

## Research paper

# Psychological distress, rumination and problematic smartphone use among Spanish adolescents: An emotional intelligence-based conditional process analysis

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## ABSTRACT

**Background:** Problematic smartphone use (PSU) is a public health issue that is currently rising among adolescents. The Compensatory Internet Use Theory (CIUT) poses that difficulties in handling negative life circumstances could result in PSU. Furthermore, the Interaction of Person-Affect-Cognition-Execution (I-PACE) model suggests that the interaction between core characteristics and affective and cognitive responses could lead to PSU. The present study aimed to clarify the links between psychological distress and PSU by exploring rumination as a mediator and emotional intelligence (EI) as a moderator.

**Methods:** A sample of 1882 adolescents (54% female, 46% male) completed measures of psychological distress, rumination, EI and PSU. The PROCESS macro was used to conduct a moderated mediation analysis.

**Results:** The mediation results showed a significant indirect effect from psychological distress to PSU through rumination. Furthermore, EI was a significant moderator of this effect. Thus, in adolescents with higher EI, the effect of psychological distress on PSU through rumination was not significant.

**Limitations:** Cross-sectional data do not imply causality and further studies should use longitudinal designs. Self-report questionnaires may be susceptible to social desirability bias and future studies including other sources of information may help to minimize such bias.

**Conclusions:** This study contributes to the field of problematic digital technology usage, showing that the link between psychological distress and PSU depends on the EI levels, which might influence PSU indirectly through rumination. Furthermore, empirical evidence for the CIUT and I-PACE models was provided. Lastly, interventions aiming at training EI may aid in the prevention of PSU.

## 1. Introduction

Throughout the world in 2020 there were over 3.5 billion smartphone users and this number is estimated to grow 6.7% every year (Newzoo, 2020). Spain has over 34.5 million smartphone users, which represents a smartphone penetration of 74.3% (Newzoo, 2019). Despite the numerous advantages associated with an increased use of digital technology, its problematic use could lead to negative health consequences, a phenomenon that the World Health Organization has deemed to be a public health concern (World Health Organization, 2015). A recent report states that adolescents are the most active users of digital technology, contributing to a higher prevalence of problematic digital technology use in this population (World Health Organization, 2015).

Problematic smartphone use (PSU) is defined as a heterogenous and multifaceted condition where a person excessively uses their smartphone in an addictive, antisocial or dangerous way, frequently leading to their functional maladjustment (Billieux et al., 2015; Pivetta et al., 2019). Research suggests that PSU prevalence in adolescents ranges from 2% to 89% (Field, 2020), with the majority of studies finding rates between 10% and 30% (Sohn et al., 2019). One of the reasons for the growing research interest in this population could be that adolescents have to face typical developmental tasks in a complete digital immersion (Subrahmanyam and Šmahel, 2011). Furthermore, adolescence is the stage when closer contact with smartphones starts, with evidence suggesting that the most frequent age of first ownership of a smartphone is 14 years (De Sola Gutiérrez et al., 2016). Moreover, adolescence is characterized by an increase in risk-taking behavior, as well as a decreased ability to override impulses in emotionally charged situa-

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tions (Berman, 2018), which raises the probability of developing PSU (Zhitomirsky-Geffet and Blau, 2016).

PSU is a condition associated with lower psychological well-being (Horwood and Anglim, 2019) and negative psychological maladjustment, presenting as symptoms of depression, anxiety and stress (Elhai et al., 2017a), post-traumatic stress disorder (Contractor et al., 2017), higher alcohol misuse and impulsiveness problems (Dey et al., 2019; Grant et al., 2019), somatization, interpersonal sensitivity and hostility (Firat et al., 2018), sleep disturbances (Thomé et al., 2011) and suicidal ideation (Arrivillaga et al., 2020). The numerous negative consequences associated with PSU, as well as the growing prevalence in adolescents, grant the need to advance the research and understanding of this phenomenon.

The Compensatory Internet Use Theory (CIUT: Kardefelt-Winther, 2014) underlines that negative life situations may give rise to a motivation to go online in order to alleviate negative feelings. That is, a person resorts to Internet applications as a way to cope or satisfy a need that is currently being unmet in their offline life. Although such usage may not become addictive at first, if it grows into a habit then the amount of compensation required to reduce negative emotional states may increase the probability of developing addiction-like symptoms (Kardefelt-Winther, 2014).

Moreover, the Interaction of Person-Affect-Cognition-Execution (I-PACE) model (Brand et al., 2016, 2019) presents a complementary theory that aims to explain the underlying processes in the development and maintenance of Internet-related problems. The P component refers to personal core characteristics, such as psychopathological features, personality, social cognitions and using motives (Brand et al., 2016). The A and C components refer to the affective and cognitive responses that are linked to the subjective perception of stressful situations in the person's life, which include coping style, Internet-related cognitive biases, attention biases and the urge to regulate mood (Brand et al., 2016). Finally, the E component refers to the executive functions, inhibitory control and the decision to use certain Internet applications (Brand et al., 2016). Thus, according to this approach, Internet-related problems are a consequence of the interaction of predisposing factors and mediation and moderation variables.

Concerning the mental health problems related to PSU, there is substantially more empirical evidence associating this phenomenon to depression and anxiety (Elhai et al., 2017a; Kim et al., 2015; Rozgonjuk et al., 2018). In accordance with the CIUT (Kardefelt-Winther, 2014) and the I-PACE model (Brand et al., 2019), in this study psychological distress is considered to be a predisposing factor for PSU.

### 1.1. Mediating role of rumination

Previous research has found that rumination is a prominent process that helps to explain the maintenance of depression and anxiety (Olatunji et al., 2013), stress (Zoccola and Dickerson, 2012), obsessive-compulsive symptoms (Raines et al., 2017), eating disorders (Smith et al., 2018) and substance abuse (Memedovic et al., 2019). Moreover, some studies have researched the mechanisms linking depression and anxiety (e.g., boredom proneness: Elhai et al., 2018; fear of missing out: Wolniewicz et al., 2020) and stress (e.g., self-control, neuroticism and extraversion: Cho et al., 2017; self-efficacy: Sim et al., 2016) to PSU. Recently, rumination has been proposed as a mechanism that mediates the relation between psychological distress and PSU (Elhai et al., 2020, 2019b).

Rumination can be conceptualized as a maladaptive coping strategy (Garnefski et al., 2001) in which a person repetitively thinks about the symptoms, causes and consequences of their negative affect (Smith and Alloy, 2009). Similarly, PSU could also be considered as a dysfunctional coping mechanism in which a person overuses their smartphone to reduce negative emotions and fulfill an unmet need, according to the CIUT (Kardefelt-Winther, 2014). Evidence suggests that rumination is a

significant predictor of PSU (Elhai and Contractor, 2018; Extremera et al., 2019a). Furthermore, because the I-PACE model (Brand et al., 2019) suggests that coping mechanisms are among the mediating factors that help to explain Internet-related problems, in this study rumination is proposed as a mediating variable between psychological distress (i.e., depression, anxiety and stress) and PSU, as other researchers have studied recently (Elhai et al., 2019b, 2018a).

### 1.2. Moderating role of emotional intelligence

It has been proposed that PSU may develop through three pathways: (a) excessive reassurance is associated with an addictive pattern of smartphone usage; (b) impulsivity is linked to an antisocial use of the device; and (c) extraversion is related to a risky pattern of usage (Billieux et al., 2015). In a recent study that empirically validated the model, Pivetta et al. (2019) found that attention impulsivity is linked to the addictive and antisocial usage patterns, which they propose could be explained by emotion management difficulties. Moreover, PSU has been associated with several emotional experiences and processes, such as negative affect (Wolniewicz et al., 2018), maladaptive cognitive emotion regulation strategies (Extremera et al., 2019a), expressive emotion suppression (Rozgonjuk and Elhai, 2019), limited impulse control (Firat et al., 2018) and emotional instability (Pasquale et al., 2015). Recently, PSU has also been linked to lower emotional intelligence (Arrivillaga et al., 2020; Díaz and Extremera, 2020; Sun et al., 2019).

Emotional intelligence (EI) is defined as a set of abilities for perceiving emotion-related information, using emotions to enhance thought and managing emotions effectively (Mayer et al., 2016). Moreover, EI has been associated with subjective well-being (Sánchez-Álvarez et al., 2016) and mental health (Martins et al., 2010). Similarly, EI has shown a consistent negative association with depression (Fernández-Berrocal and Extremera, 2016), stress (Lea et al., 2019), substance-related and behavioral addictions (Kun and Demetrovics, 2010), alcohol involvement (Peterson et al., 2011) and aggression (García-Sancho et al., 2014). Furthermore, evidence suggests that higher EI is related to lower levels of rumination (Abdollahi and Talib, 2015; Kircaburun et al., 2019; Liu and Ren, 2018).

Lastly, the I-PACE model (Brand et al., 2019) suggests that cognitive and affective responses to stress might also act as moderators between psychological distress and Internet-related problems. For instance, it has been claimed that higher EI buffers stress reactivity and promotes stress recovery by facilitating the utilization of adaptive mechanisms to regulate emotional responses, by reducing intrusive thoughts and by dampening the experience of negative emotions, which allows the individual to focus their resources on goal-oriented behavior (Lea et al., 2019). Moreover, several studies have suggested that EI moderates the link between distressful situations and different mental health problems (e.g., Arrivillaga et al., 2020; Lea et al., 2019; Piqueras et al., 2020). Consequently, as previous literature has established that EI has a consistent negative association with several indicators of psychological maladjustment, rumination and PSU, this study aims to investigate whether EI, proposed as a set of abilities that can elicit adaptive cognitive and affective responses to stress, might act as a buffer in the links between these variables.

### 1.3. Present study

The aim of this study is to clarify the links between psychological distress, rumination, PSU and EI in a relatively wide sample of adolescents. Based on the previous literature, the following hypotheses were posited:

**H1.** Psychological distress is significantly and positively associated with PSU.

**H2.** Rumination is significantly and positively related to PSU and medi-

ates the association between psychological distress and PSU.

**H3.** EI moderates the direct effect of psychological distress and PSU (H3a, pathway c), as well as the indirect effect through rumination (H3b), either in the association between psychological distress and rumination (pathway a), the association between rumination and PSU (pathway b), or both. That is, the associations between psychological distress, rumination and PSU are weaker for adolescents with higher EI.

The proposed moderated mediation (or conditional process) model is presented in Fig. 1. We propose that the link between psychological distress and PSU is mediated by rumination. In addition, the strength of these associations is assumed to be conditional on the level of EI. Specifically, EI could act as a moderator in the direct effect (i.e., pathway c) or the indirect effect (i.e., pathway a, b or both) on PSU.

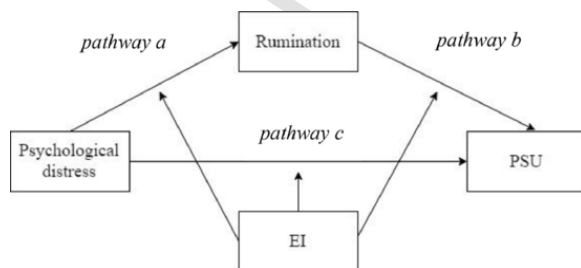
## 2. Method

### 2.1. Participants

The sample for this study came from a larger project. Cases where the adolescents claimed they did not own a smartphone were excluded from this study ( $N = 312$ ). Participants were 1882 adolescents (54% female, 46% male) aged 12–19 years ( $M = 14.71$ ,  $SD = 1.60$ ) attending school in the Andalusian Community (Spain). With regard to grade level: 34.1% were in the 3rd year and 27.5% in the 4th year of compulsory secondary education; 19% were in the 1st year and 18% in the 2nd year of post-secondary education; and 1.2% were in professional training.

### 2.2. Procedure

The research protocol was approved by the University of Malaga's ethical committee, which stated that all current ethical standards were met (Declaration of Helsinki, 2013). Schools in the Malaga Province were invited to participate in the study and those that agreed were selected according to convenience criteria. After obtaining the approval of the schools' administrators, parents were contacted by the schools to ask for their consent. There were two exclusion criteria: adolescents could not participate if they did not have parental consent and a fluid understanding of the Spanish language. Data collection took place in the adolescents' schools within a routine class session (45 minutes). Research assistants were introduced to the adolescents by their schoolteachers. Participants were informed of the objectives of the study and assured of the anonymity and confidentiality of the information they provided, as well as of the voluntary nature of their participation. They completed paper-based questionnaires in the presence of a research assistant and a schoolteacher.



**Fig. 1.** Conceptual model illustrating hypothesized conditional direct and indirect effects for psychological distress, EI, rumination and PSU. Note. PSU = Problematic smartphone use. EI = Emotional intelligence.

### 2.3. Measures

Participants completed an ad hoc questionnaire with their demographic information (i.e., age, gender and grade level).

#### 2.3.1. Psychological distress

This variable was assessed using the Spanish adaptation of the Depression, Anxiety and Stress Scale (DASS-21; Bados et al., 2005; Lovibond and Lovibond, 1995). The composite score of the three subscales gives a total psychological distress measure. The DASS-21 is an instrument comprising 21 items that are answered on a four-point scale ranging from 0 ("did not apply to me at all") to 3 ("applied to me very much or most of the time"). An example item is "I felt that I had nothing to look forward to". The internal consistency of the DASS-21 in this study was excellent (Cronbach's  $\alpha = 0.94$ ; McDonald's  $\omega = 0.94$ ). Evidence of the convergent, divergent and discriminant validity of the DASS-21 in Spanish samples can be found in Bados et al. (2005).

#### 2.3.2. Rumination

This variable was assessed using the rumination subscale of the Cognitive Emotion Regulation Questionnaire (CERQ; Garnefski et al., 2001). This subscale is comprised of four items (e.g., "I often think of how I feel about what happened") that are measured on a five-point scale from 1 ("almost never") to 5 ("almost always"). In this study the internal consistency of the rumination subscale was acceptable ( $\alpha = 0.72$ ;  $\omega = 0.73$ ). The Spanish version of the CERQ has been validated with an adolescent sample and evidence shows it to be a valid and reliable measure (Chamizo-Nieto et al., 2020).

#### 2.3.3. Emotional intelligence (EI)

The Spanish version of the Wong & Law Emotional Intelligence Scale (WLEIS; Extremera et al., 2019; Wong and Law, 2002) was used to measure the self-report EI. The questionnaire has 16 items that are answered on a scale from 1 ("totally disagree") to 7 ("totally agree"). A total score is calculated based on the sum of four dimensions: self-emotion appraisal ("I have a good sense of why I feel certain feelings most of the time"), other-emotion appraisal ("I always know my friends' emotions from their behavior"), use of emotions ("I always set goals for myself and then try my best to achieve them") and regulation of emotions ("I am able to control my temper and handle difficulties rationally"). The internal consistency of the questionnaire in this study was good ( $\alpha = 0.88$ ;  $\omega = 0.88$ ).

#### 2.3.4. Problematic smartphone use (PSU)

This construct was measured using the Spanish short version of the Smartphone Addiction Scale (SAS-SV; Kwon et al., 2013; Lopez-Fernandez, 2017). The SAS-SV has 10 items that are scored from 1 ("strongly disagree") to 6 ("strongly agree"). Higher scores are indicative of PSU. An example item is: "having my smartphone in my mind even when I am not using it". Lopez-Fernandez (2017) provides supporting evidence of the validity of the SAS-SV in a Spanish sample. The internal consistency of the SAS-SV in this study was good ( $\alpha = 0.86$ ;  $\omega = 0.86$ ).

### 2.4. Statistical analyses

Analyses were carried out using SPSS version 23 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were calculated and Pearson bivariate correlations were estimated. As self-report questionnaires were used to measure all the variables, common-method variance might be a problem. Hence, Harman's single-factor test (Podsakoff and Organ, 1986) was used to test for this bias. An exploratory factor analysis has to be conducted, entering all the items of the studied variables (Podsakoff and Organ, 1986). Common-method bias is present if a single factor accounts for most of the variance.

The PROCESS macro was used to conduct mediation and moderated mediation analyses (Hayes, 2018). The bootstrapping method was used to obtain 95% confidence intervals (95%CI) with 5000 re-samples for the indirect effects. Prior to conducting the analyses, the assumptions of independence, normality, multicollinearity and homoscedasticity were tested. As the last assumption was not met, heteroscedasticity-consistent standard error estimators were used. First, a simple mediation analysis (model 4) was conducted, entering psychological distress as the independent variable, rumination as the mediator and PSU as the outcome variable. Then, moderated mediation was tested using model 59 in PROCESS (Hayes, 2018) with the same variables and adding EI as the moderator. Furthermore, significant interactions were tested at two levels of EI, determined by one standard deviation above (i.e., high EI) and below (i.e., low EI) the mean. Continuous variables that defined products were mean centered prior to conducting the analyses. Age and gender were entered as covariates in both analyses because evidence suggests that they have an effect on PSU (Csibi et al., 2019; Lee et al., 2018). An effect was considered significant when the 95%CI did not contain zero.

### 3. Results

#### 3.1. Preliminary analyses

Descriptive statistics and correlations among the main study variables are presented in Table 1. As shown, PSU was directly associated with psychological distress ( $r = 0.32$ ) and rumination ( $r = 0.24$ ) and inversely related to EI ( $r = -0.13$ ). Furthermore, EI was negatively associated with psychological distress ( $r = -0.25$ ) and positively related to rumination ( $r = 0.12$ ). Finally, psychological distress and rumination were positively correlated ( $r = 0.40$ ). All correlations were significant at  $p < 0.01$ .

In order to check for common-method bias, Harman's single-factor test (Podsakoff and Organ, 1986) indicated that there were eight factors with eigenvalues higher than 1. The first factor accounted for 23% of the variance so common-method variance was not an issue in this study.

#### 3.2. Mediation analysis

Table 2 presents the results of the mediation analysis. The positive association between psychological distress and rumination was statistically significant [path a:  $b = 0.52$ ,  $SE$  (HC3) = 0.02,  $p < 0.001$ ], as was the relation between rumination and PSU [path b:  $b = 0.10$ ,  $SE$  (HC3) = 0.02,  $p < 0.001$ ]. The direct effect of psychological distress on PSU [path c':  $b = 0.36$ ,  $SE$  (HC3) = 0.03,  $p < 0.001$ ] was also statistically significant. Moreover, the total effect [path c:  $b = 0.41$ ,  $SE$  (HC3) = 0.03,  $p < 0.001$ ] was also statistically significant. The 95%CI for the indirect effect [path ab:  $b = 0.05$ ,  $SE = 0.01$ , 95%CI = 0.02–0.08] did not contain zero, indicating that rumination mediated the association between psychological distress and PSU. The model accounted for 18% of the variance in PSU.

**Table 1.**  
Means, standard deviations and correlations between variables.

	1	2	3	4
1. Psychological distress	0.83 (0.66)			
2. Rumination	0.40**	3.19 (0.93)		
3. EI	-0.25**	0.12**	4.74 (1.00)	
4. PSU	0.32**	0.24**	-0.13**	2.69 (1.03)

Note. EI = Emotional intelligence; PSU = Problematic smartphone use. Means are shown in the diagonal line and standard deviations are in parenthesis.

\*\*  $p < 0.01$

**Table 2.**  
Results of the mediation analysis.

	B	SE (HC3)	t	p	LLCI	ULCI
path a = PD → rumination	0.52	0.02	17.64	0.000	0.46	0.57
path b = rumination → PSU	0.10	0.02	3.88	0.000	0.05	0.15
path c' = PD → PSU (direct effect)	0.36	0.03	9.38	0.000	0.28	0.44
path c = PD → PSU (total effect)	0.41	0.03	11.49	0.000	0.34	0.48
Gender (total effect)	0.38	0.04	8.72	0.000	0.29	0.46
Age (total effect)	0.13	0.01	9.94	0.000	0.11	0.16
	Boot Effect	Boot SE	Boot LLCI	Boot ULCI		
Rumination (indirect effect)	0.05	0.01	0.02		0.08	

Note. PD = psychological distress; PSU = problematic smartphone use. B = unstandardized coefficient; SE (HC3) = Heteroscedasticity Consistent Standard Error; LLCI = 95 % lower limit confidence interval; ULCI = 95 % upper limit confidence interval.

#### 3.3. Moderated mediation analysis

As the mediation analysis showed a significant indirect effect from psychological distress to PSU through rumination, the hypothesis of EI being a moderator in this mediation model was tested. Model 59 in PROCESS (Hayes, 2018) tests whether the indirect effect (i.e., pathway a: from psychological distress to rumination; pathway b: from rumination to PSU) and/or the direct effect (pathway c: from psychological distress to PSU) are moderated by EI. The moderated pathways are indicated by the interaction terms in Table 3. As demonstrated, the interaction in pathway a (i.e., psychological distress × EI when the outcome variable is rumination) is not statistically significant ( $B = 0.01$ ,  $SE$  (HC3) = 0.02, 95%CI = -0.046 to 0.062]. However, the interaction in pathway b (i.e., rumination × EI when the outcome variable is PSU) was statistically significant at  $p < 0.05$  [ $B = -0.05$ ,  $SE$  (HC3) = 0.02,

**Table 3.**  
Results of the moderated mediation analyses.

	B	SE(HC3)	t	p	LLCI	ULCI
Outcome variable: Rumination $R^2 = 0.23$ ; $F$ (HC3) (5, 1830) = 112.62; $p < 0.001$						
Constant	-0.70	0.19	-3.64	0.000	-1.081	-0.324
PD	0.60	0.03	20.03	0.000	0.545	0.664
EI	0.20	0.02	9.80	0.000	0.164	0.246
PD x EI	0.01	0.02	0.29	0.766	-0.046	0.062
Gender (cov)	0.25	0.03	6.38	0.000	0.173	0.327
Age (cov)	0.02	0.01	1.75	0.078	-0.002	0.045
Outcome variable: PSU $R^2 = 0.19$ ; $F$ (HC3) (7, 1828) = 57.95; $p < 0.001$						
Constant	0.20	0.21	0.95	0.339	-0.220	0.640
PD	0.31	0.04	7.44	0.000	0.234	0.401
Rumination	0.12	0.02	4.64	0.000	0.073	0.181
EI	-0.09	0.02	-3.77	0.000	-0.145	-0.046
PD x EI	0.06	0.03	1.69	0.089	-0.010	0.142
Rumination x EI	-0.05	0.02	-2.13	0.033	-0.106	-0.004
Gender (cov)	0.36	0.04	8.20	0.000	0.275	0.448
Age (cov)	0.13	0.01	9.53	0.000	0.105	0.159
Conditional indirect effect of psychological distress (X) on PSU (Y) through rumination (M) at two levels of EI (W)						
Levels of EI		Boot Indirect Effect	Boot SE	Boot LLCI	Boot ULCI	
Low ( $M - SD$ )	-1.0047	0.1092	0.0261	0.0589	0.1618	
High ( $M + SD$ )	1.0047	0.0438	0.0223	-0.0005	0.0890	

Note. PD = psychological distress; EI = emotional intelligence; PSU = problematic smartphone use; cov = covariate. B = unstandardized coefficient; SE (HC3) = Heteroscedasticity Consistent Standard Error; LLCI = 95 % lower limit confidence interval; ULCI = 95 % upper limit confidence interval. All antecedent variables were mean centered.

95%CI = - 0.106 to - 0.004], controlling for the effects of age and gender. The residual direct effect of psychological distress on PSU (i.e., pathway c) was not moderated by EI because the interaction term was not statistically significant [ $B = 0.06$ ,  $SE$  (HC3) = 0.03, 95%CI = - 0.010 to 0.142]. The model accounted for 19% of the variance in PSU.

Furthermore, the conditional indirect effect of psychological distress on PSU via rumination was analyzed at two levels of EI ( $M \pm SD$ , shown in the lower part of Table 3). As demonstrated by the 95%CI, this effect was significant at low (Effect = 0.1092; 95%CI = 0.0589–0.1618) but not at high levels of EI (Effect = 0.0438; 95%CI = - 0.0005 to 0.0890). Thus, the effect of psychological distress on PSU through rumination is significantly stronger for adolescents with lower EI. In other words, this effect was not significant only in adolescents with higher EI. The conditional indirect effect was plotted for pathway b (i.e., rumination  $\times$  EI to predict PSU), where the significant buffering effect of EI was found (Fig. 2). Finally, Fig. 3 depicts the complete moderated mediation model.

#### 4. Discussion

Problematic digital technology usage is a growing concern in most countries, especially in adolescents (World Health Organization, 2015). The aim of this study was to clarify the links among psychological distress, rumination, EI, and PSU in this population. Firstly, it was hypothesized that psychological distress would be positively associated with PSU (H1). The results support this hypothesis and they are in accor-

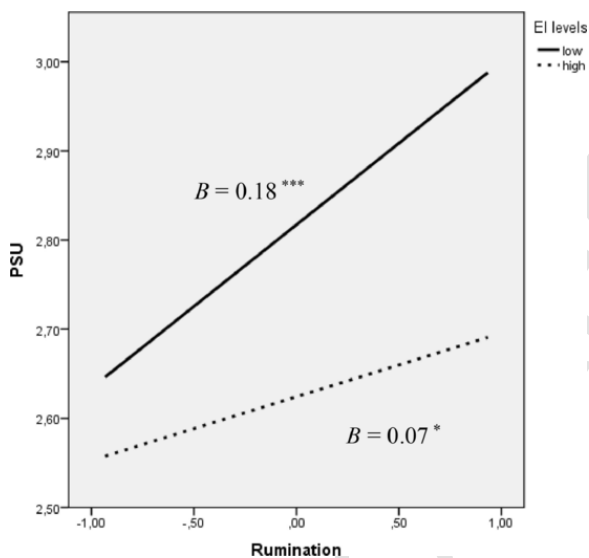


Fig. 2. Problematic smartphone use (PSU) as a function of rumination and emotional intelligence (EI).

Note. Levels of EI are determined by one standard deviation below (low) and above (high) the mean. Rumination and EI were mean centered. \*\*\*  $p < 0.001$ ; \*  $p < 0.05$ .

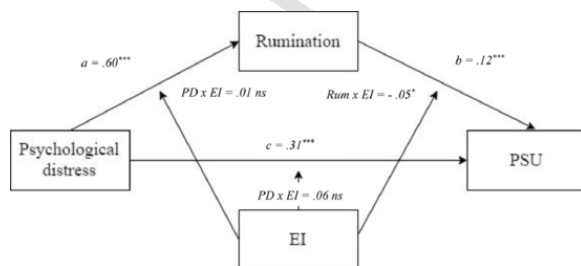


Fig. 3. Final moderated mediation model with OLS regression coefficients.

Note. PSU = Problematic smartphone use. EI = Emotional intelligence. \*\*\*  $p < 0.001$ ; \*  $p < 0.05$ ; ns = not significant.

dance with previous findings (Elhai et al., 2017a; Kim et al., 2015). Furthermore, the CIUT (Kardefelt-Winther, 2014) poses that problematic use of Internet applications may develop when people use their devices as a means to fulfill needs that should be satisfied through other channels (e.g., scrolling through social networking sites as a way to connect with others instead of having a face-to-face conversation). Admittedly, emotional gain from the use of a smartphone is one of the most significant predictors of PSU in younger populations (Zhitomirsky-Geffet and Blau, 2016), which could suggest that there is an emotional need that is unmet offline and is attempting to be satisfied online. Moreover, non-social smartphone use is related to higher PSU severity (Elhai et al., 2019a) and it has been found that preferred online social interaction explains problematic Internet use (Caplan, 2003). Therefore, if adolescents experience negative emotions on a daily basis due to depression, anxiety or stress, and avoid offline social situations that could help them develop more effective strategies to deal with negative moods, then the need for online compensation becomes constant and PSU could develop as a maladaptive coping strategy, as proposed in the CIUT (Kardefelt-Winther, 2014).

Secondly, it was posited that rumination would be a mechanism that contributes to explaining the association between psychological distress and PSU. The findings on this study support the mediation hypothesis (H2) and are consistent with previous research literature (Elhai et al., 2019b, 2018a). Furthermore, the I-PACE model (Brand et al., 2019, 2016) provides a theoretical basis to explain these results. One of the reasons why rumination is a maladaptive cognitive regulation strategy is because recurrent thinking about adverse circumstances does not imply actually doing something about them, which immobilizes the person in indecision (Aldao et al., 2010; Ward et al., 2003). Thus, a personal core characteristic (P component) such as a psychopathological predisposition (i.e., psychological distress) and a cognitive response (C component) such as a maladaptive coping strategy (i.e., rumination) may lead adolescents to engage in excessive use of the smartphone for no specific reason (Zhitomirsky-Geffet and Blau, 2016) or in a non-social manner (E component) (Elhai et al., 2017b), which, in the long term, does not improve the negative affect and increases the likelihood of PSU.

Thirdly, it was posited that EI would moderate the effects of psychological distress on PSU, either directly (H3a) or indirectly (H3b). Findings of this study partially support H3b, but not H3a, which means that the buffering effect of EI was found in the pathway that links psychological distress to PSU through rumination: specifically, in the association between rumination and PSU (pathway b). As the indirect effect was significant in adolescents with low EI but not in those with high EI, the findings suggest that distressed ruminating adolescents with higher EI do not typically use their smartphone in a problematic way.

These results provide empirical evidence for the CIUT (Kardefelt-Winther, 2014), as higher EI could be providing the skills needed to control ruminative thoughts, preventing adolescents from overusing their smartphone as a way to compensate for offline unmet needs. Moreover, in light of the I-PACE model (Brand et al., 2019, 2016), psychological distress (i.e., depression, anxiety and stress) could be considered part of the core characteristics of a person, with a vulnerability towards PSU. Furthermore, EI could be considered as a set of abilities that aid adolescents in having adaptive affective and cognitive responses towards stress. Therefore, if an adolescent has a predisposing psychopathological vulnerability (P component), a ruminative coping style (C component) and higher EI (A and C components), even though s/he may feel distressed and overthink about it, s/he may also use different emotional and behavioral strategies to avoid the decision of over-using their smartphone (E component). This explanation is also consistent with the “pathways” model of PSU (Billieux et al., 2015), as it has been suggested that the excessive reassurance and the impulsive pathways that lead to an addictive and antisocial usage pattern, respectively, are both associated with difficulties in managing emotions (Pivetta et al.,

2019). For instance, it has been suggested that emotionally intelligent adolescents may have a wider set of abilities for regulating negative emotions (Matthews et al., 2017), may be more able to look for social support (Di Fabio and Kenny, 2012; Lopez-Zafra et al., 2019) and may use their smartphones in a more productive way (Elhai et al., 2018a). Since our results support a significant interaction between rumination and EI, it is tentative to think that, although distressed adolescents might typically ruminate about negative life situations, those who have higher EI might be better able to use negative emotions to facilitate a better understanding of their life circumstances (Arrivillaga et al., 2021), might refocus their attention to planning how to solve the negative situations (Extremera et al., 2019a) and, in general, choose more active and adaptive ways to regulate their emotional responses (Lea et al., 2019). These strategies might reduce the deleterious effects of rumination on mental health and the urgent need to use the smartphone as a regulatory strategy.

The present study had several limitations. Firstly, the cross-sectional data do not allow the causality portrayed by the I-PACE model to be established, so it could be that PSU leads to psychological distress. As the evidence supports both views, a more comprehensive approach would be to use a longitudinal design where all constructs are measured at all times. Secondly, the symptoms of psychological distress were measured using a self-report scale on a non-clinical sample, so the results can only suggest promising grounds for further studies attempting to empirically validate the I-PACE model's proposal of psychopathology as a predisposing factor for PSU. Further clinical assessment of psychopathology may provide more robust findings towards this purpose. Lastly, the use of self-report measures of socially sensitive information (i.e., psychopathology and PSU) may be affected by social desirability biases. Future studies could include other sources of information (i.e., clinical assessments or parental reports) to help minimize these effects.

Despite these limitations, the study has contributed to the field of problematic digital technology usage in adolescents by giving supporting evidence with important theoretical implications. Concerning the CIUT (Kardefelt-Winther, 2014), the results suggest that psychological distress could be an indicator of an unmet offline need that adolescents are attempting to compensate for by over-using their smartphones. Likewise, higher EI is among the abilities that prevent them from ruminating about such distress and could be redirecting them towards more adaptive ways to cope than over-using their smartphone. Similarly, the results provide evidence to support the I-PACE theory (Brand et al., 2019) by empirically testing variables that exemplify the model (e.g., psychological distress as a predisposing personal core characteristic; rumination as a cognitive response to stress; EI as cognitive and affective responses; and PSU as a specific form of Internet-related problem). Lastly, the results suggesting that EI could be a moderating factor help to support the notion that emotion regulation difficulties could be the basis of some of the pathways leading to PSU (Pivetta et al., 2019).

Furthermore, the results of this study also have important practical implications. For instance, they provide an empirical background for considering EI as a protective factor in the development of PSU. Evidence suggests that EI is highly trainable (Kotsou et al., 2019; Mattingly and Kraiger, 2019). Hence, clinical and educational researchers and practitioners could implement interventions to train EI abilities in adolescents in order to help them manage negative emotions and ruminative thinking, as well as to learn how to use smartphones in a healthier way. To illustrate, Arrivillaga et al., (2021) found that, among EI dimensions, the use of emotions was the most significant predictor of problematic Internet use, suggesting that this ability might help adolescents in the decision-making process about which content they access on the Internet depending on their mood. Emotion theorists have claimed that different emotions serve specific purposes (e.g., Fredrickson, 2004; Izard, 2011). Thus, teaching about the functions of emotions and training about how to use them to facilitate thought might help adolescents consciously choose activities that might benefit

from their mood states and facilitate persistent efforts in planning and critical analysis. Being more aware of emotions, thoughts and actions, along with a better understanding and management of emotions (Baudry et al., 2018) might be a more effective way to cope with unpleasant negative mood states than overusing the smartphone to reduce them. Moreover, regarding EI dimensions, evidence suggests that higher levels of other-emotion appraisal and lower levels of emotion regulation are also associated with problematic Internet use (Arrivillaga et al., 2021), which provides specific avenues for EI training towards the prevention of Internet-related problems, such as PSU.

## 5. Conclusion

The present study indicates that rumination is a mediating factor in the effect of psychological distress on PSU. Furthermore, it was found that EI moderated this effect. Specifically, the results suggest that in adolescents who were more emotionally intelligent, the effect of psychological distress on PSU through rumination was not significant. Interventions aimed at improving EI abilities would most likely help adolescents to manage negative emotions and ruminative thinking, thus preventing them from developing PSU.

## Contributors

Christiane Arrivillaga contributed to the conceptualization, formal analysis, and writing of the first draft of the manuscript and following editions. Lourdes Rey contributed to the conceptualization of the research, funding acquisition, investigation, methodology, project administration, supervision and reviewing different drafts of the manuscript. Natalio Extremera contributed to the conceptualization of the research, formal analysis, funding acquisition, investigation, methodology, supervision and reviewing different drafts of the manuscript.

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## Declaration of Competing Interest

The authors declare they have no conflicts of interest.

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