



# Cognitive- and Emotion-Related Dysfunctional Coping Processes: Transdiagnostic Mechanisms Explaining Depression and Anxiety's Relations with Problematic Smartphone Use

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Published online: 27 May 2019

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## Abstract

**Purpose of Review** Depression and anxiety symptoms typically demonstrate relationships with problematic smartphone use (PSU) across the literature. However, mechanisms involved in these relationships have not been widely reported. In this paper, we focus on important but relatively neglected transdiagnostic mechanisms between depression and anxiety with PSU, involving maladaptive cognitive and emotion processes. Cognitive processes we discuss include repetitive negative thinking (i.e., rumination and worry), boredom proneness, and the fear of missing out (FOMO). Emotion processes we discuss include emotion dysregulation and distress intolerance.

**Recent Findings** Studies demonstrate support for maladaptive cognitive and emotion processes correlating with PSU severity, and serving as mediators between anxiety and depression with PSU.

**Summary** Maladaptive cognitive and emotion processes are important transdiagnostic mechanisms that can account for relationships between depression and anxiety with PSU, and should be further studied.

**Keywords** Problematic smartphone use · Depression · Anxiety · Maladaptive cognitions · Coping · Rumination · Transdiagnostic factors

## Introduction

### Background

A staggering number of 2.7 billion smartphone users are estimated worldwide for 2019 [1]. This number is noteworthy, because the smartphone represents a relatively recent innovation, perhaps with the introduction of the iPhone in 2007 as a dramatic accelerator of the movement towards a digital society [2]. The impact of smartphones on everyday life can be observed by objectively tracked smartphone behavior; in a study of more than 2400 participants, average smartphone usage time was about 2.5 h each day (this would translate to nearly two working days each week) [3]. A growing number of scientists are concerned that problematic smartphone use (PSU), to be defined in the next section, has detrimental effects on mental health. Of note, it is important to emphasize that the smartphone itself is not good or bad per se, but rather the type or context of usage of smartphones might exert negative effects on a large range of investigated psychological variables.

Without a doubt, smartphones help us in many ways across different life situations, such as being able to navigate through

This article is part of the Topical Collection on *Technology Addiction*

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unknown geographical territory or having instant access to video chat applications when being far away from one's own family. Smartphones can also increase our productivity, but the association between smartphone usage and productivity might resemble an inverted U function [4]. Following such a model, appropriate usage of the smartphone makes us more productive (such as navigating from location A to location B more quickly), but at a certain point smartphone usage could make us unproductive. Such a position on the inverted U function could be characterized by fragmentation of everyday life, whereby constant interruptions due to smartphone notifications undermine flow behavior at work [5]. This idea is in line with work by Kushlev, Proulx et al. [6] reporting that high interruptive smartphone behavior might even result in the attention deficit hyperactivity disorder's inattention symptoms [see also 7].

Beyond these findings, a number of papers observed that smartphone usage impacts interpersonal communication: Kushlev and Dunn [8] observed that the smartphone drew away attention from parents when visiting a science museum with their children, and Dwyer, Kushlev et al. [9] reported that smartphone usage might reduce enjoyment of direct face-to-face interaction. Kushlev, Hunter et al. [10] also observed that the presence of a smartphone reduces smiles in strangers. And a recent paper by Lachmann, Sindermann et al. [11] investigated if PSU is associated with lower empathy. Although problematic Internet use (PIU) was associated with lower empathy in this work in Germany and China [supporting prior work, 12], at best only very small correlations between PSU and empathy measures could be observed. In general, interdisciplinary research endeavors currently aim to understand unintended side effects of the digital transition [13].

In sum, the adverse health and mental health conditions associated with PSU have been widely studied in recent years, as reported in a recent review [14•]. Numerous papers have taken a symptom- and disorder-based approach to examining mental health correlates of PSU, primarily finding associations with depression and anxiety severity [reviewed in 15•, 16, 17]. However, little work has been conducted examining maladaptive cognitive and emotion process mechanisms that may account for associations between both depression and anxiety with PSU. In the present paper, we discuss examples of such cognitive and emotion processes, and evidence for their relations with PSU severity, and their mediating effects between depression/anxiety and PSU.

## Defining Problematic Smartphone Use

PSU is a construct typically defined by excessive smartphone use and associated functional impairment [18•]. Other similar terms have been used in the literature, such as smartphone use disorder [11] (for a detailed discussion on these terms by author CM's group, see [19]), but we will use the term "PSU"

here. Symptoms of PSU resemble, in part, those of substance use disorders. For instance, individuals engaging in PSU may have symptoms of psychological withdrawal when separated from their smartphone, the desire to engage in increasingly more frequent smartphone use (i.e., tolerance), use despite adverse effects, and difficulty controlling use [14•, 18•]. In fact, instruments measuring PSU typically query substance use disorder criteria, adapted to measure smartphone use as the target variable instead of substance use [14•]. We should emphasize that most PSU assessments are conducted via self-report methodology, whereas objective measures of smartphone use are found to be more accurate [20, 21], such as minutes of phone use and number of screen unlocks [22, 23]. This research also resulted in a call for implementing more app-based technologies to better assess problems related to excessive digital use behavior [24–26].

We should clarify that in contrast to substance use disorder, PSU is currently not considered a disorder in mental health or medical diagnostic manuals, and there is insufficient evidence for smartphone use being an "addiction" thus far [27]. Nonetheless, PSU is maladaptive, associated with physical health problems such as musculoskeletal pain [28, 29], traffic and pedestrian accidents [30, 31], and mental health problems. Furthermore, a specific form of PIU has found its way into the ICD-11 issued by the World Health Organization (WHO). Specifically, gaming disorder is included in the overarching category of "disorders due to addictive behaviors" in the proposed ICD-11 [32]. Therefore, it is also imaginable that other areas of problematic specific Internet use might follow in the future.

The concept of PSU is also controversial, because researchers have debated if persons are addicted to the smartphone itself—or more likely, to certain applications such as WhatsApp, originally only designed for the smartphone. Fittingly, self-report measures of "smartphone addiction" or PSU strongly correlate with overuse of WhatsApp (about .70) and to a lesser extent with overuse of Facebook [19]. In this context, it might also be important to ask if the concept of generalized and specific PIU can be transferred to this mobile form of PIU. Davis [33] distinguished between persons overusing many online channels compared with those exclusively overusing only one distinct content type such as gaming, pornography, and social media [for overlap between specific and generalized PIU, see also 34, 35]. Following this distinction, one might only speak of PSU (i.e., generalized mobile PIU), when multiple apps of the smartphone are excessively used. For many users, this might not be the case, because as mentioned, for many users, there is a strong overlap between PSU and problematic use of messenger/social media apps. Relatedly, several researchers have posed the question if Internet communication disorder might be at the heart of PSU [for examples, see works on Internet communication disorder, 36, 37].

## PSU and Relations with Traditional Psychopathology Constructs

Numerous studies have examined PSU in relation to mental health problems—especially, depression, anxiety, stress, and low self-esteem. Depression and anxiety are the most commonly studied psychopathology constructs examined in relation to PSU [15•]. Depression and PSU severity have demonstrated moderate, positive relationships across studies [reviewed in 15•]. Furthermore, anxiety and PSU severity have demonstrated small to moderate, positive relations across studies [reviewed in 16, 17].

However, this mental health symptom- and disorder-based approach to studying PSU's pathways fails to take into account the role of psychopathology-related constructs and processes that are not strictly mental disorders, but in fact are observed in the clinical presentation of numerous mental disorders. Such “transdiagnostic” constructs are important in understanding the etiology and maintenance of mental illness [38•]. Transdiagnostic constructs have been supported as explanatory mechanisms in maintaining other problematic behaviors, such as substance use [39]. Such constructs may serve as mechanisms that explain relations between depression/anxiety and PSU.

An important theoretical model addressing this issue of mechanisms between psychopathology and excessive technology use is the Interaction of Person-Affect-Cognition-Execution (I-PACE) model [40, 41•]. I-PACE proposes general components of variables that influence excessive technology use. First is the personal predisposition component, which includes genetic, biological, personality, psychopathology, cognition, and Internet use motives as influences. Second is the affective and cognitive responses to predisposition component, which includes risk and resilience variables such as cognitive and attention bias, Internet use expectancies, coping strategies, inhibitory control, and craving. These response variables are conceptualized in I-PACE as moderator or mediator variables between predisposition variables and excessive Internet use [41•]. Finally, I-PACE assumes that response variables influence the decision to use particular Internet features or applications, which may lead to adaptive use or problematic use. Numerous studies find support for I-PACE in modeling excessive Internet use [e.g., 5, 42, 43, 44].

In the present paper, we focus on two major types of transdiagnostic psychopathology constructs. Specifically, we discuss maladaptive cognitive and emotion processes. We review repetitive negative thinking (i.e., rumination and worry), boredom proneness, and the fear of missing out (FOMO), which are conceptualized as maladaptive cognitive coping processes. We also discuss emotion dysregulation and distress intolerance, conceptualized as maladaptive emotion coping processes. Such maladaptive coping processes fall within the response variable component in I-PACE. We discuss these

constructs next and how they may serve as mechanisms between both depression and anxiety (psychopathology predispositions in I-PACE) and PSU.

## Repetitive Negative Thinking

One type of maladaptive cognitive coping is repetitive negative thinking [45]. Repetitive negative thinking by definition involves thought that has negative content, is repetitively engaged in by the individual, and is passive or uncontrollable [46].

A prominent example of such repetitive thinking style is worry. Worry is defined as persistent and unwanted, negative verbal thought [47]. Worry functions to suppress negative affect and prepare for aversive threat [47, 48]. Furthermore, worry is a hallmark of generalized anxiety disorder [48].

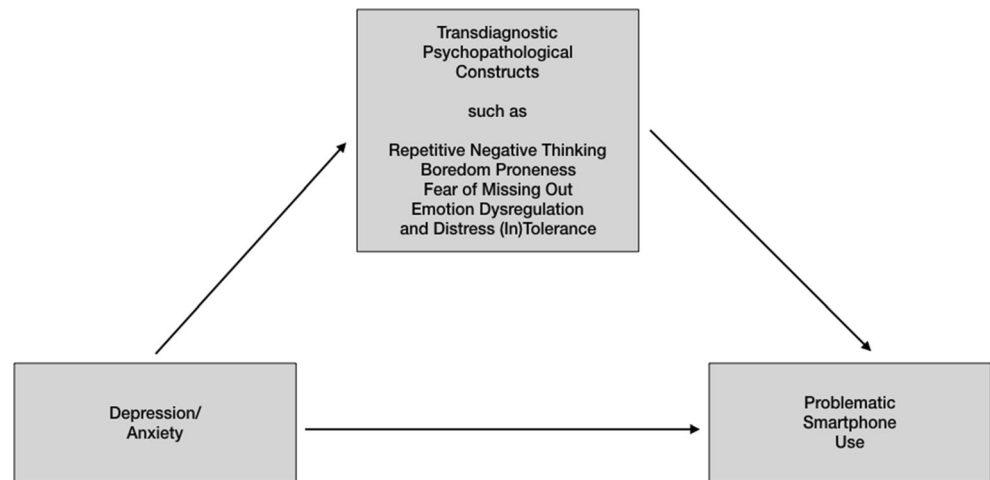
An additional, similar cognitive coping process is rumination. Rumination involves persistent, negative self-referencing thought, functioning to assist in avoiding negative emotion [49]. Rumination is maladaptive because it involves fixation on the thought rather than problem-solving [50]. Rumination is associated with mood and anxiety disorders [51, 52], with reciprocal relationships evidenced [50].

Worry and rumination are conceptualized as maladaptive cognitive strategies that individuals use to avoid dealing with negative emotion [48, 49]. They are considered transdiagnostic psychopathology constructs [53]. These two constructs are similar, with the primary difference involving temporal orientation; rumination involves repetitive thinking about past events, but worry involves repetitive thinking about possible future events [46].

These repetitive negative thinking styles fit into the coping strategy response component in I-PACE. As such, these thinking styles can be conceptualized in I-PACE as variables that can account for relationships between predisposing psychopathology (such as depression and anxiety) and PSU. That is, depression/anxiety alone may not drive an individual to engage in PSU, but ruminative thought or worry may account for these relationships (see Fig. 1). Specifically, depression or anxiety may lead to unconstructive, maladaptive repetitive negative thinking in some individuals, which may drive them to relieve such thinking processes by engaging in PSU. In fact, one possible explanation is that repetitive negative thinking may drive depressed/anxious individuals to use their smartphones to engage in excessive reassurance seeking behavior from their friends, family, and acquaintances (e.g., increased back-and-forth messaging and soliciting “likes” on social media, to obtain reassurance and evidence for self-worth) [18•].

Several studies have supported repetitive negative thinking in association with PSU severity. Studies found rumination positively associated with PSU severity [54, 55] and increased levels of smartphone use frequency [56]. One study found that

**Fig. 1** PSU relationship with depression/anxiety alone and ruminative thought or worry



rumination mediated relations between both depression and anxiety with PSU severity [55]. Additionally, another study found that worry was associated with increased levels of PSU severity [57]. In the realm of the I-PACE model, it should also be mentioned that the predisposition “P” component includes personality. One of the most widely supported personality traits strongly linked to depression and anxiety is neuroticism [58]. Therefore, it is not surprising that the combination of high neuroticism together with low conscientiousness has been observed to be robustly associated with PSU [59].

### Boredom Proneness

An additional type of cognitive coping process is the proneness to boredom. A leading conceptualization for why people experience boredom is that boredom occurs as a result of attentional difficulties that are attributed to environmental stimuli. Specifically, boredom occurs when the individual has difficulty engaging attention, is aware of such inattention, and negatively attributes the environment for such inattention [60]. Boredom proneness is associated with depression and anxiety [61–63], as well as impulse control problems [63, 64].

Boredom proneness fits as a maladaptive coping process, and also as an attention bias, within the response style component in I-PACE. Boredom proneness may mediate associations between both depression and anxiety with PSU severity. Depression and anxiety involve attentional problems, such as difficulty concentrating [65]. Such attentional difficulties among depressed and anxious individuals may set the stage for them to experience boredom and boredom proneness [60, 66]. Because of the impulse control and inattention experienced when in a state of boredom [60], boredom proneness can in turn drive individuals to overuse their (easily accessible) smartphones as a means of relieving their boredom [66]. This conceptualization fits well with the conditioning processes described in the behavioral model of learning smartphone usage [67].

Studies have found that boredom proneness is related to PSU severity [66, 68, 69]. Furthermore, one study found that boredom proneness mediated relations between both depression and anxiety with PSU severity [66]. This mediation effect was also supported in a study examining PIU as the outcome variable [70].

### Fear of Missing Out

FOMO is defined as the fear of missing out on rewarding experiences, and the persistent need to stay connected with one’s social network [71]. FOMO is conceptualized to result from unmet social relatedness needs [71]. Not surprisingly, FOMO is related to increased social media engagement [42, 43, 72]. FOMO is also related to negative affectivity [43, 73–75].

FOMO can be considered a maladaptive cognitive coping process within I-PACE; it has also been considered a cognitive bias within this model [76]. FOMO can explain the relationships between both depression and anxiety with PSU. Depression and anxiety can involve negative affect and social isolation, which in turn can lead to FOMO as a result of such isolation. FOMO in turn can lead to PSU engagement (e.g., social media use) as a means of relieving the perceived dearth of social connection and relatedness [71].

Numerous studies have found FOMO related to increased PSU severity [43, 73–75, 77, 78]. Furthermore, studies have supported FOMO as a mediator between both depression and anxiety with PSU severity [43, 74]. Finally, a recent study by Sha, Sariyska et al. [19] presented data in more than 2000 participants showing that FOMO fully mediates the link between life satisfaction and PSU.

### Emotion Dysregulation and Distress (In)Tolerance

How individuals regulate their emotions has been widely studied. A commonly accepted model conceptualizes emotion



regulation processes as involving cognitive reappraisal and expressive suppression [79]. Cognitive reappraisal is considered to be an adaptive emotion regulation strategy, while expressive suppression is a maladaptive strategy [80]. Dysregulation of emotion has been supported as a transdiagnostic psychopathology construct [81, 82].

Related to emotion dysregulation is the construct of distress (in)tolerance. Distress tolerance is defined as the ability to endure emotional distress [39]. This construct consists of several appraisals of experiencing negative emotion: tolerability, perception of acceptability, attentional interference, and regulation of the emotion [83]. Distress tolerance can influence the specific type of emotion regulation (or dysregulation) strategy used [83].

Research has shown that emotional dysregulation mediates the relationship between problematic behaviors (such as substance use) and associated mental disorders [84]. Emotion dysregulation serving as a mediator between depression and anxiety with PSU would fit with I-PACE. In fact, some frameworks conceptualize excessive Internet use (e.g., PSU) as a coping skill aimed at regulating negative emotion [85]. Therefore, depression and anxiety may cause dysregulated emotion, in turn resulting in PSU as a means of alleviating negative emotion [85]. In this context, affective neuroscience theory [86] [see selected principles in 87] might illuminate in a bottom-up approach how individual differences in primary emotional systems can impact PSU, as well as on a molecular and systemic neuroscience level [88].

Studies find that emotion dysregulation is related to PSU severity [75, 89, 90] and increased frequency of smartphone use [22]. One study [75] found that emotional dysregulation mediated relations between depression and PSU severity. Furthermore, distress tolerance was found inversely related to PSU severity, and mediated relations between anxiety and PSU severity [91].

Finally, we should mention that emotion-laden impulsivity (especially impulsivity's urgency dimension) is related to PSU severity [92–95]. Indeed, processes that have been proposed to underlie urgency behaviors not only include inhibitory control but also emotion dysregulation-related processes [96, 97]. Moreover, research finds urgency-related behaviors as involving regulation of affect in the short-term, despite adverse delayed consequences (i.e., coping) [96]. Finally, urgency is known as a strong transdiagnostic factor [98].

## Summary and Conclusions

PSU is maladaptive and found associated with mental health problems—primarily, anxiety and depression symptoms. While most prior studies have taken a symptom- and disorder-based approach to understanding influences of PSU, a transdiagnostic approach is also important in understanding the causes of PSU. Worry and rumination (types of

repetitive negative thinking), boredom proneness, and FOMO are transdiagnostic psychopathology-related constructs that fit within I-PACE's response variables influencing PSU. Emotion dysregulation and distress tolerance also fit within I-PACE's response variables. These variables are mechanisms that can function as intermediate variables between depression/anxiety and PSU. Recent studies have supported these transdiagnostic variables in association with PSU, as well as mediating associations between depression and anxiety with PSU severity. Future studies should adopt a transdiagnostic approach to studying psychopathology in relation to PSU.

Finally, it is important to include neuroscientific research as a further data layer to better understand and characterize PSU. This research is best supplemented by real-world tracking variables. Feasibility to do such work has been demonstrated in recent research. For example, in Montag, Markowitz et al. [99], real-world Facebook app usage on the smartphone could be linked to gray matter volumes of the nucleus accumbens, the brain's reward center. And Sariyska, Rathner et al. [100] demonstrated that molecular genetic variables could be linked to active social network size as recorded from smartphones. In sum, the combination of psychological, computer science and neuroscientific methods will likely be most successful to disentangle the nature of PSU. This will clearly illuminate both cognitive and emotional dysfunction being of high relevance to understand this still new phenomenon.

**Funding** The position of CM is funded by a Heisenberg grant awarded to him by the German research Foundation (DFG, MO 2363/3-2).

## Compliance with Ethical Standards

**Conflict of Interest** Dr. Elhai reports royalties from John Wiley and Sons, and Elsevier, and grants from Tianjin Normal University, US Department of Defense, and US National Institutes of Health outside of the submitted work. Dr. Montag reports grants from the German Research Foundation, during the conduct of the study. Dr. Haibo has nothing to disclose.

**Human and Animal Rights and Informed Consent** This article does not contain any studies with human or animal subjects performed by any of the authors.

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