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The association between depression and problematic smartphone behaviors through smartphone use in a clinical sample

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Abstract

The increasing adoption rate of smartphones has raised scholars' attentions to the associations between smartphone use, especially problematic smartphone use (PSU), and psychological well-being. Guided by the compensatory internet use theory, this study investigates how the relationship between depression and PSU is mediated through two distinct smartphone use motivations (i.e., process vs. social) and the actual smartphone use. An online survey completed by 317 participants who have been diagnosed with depression revealed that depression was positively associated with PSU. Moreover, depression was positively associated with process motive, which exerted not only a direct, but also an indirect effect on PSU through the actual smartphone use. These results suggest that process motive using smartphone for escapism is detrimental among people with depression for developing PSU. The results also support the necessity of distinguishing motivations from the actual smartphone usage.

KEYWORDS
actual smartphone usage, compensatory internet use theory, depression, motivations, problematic smartphone use

1 | INTRODUCTION

Smartphones have become pervasively used in the United States, with about 77% of adults reporting ownership of a smartphone (Smith, 2017). Problematic smartphone use (PSU) refers to excessive use of smartphones that interferes with daily lives and is characterized by compulsive participation and craving urges preceding smartphone use (Mok et al., 2014). A recent systematic review analyzing 23 studies has shown that PSU is consistently correlated with mental health issues including depression, anxiety, and chronic stress (Elhai, Dvorak, et al., 2017). These existing studies have primarily relied on college and high school students (Smetaniuk, 2014) and Amazon Mechanical Turk subjects (Elhai, Levine, et al., 2017) who did not necessarily have mental illness. In this article, we argue that it is indispensable to examine the relationship between mental health and PSU among people who have been diagnosed with depression.

Compensatory internet use theory (CIUT) suggests that people encountering negative life situations may be motivated to relieve their adverse feelings by engaging in excessive smartphone use. People living with depression could be more subject to PSU than people with a healthy psychological makeup (Kardefelt-Winther, 2014; Kim et al., 2015). People with depression tend to withdraw from social interactions because of nonrewarding experience in social relationships (Allen et al., 2006). This tendency of social withdrawal could extend to smartphone use such that people with depression are less motivated to interact with their social contacts via smartphones. Moreover, people with depression typically experience negative emotions such as sadness and hopelessness (Rottenberg, 2005). Therefore, they are motivated to consume entertainment media content for alleviating negative feelings (Kim et al., 2015). However, due to the lack of self-regulation ability among people with depression (Strauman, 2002), they might be

more vulnerable to uncontrollable use of smartphones when seeking hedonic experience.

Although CIUT has been widely applied to understand how various psychosocial problems progress to PSU, many studies treated smartphone use motivations and smartphone use as interchangeable variables when testing them as mediators (Elhai, Hall, et al., 2017; Elhai et al., 2018, 2020; Rozgonjuk et al., 2019; van Deursen et al., 2015). This practice, however, may obscure the precise mechanism underlying the link between psychological well-being and PSU. To distinguish the role of these two variables, this study considers motivations and smartphone use as serial mediators linking depression and PSU given that people's media use is driven by their motivations or needs (Katz et al., 1974; Rubin, 2009) and that smartphone use may be a more proximal antecedent to the outcome considering excessive smartphone use is a critical component of PSU (Billieux et al., 2015).

Therefore, the present article aims to (1) investigate the relationship between depression severity and PSU among people who have been diagnosed with depression and (2) test smartphone use motivations and the actual smartphone use as serial mediators in the relationship between depression severity and PSU. The findings of this study can shed light on how at-risk populations develop problematic media technology use.

2 | LITERATURE REVIEW

2.1 | Depression and PSU

Although there is no concensus on whether PSU is an addictive behavior (Panova & Carbonell, 2018; Pivetta et al., 2019), scholars have agreed on that PSU is characterized by an impaired control of use that interferes with daily activities and causes functional impairment (Demirci et al., 2015; Lin et al., 2017; van Deursen et al., 2015). The impaired control of use may not only refer to excessive use of smartphones than intended, but also involves the usage pattern driven by a compulsive and unconscious urge (Lin et al., 2017). Additionally, even though people may attempt to restrain from using smartphones, those who engage in PSU typically experience discomfort following cessation of use, which leads them to relapse into the problematic behavior to remove the negative feeling. As such, recurrent failures to regulate smartphone use have also been conceptualized as a defining characteristic of PSU.

PSU has been found to be associated with various mental health issues, such as depression (Elhai, Dvorak, et al., 2017; Demirci et al., 2015). In a recent systematic review, PSU has been reported having a positive association with depression, with a medium effect size ranging from .30 to .50 (Elhai, Dvorak, et al., 2017). When explaining the relationship between depression and PSU, many studies consider smartphone use motives as a major mechanism explaining why psychological problems are linked to PSU (Wang et al., 2015). One representative theoretical framework is CIUT (Kardefelt-Winther, 2014). Although this theory was originally developed to explain problematic internet use, it has also been widely applied to understand why people engage in PSU given many smartphone functions and activities are internet-based (Kim et al., 2015).

CIUT argues that lower psychological well-being, which is typically originated from negative life situations, can motivate people to use the internet for alleviating negative feelings or compensating for what they lack in real life (e.g., social stimulation; Kardefelt-Winther, 2014). However, the compensatory use of the internet may become excessive because of the constant need to alleviate their negative feelings due to their adverse life situations. Guided by this theory, research on PSU considers smartphone use as a coping mechanism for people with psychological issues to either remove negative feelings, elicit positive affect, or compensate for lack of offline socialization (Contractor et al., 2019). For example, people with higher levels of stress used smartphones primarily for escaping aversive emotions, which in turn, was associated with higher levels of PSU (Wang et al., 2015).

Although there is an abundance of research on PSU supporting CIUT, existing literature in this area is limited in two aspects. First, smartphone use motivations are often mixed with smartphone use when testing the mechanism underlying the relationship between mental health problems and PSU. For some studies, while the theoretical interest focused on the actual smartphone use, smartphone use motivations were measured (Elhai, Hall, et al., 2017; Elhai et al., 2018; Elhai et al., 2020; Rozgonjuk et al., 2019; van Deursen et al., 2015). To be clear, although smartphone use motivations and smartphone use are associated, they are separate constructs (Meng et al., 2020). That is, whereas motivations concern with the expected gratification that drives individuals to use smartphones, smartphone use focuses on the time engagement with this device. Mixing smartphone use motivations and smartphone use can be problematic for the following reasons. It is theoretically invalid to conclude that *smartphone use motivations* mediate the relationship between psychological states and PSU based on empirical findings measuring the *actual smartphone use* as a mediator. Moreover, it raises a question about the role of smartphone use in the pathway from mental health through smartphone use motivations to PSU.

Instead of considering motivations and the actual usage of smartphone as competing mechanisms underlying the relationship between psychological problems and PSU, this study argues that they work as mediators in sequence. The Uses and Gratification Theory (UGT) claims that people actively use media to satisfy their needs (Katz et al., 1974; Rubin, 2009), suggesting motivations as antecedents to smartphone use. Extending this logic, the CIUT indicates excessive smartphone use can serve as a linking mechanism between motivations and problematic media use. Specifically, this theory proposes "…where the motivations to go online is grounded in an un-met real life need…, an individual may feel a strong desire to spend more time online which could lead to problematic outcomes" (Kardefelt-Winther, 2014, p. 353). To date, however, whether smartphone use motivations and the actual smartphone use can serve as serial mediators linking psychological states and PSU has not yet been tested. Therefore, this study tests the idea that motivations and smartphone

use as serial mediators to distinguish the role of the two variables in the process through which depression progresses to PSU.

Second, many of these studies that applied CIUT focused on general populations or college students (Elhai, Levine, et al., 2017; Smetaniuk, 2014). Although these populations may experience emotional ups and downs, it is unclear to what extent that these populations have a constant need for compensation that drives their smartphone use to become excessive or even compulsive. Moreover, although it is common for people to use smartphones to cope with their temporary emotional disturbance or lack of social stimulation, it is unclear how and why these populations elapse to PSU when their needs have been met through compensatory smartphone use. To get over these challenges and test CIUT, extending this line of research on PSU to people with depression is important. For this population, they suffer from persistent distress and loss of interest in life (Watson et al., 1995), creating a constant need to cope with these negative feelings by engaging in excessive smartphone use. Moreover, their excessive smartphone use may be exacerbated to compulsive smartphone use because of the lack of self-regulation in assessing and controlling their smartphone use when the needs are satisfied. The following section will turn to explicate how depression could foster different smartphone use motivations that ultimately lead to PSU among people with depression under the guidance of CIUT.

2.2 | Smartphone use motives and depression

This study focuses on social and process motives of using smartphones to understand the association between depression and PSU. The two motives have been found to be associated with use/problematic use of smartphones (Stafford & Gillenson, 2004; van Deursen et al., 2015). Process and social moves of using smartphones are originated and have been extensively studied in the literature on UGT. Process motive involves consuming media for the purposes of seeking entertainment and escapism (Song et al., 2004; Stafford et al., 2004), whereas social motive involves using media for communicating and building relationship with others (Stafford et al., 2004; van Deursen et al., 2015).

For people with depression, they are likely to use smartphones for process motives to compensate for their negative emotions such as sadness and hopelessness (Rottenberg, 2005; Watson et al., 1995). This is because playing with smartphones for entertainment or escapism could bring pleasant experience or distract them from the reality for the moment (Wang et al., 2015). The compensatory potential of smartphones may be due to technology affordances such as navigability and interactivity (Sundar & Limperos, 2013). By enabling users to navigate through different interfaces or sites seamlessly via various hyperlinks, smartphones provide an opportunity for people to explore the cyberspace for diversion that requires little mental effort. Specific apps such as smartphone games that allow users to advance through levels, they can generate a sense of playfulness and engage people in pursuing the next level of challenge, which distract people from focusing on negative feelings (Sundar & Limperos, 2013). Additionally, the interactive feature of smartphones makes it possible for users to actively participate in narratives (e.g., video games and interactive movies) that create enjoyment and immersion (Green et al., 2004). These affective and cognitive states associated with process use of smartphones may temporarily alleviate depressed people's negative mood and recover them from adverse situations (Reinecke et al., 2011).

However, people with depression may be less likely to use smartphones for social purposes. This population is characterized by social withdrawal and isolation (Allen et al., 2006). They typically experience impaired interpersonal relationships (e.g., marital distress, peer victimization, Katz et al., 2011) and tend to interact with others in a way that induces rejections (Hames et al., 2013), which makes them consider social relationships to be nonrewarding. Additionally, depressed people tend to believe they are socially incompetent, which further inhibits them from engaging in interpersonal relationships (Hames et al., 2013). Because of the social withdrawal tendency, depressed people are less motivated to affiliate with or even avoid interacting with others (Girard et al., 2014). For example, Elhai and his colleagues (2017) found that college students who reported more severe depression symptoms were less likely to use smartphones for social purposes.

2.3 | Motives, smartphone use, and PSU

Thus far, the article has discussed how depression may promote process motives but reduce social motives among people with depression. Both process and social motives of using smartphones may lead to PSU by increasing the actual smartphone use. As the UGT suggests (Rubin, 2009), motivations drive and maintain people's engagement in smartphone use indicated by frequency of use and time spent on using smartphones. For process motive, to satisfy a constant need for escaping from their negative feelings, people with depression may engage in frequent smartphone activities (Shen et al., 2019). For social motive, the need for a sense of belonging may create a fear of missing out communication with others. To satisfy the need, people may become obsessed with smartphone check (Elhai et al., 2020). Smartphones possess a wide range of affordances (e.g., interactivity, modality) and apps that allow people to gratify their multiple needs and motives on a single device (Sundar & Limperos, 2013). For example, social networking apps could satisfy people's needs for not only social interactions (e.g., through posting and responding to comments), but also diversions (e.g., through browsing others' updates). Therefore, we speculate that both process and social motives should positively predict people's actual smartphone use.

Furthermore, the increased smartphone use is positively associated with PSU. People with depression may initially use smartphones to satisfy their needs such as diversion and social stimulation (Katz et al., 1974) so that they can relieve their negative feelings. However, with frequent smartphone usage over time, people may develop dependency on smartphones because of craving for gratifications and engaging in habitual and excessive use of smartphones that characterizes PSU (Billieux et al., 2015). With deficit self-regulation (Strauman, 2002), people with depression may have difficulties in monitoring their actual amount of smartphone use and assessing

when their needs are met (Deng et al., 2018). Therefore, we speculate that people with depression are more susceptible to the progression into PSU. In other words, we should observe a positive linkage between the actual smartphone usage and PSU.

2.4 | Hypotheses and competing models

In summary, this study examines the process through depression severity develops into PSU among people clinically diagnosed with depression. Specifically, given the robust positive association between PSU and depression, this study expects such an association can be extended to people with depression. Therefore, we propose the following hypothesis.

H1. PSU will be positively associated with depression among people with depression.

In addition to the direct association between depression and PSU, this study also examines the mechanism that links the two variables. Following CIUT and UGT, this study proposes smartphone use motivations (including social and process motives) and the smartphone usage as two serial mediators underlying the association between depression and PSU. Specifically, this study operationalizes smartphone usage as the frequency of smartphone use because this variable can reflect the repetitive usage pattern, a key step that transitions from regular smartphone use to PSU (Tokunaga, 2015). It is expected that:

H2. Depression will be (a) positively associated with process motive but (b) negatively associated with social motive.

H3. Both (a) process and (b) social motives will be positively associated with the frequency of smartphone use.

H4. The frequency of smartphone use will be positively associated with PSU.

Figure 1 presents the hypothesized paths and model.

To provide further evidence that the hypothesized model offers a greater explanatory power for the relationship between mental health problems and PSU, it will be tested against three competing models that consider the roles of smartphone motivations and the actual usage in alternative ways (Figure 2).

Alternative Model 1 proposes that social and process motives mediate the depression-PSU link, but smartphone usage is not considered as a mediator. Following the prediction of CIUT, many studies on psychological issues and problematic media use have highlighted the mediating role of different motives without considering the actual smartphone usage (Shen et al., 2019; Wang et al., 2015). Following this practice, Alternative Model 1 will be tested. Alternative Model 2 proposes that smartphone usage mediates the depression-PSU link, but social and process motives are not considered as mediators. Grounded in UGT and the theory of classical conditioning, some research has argued that frequent uses of smartphone is a key that transforms poor mental health to PSU (Contractor et al., 2019; Elhai, Levine, et al., 2017; Elhai et al., 2019). Smartphones may be initially used to relieve symptoms (e.g., negative feelings) of mental health problems. However, overtime people may develop excessive use of smartphones that characterizes PSU. Finally, Alternative Model 3 proposes that smartphone usage, social and process motives serve as parallel mediators in the depression-PSU link. Previous research has not considered the actual usage of smartphones and motives in the same model in explaining the relationship between depression and PSU (e.g., Elhai, Hall, et al., 2017; Rozgonjuk et al., 2019). When including them in the same model, Alternative Model 3 serves as a reasonable reference to compare with our hypothesized model conceptualizing smartphone motives and usage as sequential mediators.

3 | METHOD

3.1 | Participants and procedures

Three hundred and fifty-three participants in United States recruited through the Qualtrics panel service participated in the online survey questionnaire. The participants were screened based on the following

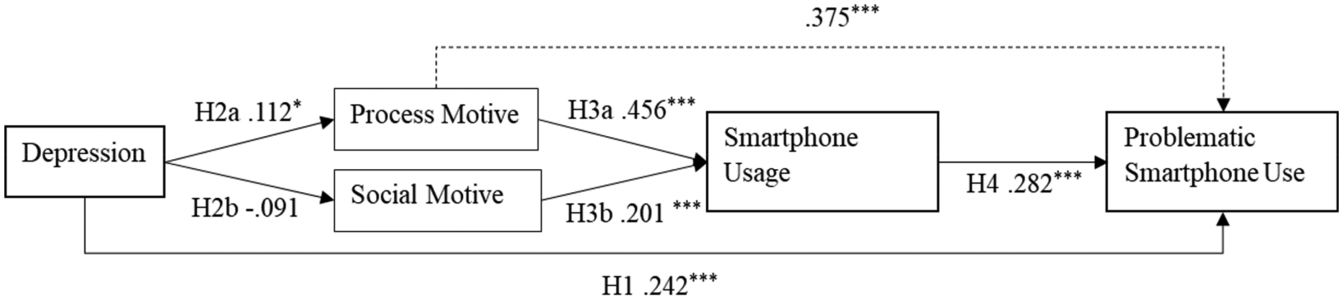

FIGURE 1 Diagrammatic representation of the hypothesized mediation model with path coefficients. N = 317. Only solid lines represent hypothesized paths. The dashed path is added following the modification indices suggestion. The line and the coefficient for the correlation between smartphone use motives are omitted because the two motives may be caused by a common, distal variable that is not of the theoretical interest in this study. *p <.05; ***p <.001

Diagrammatic Representation of the Alternative Models with Path Coefficients

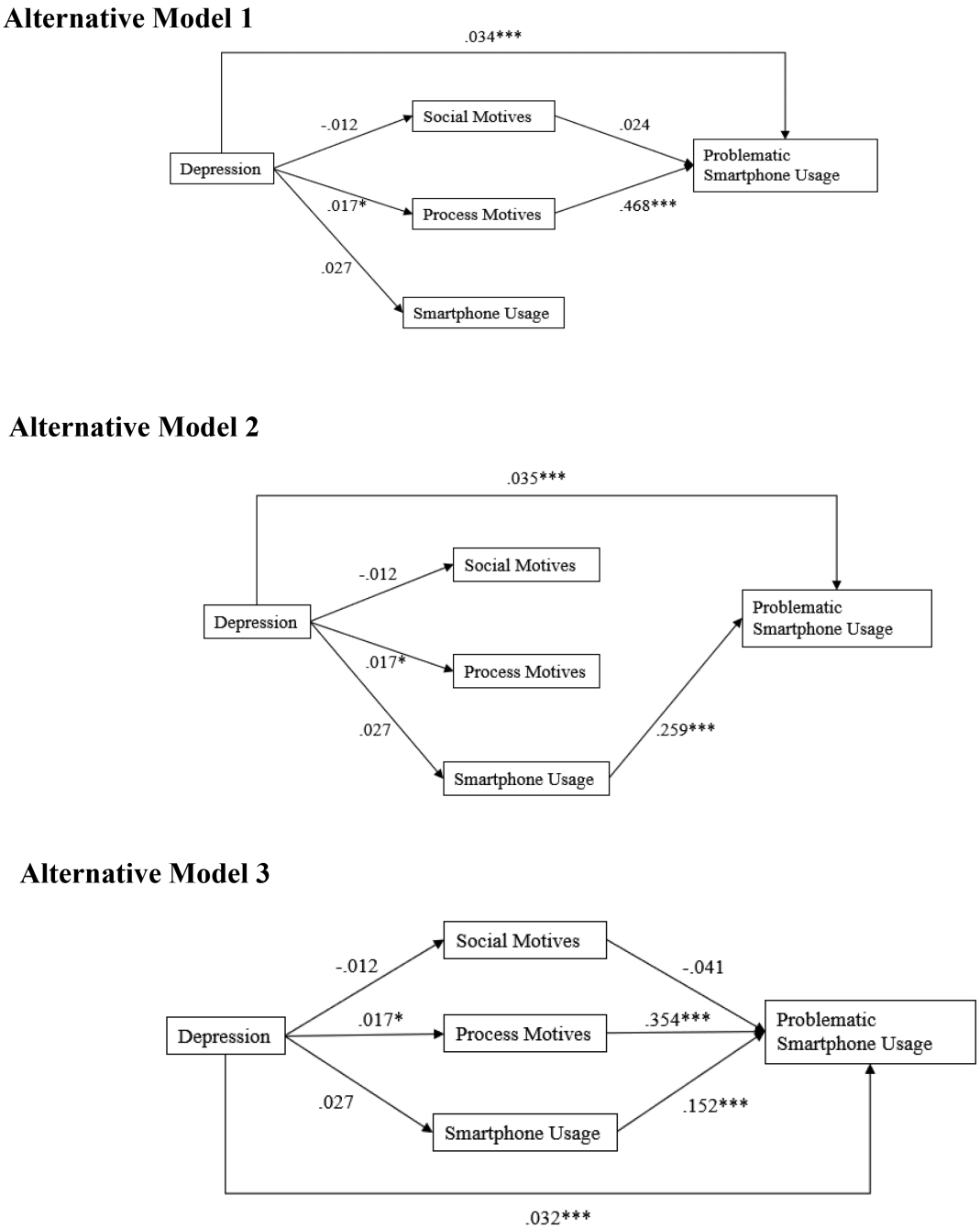

FIGURE 2 Diagrammatic representation of the alternative models with path coefficients. *N* = 317. The line and the coefficient for the correlation between smartphone use motives are omitted because the two motives may be caused by a common, distal variable that is not of the theoretical interest in this study. **p* <.05; ****p* <.001

criteria: (1) have been diagnosed with clinical depression, (2) age between 18 and 35 years old, (3) living in the U.S., and (4) owning a smartphone. Specifically, participants were asked to identify the major diseases (e.g., diabetes, heart disease, and depression) that they have been clinically diagnosed by a doctor. Participants who have selected depression continued to the answer questions about their motivations of using smartphones, smartphone use frequency, PSU, severity of depression, and demographic information.

Among those who met our selection criteria, 317 respondents reporting more than minimally depressive (PHQ-9 score >4) were included in the analysis. The average age of the eligible sample was 30.25 years (*SD* = 6.04). The majority of the participants were females (*n* = 272, 85.80%) and Caucasians (*n* = 258, 81.38%). More than half of the participants reported having a partner (101 married and 79 in a committed relationship). The median annual income of the sample fell in the range of $25,000–$34,999. Most participants reported

attaining some college education or an associate degree (n = 133, 41.96%), followed by completing high school (n = 86, 27.13%) and receiving 4-year university or college education (n = 67, 21.14%). Table 1 summarizes the descriptive information of participants' demographic characteristics.

3.2 | Measurement

3.2.1 | Smartphone use motives

Process and social motives were measured by two scales developed by van Deursen et al. (2015). The scale of process motive consists of four items (M = 4.003, SD = 0.924, Cronbach α = .816), and sample items of process motive included "I use my smartphone in order to escape from real-life" and "I use my smartphone in order to relax." The scale of social motive consists of four items (M = 4.330, SD = 0.815, Cronbach α = .806), and sample items evaluating social motive included "I use my smartphone to interact with people" and "I use my smartphone to maintain relationships." Responses were recorded on five-point scales (1 = definitely no, 5 = definitely yes).

3.2.2 | Actual smartphone usage

Smartphone use was assessed by the frequency of eight types of smartphone features, including: (1) taking photos, (2) playing games, (3) watching videos, (4) listening to music, (5) instant messaging, (6) social networking, (7) email, and (8) video chat. These items were adapted from Liu and Yu (2017), and responses were rated on 9-point scales (1 = never, 9 = 11 times or more each day). Given the use of these smartphone features may involve various activities such as social interaction, browsing, and entertainment, an exploratory confirmatory analysis (EFA) was used to test the dimensionality of the scale.

TABLE 1 Descriptive information on demographic characteristics (N = 317)

	n	%	*M* (*SD*)
Age			30.35 (6.04)
Sex			
Male	42	13.25	
Female	272	85.80	
Ethnicity			
African American	21	6.62	
Asian American	9	2.84	
Caucasian	258	81.39	
Hispanic	11	3.47	
Native American	8	2.52	
Other	10	3.15	
Annual household income			
Under $15,000	61	19.24	
$15,000–$24,999	48	15.14	
$25,000–$34,999	62	19.56	
$35,000–$49,999	35	11.04	
$50,000–$74,999	64	20.19	
$75,000–$99,999	25	7.89	
$100,000–$149,999	15	4.73	
$150,000 and above	7	2.21	
Education			
Elementary	3	0.95	
High school	86	27.13	
Some college or associate degree	133	41.96	
Four-year college/university degree	86	27.13	
Advanced degree	28	8.83	
Marital status			
Married or in a committed relationship	192	60.57	
Others	125	39.43	

Based on the principle component extraction and the promax rotation method, the EFA results showed these items were loaded on a single factor, which account for 46.11% of the overall variance in smartphone use. The factor loading of each item was above .576. Given the items formed a single dimension, a composite score of smartphone use was created (M = 5.068, SD = 1.585, Cronbach α = .823).

3.2.3 | Problematic smartphone use

PSU was adapted from a scale developed by Kwon et al. (2013). This instrument measures PSU as a secondary-order construct and consists of six subscales including daily life disturbance (three items), positive anticipation (four items), withdrawal (three items), tolerance (five items), overuse (two items), and cyberspace-oriented relationships (three items) (M = 2.864, SD = 0.833, Cronbach α = .920). On a five-point Likert scale (1 = strongly disagree, 5 = strongly agree), participants rated the extent to which they were addicted to using smartphones. Sample items included "Missing planned works due to smartphone usage" and "Feeling impatient and fretful when I am not holding my smartphone."

3.2.4 | Depression

Depression was measured by the Patient Health Questionnaire (PHQ-9) (Kroenke et al., 2001). Participants rated the extent to which they have experienced depression symptoms over the past 2 weeks on 4-point scales (0 = not at all, 3 = nearly every day), M = 14.224, SD = 6.180, Cronbach α = .820. Sample symptoms involved "Little interest or pleasure in doing things" and "Poor appetite or overeating."

3.2.5 | Demographic characteristics

The demographic characteristics measured included sex, age, ethnicity, annual household income, education, and marital status.

3.3 | Analysis

Following Anderson and Gerbing (1988), this study conducted a two-stage structured equation modeling (SEM) to examine the measurement model and the proposed structural models. In the first stage, all scales were submitted to a confirmatory factor analysis in AMOS to test the internal consistency and parallelism. Standards for a good measurement model fit involved Comparative Fit Index (*CFI*) $\geq$.95, Root Mean Square Error of Approximation (*RMSEA*) $\leq$ .06, and Standardized Root Mean Square Residual (*SRMR*) $\leq$.05. Standards for an acceptable model fit involved *CFI* $\geq$.90, *RMSEA* $\leq$ .08, and *SRMR* $\leq$.08 (Hu & Bentler, 1999).

In the second stage, this study performed a series of path analyses[1] for model comparison and hypothesis testing. Because the hypothesized and the alternative models contained both nested and non-nested models, different indices were used for model comparison. Specifically, a nested model contains the same variables as another model but has fewer structural paths to be assessed; put it differently, the model with more degrees of freedom is nested within another model with the same variables but fewer degrees of freedom. As such, alternative model 1 and 2 are nested in alternative model 3. To compare these models, significance tests of χ^2 differences were conducted. If the χ^2 test is significant, the model with fewer degrees of freedom will be favored. In contrast, if the χ^2 test is insignificant, the model with more degrees of freedom (i.e., the nested model) will be favored to due to its parsimoniousness and comparable fit to the model with fewer degrees of freedom (Schermelleh-Engel et al., 2003).

In comparison, models are non-nested if neither can be derived from the other by either imposing or removing paths. Although the hypothesized and the alternative models had the same variables, they are non-nested because obtaining the hypothesized model requires adding paths to the alternative models and removing other paths simultaneously. To assess whether the hypothesized model can better explain the relationship between depression and PSU, this model was tested against the alternative model achieving the best fit in the previous χ^2 significance test. To compare non-nested models, Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC) were employed. A model with lower AIC and BIC indices suggests a better fit to the data (Nylund et al., 2007).

Finally, a structural path analysis of the best model is examined in further details for hypothesis testing. Such a model was evaluated for its overall fit (i.e., CFI, SRMR, and RMSEA) and the significance of path coefficients. The same cut-off standards stated above were applied to assess the structural model fit. If the overall fit was insufficient, the model would be revised accordingly based on the modification indices to include additional paths before assessing the coefficients of hypothesized paths. Any revised model would be re-submitted to a path analysis to test the fit indices.

4 | RESULTS

4.1 | Confirmatory factor analysis

The fit of the measurement model was acceptable, χ^2 (582) = 1136.063, p <.001, *CFI* = .902, *RMSEA* = .055, *SRMR* = .074. Figure 3 presents the diagram representation of the measurement model. Table 2 reports the means, standard deviations, reliabilities, and correlations of the major variables.

4.2 | Model comparison

The study first compared Alternative Models 1–3 as the first two alternative models were nested within Alternative Model 3. The results of model comparison were summarized in Table 3. When

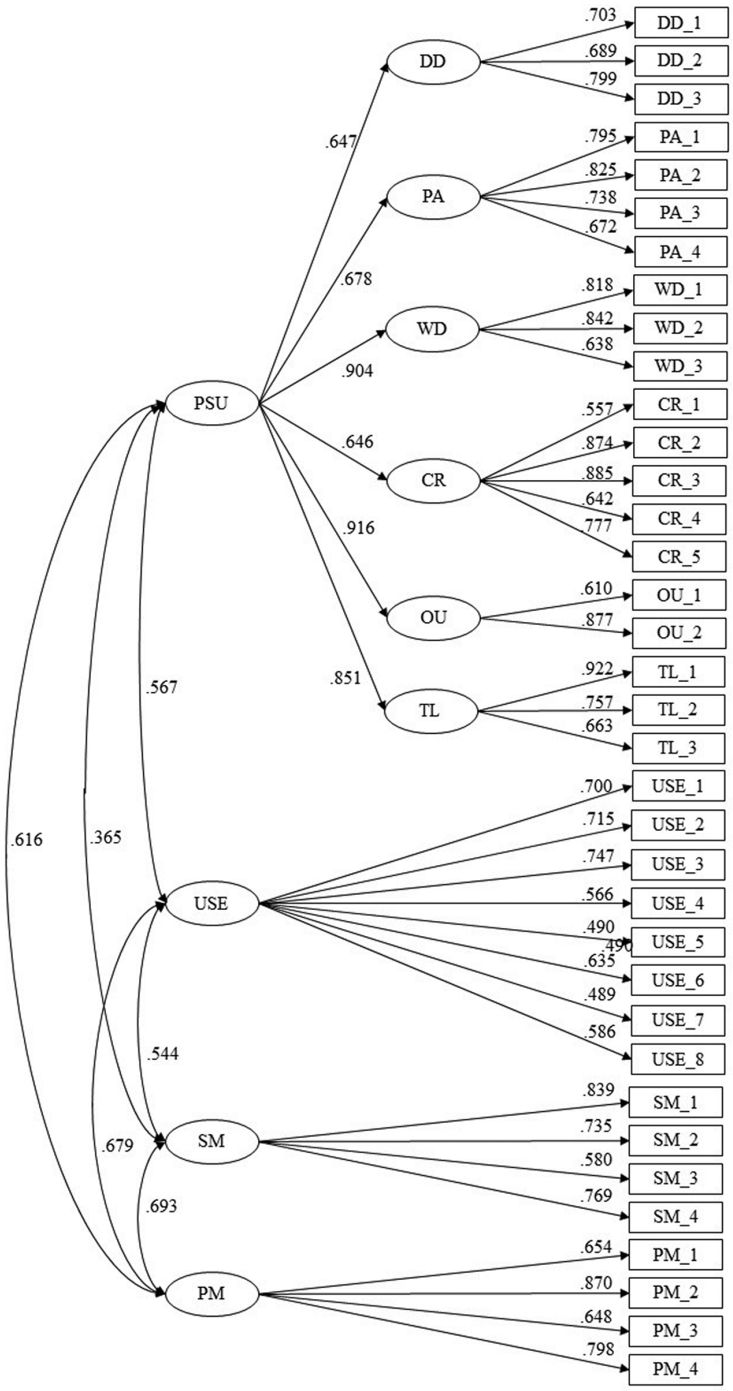

FIGURE 3 Diagram representation of the measurement model. χ^2 (582) = 1136.063, p <.001, *CFI* = .902, *RMSEA* = .055, *SRMR* = .074. The residuals are omitted for the simplicity purpose. CR = cyber-oriented relationship. DD, daily-life disturbance. OU, overuse. PA, positive anticipation. PSU, problematic smartphone usage. PM, process motives. SM, social motives. TL, tolerance. USE, smartphone usage. WD, withdrawal. The measurement of depression (PHQ-9) was not included in the model because it has been previously validated (Beard et al., 2016; González-Blanch et al., 2018)

TABLE 2 Descriptive statistics and correlations of primary variables (N = 317)

	M	*SD*	Reliability	1	2	3	4
1. PHQ-9	14.224	6.180	.820				
2. Process Motive	4.003	0.924	.816	.112*			
3. Social Motive	4.330	0.815	.806	–.091	.581***		
4. Smartphone Usage	5.068	1.585	.823	.104	.573***	.466***	
5. Problematic Smartphone Use	2.864	0.833	.920	.311***	.561***	.301***	.520***

* p <.05.
*** p <.001.

TABLE 3 Results of model comparison

	X^2	*df*	CFI	SRMR	RMSEA	AIC	BIC	Δ*df*	ΔX^2	X^2 test difference	Model favored
Alternative Model 1 (AMI)	166.306	3	.642	.228	.415	190.306	235.413	1	22.661 (vs. AM3)	<.001	AM3
Alternative Model 2 (AM2)	186.301	4	.600	.248	.380	208.301	249.649	2	36.897 (vs. AM3)	<.001	AM3
Alternative Model 3 (AM3)	137.887	2	.702	.202	.464	163.887	212.752				
Hypothesized Model (HM)	51.032	3	.895	.071	.225	75.032	120.139		Model 3		HM

comparing Alternative Model 1 to Alternative Model 3, the study showed that neither model achieved an acceptable level of fit, although Alternative Model 3 demonstrated slightly better fit indices (alternative model 1: χ^2 = 166.306, *df* = 3, *CFI* = .642, *RMSEA* = .415, *SRMR* = .228; alternative model 3: χ^2 = 137.887, *df* = 2, *CFI* = .702, *RMSEA* = .464, *SRMR* =. 202). Additionally, χ^2 difference test revealed a significant result, Δ χ^2 = 22.661, Δ *df* = 1, *p* <.001, suggesting Alternative Model 3 enhanced the overall model fit.

Similarly, the comparison between Alternative Model 2 (χ^2 = 186.301, *df* = 4, *CFI* = .600, *RMSEA* = .380, *SRMR* = .248) to Alternative Model 3 demonstrated neither model achieved a sufficient fit. Despite the insufficient fit of both models, χ^2 difference test showed Alternative Model 3 provided a better fit to the data compared to Alternative Model 2, Δ χ^2 = 36.987, Δ *df* = 2, *p* <.001.

As Alternative Model 3 achieved the best fit among the competing models, it was tested against the non-nested hypothesized model. The AIC (190.306) and BIC (235.413) of Alternative Model 3 were greater than the hypothesized model (AIC = 75.032, BIC = 120.139). Therefore, the hypothesized model provided a better fit to the data.

The results of model comparison were presented in Table 3.

4.3 | Hypotheses testing

Although the hypothesized model achieved a better fit compared to the alternative models, its model fit was still inadequate, χ^2 (3) = 51.032, *p* <.001, *CFI* = .895, *RMSEA* = .225, *SRMR* = .071. The modification indices suggested adding a path between process motive and PSU. With the addition of this path (β = .375, *p* <.001), the modified model achieved a satisfactory fit, χ^2 (2) = 3.166, *p* = .205, *CFI* = .997, *RMSEA* = .043, *SRMR* = .021. Hence, the study proceeded to test the coefficients of each direct path.

H1 predicted a positive association between depression and PSU. Consistent with the hypothesis, people with more severe depression symptoms were more likely to engage in PSU (β = .242, *p* <.001).

Moreover, the results also showed the role of process motive and the frequency of smartphone use as serial mediators linking depression and PSU. Specifically, depression was positively associated with process motive (β = .112, *p* = .046), which in turn predicted the frequency of smartphone use (β = .456, *p* <.001). Furthermore, as people with depression used smartphone more frequently, their likelihood of engaging in PSU increased (β = .282, *p* <.001). Therefore, the data were consistent with H2a, H3a, and H4.

However, no evidence indicated the role of social motive as a serial mediator in the relationship between depression and PSU. That is, the association between depression and social motive did not reach the significance level (β = −.091, *p* = .105), although a stronger social motive of smartphone use positively predicted more frequent smartphone use (β = .201, *p* <.001). Therefore, the data were inconsistent with H2b but consistent with H3b.

5 | DISCUSSION

Focusing on a clinical sample, this study sheds light on how depression is associated with PSU. By testing the hypothesized model against three alternative models, we distinguished motivations from smartphone use underlying this process by testing the potential for these two variables to serve as serial mediators of depression and PSU. Overall, the results showed the link between depression severity and PSU was partially mediated by process motive and the actual smartphone use, such that depression predicts greater process motive of using smartphones, which further lead to more frequent smartphone use and even PSU. However, no evidence suggested the role of social motive as a potential mediator in the relationship between depression and PSU.

In the current study, support for serial mediation was found for process motive and smartphone use in the relationship between depression and PSU. Notably, the results of model comparison further revealed that this serial mediation had a better model fit than alternative models considering that the link between depression and PSU was mediated by (1) motives, (2) actual usage, or (3) the parallel effects of motives and actual usage of smartphones. The findings are consistent with UGT and CIUT (Elhai, Hall, et al., 2017; Kim et al., 2015) because (1) psychosocial problems can give rise to motivations to compensate for the problem, (2) motivations drive media technology use, and (3) motivations and excessive media use predict problematic media use behaviors. This serial mediation also indicates that like the general population, depressed people are also motivated to use

smartphones for diversion to relieve their negative feelings. However, this coping strategy may not be constructive as increased process motives may lead people with depression to repetitive smartphone use, potentially because of the lack of self-regulation (Strauman, 2002) among depressed people. Notably, frequent smartphone use is a key process that contributes to problematic outcomes. This finding adds a new piece to the puzzle on whether excessive time on smartphones leads to PSU. Whereas previous research has argued that excessive time spent on smartphones to handle work-related tasks may not necessarily lead to negative outcomes (Panova & Carbonell, 2018), the current study suggests that frequent smartphone use driven by a need for escapism or entertainment can enhance the likelihood for depressed people to develop problematic smartphone behaviors.

Although not hypothesized, process motive also mediated the link between depression and PSU even when the frequency of smartphone use was controlled. It is possible that the direct link between process motive and PSU may be explained by other indicators of time investment on smartphone use that were not measured by the study, such as the duration of time spent on playing with smartphones. Specifically, because of the deficit in self-regulation and cognitive dysfunctions (Gonda et al., 2015; Strauman, 2002), depressed people may lose track of the goals they seek to satisfy during the process of smartphone use or need a longer period of time of smartphone use to reach the same level of gratifications as their peers with a healthy mental state. The longer screen time, in turn, exacerbates their dependence on smartphones.

In addition to the indirect effect of depression on PSU via process motive and smartphone use frequency, this study also observes its direct, positive association. That is, those with more severe depression symptoms were at a higher risk to engage in problematic smartphone behaviors. This finding is consistent with the literature on the relationship between mental health issues and unhealthy smartphone use (Elhai, Dvorak, et al., 2017). Moreover, the fact that there was a direct link between depression and PSU even when motivations were included as mediators also points to the possibility that at some point in time, the conscious, compensatory use of smartphone may transition to automatic, compulsory smartphone use for people with depression.

Inconsistent with the hypothesis, social motive of smartphone use did not emerge as a serial mediator in the association between depression and PSU. That is, the link between depression and social motives of smartphone use was insignificant. One explanation may be that the relationship between depression and social motives of smartphone use is moderated by factors (e.g., face-to-face communication) not assessed in this study (Kim et al., 2015). Despite the lack of evidence suggesting the association between depression and social motive, those who experience stronger needs for social interactions were found to engage in more frequent smartphone use. This finding is consistent with the literature showing that the need to constantly stay connected will lead people to frequent check for communications from others on smartphones Elhai, Levine, et al., 2017; Elhai et al., 2020).

5.1 | Implications

This study extends the research on mental health and smartphone use in many ways. First, this study delineates the process through which depression transitions to problematic smartphone behaviors. Although CIUT highlights motivation as a mechanism underlying the relationship between psychological problems and problematic media use, this theory makes an implicit assumption about the role of excessive smartphone use in transitioning from motivations to PSU (Kardefelt-Winther, 2014). As a result, when examining the process mediating the link between psychological issues and PSU, many studies on this topic mixed smartphone use motivation and the actual smartphone usage. By disentangling motivations from smartphone use and testing the two variables as serial mediators, this study provides a clearer picture of how a healthy, compensatory need in response to adverse situations can relapse into problematic behavior outcomes.

Second, many studies on the link between psychological well-being and problematic smartphone behaviors are conducted among the general population or college students Elhai, Levine, et al., 2017; Kim et al., 2015; van Deursen et al., 2015). Extending this line of research, the present study focuses on a clinical sample. That is, in previous research conducted among the general population, although there were mixed findings regarding whether depression triggered or suppressed social motives that ultimately led to PSU, social motives (compared to process motives) emerged as a more prominent mediator in the relationship between depression and PSU Elhai, Levine, et al., 2017; Kim et al., 2015). In contrast to these findings, this study reveals that process motive may be especially detrimental for depressed people to engage in excessive smartphone use and develop PSU. This finding implies the need to consider both process motive and the frequency of smartphone use to reduce depressed people's risk for PSU. For example, counselors may work with depressed people to engage them in reappraising negative events to prevent this clinic population from using smartphones for diversion or escapism. Also, practitioners may develop applications that help depressed people monitor their smartphone use frequencies and thus enhance their self-regulation of repetitive smartphone use. Additionally, although previous studies call for incorporating communication functions in smartphone applications to help depressed people cope with mental health issues with social support (Bakker et al., 2016), no evidence indicates that this population engages in compensatory smartphone use for social purposes in the current study. Moreover, given the need for social interactions may lead to more frequent smartphone use that ultimately contributes to PSU, future research can explore the technology functions that can simultaneously encourage the appropriate amount of smartphone use and help depressed people garner the benefit of social support.

5.2 | Limitations and future research

As other research, this study also contains a couple of limitations. First, although the study suggests the important role of executive

functions (e.g., self-regulation) in leading to PSU, this cognitive skillset was not explicitly measured. Executive functions refer to the mental processes that enable people to concentrate cognitive resources on controlling, adjusting, and monitoring thoughts, emotions, or behaviors to attain goals (Diamond, 2013). Core executive functions include inhibition (i.e., controlling attention, behavior, thoughts, or emotions to resist impulses), working memories (i.e., retaining and manipulating information over a short period of time), and cognitive flexibility (i.e., adjusting to changed demands and changing perspectives) (Diamond, 2013). Previous studies have reported that depression severity was associated with impaired executive functions (Snyder, 2013), which in turn, could lead to PSU (Gökçearslan et al., 2016). In addition, impaired executive functions may serve as a moderator that strengthens the relationship between the actual usage of smartphone and PSU. Due to the deficit ability in monitoring and regulating one's smartphone usage behaviors, people with depression are especially likely to progress from the initial, compensatory use of smartphones to PSU. Researchers are encouraged to measure executive functions and identify its role in the relationship between depression, smartphone usage, and PSU. Second, this study is based on a cross-sectional survey. Without longitudinal data, the study cannot establish the causal order whether depression predicts PSU via a series of mediators or vice versa. Future researchers can collect data at multiple waves to determine the direction of this relationship. Third, this study used a self-report measure to assess smartphone usage, yet Deng et al. (2018) showed that people tend to overestimate their actual usage. Future research can adopt objective measures (e.g., log data) to examine the role of excessive smartphone use in the relationship between depression and PSU. Related to this measurement issue, this study focused on the frequency of smartphone use as an indicator of smartphone usage given frequency adequately captures repetitive usage, which is a critical step that transforms compensatory, conscious media use to habitual, automatic behaviors. However, future research can explore how other indicators of excessive smartphone use, such as the amount of time spent on smartphone and the number of app switches, can impact mental health and PSU. Additionally, the study assessed smartphone use based on the usage of smartphone apps (e.g., social networking sites, gaming) instead of the specific activities (e.g., social networking, entertainment). As an app (e.g., Facebook) may enable multiple media activities, such as social networking, entertainment, and browsing, measuring smartphone app usage as a mediator did not allow for specifying the distinct roles of smartphone use activities in affecting PSU. Future research can seek to gain a more nuanced understanding of how motivations can lead to specific smartphone use activities and which activities are most detrimental to PSU behaviors.

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CONFLICT OF INTEREST

The authors have no conflict of interest.

ENDNOTE

[1] Path analysis is a subset of structural equation modeling, which only assesses the relationship among measured variables (i.e., the structure model). According to the two-step approach (Anderson & Gerbing, 1988), a path analysis is usually performed after a confirmatory factor analysis which showed an acceptable fit of its measurement model. This approach is different from some models in the SEM literature that examine the relationship between measured and latent variables at the same time. One advantage of the two-stage SEM approach is that researchers can diagnose the errors in the measurement model and the structure model more precisely.

PEER REVIEW

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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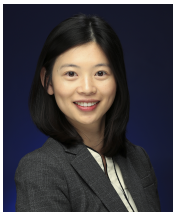

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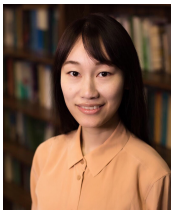

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