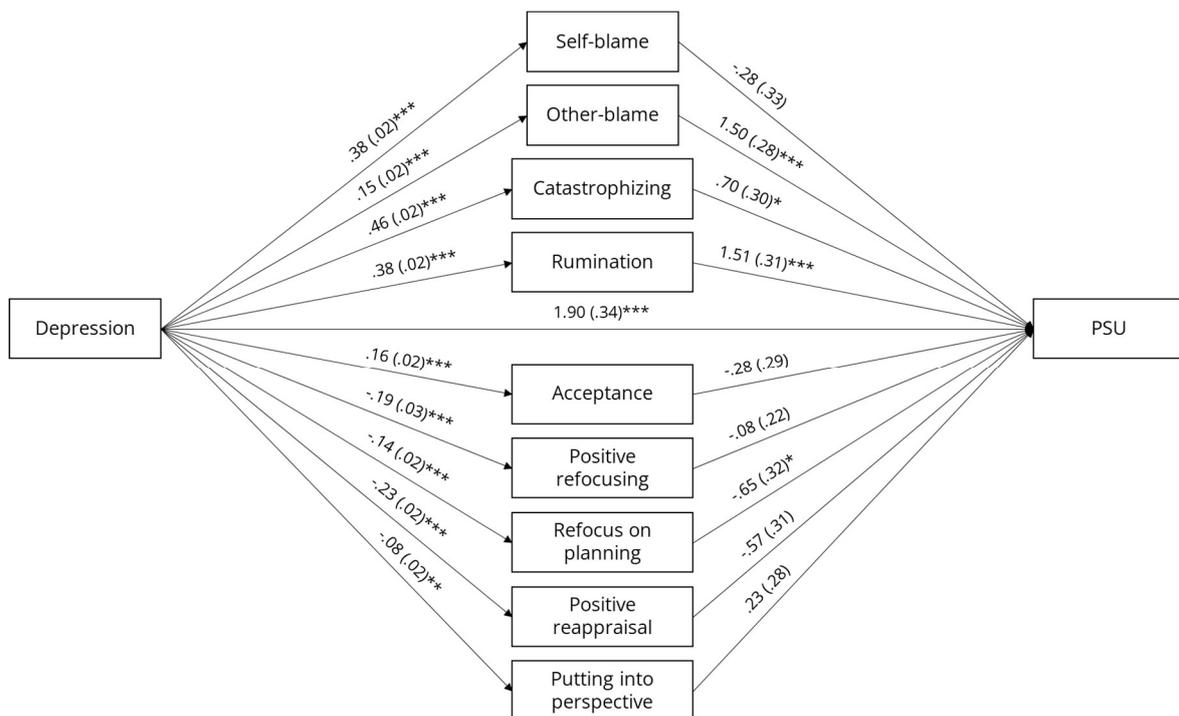
Note. Unstandardized coefficients are indicated, with standard errors in parentheses. Covariates were not added in the figure for simplicity.
***$p < .001$, *$p < .05$.

Table 2. *Total and Indirect Effects of the Parallel Mediation Model.*

Mediation results	B	SE	p	LLCI	ULCI
Total effects					
Dep → PSU	3.12	0.30	< .001	2.53	3.71
Gender → PSU	3.86	0.41	< .001	3.04	4.68
Age → PSU	1.54	0.13	< .001	1.28	1.79
Indirect effects					
Dep → self-blame → PSU	−0.10	0.12	−	−0.36	0.13
Dep → other-blame → PSU	0.23	0.06	−	0.13	0.36
Dep → catastrophizing → PSU	0.32	0.14	−	0.04	0.60
Dep → rumination → PSU	0.58	0.12	−	0.34	0.84
Dep → acceptance → PSU	−0.04	0.04	−	−0.14	0.04
Dep → positive refocusing → PSU	0.01	0.04	−	−0.07	0.10
Dep → refocus on planning → PSU	0.09	0.05	−	0.01	0.20
Dep → positive reappraisal → PSU	0.13	0.07	−	−0.01	0.27
Dep → putting into perspective → PSU	−0.01	0.02	−	−0.07	0.02

Note. Dep = depression. PSU = problematic smartphone use severity. Unstandardized coefficients are presented. A heteroscedasticity consistent standard error and covariance matrix estimator was used. Gender was coded 1 = *males*, 2 = *females*.

Discussion

Because internet and smartphone use are widely integrated in the adolescent population, there is current scientific interest in the potential risk factors and mechanisms associated with problematic usage of digital technology. In the present study, we aimed to contribute to the research literature by analyzing the mediating role of cognitive emotion regulation strategies in the association between depressive symptomatology and PSU severity in Spanish adolescents.

Our results indicated a positive association between depressive symptoms and PSU severity, supporting H1 and in accordance with prior findings (Augner et al., 2023; Yuan et al., 2021; Zhou et al., 2021). Current theoretical approaches suggest that PSU, as well as other internet-related conditions, could be prompted by predisposing variables, such as psychopathology (Brand et al., 2019). Similarly, it has been proposed that PSU may result from overusing one's smartphone as a means of alleviating negative affect (Kardefelt-Winther, 2014). Because we used a nonclinical community sample and cross-sectional data, we cannot conclude, on the basis of our results, that clinical depression is associated with increased PSU. Nonetheless, our results support the notion that adolescents who experience depressed mood may be overusing their smartphones as a means of lessening their distress. In an attempt to better understand the mechanisms underlying this link, we next discuss findings about the mediating role of cognitive emotion regulation strategies.

The results of direct-effect analyses supported our second hypothesis because we found a significant and positive association between depressive symptoms and maladaptive regulation strategies, such as self-blame, other-blame, catastrophizing, and rumination (H2a) and a significant and negative link between depressive symptomatology and adaptive strategies, such as positive refocusing, refocus on planning, positive reappraisal, and putting into perspective (H2b). These results are partly in accordance with prior research in adolescent samples that has found positive associations between depression and rumination, self-blame, and catastrophizing and negative links with positive reappraisal and positive refocusing (Garnefski & Kraaij, 2006, 2018). The findings are also concordant with more general results regarding a positive relation between depression and maladaptive strategies and a negative relation between depression and adaptive strategies (Schäfer et al., 2017; Young et al., 2019). It is worth mentioning, though, that most studies on this subject have cross-sectionally analyzed depression as the outcome of using certain emotion regulation strategies because explaining how depression develops was the main objective. Nevertheless, other studies also have suggested that the use of certain cognitive emotion regulation strategies can be the result of thinking about depression as an affective type (Domaradzka & Fajkowska, 2018; Fajkowska et al., 2018). In addition, some research indicates that the use of maladaptive strategies is a key factor in the maintenance of depression (Visted et al., 2018). This notion is consistent with our proposal within the

I-PACE model because the aim of our study was to explain the development of PSU, not depression, as an outcome; thus, it was most fitting to analyze emotion regulation strategies as underlying mechanisms/mediators between depressive symptoms and PSU severity. Contrary to our expectations, we found a positive association between depression symptoms and acceptance. Although this finding is inconsistent with those of some previous studies (Schäfer et al., 2017; Young et al., 2019), it is in accordance with others (Garnefski & Kraaij, 2018; Martin & Dahlen, 2005). To this end, it has been suggested that items on the Acceptance subscale might reflect a certain degree of hopelessness, and thus acceptance could only be cautiously deemed an adaptive strategy, because circumstances (i.e., whether they are subject to change) and mood (i.e., positive or negative) should also be considered (Martin & Dahlen, 2005).

The direct-effect results largely supported H3a because we found significant and positive associations between other-blame, catastrophizing, and rumination (although not self-blame) and PSU severity. The results are mostly consistent with those of prior research that has explored these specific strategies (Extremera et al., 2019) and more general maladaptive strategies (Sun et al., 2019; Yildiz, 2017). In addition, we found evidence only for the inverse association between the adaptive strategy of refocus on planning (H3b) and PSU severity, which is not supported by specific previous findings but is consistent with general approaches between adaptive emotion regulation and PSU (Sun et al., 2019; Yildiz, 2017).

The most important contribution of our research is the parallel analysis of multiple cognitive emotion regulation strategies as underlying mechanisms that explain the association between depressive symptoms and PSU severity. We found partial support for H4 in that significant indirect effects were found through rumination, catastrophizing, other-blame, and refocus on planning. We discuss these findings next.

Prior studies have supported the mediating role of rumination in the link between psychological maladjustment and PSU severity (Arrivillaga et al., 2022b; Elhai, Tiamiyu, & Weeks, 2018; Vally et al., 2021). Rumination is a multifaceted construct that involves adaptive and maladaptive aspects; in this study we focused on the latter, which refers to a strategy whereby an individual repetitively focuses on the negative thoughts and emotions associated with an experience (Garnefski & Kraaij, 2018). One reason why rumination could be a maladaptive strategy is because although the person constantly thinks about the negative experience they do not necessarily engage in any action to resolve the situation, thus usually increasing indecision and distress (Aldao et al., 2010; Ward et al., 2003).

To the best of our knowledge, no previous research has analyzed the role of catastrophizing, other-blame, and refocus on planning as mediators in the proposed model; thus, our results are innovative. First, prior studies have demonstrated that catastrophizing is a common strategy among depressed adolescents (Weeks et al., 2017). Catastrophizing involves emphasizing the terror of experiences (Garnefski & Kraaij, 2018). Thus, adolescents who experience depressed mood (e.g., sadness, hopelessness, worthlessness) and catastrophize these emotions, instead of relieving their discomfort, might end up feeling more distressed and experience more negative outcomes (Rodríguez-Menchón et al., 2021). Second, other-blame implies putting the blame for a negative experience on the environment or another person (Garnefski & Kraaij, 2018). A theory that could help explain why other-blame mediated the link between depression and PSU severity is *locus of control theory*, which states that individuals tend to have an internal or external locus of control to explain situations they experience (Rotter, 1966). An external locus of control involves perceiving outcomes as dependent on external causes, such as luck, chance, or other people, or as unpredictable (Rotter, 1966). An external locus of control is associated with psychological maladjustment in adolescents (Flores et al., 2020). Therefore, blaming others as a way of coping with a depressed mood would also result in an increase in, rather than a reduction of, negative affect. Thus, the mediating role of the maladaptive strategies of rumination, catastrophizing, and other-blame might be explained by noting that adolescents who experience depressive symptomatology and use these cognitive strategies do not resolve their discomfort but rather increase it, and therefore they turn to other behavioral strategies, such as overusing their smartphone. This explanation is consistent with the notion of PSU as a strategy for coping with negative emotions (Kardefelt-Winther, 2014) and the proposal of cognitive appraisal processes preceding actions (Garnefski et al., 2001).

Refocus on planning was the only adaptive strategy that mediated the path between depressive symptomatology and PSU severity. This implies that one is thinking about steps that should be taken and how to manage a negative situation (Garnefski & Kraaij, 2018). In accordance with locus of control theory, a refocus on planning might entail an internal locus of control, suggesting that the individual perceives the effect of an event as contingent on their own behavior (Rotter, 1966). A greater internal locus of control is associated with increased well-being (Flores et al.,

2020). In line with expectations about maladaptive strategies, refocus on planning is an adaptive strategy because it might help reduce depressive symptomatology. Thus, refocusing on planning can decrease the need to use smartphones excessively to cope with negative affect because this strategy focuses on how to solve such discomfort instead of why it occurred in the first place. In addition, the proposal of locus of control as a potential explanation for strategies of other-blame and refocus on planning is consistent with current theories suggesting that some people may be more prone to PSU because they have difficulties controlling their impulses (Pivetta et al., 2019).

Our study is not without limitations. First, we used a cross-sectional research design; thus, causality between study variables cannot be inferred. Future prospective studies might address this limitation. Second, because we asked the adolescent participants about sensitive information, they may have been susceptible to a social desirability bias (Krumpal, 2013). Using objectively measured data in future research could address this shortcoming. Third, the internal consistency of some CERQ subscales was less than ideal. To this end, some researchers have proposed that short scales should address construct representation more so than internal consistency, in particular when used in group research (Ziegler et al., 2014). Therefore, we used the CERQ version that has been proven reliable and valid for Spanish adolescents (Chamizo-Nieto et al., 2020). Nonetheless, future studies might use a longer CERQ version to address this issue. Fourth, we assessed PSU severity using a self-report questionnaire with a nonclinical sample. Future studies could use clinical interviews or other methods to assess this construct, as well as clinical samples, to overcome this limitation. Fifth, we did not measure online activities performed on the smartphones. Many researchers in the field consider that people become addicted not to smartphones but to a specific type of online activity (e.g., social networking sites and video games; Griffiths, 2020). Thus, future research should consider these types of content to gain a better understanding of problematic smartphone-related behaviors.

Despite these limitations, our study has important implications. With regard to practical implications, a recent meta-analytic study found that psychological interventions, mainly based on cognitive behavior therapy (CBT), are effective in reducing PSU severity (Augner et al., 2022). Another meta-analysis found that group interventions tended to decrease problematic internet use and PSU in adolescents (Malinauskas & Malinauskiene, 2019). Nonetheless, these studies analyzed a relatively small number of studies (i.e., four PSU studies, and six total, respectively) because few PSU interventions have been evaluated. In comparison, more studies have found that CBT is an effective prevention and treatment approach to clinical and subclinical depressive symptoms in adolescents, both individually and in groups (Ebert et al., 2015; Keles & Idsoe, 2018; Rasing et al., 2017). One of the core aims of CBT is challenging negative beliefs and teaching positive ones (Garnefski & Kraaij, 2018). Our results suggest that specifically challenging the use of strategies such as other-blame, catastrophizing, and rumination, while teaching about refocusing on planning, could be a promising approach to preventing and treating PSU severity in adolescents. Finally, concerning theoretical implications, our study provides partial evidence to support the I-PACE model, contributing to prior research that has used this approach (e.g., Arrivillaga et al., 2022a; Hallauer et al., 2022; Servidio et al., 2022). In other words, when depressive symptomatology acts as a predisposing variable the use of specific cognitive emotion regulation strategies take the form of affective and cognitive mechanisms that underlie the association with PSU severity in adolescents.

Conflict of Interest

Authors' Contribution

Acknowledgement

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