Get off of your phone and into your life: elucidating contributions of anxiety, depression, and psychological inflexibility on problematic smartphone use

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Get off of your phone and into your life: Elucidating contributions of anxiety, depression, and psychological inflexibility on problematic smartphone use

by

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Abstract

**Background:** Problematic smartphone use (PSU) is a growing behavioral health problem; one that is associated with depression and anxiety. The aim of the present study was to elucidate processes that may account for such relations, with specific attention on a multidimensional transdiagnostic construct known as psychological inflexibility (PI). **Methods:** Undergraduates ($N = 549; M_{age} = 18.84, SD_{age} = 1.26; 62.7\%$ female) completed a survey battery assessing PI and its six component processes, problematic smartphone use, and depression and anxiety. We tested PI, and then its six component processes, as mediators of relations between anxiety and depression and PSU. We also reversed the model to evaluate relations between PSU and anxiety and depression. **Results:** As expected, anxiety and depression predicted PSU. Yet, this relation was fully mediated by PI. In multiple mediation models, two PI component processes (i.e., lack of contact with values and inaction) mediated each pathway, but experiential avoidance did not. Testing models in reverse yielded significant mediational models which are discussed in the context of a theoretical recursive model. **Discussion:** Anxiety and depression share a common process pathway to PSU via PI, or a rigid and inflexible pattern of relating with unwanted internal experiences. Lack of contact with values and inaction further define this pathway. Experiential avoidance failed to emerge as as significant mediator in any model, thus calling into question the view that PSU predominantly serves an avoidant, emotion regulatory function. **Conclusion:** Process-oriented intervention efforts targeting PI, and lack of values clarity and inaction specifically, may highlight a viable approach to mitigate PSU. This approach moves beyond conceptualizing PSU as serving an emotion regulatory function and includes the importance of values and behavioral engagement processes. **Keywords:** Problematic Smartphone Use, Psychological Inflexibility, Anxiety, Depression
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Overview

As smartphones are increasingly incorporated throughout daily life, their problematic, or negatively life-impacting usage have become the subject of concern, debate, and research (see Elhai et al., 2019b). One line of research arose in response to the repeated finding that problematic smartphone use is associated with anxiety and depression symptomology (reviewed in Elhai et al., 2017a). That is, those who use their phone in life-interfering ways, often report increased anxiety and depression, and a recent line of research has investigated psychological processes which may account for such relations. A prevailing theoretical conceptualization framing this line of research is that anxiety and depression eventuate in problematic smartphone use, which itself is thought to serve avoidant, emotion regulation functions (e.g., Kardefelt-Winther, 2014). Put another way, problematic smartphone use is thought to function as experiential avoidance of anxiety and depression (e.g., Elhai et al., 2017a).

Numerous researchers have subsequently tested theoretically-consistent, psychological processes that might account for the relations between anxiety, depression, and problematic smartphone use, to elucidate targets for intervention and to further refine theoretical conceptualization of the problem (see Elhai et al., 2019b). The present study aimed to contribute to this literature by focusing in on a multidimensional, transdiagnostic construct: psychological inflexibility (Hayes et al., 2012). We aimed to extend recent literature that found anxiety and depression’s relations with problematic smartphone use were mediated by psychological inflexibility (Kuru & Çelenk, 2021) as measured by a unidimensional scale, by conducting a more fine-grained analysis of psychological inflexibility’s component processes as mediators of anxiety and depression’s relations with problematic smartphone use using a multidimensional scale. In doing so, we aimed to both (1) test and refine the theoretical conceptualization of
problematic smartphone use serving the function of experiential avoidance of anxiety and depression symptomology, and (2) identifying process-level targets for intervention development. While multiple other theoretically-plausible process variables have been tested as mediators of anxiety and depression’s relations with problematic smartphone use (see Elhai et al., 2019b), we believe psychological inflexibility, and its underlying component processes including experiential avoidance, provide a more direct test of the prevailing theoretical conceptualization of this problem, as well as directly elucidate potential targets for intervention that are uniquely tied to an evidence-based treatment model: Acceptance and Commitment Therapy (ACT; Hayes et al., 2012). Thus, homing in on psychological inflexibility and then its underlying processes, as we do in the present study, will not only test and extend a predominant theoretical conceptualization of the process by which problematic smartphone use manifests and is maintained, but also could point to potentially impactful intervention targets for which empirically-supported interventions already exist.

1. Introduction

Smartphones have become an increasingly common component of daily life in the United States and around the world. Eighty-one percent of all US adults own a smartphone, and 96% of US adults between the ages of 18 to 29 are smartphone owners (Pew Research Center, 2019). Smartphones have become so much a part of daily life that some individuals perceive them as extensions of themselves (Park & Kaye, 2018). As a technological tool, smartphones have imparted immense changes upon humanity in the way we interact with one another, receive and share information, and navigate our physical environment. Recently, smartphone videos documenting instances of police-involved fatalities are poised to catalyze society-wide discussion of policing practices. In the era of the COVID-19 pandemic, smartphones also
functioned as social lifelines for those in quarantine, and were used in contact tracing to reduce the spread of the virus.

In short, the capabilities and functionalities of smartphones hold tremendous capacity to influence individual and group behavior in many ways. Moreover, smartphones are small and unobtrusive, and thus can be found in nearly every situation and context. Their use is also socially acceptable in a wide variety of contexts. Portability and social acceptability distinguish their potential for omnipresent life impact from other forms of technology such as traditional video game platforms, desktop and laptop computers, and television (Sohn et al., 2019). As powerfully beneficial as smartphones can be, they can also be used in equally impactful, problematic ways in some contexts and for some people.

1.1 Problematic Smartphone Use

Since the introduction of smartphones in the early 2000’s, behavioral scientists have questioned their potential for harm. Over the past 20 years, substantial research has revealed a litany of risks associated with smartphones, including the potential for addiction-like behavior or problematic use. Problematic Smartphone Use (PSU) is generally defined as “an inability to regulate one’s use of the mobile phone, which eventually involves negative consequences in daily life” (Billieux, 2012, p. 1), and is the label most commonly used to reference this phenomenon. Of note, PSU does not currently constitute a discrete diagnostic entity and its classification as either an addiction or problematic behavior has been the focus of some debate (e.g., Bhatia, 2008; Panova & Carbonell, 2018). Regardless of its classification, PSU appears to be a highly prevalent and growing behavioral health problem (Sohn et al., 2019).

Estimated prevalence rates of PSU are high across the globe. Sohn et al. (2019) reviewed 41 PSU studies including 41,871 participants to estimate prevalence rates among children and
young people (i.e., individuals under age 25). They found that 17- to 19-year-olds, and females more so than males, are most likely to engage in PSU. Across the studies reviewed, the estimated prevalence rate of PSU was between 10-30%, with a median of 23.3%. In other words, approximately one in four people under the age of 25 may struggle with PSU. These high prevalence rates indicate directing research attention toward understanding and mitigating PSU, especially considering the growing list of negative life consequences with which PSU has been associated.

In addition to being problematic by definition, PSU has been associated with other negative life experiences and problems. Such problems including texting while driving leading to high risk of bodily harm (e.g., Cazzulino et al., 2014; Feldman et al., 2011), poor academic performance and low life satisfaction among college students (e.g., Lepp et al., 2013), and suicidal ideation (Kim et al., 2017). Moreover, PSU is linked with symptomatic mental health distress, particularly anxiety and depression (reviewed in Elhai et al., 2017a; Sohn et al., 2019). In sum, PSU seems to be linked with anxiety, depression, and a host of negative life experiences. These associations are fairly well-established, but the processes through which their relationships operate are less clearly understood. Examining mediating mechanisms between psychopathology and PSU, therefore, is a new and growing area of research that warrants continued attention (Elhai et al., 2019b; Kardefelt-Winther, 2014). Indeed, observing direct relations between mental health problems and PSU is of less clinical and research utility than investigating mechanisms or processes that may account, either in whole or in part, for how such relations operate. This process-oriented approach would, in principle, point to factors that could be identified and targeted directly to ameliorate PSU, whether that be in prevention or intervention contexts. Firm theoretical grounding is needed to extend empirical investigation into this developing territory.
1.2 Theory

Multiple theories have been applied to frame the process pathway question as it relates to psychological distress and PSU. Compensatory Internet Use Theory (CIUT; Kardefelt-Winther, 2014) is commonly applied to conceptualize the relation between distress and PSU (e.g., Elhai et al., 2018a; Wang et al., 2015; Wolniewicz et al., 2018). Through the lens of CIUT, problematic smartphone use develops out of one’s attempt to use a smartphone to alleviate or avoid unwanted emotions or escape from life’s problems and obligations (Kardefelt-Winther, 2014). As such, motivations including escapism and avoidant coping are thought to account for the relations between distress and problematic smartphone use. CIUT therefore asserts that symptomatic distress leads to problematic technology use, mediated by avoidance motives.

Interaction of Person-Affect-Cognition-Execution (I-PACE; Brand et al., 2016) and Uses and Gratification Theory (UGT; Blumler, 1979) have also been used as frameworks for understanding PSU’s relations with symptomatic distress (e.g., Elhai et al., 2017a; Elhai et al., 2020; Elhai et al., 2018b; Grellhesl & Punyanunt-Carter, 2012). While each theory offers unique perspectives and variables to consider, Elhai et al. (2019b) synthesized a common feature among all extant theories that explain relations between symptomatic distress and PSU; namely, that PSU develops as a consequence of smartphones being used repeatedly to escape or avoid unpleasant life experiences and unwanted emotions. Put another way, PSU is predominantly thought to function as a form of experiential avoidance (Elhai et al., 2017a).

1.2.1 Experiential Avoidance

Experiential avoidance (EA; Hayes et al., 1996; Hayes et al., 2012) is a “transdiagnostic process” (i.e., a common psychological process that underlies a multitude of seemingly disparate forms of psychopathology; Dalgleish et al., 2020), defined by engagement in rigid and inflexible
efforts to escape, avoid, or otherwise alter one’s private events, even when such behaviors cause harm in the long run. As such, EA can also be thought of as a maladaptive emotion regulation strategy. In the context of PSU, EA could manifest in picking up and using a smartphone to distract oneself from, or to alter thoughts and feelings, associated with anxiety, depression, or any other unwanted internal state. While this form of avoidance may temporarily reduce the uncomfortable feelings, a rigid and repeated pattern of such relating to internal experiences would theoretically increase distress and interfere with important pursuits, thus contributing to functional impairment and life problems.

Emotion and thought suppression literature supports this view. For instance, deliberate and effortful attempts to regulate unpleasant private events (i.e., thoughts, feelings, physical sensations), are shown to yield paradoxical effects in the form of potentiation of the undesired private event and resurgence of the thought and emotion in the future (e.g., Gross & Levenson, 1993; Wegner et al., 1987). This body of literature suggests that using a smartphone to suppress unwanted thoughts and feelings is likely to increase the form, frequency, or intensity of the unwanted private events and increase the likelihood that those thoughts and feelings will return with greater frequency and intensity in the future. In addition, the repeated act of engaging with a smartphone to escape unwanted feelings can eventuate in behavioral patterns that are inconsistent with living in accordance with one’s values and goals. For example, if one endeavors to meet new people and experiences feelings of social anxiety in social situations, the use of a phone in situations where face-to-face conversations are available might function to reduce social anxiety and also to inhibit the actual desired behavior of meeting and connecting with new people. The more generalized this emotional avoidance pattern becomes, the more this
type of smartphone use could negatively impact engaging in behaviors that matter most to someone, thus contributing to the pain of an unlived life.

Few studies have directly investigated associations between EA and PSU (i.e., García-Oliva & Piqueras, 2016; Kuru & Çelenk, 2021; Ruiz-Ruano et al., 2018) and EA and problematic internet use (e.g., Chou et al., 2017; Kingston et al., 2010). Yet, those that have show PSU is directly associated with EA (Ruiz-Ruano et al., 2018), and that EA accounts for a significant proportion of variance in PSU, internet addiction, and video game addiction (García-Oliva & Piqueras, 2016). Growing evidence supports the theoretical conceptualization that many problem behaviors like PSU develop out of a common EA function in response to symptomatic distress. For example, EA has been shown to mediate relations between negative affectivity and various problematic behaviors such as self-harm, sexual promiscuity, excessive exercise, restrictive and binge eating, excessive internet/computer game use, nicotine use, excessive alcohol use, illicit drug use, and aggression (Kingston et al., 2010). Recently, EA was shown to mediate relations between anxiety, depression, and PSU (Kuru & Çelenk, 2021). Collectively, this work supports EA as an important transdiagnostic process underlying many topographically disparate problem behaviors, including PSU.

Studies highlighting problems with emotion regulation and avoidant coping further implicate EA, and maladaptive emotion regulation more broadly, as potentially important processes leading to PSU. For example, smartphones have been identified as an avoidant coping tool used by undergraduates to cope with stress (Flynn et al., 2020). Moreover, problems with emotion regulation are frequently conceptualized as fostering relations between negative emotionality and PSU (Elhai et al., 2019a; Extremera et al., 2019; Feldman et al., 2011; Squires et al., 2020; Yildiz, 2017). Indeed, 55% of a representative undergraduate sample endorsed using
smartphones to escape problems or alleviate a bad mood (see Emanuel et al., 2015). This work suggests that EA may serve an important role in PSU while also implicating EA as an important mediational process that could help explain relations between unpleasant private events and problematic smartphone use.

Taken together, this line of research suggests that EA could be a key transdiagnostic process accounting for anxiety and depression’s relations with PSU. One of the main aims of the present research is to expand this line of research beyond EA. Experiential avoidance is just one of six transdiagnostic processes thought to function interrelatedly to comprise the construct known as psychological inflexibility (defined below). As will be seen, psychological flexibility is emerging as an over-arching transdiagnostic construct that appears to account for a broad spectrum of human suffering. It is to a discussion of psychological inflexibility and its probable relations with PSU that we now turn.

### 1.2.2 Psychological Inflexibility

Psychological inflexibility (PI; Hayes et al., 2012b) is a transdiagnostic process defined as “the rigid dominance of psychological reactions over chosen values and contingencies in guiding action” (Bond et al., 2011, p. 678). PI is conceptualized and measured as a global construct derived out of the interrelation of six lower order transdiagnostic processes (Hayes et al., 2012b; Rolffs, Rogge, & Wilson, 2018). These interrelated processes are experiential avoidance, lack of contact with the present moment (i.e., unhelpful dominance of thoughts about the past or the possible future), self-as-content (i.e., rigidly adhering to unhelpful self-narratives), cognitive fusion (i.e., responding to thoughts literally, especially when they are unhelpful), lack of contact with values (i.e., disconnection from what the individual cares about in life), and inaction (i.e., behaving in ways that are incompatible with living in accordance with one’s
values). Reducing psychological inflexibility, and increasing psychological flexibility, are central intervention targets in acceptance-based behavior therapies such as Acceptance and Commitment Therapy (ACT; Hayes et al., 2012b), as well as related models like Acceptance-Based Behavior Therapy (Roemer & Orsillo, 2020).

EA has been primarily theorized to drive the relation between symptomatic distress and various problematic behaviors (e.g., Kingston et al., 2010). However, studies examining these models, including the one mediational study of the distress-to-PSU pathway (Kuru & Çelenk, 2021), have relied on unidimensional self-report measures (i.e., AAQ-II; Bond et al., 2011; AAQ, Hayes et al., 2004; AFQ-Y; Greco, Lambert, & Baer, 2008). There is also some confusion as to what these measures are measuring. For instance, the AAQ and AAQ-II have been described in relevant research as measuring experiential avoidance (e.g., Kingston et al., 2010), psychological inflexibility (e.g., Kuru & Çelenk, 2021), or combined PI/EA (e.g., Hsieh et al., 2019). Yet, EA is thought to be conceptually distinct from, but related to, PI (Hayes et al., 2012b). Due to the unidimensional nature of the measures commonly used to evaluate PI/EA, researchers have been unable to empirically specify whether the overarching PI construct, or any underlying process(es) like experiential avoidance, most precisely account for relations between negative affect and problem behaviors (Rolffs et al., 2018). Thus, we aim to add this level of specificity to the model of PSU tested in the present study by including a newer, psychometrically sound, multidimensional measure of PI (i.e., Multidimensional Psychological Flexibility Inventory; Rolffs et al., 2018).

1.3 Current Study Aims and Contributions

The central aim of the present study was to clarify the role of several transdiagnostic processes in account for PSU and to evaluate whether they may explain, either in whole or in
part, relations between anxiety and depression and PSU. Here, we focused this work on a large and diverse sample of undergraduates. Undergraduates are known to experience high levels of psychopathology (Blanco et al., 2008) as well as PSU (Emanuel et al., 2015; Lepp et al., 2013; Long et al., 2016; Wang et al., 2015), and thus represent an important target population.

This study further addressed a substantial gap in the literature described above. Namely, of the studies that have evaluated PI/EA in relation to PSU, all of them have relied on unidimensional measures of these constructs, and reported inconsistent terminological, and subsequently inconsistent conceptual, conclusions. As a consequence, prior research has been unable to specify the unique contributions of the six component processes underlying the PI model. The present research aimed to do just that. In doing so, we hoped to be able to clarify whether PI as a whole (i.e., the interrelation of the underlying inflexibility processes), or any unique underlying process(es) such as EA, account for relations between anxiety, depression, and PSU. To address the possibility of a recursive or reciprocal process between distress and PSU (further elaborated upon in the discussion), we also tested for simple and multiple mediation in models with PSU as the predictor of anxiety and depression.

This work is sorely needed so as to clarify the unique contribution of EA on PSU when considered in the context of other theoretically plausible mediators within the PI model. Testing these simple mediations represents an extension of literature showing associations between PSU and global PI and EA (i.e., as assessed with variants of the AAQ). More practically, efforts to address processes that mediate relations between distress and PSU ought to aid in the development and refinement of theory and interventions for PSU, where the process would become a central intervention target, thus contributing important information to the field in multiple domains.
1.4 Hypotheses

H1. Because anxiety and depression are each consistently associated with PSU (see Elhai et al., 2017a; Sohn et al., 2019, for reviews), we expected that both anxiety and depression would positively covary with PSU.

H2. Previous research demonstrated associations between PI/EA and PSU (García-Oliva & Piqueras, 2016; Kuru & Çelenk, 2021, Ruiz-Ruano et al., 2018). We therefore anticipated that psychological inflexibility will positively covary with problematic smartphone use.

H3. Psychological inflexibility is a transdiagnostic construct underlying multiple anxiety and mood disorders (e.g., Hayes et al., 2006; Levin et al., 2014). In accordance, we expected greater psychological inflexibility would be associated with more anxiety and depression.

H4. Psychological inflexibility is conceptualized as mediating relations between negative affectivity and numerous problem behaviors (e.g., Kingston et al., 2010), and has been shown (assessed using the AAQ-II) to mediate anxiety and depression’s relations with PSU (Kuru & Çelenk, 2021). As such, we predicted that psychological inflexibility would (cross-sectionally) mediate both relations between anxiety and PSU, and depression and PSU, demonstrating that PSU is one of the many problem behaviors that can emerge out of a psychologically inflexible relationship with unwanted internal experiences and replicating Kuru and Çelenk’s (2021) recent finding.

H5. Compensatory Internet Use Theory (Kardefelt-Winther, 2014) and research demonstrating that emotion dysregulation and avoidant coping specifically account for relations between anxiety, depression, and PSU (e.g., Elhai et al., 2019a; Extremera et al., 2019; Feldman et al., 2011; Flynn et al., 2020; Squires et al., 2019; Yildiz, 2017), implicate experiential avoidance as a key transdiagnostic process mediator. Because EA is a process theorized as
operating interrelatedly within a model of six PI sub-processes, testing EA in a parallel multiple mediation model with each of the other processes was undertaken to elucidate the unique importance of EA as a mediator. Moreover, because each of the six underlying PI processes can be conceptualized as arising in response to anxiety and depression and leading to unhelpful behaviors like PSU, it is plausible that multiple PI processes would emerge as key mediators. Thus, we included all six psychological inflexibility processes as parallel mediators of relations between anxiety and PSU, and depression and PSU, and anticipated that experiential avoidance would emerge as a key mediator in both models.

In addition to our hypothesized models, we also evaluated both simple and both multiple mediation models with PSU predicting both anxiety and depression. These analyses were undertaken to explore alternative model structures while also recognizing that relations between PSU and negative emotional events are likely non-linear and instead reciprocal. For instance, PSU may contribute to anxiety and be mediated by PI; however, it is also likely that anxiety may, in turn, contribute to PSU and be mediated by one or more PI processes, including PI itself. In short, the focal and exploratory models are not mutually exclusive and their evaluation may help better understand the processes underlying PSU.

2. Method

2.1. Participants and Procedure

Participants were undergraduates \((N = 549; \ M_{\text{age}} = 18.84, \ SD_{\text{age}} = 1.26; \ 62.7\% \ \text{female})\) at a large Northeastern University and were recruited online via the psychology department research pool. All were over the age of 18 and endorsed owning a smartphone. The ethnic and racial composition of the sample was diverse, with 50.1% identifying as White, 18.4% Black, 16.2% Latinx, 10.9% Asian, 4.0% Multiracial or another race or ethnicity, 0.2% American
Indian, and 0.2% Native Hawaiian. Participants accessed the survey battery online via a secure Qualtrics platform, gave informed consent, then completed the online survey. The university’s Institutional Review Board approved all research procedures. Course credit was awarded in return for participation.

2.2. Measures

Participants first completed an idiosyncratic demographic questionnaire asking about age, gender identity, race/ethnicity, and smartphone ownership. Participants then completed the measures described below. The ordering of the measures was randomized and an attention check item was included to screen out inattentive responders, thereby increasing data integrity (Meade & Craig, 2012).

2.2.1. Depression Anxiety and Stress Scale – 21 (DASS-21)

The 21-item Depression, Anxiety, and Stress Scale, 21 (DASS-21; Lovibond & Lovibond, 1995) is a self-report measure containing three 7-item subscales measuring dimensions of depression, anxiety, and stress over the past week. Each item is rated on a Likert type scale anchored from 0 = “Did not apply to me at all” to 3 = “Applied to me very much, or most of the time.” Scale totals are calculated by adding the scale items and then multiplying by a factor of two (Lovibond & Lovibond, 1995). The DASS-21 has adequate psychometric properties with non-clinical samples (α = .82 for the anxiety subscale, α = .88 for the depression subscale; Henry & Crawford, 2005). The anxiety and depression subscales were used in the present study, with Cronbach alpha levels of .76 and .90 respectively.

2.2.2. Multidimensional Psychological Flexibility Inventory (MPFI)

The 60-item Multidimensional Psychological Flexibility Inventory (MPFI; Rolffs et al., 2018) assesses six psychological flexibility and six inflexibility processes underlying the
flexibility and inflexibility dimensions of the ACT Hexaflex model (Hayes et al., 2012b). Each of the twelve subscales includes 5-items, anchored from 1 = “never true” to 6 = “always true,” evaluating flexibility and inflexibility processes over the past two weeks. Each subscale represents that average of the 5 corresponding 5-items. Furthermore, the six flexibility and six inflexibility subscale scores can be averaged to create two global composite scores, denoting flexibility or inflexibility, with greater scores indicating more inflexibility or flexibility. The MPFI inflexibility composite has been shown to have excellent internal consistency across diverse demographic groups (α = .95-.96), and convergent validity with other common measures of inflexibility (e.g., AAQ-II, r = .87; Rolffs et al., 2018). The psychological inflexibility global composite score (α = .96 in our sample) and underlying inflexibility process subscale scores, were used in the present study. Internal consistency for inflexibility subscales of the MPFI in the present sample were as follows: experiential avoidance (α = .90), lack of contact with the present moment (α = .93), self as content (α = .93), fusion (α = .93), lack of contact with values (α = .92), and inaction (α = .94).

2.2.3. Problematic Use of Mobile Phones Scale (PUMP)

The 20-item Problematic Use of Mobile Phones Scale (PUMP; Merlo et al., 2013) was used to evaluate self-reported problematic smartphone use. This measure was selected due to its inclusion of items tapping the functional consequences of smartphone use. Sample items include: “At times, I find myself using my cell phone instead of spending time with people who are important to me and want to spend time with me,” and “I have gotten in trouble at work or school because of my cell phone use.” The PUMP Scale assesses agreement with items on a 5-point Likert-type scale, anchored from 1 = “strongly disagree” to 5 = “strongly agree.” The measure yields a total score, ranging from 20-100, with greater scores indicating more
problematic smartphone use. The PUMP Scale demonstrates adequate convergent validity with other common measures of problematic smartphone use (e.g., CPDQ and CUQ; Merlo et al., 2013) and excellent internal consistency ($\alpha = .94$; Merlo et al., 2013). Chronbach’s alpha in the present sample was .89.

2.3 Analyses

2.3.1. Preliminary Data Evaluation

Analyses and assumption checks were conducted using SPSS version 27, and mediation analyses were conducted with Hayes’ (2018) PROCESS macro version 3.4. An initial sample of undergraduate participants ($N = 796$) consented to and submitted the online survey. Those who failed an attention check item ($n = 208$; 26.1%) were removed. Marginal item-level missing data was observed (i.e., all items had at least 98.8% complete data) and evaluated in the remaining cases. Little’s MCAR test was non-significant ($p = 0.19$), indicating that missing data among retained participants was missing completely at random. Study analyses were also run both with and without the 25 cases, and this resulted in no change to the observed relations. Cases with any missing data ($n = 25$; 4.3% of remaining participants) were addressed with listwise deletion. Listwise deletion was selected due to satisfying the MCAR assumption, not influencing results, and causing no detriment to statistical power. Four univariate outliers (i.e., $z$-scores $\pm 3.29$) and 10 multivariate outliers (i.e., mahalanobis distance $p$-value <.001) were detected and removed, yielding the final sample of 549.

Variables were assessed for fit of modeling assumptions. Variables appeared linearly associated. The Shapiro-Wilk test of normality was non-significant ($p = 0.39$) for the primary dependent variable, Problematic Smartphone Use, indicating univariate normality. Plotted residuals of regression paths in the mediation analyses also appeared normally distributed and
homoscedastic. The inflexibility processes demonstrated moderate-to-high bivariate correlations with one another, which is theoretically expected under the PI model that posits that all processes are unique but interrelated. Variance inflation factors were tested and were all below four in each model indicating no issues with multicollinearity. Linear regression assumptions were satisfied. Bivariate correlations were run to test Hypotheses 1-3. Table 1 lists means, standard deviations, and correlations for all variables in the present study.

2.3.2. Simple Mediation Analyses

Simple mediation analyses were undertaken to evaluate whether psychological inflexibility mediated anxiety and depression’s relations with PSU (see Figure 1), as a replication of Kuru and Çelenk’s (2021) recent finding. Compensatory Internet Use Theory (Kardefelt-Winther, 2014) and Acceptance and Commitment Therapy (Hayes et al., 2012) provided firm theoretical rationale for anxiety and depression predicting PSU, mediated by rigid dominance of unpleasant private experiences. In addition, empirical precedent supports our hypothesized variable ordering based on studies which have tested transdiagnostic process mediators between symptomatic distress and PSU (e.g., Elhai et al., 2018a; Elhai et al., 2019a; Elhai et al., 2017b; Kim, Seo, & David, 2015; Kuru & Çelenk, 2021; Squires et al., 2020; Wolniewicz et al., 2018), and PI/EA leading to PSU (García-Oliva & Piqueras, 2016; Kuru & Çelenk, 2021; Ruiz-Ruano et al., 2018). Age and gender were held constant in each model as these demographic variables have been associated with PSU (De-Sola Gutierrez et al., 2016; Sohn et al., 2019). Holding such demographic variables constant allowed for a cleaner interpretation of the specific effects of symptomatic distress and mediating process variables on PSU.

In Model 1, anxiety was the exogenous variable $X$, imparting effects on psychological inflexibility $M$, and problematic smartphone use $Y$, while controlling for age $C_1$ and gender $C_2$. In
Model 2, anxiety was replaced with depression as the exogenous variable $X$. Significance of the indirect effect was tested using non-parametric percentile bootstrapping (Preacher & Hayes, 2004) with 10,000 iterations. Those interested in reviewing regression coefficients along each path of the mediation models are referred to the figures in Appendices A. and B. The simple mediation models were each reversed and re-run (i.e., PSU leading to Anxiety/ Depression, mediated by PI) in Models 5 and 6 in line with the notion that such relations may be recursive and bi-directional.

![Diagram](image)

**Fig. 1.** Simple mediation model.
*Note: $c =$ direct effect of $X$ on $Y$; $c' =$ direct effect of $X$ on $Y$ in model that includes the mediator $M$.*

### 2.3.3. Multiple Mediation Analyses

Parallel multiple mediation analyses were set up and run as depicted in Figure 2., first with anxiety (Model 3) and then with depression (Model 4), to evaluate whether experiential avoidance, or any of the other PI processes, would emerge as key mediators within the PI construct (see Hypothesis 5). These variable orderings were then reversed and re-run (i.e., PSU
leading to anxiety in Model 7, and to depression in Model 8). Each model controlled for age and gender and significance of the indirect effects were tested with percentile bootstrapping and 10,000 iterations.

![Diagram of multiple mediation model](image)

**Fig. 2.** Multiple mediation model. Notes: PSU = Problematic Use of Mobile Phone Scale; ANX = Depression Anxiety and Stress Scale (DASS-21) Anxiety Subscale; DEP = DASS-21 Depression Subscale; PI = Multidimensional Psychological Flexibility Inventory (MPFI) Psychological Inflexibility Global Composite; EA = MPFI Experiential Avoidance Subscale; LPM = MPFI Lack of Contact with Present Moment Subscale; SCT = MPFI Self-as-Content Subscale; F = MPFI Fusion Subscale; LV = MPFI Lack of Contact with Values Subscale; INA = MPFI Inaction Subscale; GEN = Gender. For visual clarity, covariate paths are drawn only to outcome variable PSU.
3. Results

3.1 Bivariate and Point Biserial Correlations

Table 1 illustrates the descriptive statistics among and bivariate correlations between all study variables. Consistent with expectation, PSU moderately covaried with both anxiety ($r = .30, p < .01$) and depression ($r = .33, p < .01$). Psychological inflexibility likewise moderately covaried with PSU ($r = .44, p < .01$) and more strongly with anxiety ($r = .55, p < .01$) and depression ($r = .67, p < .01$).

Table 1
Means, standard deviations, and correlations among primary and demographic variables, rounded to nearest tenth

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age</td>
<td>18.84</td>
<td>1.26</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Gen</td>
<td>N/A</td>
<td>N/A</td>
<td>.02</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. PSU</td>
<td>52.71</td>
<td>12.58</td>
<td>-.09*</td>
<td>.10*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. ANX</td>
<td>8.17</td>
<td>7.12</td>
<td>.03</td>
<td>.13**</td>
<td>.30**</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. DEP</td>
<td>11.53</td>
<td>9.75</td>
<td>.09*</td>
<td>.16**</td>
<td>.33**</td>
<td>.60**</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. PI</td>
<td>2.90</td>
<td>0.91</td>
<td>.02</td>
<td>.13**</td>
<td>.44**</td>
<td>.55**</td>
<td>.67**</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. EA</td>
<td>3.74</td>
<td>1.06</td>
<td>-.02</td>
<td>.18**</td>
<td>.18**</td>
<td>.21**</td>
<td>.22**</td>
<td>.53**</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. LPM</td>
<td>2.83</td>
<td>1.15</td>
<td>.01</td>
<td>.09*</td>
<td>.33**</td>
<td>.35**</td>
<td>.50**</td>
<td>.75**</td>
<td>.36**</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. SCT</td>
<td>2.81</td>
<td>1.24</td>
<td>-.03</td>
<td>.04</td>
<td>.33**</td>
<td>.46**</td>
<td>.47**</td>
<td>.82**</td>
<td>.36**</td>
<td>.50**</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. F</td>
<td>3.02</td>
<td>1.24</td>
<td>.03</td>
<td>.12**</td>
<td>.39**</td>
<td>.50**</td>
<td>.64**</td>
<td>.87**</td>
<td>.30**</td>
<td>.53**</td>
<td>.71**</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>11. LV</td>
<td>2.39</td>
<td>1.07</td>
<td>.04</td>
<td>.07</td>
<td>.41**</td>
<td>.43**</td>
<td>.56**</td>
<td>.80**</td>
<td>.26**</td>
<td>.53**</td>
<td>.56**</td>
<td>.66**</td>
<td>-</td>
</tr>
<tr>
<td>12. INA</td>
<td>2.60</td>
<td>1.22</td>
<td>.05</td>
<td>.11**</td>
<td>.42**</td>
<td>.57**</td>
<td>.69**</td>
<td>.86**</td>
<td>.26**</td>
<td>.56**</td>
<td>.62**</td>
<td>.78**</td>
<td>.74**</td>
</tr>
</tbody>
</table>

Note: Gen. = Gender; PSU = Problematic Use of Mobile Phone Scale; ANX = Depression Anxiety and Stress Scale (DASS-21) Anxiety Subscale; DEP = DASS-21 Depression Subscale; PI = Multidimensional Psychological Flexibility Inventory (MPFI) Psychological Inflexibility Global Composite; EA = MPFI Experiential Avoidance Subscale; LPM = MPFI Lack of Contact with Present Moment Subscale; SCT = MPFI Self-as-Content Subscale; F = MPFI Fusion Subscale; LV = MPFI Lack of Contact with Values Subscale; INA = MPFI Inaction Subscale. *p < 0.05, **p < 0.01, two-tailed.

3.2 Simple Mediation Analysis for Anxiety (Model 1)

The standardized regression coefficient for the direct effect of anxiety on problematic smartphone use decreased from $\beta = .30$ ($p < .001$; path c in Figure 1) to $\beta = .08$ ($p = .07$; path c’ in Figure 1) after including psychological inflexibility as a mediator, thus supporting full mediation (Baron & Kenny, 1986). Significance of the indirect effect was tested with percentile bootstrapping, which yielded a significant standardized effect estimate of .21 (95% C.I. [0.16,
These findings suggest psychological inflexibility fully mediates relations between anxiety and PSU (see Table 2, Model 1).

3.3 Simple Mediation Analysis for Depression (Model 2)

The pattern of relations observed with anxiety were similar to those observed for depression on PSU. When psychological inflexibility was included in the model, the standardized regression coefficient for the direct effect of depression on problematic smartphone use decreased from $\beta = .33$ ($p < .001$; path c in Figure 1) to $\beta = .07$ ($p = .16$; path $c'$ in Figure 1), indicating full mediation (Baron & Kenny, 1986). As can be seen in Table 2 (Model 2), the bootstrapped test of the indirect effect demonstrated significance and a standardized estimated effect of .26 (95% C.I. [0.19, 0.34]). Thus, psychological inflexibility also fully mediates depression’s relation with PSU.

3.4 Multiple Mediation Analyses for Anxiety (Model 3) and Depression (Model 4)

The structure of multiple mediation models evaluating relations between anxiety and depression on PSU and the role of the six inflexibility processes as mediators is illustrated in Figure 2. These analyses showed that after accounting for all of the processes together, lack of contact with values and inaction emerged as significant mediators of relations between anxiety and PSU and depression and PSU. Somewhat surprisingly, experiential avoidance was not a significant mediator in either model. Tests of indirect effects with each parallel mediator are shown in Table 2 as Models 3 and 4, respectively. Regression coefficients along each path in the models can be found in appendices A. and B.
Analyses of Alternative Mediational Model Structures

Both simple mediation models and both multiple mediation models described above were run a second time reversing the order of $X$ and $Y$, while still controlling for age and gender. In the first reversed simple mediation, after accounting for psychological inflexibility, PSU’s relation with anxiety (Model 5) reduced from $\beta = .30$ ($p < .001$) to $\beta = .07$ ($p = .07$), indicating full mediation (Baron & Kenny, 1986). After controlling for psychological inflexibility, PSU’s relation with depression (Model 6) similarly reduced from $\beta = .33$ ($p < .001$) to $\beta = .05$ ($p = .16$), also suggesting full mediation (Baron & Kenny, 1986).

In the reversed multiple mediation models, self-as-content and inaction significantly mediated PSU’s relation with Anxiety (Model 7). Separately, lack of contact with the present moment, fusion, and inaction each significantly mediated PSU’s relation with depression (Model

Table 2.
Hypothesized mediation results with standardized effect estimates and bootstrapped confidence intervals.

<table>
<thead>
<tr>
<th>Model</th>
<th>Indirect Effect</th>
<th>Standardized Effect</th>
<th>Bootstrapped SE</th>
<th>Bootstrapped 95% C.I.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Anxiety $\rightarrow$ Psychological Inflexibility $\rightarrow$ PSU</td>
<td>.21*</td>
<td>.03</td>
<td>[.16, .28]</td>
</tr>
<tr>
<td>2</td>
<td>Depression $\rightarrow$ Psychological Inflexibility $\rightarrow$ PSU</td>
<td>.26*</td>
<td>.04</td>
<td>[.19, .34]</td>
</tr>
<tr>
<td>3</td>
<td>Anxiety $\rightarrow$ Experiential Avoidance $\rightarrow$ PSU</td>
<td>.01</td>
<td>.01</td>
<td>[-.01, .02]</td>
</tr>
<tr>
<td></td>
<td>Anxiety $\rightarrow$ Lack of Present $\rightarrow$ PSU</td>
<td>.03</td>
<td>.02</td>
<td>[-.01, .06]</td>
</tr>
<tr>
<td></td>
<td>Anxiety $\rightarrow$ Self as Content $\rightarrow$ PSU</td>
<td>-.0002</td>
<td>.03</td>
<td>[-.06, .05]</td>
</tr>
<tr>
<td></td>
<td>Anxiety $\rightarrow$ Fusion $\rightarrow$ PSU</td>
<td>.04</td>
<td>.04</td>
<td>[-.03, .11]</td>
</tr>
<tr>
<td></td>
<td>Anxiety $\rightarrow$ Lack of Values $\rightarrow$ PSU</td>
<td>.07*</td>
<td>.03</td>
<td>[.02, .13]</td>
</tr>
<tr>
<td>4</td>
<td>Anxiety $\rightarrow$ Inaction $\rightarrow$ PSU</td>
<td>.08*</td>
<td>.04</td>
<td>[.001, .16]</td>
</tr>
<tr>
<td>5</td>
<td>Depression $\rightarrow$ Experiential Avoidance $\rightarrow$ PSU</td>
<td>.01</td>
<td>.01</td>
<td>[-.01, .03]</td>
</tr>
<tr>
<td></td>
<td>Depression $\rightarrow$ Lack of Present $\rightarrow$ PSU</td>
<td>.04</td>
<td>.02</td>
<td>[-.01, .09]</td>
</tr>
<tr>
<td></td>
<td>Depression $\rightarrow$ Self as Content $\rightarrow$ PSU</td>
<td>.01</td>
<td>.03</td>
<td>[-.05, .06]</td>
</tr>
<tr>
<td></td>
<td>Depression $\rightarrow$ Fusion $\rightarrow$ PSU</td>
<td>.05</td>
<td>.05</td>
<td>[.05, .14]</td>
</tr>
<tr>
<td></td>
<td>Depression $\rightarrow$ Lack of Values $\rightarrow$ PSU</td>
<td>.09*</td>
<td>.04</td>
<td>[.02, .17]</td>
</tr>
<tr>
<td></td>
<td>Depression $\rightarrow$ Inaction $\rightarrow$ PSU</td>
<td>.11*</td>
<td>.05</td>
<td>[.02, .21]</td>
</tr>
</tbody>
</table>

Notes: Models 1 and 2 = Simple mediations; Models 3 and 4 = Parallel multiple mediations. * indicates a significant indirect effect.
8). Bootstrapped significance tests of the indirect effects are reported in Table 3. These reversed models yielded similar patterns when compared with earlier models evaluating anxiety and depression on PSU. There were also some unique observations with the reversed models, which may have implications for conceptualizations of relations between negative affect and PSU. Interpretations of our hypothesized and unexpected findings are discussed below.

### Table 3.
Reversed mediation results with standardized effect estimates and bootstrapped confidence intervals.

<table>
<thead>
<tr>
<th>Model</th>
<th>Indirect Effect Tested</th>
<th>Standardized Effect</th>
<th>Bootstrapped SE</th>
<th>Bootstrapped 95% C.I.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>PSU → Psychological Inflexibility → Anxiety</td>
<td>.22*</td>
<td>.03</td>
<td>[.17, .28]</td>
</tr>
<tr>
<td>6</td>
<td>PSU → Psychological Inflexibility → Depression</td>
<td>.28*</td>
<td>.03</td>
<td>[.22, .34]</td>
</tr>
<tr>
<td>7</td>
<td>PSU → Experiential Avoidance → Anxiety</td>
<td>.003</td>
<td>.01</td>
<td>[-.01, .02]</td>
</tr>
<tr>
<td></td>
<td>PSU → Lack of Present → Anxiety</td>
<td>-.001</td>
<td>.02</td>
<td>[-.03, .03]</td>
</tr>
<tr>
<td></td>
<td>PSU → Self as Content → Anxiety</td>
<td>.05*</td>
<td>.02</td>
<td>[.01, .09]</td>
</tr>
<tr>
<td></td>
<td>PSU → Fusion → Anxiety</td>
<td>.01</td>
<td>.03</td>
<td>[-.04, .06]</td>
</tr>
<tr>
<td></td>
<td>PSU → Lack of Values → Anxiety</td>
<td>-.01</td>
<td>.02</td>
<td>[-.06, .04]</td>
</tr>
<tr>
<td></td>
<td>PSU → Inaction → Anxiety</td>
<td>.18*</td>
<td>.03</td>
<td>[.12, .25]</td>
</tr>
<tr>
<td>8</td>
<td>PSU → Experiential Avoidance → Depression</td>
<td>-.004</td>
<td>.01</td>
<td>[-.02, .01]</td>
</tr>
<tr>
<td></td>
<td>PSU → Lack of Present → Depression</td>
<td>.04*</td>
<td>.01</td>
<td>[.02, .07]</td>
</tr>
<tr>
<td></td>
<td>PSU → Self as Content → Depression</td>
<td>-.01</td>
<td>.02</td>
<td>[-.05, .01]</td>
</tr>
<tr>
<td></td>
<td>PSU → Fusion → Depression</td>
<td>.10*</td>
<td>.03</td>
<td>[.05, .16]</td>
</tr>
<tr>
<td></td>
<td>PSU → Lack of Values → Depression</td>
<td>.01</td>
<td>.02</td>
<td>[-.04, .05]</td>
</tr>
<tr>
<td></td>
<td>PSU → Inaction → Depression</td>
<td>.17*</td>
<td>.03</td>
<td>[.12, .23]</td>
</tr>
</tbody>
</table>

Notes: Models 5 and 6 = Reversed simple mediations; Models 7 and 8 = Reversed parallel multiple mediations. * indicates a significant indirect effect.

### 4. Discussion

The present study aimed to extend and refine understanding of the relations between anxiety and depression and problematic smartphone use (PSU). Following Elhai et al.’s (2019b) urging to test transdiagnostic process mediators of anxiety and depression’s relations with PSU, we tested psychological inflexibility (PI) and its associated component processes. Though PI/EA has been shown to covary with PSU in previous research (i.e., García-Oliva & Piqueras, 2016; Ruiz-Ruano et al., 2018), and even to mediate anxiety and depression’s relations with PSU (Kuru & Çelenk, 2021), this prior work was limited by the use of a singular measure of PI/EA (i.e.,
AAQ-II; Bond et al., 2011). That limitation is problematic given growing uncertainty about what the AAQ-II measures (e.g., experiential avoidance, psychological flexibility, or both; Rochefort et al., 2018; Tyndall et al., 2019; Wolgast, 2014). Testing PI and its composite processes with a psychometrically sound instrument with improved construct validity (i.e., MPFI; Rolffs et al., 2018), therefore, was an important step toward clarifying the processes that contribute to PSU and identifying possible intervention targets for those who wish to reduce their PSU. Most of our hypotheses were supported, but some unexpected findings emerged.

Substantial prior research has found associations between anxiety, depression, and PSU (reviewed in Elhai et al., 2017a), and these associations were demonstrated in the present study (supporting hypothesis 1). In addition, PI positively covaried with PSU (supporting hypothesis 2), and with anxiety and depression (supporting hypothesis 3), and cross-sectionally mediated relations between both types of symptomatic distress and PSU (supporting hypothesis 4). These simple mediations replicated prior research (i.e., Kuru & Çelenk, 2021) and strengthen the empirical case for symptomatic distress imparting effects on PSU, fully accounted for by psychological inflexibility. As such, PSU seems to represent yet another topographically distinct manifestation of problematic behavior emerging out of an underlying rigid and inflexible relationship with one’s unwanted internal experiences (Kingston et al., 2010).

Because PI represents an overarching construct comprised of six transdiagnostic processes (Hayes et al., 2006), we extended beyond simple mediation to test whether any of the processes within the PI construct uniquely contributed to the relations between negative affective states and PSU. Multiple mediation analyses showed that the role of PI as a mediator is much more nuanced than unidimensional measures can deduce. Indeed, inaction and lack of contact with values emerged as significant mediators of both anxiety and depression’s relations with
PSU. The role of these two processes in the distress-to-PSU pathway will be discussed below. First, the unexpected finding (i.e., contrary to hypothesis 5) that experiential avoidance did not emerge as a significant mediator in either model warrants discussion.

Previous theory (e.g., CIUT; Kardefelt-Winther, 2014) and research (e.g., García-Oliva & Piqueras, 2016; Ruiz-Ruano et al., 2018) led us to hypothesize that experiential avoidance would be a core process underlying relations between symptomatic distress and PSU. As noted earlier, though, such studies were limited to a single unifactorial measure of experiential avoidance which has been criticized for its construct validity (e.g., Rochefort et al., 2018; Tyndall et al., 2019; Wolgast, 2014). Admittedly, we were surprised that experiential avoidance failed to mediate relations between anxiety and PSU and depression and PSU because of the wealth of conceptual and theoretical rationale to support EA’s mediating role. However, EA’s lack of importance in the distress-to-PSU pathway further highlights the potential for theoretical confusion when drawing process-level inferences from studies that relied on the AAQ-II (see Wolgast, 2014). Our findings additionally run counter to the widely accepted Compensatory Internet Use Theory model of PSU, which states that emotional escapism is one of the primary drivers of problematic technology usage (Kardefelt-Winther, 2014), as well as to arguments that “[…] smartphone use could function as an experiential avoidance strategy to deflect aversive emotion content […]” (Elhai et al., 2017a, p. 257). Rather, the present findings suggest that PI and a subset of its component processes other than EA, function uniquely in accounting for PSU.

As stated above, our findings are at odds with extant theory and evidence suggesting that unpleasant emotion and its dysregulation contribute largely to PSU (e.g., Elhai et al., 2019a; Extremera et al., 2019; Feldman et al., 2011; Squires et al., 2020; Yildiz, 2017). Rather, the present work aligns more closely with an alternative stream of work on behavioral processes
such as behavioral activation (e.g., Elhai et al., 2016), and to a lesser extent boredom proneness (Elhai et al., 2017c), as undergirding PSU. Being ‘directionless’ as is the case of being out of touch with values, could manifest as low behavioral activation (i.e., not engaging in desired behaviors due to not knowing which behaviors are desired) and boredom (i.e., being disconnected from meaning and purposeful behavior in daily life resulting in attention being diffused equally across one’s environment). Thus, in the face of negatively valanced internal experiences (i.e., anxiety and depression), not knowing what you really care about (lack of contact with values) and thus not being positioned to act on what matters (inaction) may, in turn, contribute to greater use and misuse of technology, including smartphones. Put another way, someone might be out of touch with what they could be doing to move their life forward, and because smartphones are omnipresent (Sohn et al., 2019), their excessive use is a behavior which fills the void left by a lack of clear direction.

Because lack of values clarity and inaction emerged as the sole significant mediators of both anxiety and depression’s relations with PSU, this suggests the possibility that the type of distress (e.g., anxious or depressive) is less important than the common processes through which their influence is exerted on PSU. This perspective is consistent with findings that anxiety and depressive disorders regularly co-occur and measures evaluating both syndromes are often highly correlated (Brady & Kendall, 1992; Cummings, Caporino, & Kendall, 2014). Our finding of a common process pathway also emphasizes the importance of identifying and intervening at the level of transdiagnostic processes rather than designing idiosyncratic interventions aimed at various types of distress (Hofmann & Hayes, 2019). After testing our hypothesized models and elucidating processes through which distress imparts effects on PSU, we also explored our
models in reverse to test the plausible conceptualization that distress and PSU operate in bidirectional, or recursive systems.

Psychological inflexibility mediated both the distress-to-PSU, and PSU-to-distress pathways, with both anxiety and depression. Though preliminary, these findings suggest that PI may account for the relation in both directions in a recursive process. Importantly, we are not asserting this recursive process as the way in which these variables operate, largely because our cross-sectional study design precludes such inferences. A recursive model of distress-to-PSU-to-distress, mediated by inflexibility, may, however, help to explain inconsistent longitudinal and structural equation modeling findings of the direction in which distress and PSU interact. For example, Elhai et al. (2017a) review longitudinal studies in which both anxiety and depression temporally preceded and significantly predicted PSU (e.g., Kim et al., 2015). Coyne et al. (2019), on the other hand, showed that depression, but not anxiety, was temporally preceded and predicted by PSU. These conflicting longitudinal findings suggest a recursive, reciprocal process between distress and PSU could be at play. In line with recursive thinking, Kim (2017) reported that loneliness preceded and predicted PSU, which in turn preceded and predicted reduction in face-to-face interaction, resulting in more loneliness. Indeed, the present study and potential recursive model raise numerous exciting avenues for future research. Before a discussion of these future directions, we must recontextualize our conclusions within the study’s limitations.

The present study must be considered in light of its limitations, beginning with the cross-sectional design. Though the primary mediation analyses have strong theoretical (see Kardefelt-Winther, 2014) and empirical precedent for the hypothesized variable ordering (see Elhai et al., 2018a; Elhai et al., 2019a; Elhai et al., 2017b; Kim, Seo, & David, 2015; Squires et al., 2020; Wolniewicz et al., 2018), we cannot infer causation or directionality without temporal precedent.
Nonetheless, cross-sectional mediation models can be useful theory-testing tools (Preacher & Hayes, 2004), and this was the purpose with which we employed such analytic processes.

Another limitation and common criticism in PSU literature is that, like in our study, PSU is often measured with self-report as opposed to objective measures of screen time or pickups (Andrews et al., 2015; Ellis, 2019). However, we believe that self-report is a much more functionally adept manner of assessing problematic usage than objective use data (e.g., screen time and pickups). Our reasoning centers around contextual factors. Someone, for example, may use their phone for 8 hours in a day yet do so in ways that are values-consistent (e.g., using a GPS application to navigate through a hike with friends). On the other hand, someone may use their phone for one hour or less in each day but do so in ways which are problematic and/or dangerous (e.g., scrolling through Instagram while attending a course or texting while driving). When considering context, objective use data becomes arguably less relevant than self-report impressions for determining the extent to which phone use is problematic in someone’s life. To tease apart the role of context from objective use data in future studies, experience sampling methods may be useful to get at the purpose driving smartphone use in context and in real time.

Lastly, our study sample of undergraduates is a limitation in the sense that our findings are not generalizable beyond an undergraduate population. That said, undergraduates represent an important population in which to study PSU due to the high prevalence rates of PSU among undergraduates (Emanuel et al., 2015; Lepp et al., 2013; Long et al., 2016; Wang et al., 2015), who also report high levels of anxiety and depression (e.g., Blanco et al., 2008), suggesting our sample may in fact be a strength of the study considering the findings are generalizable to a heavily affected population.
More broadly, the present findings may have implications for both research and intervention. First, our findings suggest that increased attention ought to be directed toward transdiagnostic processes related to values and committed action as they relate to PSU, as opposed to studying emotion regulation functions of PSU such as avoidance or escape behavior. Moreover, testing multiple mediation models rather than simple mediations, can help elucidate contributions of plausible transdiagnostic processes in relation to, and controlling for, others. To date, a multitude of transdiagnostic process variables have been tested as mediators of relations between anxiety and depression and PSU. We identified that PI, and underlying lack of values and inaction, are additional processes that mediate such relations. Beyond PI, Elhai et al. (2019b) reported from numerous studies that behavioral activation, worry, rumination, problems with emotion regulation, distress intolerance, fear of missing out, mindfulness, and boredom proneness, are other transdiagnostic processes that have been empirically associated with PSU, and often found to mediate anxiety and depressions relations with PSU. Testing all these process variables, including PI, in a single model to assess relative importance in accounting for variance in PSU, is an important next step to narrow the focus on an empirically supported subset of core processes for intervention development.

Future research should also replicate the present findings with data collected at multiple time points. Specifically, measures of anxiety, depression, and PSU ought to be administered at three time points, so directionality can be assessed in each possible variable ordering. Moreover, because our models held in both the hypothesized and alternative variable ordering, temporal precedent is more crucial but should permit testing a recursive model, such as using autoregressive or cross-lagged panel modeling (Cain et al., 2017). As noted above, experience
sampling methods may be particularly well-suited to problematic smartphone use research and ought to be considered for future studies.

The present study also adds to a broader discussion of the challenges of psychometrics and construct validity of self-report measures commonly used in psychological research. Because prior studies that tested EA’s role in contributing to PSU relied on unidimensional measures, there were conceptual leaps taken from those studies that may have extended beyond inferences permitted by the measures used. In the present study, our use of a multidimensional measure highlighted that such leaps may, in fact, require more caution. Therefore, future research in general ought to use multidimensional measures to replicate prior research that relied on unidimensional measures of theoretically multidimensional constructs, to ascertain a more precise understanding of the processes involved and to avoid spurious conclusions (Strauss & Smith, 2008).

While preliminary, the present study also points to applied implications that could be tested in intervention studies. Namely, psychological flexibility processes evaluated in the present study are directly associated with Acceptance and Commitment Therapy (ACT; Hayes et al., 2012), a transdiagnostic, evidence-based intervention approach to promote psychological health, ameliorate human suffering, and foster value-guided behavior change. As such, the present findings implicate Acceptance and Commitment Therapy as a potentially useful intervention approach to mitigate PSU. Motivational Interviewing (MI; Miller & Rollnick, 2002) could be another useful intervention system to ameliorate PSU. Like ACT, motivational interviewing highlights discrepancies between one’s values and the unwanted behaviors in which individuals engage, in order to motivate engagement in more values-consistent actions. Motivational Interviewing plus Acceptance and Commitment Therapy (Bricker & Tollison,
2011) could also be a unique integrated approach that seems well suited to address problematic smartphone use and its specific underlying processes highlighted in the present study. However, these suggestions are speculative and their usefulness in addressing PSU remains to be seen.

5. Conclusion

To elucidate viable intervention targets for problematic smartphone use and to advance conceptual understanding of the distress-to-PSU pathway, we tested psychological inflexibility and its component processes as mediators of anxiety and depression’s relations with PSU. Psychological inflexibility as a whole, and two of its component subprocesses (i.e., lack of values clarity and inaction) significantly accounted for anxiety and depression’s influence on PSU. The present study adds to a growing list of transdiagnostic processes tested in such mediational models and extends prior work beyond simple mediation to evaluate several transdiagnostic processes linked with PI. This study is unique in its incorporation of a multiple mediation model of a number of conceptually relevant processes that may serve as useful targets for future intervention studies, and also help advance efforts to develop workable technologies to address PSU. In a society where smartphones are ubiquitous and their problematic usage is growing, this identification of viable treatment targets, and gaining a clear understanding of the nature of what makes smart phone use a problem, are much needed additions to the knowledge base.
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Appendix A.

ANXIETY MODELS
Appendix B.

DEPRESSION MODELS