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Non-social features of smartphone use are most related to depression, anxiety and problematic smartphone use

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ABSTRACT

Little is known about the mechanisms of smartphone features that are used in sealing relationships between psychopathology and problematic smartphone use. Our purpose was to investigate two specific smartphone usage types – process use and social use – for associations with depression and anxiety; and in accounting for relationships between anxiety/depression and problematic smartphone use. Social smartphone usage involves social feature engagement (e.g., social networking, messaging), while process usage involves non-social feature engagement (e.g., news consumption, entertainment, relaxation). 308 participants from Amazon's Mechanical Turk internet labor market answered questionnaires about their depression and anxiety symptoms, and problematic smartphone use along with process and social smartphone use dimensions. Statistically adjusting for age and sex, we discovered the association between anxiety symptoms was stronger with process versus social smartphone use. Depression symptom severity was negatively associated with greater social smartphone use. Process smartphone use was more strongly associated with problematic smartphone use. Finally, process smartphone use accounted for relationships between anxiety severity and problematic smartphone use.

1. Introduction

Smartphone use is prevalent across the world. A recent study showed that 72% of Americans own a smartphone, and worldwide ownership averaged 43% (Poushter, 2016, February 22). Smartphone use benefits society by aiding productivity in the workplace (Leftheriotis & Giannakos, 2014; Wu, 2013) and in school (Godwin-Jones, 2011). However, many individuals engage in "problematic smartphone use," which involves excessive use accompanied by symptoms resembling substance-related dependence, withdrawal when not using their phones, and associated functional impairment (Billieux, Maurage, Lopez-Fernandez, Kuss, & Griffiths, 2015). An important question, therefore, is: What are the antecedents to problematic smartphone use? In the present paper, we examine the role of different types of smartphone use as antecedents to problematic smartphone use.

Depression, and to a lesser extent, anxiety, are related to problematic smartphone use. Consistent support has been found for depression severity (Demirci, Akgonul, & Akpinar, 2015; Smetaniuk, 2014) and anxiety severity (Demirci et al., 2015; Elhai, Levine, Dvorak, & Hall, 2016; Harwood, Dooley, Scott, & Joiner, 2014; Kim, Lee, & Choi, 2015). However, these papers did not simultaneously examine psychopathology, types of smartphone usage and problematic smartphone use in their models. These studies mostly involved student participants, using cross-sectional designs, and standardized measures of problematic smartphone use (reviewed in Elhai, Dvorak, Levine, & Hall, 2017). Other important pathways to problematic smartphone use include impulsivity, extraversion, and excessive reassurance seeking (Billieux et al., 2015). One previous study examined differential associations between types of smartphone use (social vs. non-social) with problematic smartphone use (Lopez-Fernandez, Honrubia-Serrano, Freixa-Blanxart, & Gibson, 2014), with another study integrating mental health variables into their model (van Deursen, Bolle, Hegner, & Kommers, 2015). However, our study is

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novel because of our distinction between social and non-social patterns of smartphone use *and* our inclusion of the more mainstream and prevalent psychopathology constructs of depression and anxiety.

Several mechanisms account for the association between mental health symptoms and problematic smartphone use. Kim, Seo, and David (2015) found that smartphone use aimed at alleviating negative emotion mediated the relationship between depression severity and problematic use. Elhai et al. (2016) discovered that behavioral activation mediated relations between depression and problematic smartphone use. Another important mechanism is habitual use of a smartphone. Oulasvirta and colleagues demonstrated that increased habit formation of checking one's phone for message notifications led to increased problematic smartphone use (Oulasvirta, Rattenbury, Ma, & Raita, 2012). Furthermore, van Deursen et al. (2015) discovered that habitual smartphone use mediated relations between self-regulation and problematic smartphone use. Thus, increases in smartphone use frequency may serve as a mechanism accounting for relations between poor mental health and problematic smartphone use.

The frequency of smartphone use can involve a variety of uses and features. Smartphone technology, and internet technology in general, can be characterized by uses such as productivity enhancement (e.g., reminders and email), information seeking (e.g., web surfing, browsing the news), and social information and relationships (e.g., social media, messaging). Additional uses include diversion and relaxation (music), entertainment (e.g., gaming, movies), monetary compensation (e.g., locating consumer deals) and personal status (Dhir, Chen, & Nieminen, 2015; Song, Larose, Eastin, & Lin, 2004; van Deursen et al., 2015).

Technology feature use has distinguished between process and social use (Song et al., 2004), and this categorization has subsequently been applied to smartphone usage (van Deursen et al., 2015). Social usage is defined as engaging in smartphone use for social purposes, such as social networking, messaging, phone calls and maintaining social relationships. Social usage is a somewhat diverse category of use, because phone calls, for example, are quite different and more limited in the breadth of interaction compared to a session of interacting on social media with many friends, such as via Facebook. In contrast, process usage is defined as engaging in smartphone use for news consumption, entertainment, relaxation, and other primarily non-social purposes.

The few empirical studies examining associations between process vs. social smartphone use in predicting problematic smartphone use have found discrepant results. Using a representative Dutch internet panel, van Deursen et al. (2015) found that process use of a smartphone, but not social use, was related to problematic smartphone use. However, with a sample of school-aged adolescents, another study discovered that social smartphone use was more prevalent than process use among problematic smartphone users (Lopez-Fernandez et al., 2014), a finding typical in the internet addiction literature (Chou & Hsiao, 2000; Yang & Tung, 2007). Thus it is unclear whether process or social smartphone use is more related to problematic smartphone use.

Only one study has examined mental health variables in relation to process or social smartphone use. van Deursen et al. (2015) discovered that social stress was more strongly associated with process usage compared to social smartphone usage. This finding supports theory on social avoidance (Kashdan, 2007) as well as the role of safety behavior (Powers, Smits, & Telch, 2004; Rachman, Radomsky, & Shafran, 2008), whereby social stress may lead to experiential avoidance and safety behavior - in this case, the avoidance of social/process smartphone use. The authors also found that emotional intelligence related more to social use than to process smartphone use (van Deursen et al., 2015). Coupled with findings presented above, these results suggest that mental health variables may be related to specific types of smartphone use, which in turn may relate to problematic smartphone use.

1.1. Aims

Our overall purpose was to investigate process and social types of smartphone use for associations with psychopathology, and in accounting for relationships between psychopathology and problematic smartphone use. We had several specific aims in this study. First, we examined the role of depression and anxiety symptom severity in relation to process and social smartphone use. Second, we tested process and social use as predictors of problematic smartphone use. Finally, we explored the extent to which process and social smartphone use mediated relations between both depression and anxiety with problematic smartphone use.

2. Background and hypotheses

2.1. Theory

Uses and Gratifications Theory (UGT) (Blumler & Katz, 1974; Blumler, 1979) helps understand background characteristics and individual differences motivating people to choose using particular types of mass media. UGT was used previously to examine internet addiction (Kim & Haridakis, 2009). Park and colleagues explored psychological variables accounting for problematic smartphone use, finding that perceived control in social relationships was significantly associated with increased use (Park, Kim, Shon, & Shim, 2013). Thus UGT can explain how people with certain types of psychological and/or demographic characteristics may be drawn to increasingly use specific types of smartphone features.

UGT does not explain, however, the phenomenon of why some people's increased smartphone use frequency leads to addiction/problematic use (Oulasvirta et al., 2012; van Deursen et al., 2015), while others use smartphones productively. The “Rich get richer, poor get poorer” model, or “Matthew Effect” (Merton, 1968) is relevant in this regard (Perc, 2014). This model generally explains how people with accumulated resources have an easier time further accruing such resources, while those starting with few resources often end up in a vicious cycle of trying but failing to accrue resources. The “rich get richer” model has been used to illustrate how people with extensive social capital can use the internet to boost further social networks, while those starting with less social capital find it increasingly difficult to use technology to meaningfully increase these resources (Kraut et al., 2002). Thus, in conjunction with UGT, the “rich get richer” model can explain why people without psychopathology can flourish with technology, such as using a smartphone to boost work and social productivity, while people with psychopathology can engage in problematic smartphone use.

2.2. Model

Fig. 1 demonstrates our research model, consisting of anxiety and depression scores as predictor variables, process and social smartphone use variables as mediating variables, and problematic smartphone use as the dependent variable. Our model builds on the structural model from Kim, Seo et al. (2015), by adding anxiety as a predictor, more clearly delineating between social and process use as mediators, and adding demographic covariates. We also build upon van Deursen et al. (2015), by adding psychopathology predictors of process and social smartphone use. We modeled the covarying effects of age and sex, as younger individuals (Demirci et al., 2015; van Deursen et al., 2015) and women (Jeong, Kim,

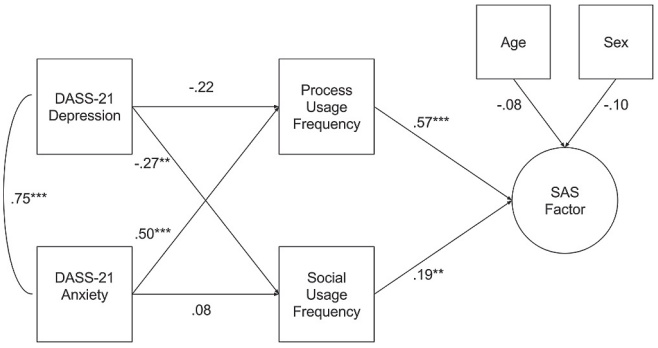

Fig. 1. Structural equation model of depression and anxiety predicting process and social smartphone use, and predicting problematic smartphone use (adjusting for age and sex). Notes: DASS-21 = Depression Anxiety Stress Scale-21; SAS = Smartphone Addiction Scale. SAS is a higher-order latent factor in this diagram, constituting the 6 lower-order SAS factors, which constitute the 33 observed SAS items (not pictured).

Yum, & Hwang, 2016; Wang, Wang, Gaskin, & Wang, 2015) have demonstrated increased problematic smartphone use.

2.3. Hypotheses

Our first two hypotheses test associations between psychopathology and smartphone uses.

1) Anxiety should be positively associated with greater process smartphone frequency, but not to social smartphone use.

This hypothesis is based on theory suggesting that greater anxiety should drive individuals to engage in social avoidance (Kashdan, 2007), and non-social, safety behaviors (Powers et al., 2004; Rachman et al., 2008). This hypothesis is also consistent with UGT, which assumes that individual characteristics such as psychological variables predict media usage (Blumler & Katz, 1974; Blumler, 1979). Thus, according to theory on social avoidance and safety behavior (Kashdan, 2007; Powers et al., 2004; Rachman et al., 2008), anxiety should drive individuals to avoid social interactions. Within the context of UGT, as an alternative to actively choosing social-related media, anxiety should specifically drive non-social media use (Blumler & Katz, 1974; Blumler, 1979) – in this case, process-related smartphone use. Empirical support for this hypothesis is derived from van Deursen et al. (2015), who demonstrated that anxiety was more related to process than social smartphone use frequency.

2) Depression severity should be negatively associated with social smartphone use frequency.

This hypothesis is based on the social deficits associated with depression (De Silva, McKenzie, Harpham, & Huttly, 2005). This hypothesis also fits with the theoretical assumptions of UGT about individual differences predicting media use (Blumler & Katz, 1974; Blumler, 1979). Thus, according to research on social impairments in depressed individuals (De Silva et al., 2005), depressed individuals should be less active in social-related activity and interaction. Additionally, based on UGT (Blumler & Katz, 1974; Blumler, 1979), this decreased social activity among depressed individuals should translate to decreased use of a smartphone's social features. In fact, people with higher depression severity overuse technology (Kuss, Griffiths, Karila, & Billieux, 2014), but not social aspects of technology, because of such social deficits (Andreassen et al., 2016).

Our next hypothesis tested associations between types of smartphone usage and problematic smartphone use.

3) We hypothesize that social smartphone use frequency will have a stronger association with problematic use severity than process smartphone use.

Although van Deursen et al. (2015) found support for process use in predicting smartphone addiction, Lopez-Fernandez et al. (2014) discovered more support for social use - a finding consistent with the internet addiction literature (Chou & Hsiao, 2000; Yang & Tung, 2007). Social technology use can keep people engaged in their technology experiences, through back-and-forth communication, paving the way toward overuse and addiction in a manner not seen with process-based consumption (Müller et al., 2016). Thus, relevant to this paper, social smartphone use should be more associated with problematic smartphone use.

Finally, our last hypothesis tested types of smartphone use as mechanisms that will account for the association between depression and anxiety and problematic smartphone use.

4) Process and social smartphone use frequency will mediate the association between depression and anxiety severity and problematic smartphone use.

Because of research finding more social smartphone use implicated in internet addiction (Chou & Hsiao, 2000; Yang & Tung, 2007), and more specifically smartphone addiction (Lopez-Fernandez et al., 2014), social aspects of smartphone use should especially account for such mediating relationships. This hypothesis is also based on previous research demonstrating the mediating role of smartphone use frequency in accounting for associations between psychological variables and problematic smartphone use (Kim, Seo et al., 2015; van Deursen et al., 2015). This hypothesis is also supported by UGT (Blumler & Katz, 1974; Blumler, 1979), which posits that specific psychological characteristics are responsible for media consumption - in this case, depression and anxiety – leading to less social smartphone use. Also, the rich get richer model (Merton, 1968) plays a role in this hypothesis, explaining that in comparison with psychologically healthy individuals, those individuals with impaired psychological health (in our case, depression and anxiety) may engage in problematic smartphone use, and not for social reasons.

3. Method

3.1. Procedure

We recruited participants in early 2016 from Amazon's Mechanical Turk (Mturk) internet labor market, often used for data collection in social science research (Shapiro, Chandler, & Mueller, 2013). As discussed by Landers and Behrend (2015), Mturk offers several advantages in data collection over others sampling approaches. Because our study involved problematic smartphone use, we chose Mturk as a recruitment platform in order to obtain a sample of avid smartphone users. We offered 75 cents to participants' Amazon Payments accounts, in exchange for a 15–20-min study on mobile devices and web service use. Participants signing up for the Mturk study were routed to a web-based consent statement and (for those agreeing) a web survey hosted on psychdata.com.

3.2. Participants

Only North American participants who spoke English were eligible for the study, which we verified using online screening. Study participants were at least age 18, required for an Mturk account, verified by credit check and identity verification. A total of

322 individuals signed up for the study. However, we removed 14 individuals, including 4 indicating non-North American residence, 5 providing no or a duplicate Mturk worker identification number, and 5 skipping multiple survey instruments. The remaining 308 subjects, all of which indicated owning a smartphone, served as the effective sample.

We queried demographic characteristics in the web survey. Among the effective sample, 165 participants (53.6%) were men. The average age was 33.15 years (SD = 10.21). The majority were White (n = 253, 82.1%), with 28 individuals (9.1%) self-identifying as Asian, 23 (7.5%) as African American, and 16 (5.3%) as Hispanic (rates are non-mutually exclusive). More than half the sample completed at least a Bachelor's degree (n = 170, 55.2%), or had some college education (n = 104, 33.8%). Most participants reported being employed full-time (n = 196, 44.1%) or part-time (n = 56,18.3%). Annual household income was reported as less than $25 K for 54 participants (24.1%), between $25 K to less than $35 K for 29 participants (9.4%), between $35 K to less than $50 K for 60 participants (19.5%), and $50 K to less than $80 K for 84 participants (27.3%), and $80 K + for 61 participants (19.8%). About one-third of participants reported being currently married (n = 114, 37.3%).

3.3. Instruments

3.3.1. Process and social usage scale

We measured seven process and five social usage items using a 5-point Likert-type scale, ranging from "1 = Strongly disagree" to "5 = Strongly agree," from a measure developed previously (van Deursen et al., 2015). The scale's process items reflect smartphone uses that are not necessarily social in nature, such as using to relax, for entertainment, and news consumption ("I use my smartphone in order to stay up to date on the latest news"). The social usage scale included items related to using smartphone for maintaining relationships, for calling or texting people, and social media ("I use my smartphone to contact people through social media"). van Deursen et al. (2015) reported alpha coefficients of 0.89 for process and 0.73 for social usage, and unique relationships for process and social usage with psychological variables, demographics and habitual and problematic smartphone use. We found alphas of 0.85 and 0.77, respectively. We used summed Process and Social Usage scores.

3.3.2. Smartphone addiction scale (SAS)

We used the SAS (Kwon et al., 2013) to measure problematic smartphone use. The SAS consists of 33 items using a Likert scale ranging from "1 = Strongly disagree" to "6 = Strongly agree." The SAS has the following subscales of smartphone-related impairment based on factor analysis (Ching et al., 2015; Kwon et al., 2013): Daily Life Disturbance (involving functional and health disturbances), Positive Anticipation (from use), Withdrawal (from non-use), Tolerance, (general) Overuse, and Cyberspace Oriented Relationships (i.e., overuse in digital relationships). Coefficient alpha for the total score is reported at 0.97, with convergent validity against scales measures internet and smartphone addiction (Kwon et al., 2013) and self-reported smartphone use (Elhai et al., 2016). Coefficient alpha for all 33 items in the present sample was 0.95. We report descriptive statistics for the summed SAS score in Table 1, while Fig. 1 displays the SAS estimated with latent variable modeling.

3.3.3. Depression anxiety stress scale (DASS)-21

We measured depression and anxiety using the 21-item DASS, a short version of the original DASS (Lovibond & Lovibond, 1995). The DASS-21 includes Likert-type ratings from "0 = Did not apply to me at all" to "3 = Applied to me very much or most of the time." There are three subscales of seven items each, including depression, anxiety, and stress. We only analyzed the depression and anxiety subscales. Coefficient alpha was found to be 0.97 for depression and 0.87 for anxiety, with convergent validity against other depression and anxiety measures (Antony, Bieling, Cox, Enns, & Swinson, 1998; Brown, Chorpita, Korotitsch, & Barlow, 1997). We discovered coefficient alphas of 0.94 for depression, and 0.85 for anxiety. We used summed Depression and Anxiety Scale scores.

3.4. Analysis

Descriptive statistics for the primary measures' total scores are included in Table 1, along with Pearson correlations and coefficient alpha values. We summed item responses to derive total scores on these measures, after first estimating missing item-level data using maximum likelihood procedures with the expectation-maximization algorithm (Graham, 2009). Based on skewness and kurtosis values, no scores significantly departed from normality (no values were greater than 2.0).

We conducted a confirmatory factor analysis (CFA) for the SAS. We modeled its 6 factors (Ching et al., 2015; Kwon et al., 2013), with a higher-order latent factor. We used weighted least squares estimation with a mean- and variance-adjusted chi-square (WLSMV), treating SAS items as ordinal data, thus involving a polychoric covariance matrix and probit regression coefficients (DiStefano & Morgan, 2014). Factor variances were fixed to a value of 1 for scaling purposes; all residual error covariances were fixed to values of zero. Goodness of fit was judged based on standard benchmarks, including Comparative Fit Index (CFI) $\geq$ 0.90, Tucker-Lewis Index (TLI) $\geq$ 0.90, and root mean square error of approximation (RMSEA) $\leq$ 0.08 (Hu & Bentler, 1999).

Next, we tested the structural equation model depicted in Fig. 1. We statistically controlled for variance in the SAS' higher-order factor by adding age and sex as covariates.

We tested Hypothesis 1 by examining path coefficients from the Anxiety scale to both Process and Social Usage scores; differences between these two paths were tested using a Wald chi-square test, assessing the null hypothesis that the difference between path coefficients was zero. We tested Hypothesis 2 by examining path coefficients from the Depression scale to Social Usage scores. We

Table 1
Descriptive statistics, zero-order intercorrelations, and coefficient alphas for the primary measure summed scores.

Variable	M	SD	1.	2.	3.	4.	5.
1. DASS-21-Depression	4.89	4.79	(0.94)				
2. DASS-21 Anxiety	3.08	4.01	0.75***	(0.85)			
3. Process Usage	25.80	4.98	−0.12*	−0.11	(0.85)		
4. Social Usage	20.34	3.34	−0.25***	−0.19***	0.58***	(0.77)	
5. SAS	167.80	88.50	0.10	0.24***	0.40***	0.16**	(0.95)

Note. DASS-21 = Depression Anxiety Stress Scale-21; SAS = Smartphone Addiction Scale; Coefficient Alpha values appear in parentheses on the diagonal.
*p < 0.05, **p < 0.01, ***p < 0.001.

explored Hypothesis 3 by viewing path coefficients from Process and Social smartphone use to the latent, higher-order SAS factor; differences were tested using a Wald chi-square test.

Finally, we tested Hypothesis 4 by examining four mediation paths. In each mediation test, the higher-order SAS factor was the dependent variable. We tested a) Depression as the predictor and Process Use as the mediator; b) Depression as the predictor and Social Use as the mediator; c) Anxiety as the predictor and Process Use as the mediator; and d) Anxiety as the predictor and Social Use as the mediator. We estimated indirect effects by calculating the cross-product of two direct path coefficients, using the Delta method. We used non-parametric bootstrapping of standard errors across 1000 samples (MacKinnon, 2008).

4. Results

Table 1 demonstrates descriptive statistics for the primary measures. Bivariate Pearson correlations indicate that Depression scores were significantly inversely correlated with Process and Social Use, while Anxiety scores were significantly inversely related to Social Use. Furthermore, Process and Social smartphone use were significantly related to Problematic smartphone use.

The 6-factor CFA of the SAS, with a higher-order factor, demonstrated nearly an adequate fit, robust $\chi^2(489, N = 308) = 2309.500$, $p < 0.001$, CFI = 0.89, TLI = 0.88, RMSEA = 0.11 (90% CI from 0.11 to 0.11). Table 2 displays standardized factor loadings for the lower and high order factors. Factor loadings for the lower order factors were uniformly high, with the smallest loading of 0.44. Factor loadings for the higher-order factor were high, with the smallest loading of 0.71.

The structural model depicted in Fig. 1 demonstrated nearly an adequate fit, $\chi^2(688, N = 308) = 2847.26$, $p < 0.001$, CFI = 0.87, TLI = 0.87, RMSEA = 0.10 (90% CI from 0.10 to 0.11). Standardized path coefficients are displayed in Fig. 1. Path coefficients were 0.50 (SE = 0.11) for the Anxiety scale to Process Usage, $p < 0.001$, and 0.08 (SE = 0.11) for Anxiety to Social Usage, p = 0.48, testing Hypothesis 1. Anxiety was more related to Process than Social Use, Wald $\chi^2(1, N = 308) = 17.14$, $p < 0.001$. The path coefficient from Depression to Social Usage was −0.27 (SE = 0.11), p = 0.01, testing Hypothesis 2.

Adjusting for age and sex, the path coefficient from Process Use to the higher-order SAS factor was 0.57 (SE = 0.08), $p < 0.001$. Social Usage was also related to the SAS factor, with an adjusted path coefficient of 0.19 (SE = 0.06), p = 0.002. Testing Hypothesis 3, the difference between these coefficients was significant, Wald $\chi^2(1, N = 308) = 12.24$, $p < 0.001$.

Finally, mediation results are displayed in Table 3, testing Hypothesis 4. Results demonstrate that after adjusting for age and sex, only one mediation test was statistically significant. Specifically,

Table 3
Mediation effects in Accounting for relations between depression/anxiety and problematic smartphone use.

Mediating Relationship	β	B	95% CI of B	SE	p
Depression → Process → SAS	−0.13	−0.02	−0.05: 0.00	0.02	0.14
Depression → Social → SAS	−0.06	−0.10	−0.02: 0.00	0.01	0.09
Anxiety → Process → SAS	0.28	0.07	0.03: 0.11	0.02	0.01
Anxiety → Social → SAS	0.02	0.00	−0.01: 0.01	0.01	0.56

Note. Process = Process Smartphone Use; Social = Social Smartphone Use; SAS = Smartphone Addiction Scale (Higher Order Factor).

Table 2
Standardized factor loadings for the SAS confirmatory factor analysis.

Item	DLD	PA	W	COR	O	T
1. Missed work	0.85					
2. Concentration problem	0.87					
3. Lightheadedness	0.86					
4. Wrist pain	0.84					
5. Tired	0.85					
6. Calm or cozy		0.49				
7. Feeling excited		0.63				
8. Confident		0.44				
9. Getting rid of stress		0.56				
10. Nothing more fun		0.88				
11. Life empty without		0.87				
12. Most liberated		0.83				
13. Most fun		0.89				
14. Can't stand being without			0.66			
15. Impatient without			0.82			
16. In mind when not using			0.87			
17. Never give up			0.82			
18. Getting bothered			0.73			
19. Use on toilet			0.62			
20. Meeting people				0.70		
21. Intimate relationships				0.89		
22. Painful as loss				0.86		
23. Buddies understand				0.86		
24. Constant checking				0.80		
25. Checking when waking				0.69		
26. Smartphone buddies				0.84		
27. Smartphone searching					0.58	
28. Battery loss					0.63	
29. Tolerance					0.83	
30. Feeling urge					0.94	
31. Failed to shorten use						0.95
32. Should shorten use						0.85
33. Feedback from others						0.85
(Scale Loadings on Higher Order Factor):	(0.71)	(0.82)	(0.95)	(0.93)	(0.87)	(0.85)

Note: DLD = Daily Life Disturbance; PA=Positive Anticipation; W=Withdrawal; COR=Cyberspace Oriented Relationship; O=Overuse; T = Tolerance.

Process Use mediated relations between Anxiety and problematic smartphone use.

5. Discussion

In the present study, we examined predictors of problematic smartphone use. We should note that while we used the term "problematic smartphone use" to label our primary construct, other similar terms have been used as well. Other terms used to describe overuse of a smartphone include the labels of "addiction," "excessive use," "compulsive use," and "compensatory use" (Kardefelt-Winther, 2014; Widyanto & Griffiths, 2006). "Compensatory use" may not be exactly the same as problematic use, but clarifies the motivation of such use – that is, to escape real-world problems and duties, and/or avoid negative emotion and affect (Kardefelt-Winther, 2014). We also note that the concept of problematic smartphone use as an addictive disorder has only limited research evidence (Billieux et al., 2015). Furthermore, frequent use of a smartphone is not necessarily a pathological behavior, unless accompanied by hallmark symptoms of addictive disorders (Billieux et al., 2015).

In this paper, we discovered differential relationships between specific types of smartphone use (process vs. social usage) with psychopathology. We also found that process and social smartphone use were differentially associated with problematic smartphone use. These findings aid in understanding how psychopathology is associated with specific types of smartphone use, as well as explaining how usage may progress to problematic use.

Our results demonstrate that anxiety was related to process, but not social usage, supporting Hypothesis 1. In mass communications theory, this finding fits with UGT, which assumes differences in mass communication based on individual differences (Blumler & Katz, 1974; Blumler, 1979). More specifically, this finding is consistent with theory and research on social avoidance (Kashdan, 2007) and safety behaviors (Powers et al., 2004; Rachman et al., 2008) among individuals with the individual difference of anxiety. That is, in-person, anxious individuals often avoid social interaction when associated with stress (Kashdan, 2007). When choosing between in-person or online social interaction, anxious individuals tend to prefer online social interaction, presumably because it is less anxiety-provoking (Andreassen et al., 2016; Kuss et al., 2014). Nonetheless, our study finds that non-social smartphone interaction is preferred to social smartphone interaction among individuals with greater anxiety.

It should be noted that engaging in safety behavior to alleviate anxiety is not always a bad thing, and can be adaptive (Rachman et al., 2008). However, there is a fine line between adaptive safety behavior, such as using a smartphone to temporarily relax or calm anxiety, vs. maladaptive and persistent social disengagement. Persistent social disengagement has negative health and mental health effects (House, 2001), including when the disengagement is conducted through excessive, problematic technology use (Kim, LaRose, & Peng, 2009).

We also found that depression severity was inversely related to social smartphone use, providing support for Hypothesis 2. That is, participants with greater depression severity engaged in less social-related smartphone use. This is consistent with recent research showing that active use of social media (i.e., interacting socially, posting more frequently, liking and commenting), relative to passive social media usage (i.e., passively scrolling through a social media feed without interacting), can be beneficial to overall mental wellbeing (Verduyn et al., 2015). This finding also fits generally with UGT. More specifically, depression is associated with social deficits and withdrawal (De Silva et al., 2005). It is precisely because of social withdrawal that depressed individuals tend to avoid the social (but not process) aspects of technology use (Andreassen et al., 2016). This creates a vicious cycle, where individuals with depression symptoms avoid social interaction, inhibiting the amount of social support and environmental reinforcement that they receive, and further increasing depression (Cronkite, Moos, Twohey, Cohen, & Swindle, 1998). Yet, social support (Kawachi & Berkman, 2001) and environmental reinforcement (Carvalho & Hopko, 2011) are important to psychological health. This vicious cycle appears to play out not only in-person, but also online, for the depressed individual. This cycle is troubling, because there are numerous social capital advantages to social internet (including social smartphone) use (Baek, Bae, & Jang, 2013; Kim, Wang, & Oh, 2016; Pendry & Salvatore, 2015), dispelling concerns that online use inhibits offline social interaction (Tardanico, 2012, April 30). Internet and/or smartphone use has been shown to increase social capital, with increased social skill competence (Tsitsika et al., 2014), social engagement (Kim et al., 2016; Pendry & Salvatore, 2015), and social support (Oh, Ozkaya, & LaRose, 2014), and decreased loneliness/isolation (Cho, 2015).

Our results demonstrate that compared to social smartphone use, process use was more related to problematic smartphone usage. This finding is opposite of what we predicted in Hypothesis 3. While problematic smartphone use was more associated with social usage in Lopez-Fernandez et al. (2014), it was more related to process use in van Deursen et al. (2015). So it is still unclear if social or process usage is most related to problematic smartphone use, based on these few studies. Future research could examine process and social use in relation to specific aspects of problematic smartphone use to assess if examining this issue at a more granular level clarifies previous mixed findings.

Among our tests of mediation proposed in Hypothesis 4, we discovered one significant mediation test, but not consistent with our Hypothesis. Specifically, process smartphone use mediated relations between anxiety and problematic smartphone use. This finding could help explain the small effects for anxiety in relation to problematic use from prior research by proposing that an important mechanism in this relationship is process smartphone use. Thus, increased process-based smartphone uses and gratifications, such as news consumption and web surfing to pass the time, could represent a mechanism by which individuals higher in anxiety progress from increased smartphone use to problematic use. In fact, process use may be used not only as a method of social avoidance, but could also be negatively reinforcing for those with greater anxiety, in turn strengthening the conditioning process from increased use to habitual use. Other research has found that increased or habitual smartphone use represents a mechanism between psychopathology and problematic smartphone use (Seo, Kim, & David, 2015; van Deursen et al., 2015). The present paper's contribution involves more specifically revealing the importance of process smartphone use in the relationship between anxiety and problematic use.

The present paper's findings can be placed in context of the rich get richer/poor get poorer model (Merton, 1968). Specifically, those individuals with depression or anxiety were not as likely to engage in social use of their smartphones. Yet social smartphone use, compared to process usage, may aid in establishing and maintaining social relationships (Baek et al., 2013; Cho, 2015; Pendry & Salvatore, 2015). In fact, we discovered that those with lower levels of depression were more likely to engage in social smartphone use. In other words, those with less depression, and thus the more psychologically healthy, were more likely to use the adaptive, social features of their smartphones. The less adaptive process smartphone use accounted for relations between anxiety and problematic smartphone use. These results support the rich get

richer model in explaining that depressive and anxious psychopathology appear to hold people back from using technology in meaningful ways to be productive, instead leading to less adaptive, non-social, and excessive problematic smartphone use (Kraut et al., 2002).

Several limitations apply to the present study. First, we used a convenience sample of participants from Mturk, which may not generalize to the general population as a whole. Second, we explored our research questions at a single cross-section in time, and thus we cannot infer causality from our statistical relationships. Future work should extend this cross-sectional study utilizing longitudinal designs and tests of mediation. Third, we relied on self-reported smartphone use, which does not always translate to actual, objectively measured smartphone use (Andrews, Ellis, Shaw, & Piwek, 2015; Boase & Ling, 2013).

Characterizing features of smartphone use into process and social use is a parsimonious way to understanding the major uses and gratifications of such technology. However, we must acknowledge the limitation that with parsimony, some granular information is lost. Some smartphone uses could conceptually cut across both process and social use. For example, a social networking site may be used by the same individual for both news consumption (process use) and social interaction (social use). Additionally, gaming may be used for both entertainment and relaxation (process use) and social interaction through multiplayer games (social use). Thus there may be some overlap between process and social smartphone use. Future research should more comprehensively examine process and social types of smartphone use, further exploring usage that cuts across both process and social use.

There are relevant practice implications from this study's findings. Depressed and anxious clinical patients should be encouraged to schedule more pleasant, social-related activities, in line with contemporary behaviorally-focused psychological treatments (Dimidjian, Barrera, Martell, Munoz, & Lewinsohn, 2011). Such social activities could be facilitated by, or involve, social smartphone use. Although social smartphone use is not a replacement for in-person social interaction, as mentioned earlier, it has social capital benefits which could benefit clinical patients.

6. Conclusions

This study offers insights into types of psychopathology related to smartphone use, and mechanisms involved in how psychopathology relates to problematic smartphone use. Prior research has not attempted to differentiate different types of smartphone use in establishing relations with psychopathology. Results demonstrate that anxiety was most related to process smartphone use, and depression was inversely related to problematic smartphone use. Furthermore, process smartphone use was most associated with problematic use. Finally, process use mediated relations anxiety and problematic smartphone use.

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