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Latent-level relations between *DSM-5* PTSD symptom clusters and problematic smartphone use

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Abstract

Common mental health consequences following the experience of potentially traumatic events include Posttraumatic Stress Disorder (PTSD) and addictive behaviors. Problematic smartphone use is a newer manifestation of addictive behaviors. People with anxiety severity (such as PTSD) may be at risk for problematic smartphone use as a means of coping with their symptoms. Unique to our knowledge, we assessed relations between PTSD symptom clusters and problematic smartphone use. Participants ($N = 347$), recruited through Amazon's Mechanical Turk (MTurk), completed measures of PTSD and smartphone addiction. Results of the Wald tests of parameter constraints indicated that problematic smartphone use was more related to PTSD's negative alterations in cognitions and mood (NACM) than to PTSD's avoidance factor, Wald $\chi^2(1, N = 347) = 12.51, p = 0.0004$; and more to PTSD's arousal compared to PTSD's avoidance factor, Wald $\chi^2(1, N = 347) = 14.89, p = 0.0001$. Results indicate that problematic smartphone use is most associated with negative affect and arousal among trauma-exposed individuals. Implications include the need to clinically assess problematic smartphone use among trauma-exposed individuals presenting with higher NACM and arousal severity; and targeting NACM and arousal symptoms to mitigate the effects of problematic smartphone use.

Keywords

DSM-5; PTSD; Problematic smartphone use Latent-level relations; MTurk

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Conflicts of interest

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1. Introduction

The co-occurrence of PTSD with addictive behaviors is normative following the experience of a potentially traumatic events (PTE) (e.g., Breslau, 2009; Khoury, Tang, Bradley, Cubells, & Ressler, 2010). More recently, research on “cyber addictions,” including smartphone addiction, is gaining traction (reviewed in Billieux, 2012). However, no study to our knowledge has examined relations between the PTSD symptom cluster severity and problematic smartphone use; this is the focus of the current study.

1.1. Problematic smartphone use as an addictive behavior

Excessive and problematic use of smartphones is characterized as a type of non-chemical behavioral cyber addiction (reviewed in Billieux, 2012; van Deursen, Bolle, Hegner, & Kommers, 2015). Smart phone addiction is defined as the overuse of smartphones despite impairment in daily functioning (Demirci, Akgönül, & Akpınar, 2015). There are no official diagnostic criteria for problematic smartphone use; however it shares similar to other addictive behaviors such as habitual overuse, functional impairment, and withdrawal following cessation of use (e.g., Ezoë et al., 2009).

First, increasingly, people are using smartphones as more than a communicative device. They use smartphones habitually for daily everyday functional uses (e.g., social media applications, games, productivity enhancement, and navigation). Such *habitual overuse* of a smartphone may render it addictive (van Deursen et al., 2015; Kwon, Lee, et al., 2013; Oulasvirta, Rattenbury, Ma, & Raita, 2012). Second, excessive smartphone use could result in *functional impairment* (Demirci et al., 2015; Kwon, Lee, et al., 2013) including impaired driving (Cazzulino, Burke, Muller, Arbogast, & Upperman, 2014), and difficulties in real-life social engagement (Kuss & Griffiths, 2011). Additionally, excessive smartphone use could relate to sleep difficulties (Demirci et al., 2015), especially for people who experience higher anxiety when separated from technological devices, and have a greater dependence on technological devices (including smartphones), which in turn influences nighttime awakenings related to smartphone use (Rosen, Carrier, Miller, Rokkum, & Ruiz, 2016). In fact, the relatively new concept of “iDisorder” highlights the relation between greater technology use and poorer mental health (Rosen, Cheever, & Carrier, 2012). Unsurprisingly, problematic smartphone use relates to depression, anxiety (Demirci et al., 2015; Elhai, Dvorak, Levine, & Hall, 2017), and “technostress” (stress related to technology use; Brod, 1984; Lee, Chang, Lin, & Cheng, 2014). The reasons and nature of technology use (including use of smartphones) can differentially relate to psychopathology. As an example, Rosen, Whaling, Rab, Carrier, and Cheever (2013) found that greater general Facebook use, greater Facebook use for impression management, and having more Facebook friends related to narcissism; whereas using technology to listen to music, and greater general Facebook use related to antisocial personality traits (Rosenm Whaling, et al., 2013).

Third, individuals may experience *withdrawal*-like symptoms when separated from their smartphones (Kwon, Lee, et al., 2013). The concept of “nomophobia” describes one’s dependency on technological devices to the extent of causing anxiety when separated from the technological device (King et al., 2013). Evidence indicates that people experience physiological symptoms (e.g., increasing heart rate and blood pressure), increased anxiety,

and a decline in cognitive performance when they are unable to answer their ringing phones (Clayton, Leshner, & Almond, 2015). Additionally, evidence indicates an increase in anxiety levels among smartphone users when separated from their technological devices, especially for students who used the technological devices more frequently (Cheever, Rosen, Carrier, & Chavez, 2014). Lastly, there may be a *reinforcement* element embedded in smartphone use such as obtaining pleasurable experiences (Kwon, Lee, et al., 2013; Song, Larose, Eastin, & Lin, 2004), and engagement in virtual social relationships (Kwon, Lee, et al., 2013). This conceptualization of smartphone addiction is similar to the defining features of addictive behaviors such as substance use (Fisher, Elias, & Ritz, 1998; Marlatt, Baer, Donovan, & Kivlahan, 1988; Shaffer, 1996).

1.2. PTSD and problematic smartphone use

In our paper, we were interested in problematic smartphone use in relation to PTSD symptoms. PTSD, a trauma-related disorder in *DSM 5*, is conceptualized as comprising of four symptom clusters: intrusions, avoidance of internal and external triggers serving as reminders of the traumatic event, alterations in affect and belief structures as a result of the traumatic event experiences (negative alterations in cognitions and mood; NACM), and physiological arousal symptoms (alterations in arousal and reactivity; AAR) (American Psychiatric Association, 2013). NACM symptoms are conceptualized as being distress-based and hypothesized to underlie co-occurring PTSD and distress-based disorders such as depression (Contractor et al., 2014).

PTSD shares common risk factors with problematic smartphone use, and other addictive behaviors. Low self-esteem, neuroticism, and impulsivity relate to problematic smartphone use (Bianchi & Phillips, 2005; reviewed in; Billieux, 2012), as well as to increased PTSD severity (Contractor, Armour, Forbes, & Elhai, 2016; Contractor, Armour, Shea, Mota, Pietrzak, 2016; Jakši, Brajković, Ivezić, Topić, & Jakovljević, 2012), and other addictive behaviors such as alcohol misuse (Fisher et al., 1998; Marlatt et al., 1988). Extrapolating from the literature linking PTSD and addictive behaviors (e.g., Keane & Wolfe, 1990; Stewart, 1996), the relation between problematic smartphone use and PTSD severity can be characterized from two perspectives: the reinforcement perspective and the socialization perspective.

1.2.1. Reinforcement perspective—There is potentially a bi-directional relationship between PTSD severity and smartphone addiction due to the reinforcing properties of smartphone use (positive and/or negative reinforcement). From a positive reinforcement model perspective, smartphone use may elicit, maintain, or increase positive affect and pleasure (reviewed in Billieux, 2012). An example is the increase in positive affect when receiving notifications on one's smartphone (Oulasvirta et al., 2012). Consequent positive effects in turn may lead to “wanting” behaviors characterized by a desire of even greater smartphone use (Robinson & Berridge, 2000; Song et al., 2004). This framework has been termed as the *incentive-sensitization theory* in substance addiction research (Robinson & Berridge, 2000), and as the *process-related gratification perspective* in smart-phone addiction research (Song et al., 2004). Thus, excessive smartphone use may be positively

reinforcing for people who experience PTSD severity, particularly among those who report social isolation and low positive affect.

From a negative reinforcement model perspective, excessive smartphone use driven by poor self-control, anxiety, impulsivity, and difficulties regulating emotions could function to reduce or distract from negative affect (e.g., NACM symptoms) and withdrawal symptoms (reviewed in Billieux, 2012; Elhai, Levine, Dvorak, & Hall, 2017; Jeong, Kim, Yum, & Hwang, 2016). This explanation has been conceptualized as the *self-medicating theory* in substance addiction research (Khantzian, 1985; Stewart, 1996), and as the *impulsive pathway perspective* in smartphone addiction research (reviewed in Billieux, 2012). In fact, the impulsive pathway perspective comprehensively details the role of several impulsivity facets (negative urgency, lack of perseverance, lack of premeditation, and sensation seeking) underlying problematic smartphone use (reviewed in Billieux, 2012). The tendency to act impulsively when experiencing intense emotional states, termed as negative urgency (Whiteside & Lynam, 2001) is highly related to PTSD subscale severity, and to NACM symptom severity in particular (Contractor, Armour, Forbes, et al., 2016; Roley, Contractor, Weiss, Armour, & Elhai, 2017); and to problematic phone use (Billieux, Van Der Linden, D'Acremont, Ceschi, & Zermatten, 2007; Billieux, Van Der Linden, & Rochat, 2008). In summary, similar to other addictive impulsive behaviors (Marshall-Berenz, Vujanovic, & MacPherson, 2011; O'Hare, Sherrer, Yeaman, & Cutler, 2009; Sacks, Flood, Dennis, Hertzberg, & Beckham, 2008), excessive smartphone use may be a negatively reinforcing coping strategy for people experiencing negative affect related to PTSD severity (i.e., primarily NACM symptom severity).

Finally, positive and negative reinforcement may interact to contribute to a compulsive pattern of smartphone use. To elaborate, one's smartphone use could be positively reinforced by the pleasure and gratification one experiences when initially using the smartphone. On discontinuation of smartphone use, one could experience negative affect (similar to a withdrawal effect) that would reduce when smartphone use is resumed. This pattern could be negatively reinforcing, and thus could contribute to increased smartphone use (Wise & Koob, 2014).

Given theoretical evidence to suggest that smartphone use may elicit, maintain, or increase positive affect and/or reduce or distract from negative affect, it is not surprising that preliminary evidence indicates a positive relationship between stress and problematic smartphone use. Specifically, one study found that university students developed an addiction to mobile phones to possibly alleviate the negative emotions of pain and tension in relation to family and emotional stress (Chiu, 2014). Thus, excessive smartphone use serve as a coping mechanism for stressor-related distress including PTSD symptoms.

1.2.2. Socialization perspective—The socialization-related purposes of smartphones use could make it addictive for people with PTSD symptoms because smart-phone use may compensate for lack of real-life socialization or may facilitate social avoidance. People with greater PTSD severity have social difficulties (e.g., lack of social relationships; discomfort in social situations) due to avoidance symptoms (Solomon, 1989) or possibly attributable to neuroticism, low self-esteem (Jakšić et al., 2012), and social anxiety (Hofmann, Litz, &

Weathers, 2003). As such, according to the *social usage perspective* (Yang & Tung, 2007) and the *relationship maintenance pathway perspective* (reviewed in Billieux, 2012), they may use their smartphones to make up for perceived deficiencies in their social life and to obtain reassurances in their relationships. Alternatively, we can hypothesize that people with PTSD severity may use smartphones as a distraction/social avoidance strategy especially when in uncomfortable social situations.

1.3. Current study

Prior theoretical and empirical literature provides preliminary support for a link between PTSD severity and problematic smart-phone use. Thus, the current study aims to assess latent-level structural relations between PTSD symptom clusters (intrusions, avoidance, NACM, and AAR) and problematic smartphone use. We consider the study as primarily exploratory given the lack of prior similar empirical studies, and the existence of alternative models linking PTSD severity to problematic smartphone use. We hypothesized that problematic smartphone use would have the strongest association with the distress-laden latent factor of PTSD-NACM cluster (*Hypothesis 1*). NACM symptoms represent changes in cognitive and emotional states following the experience of a PTE (Friedman, 2013), and symptoms comprising this cluster are significantly associated with distress-related conditions such as depression (Contractor et al., 2014; Elhai et al., 2015) and addictive behaviors such as alcohol use (Biehn et al., 2016). Extrapolating from addiction research (Biehn et al., 2016; Contractor, Pesseau, Capone, Reddy, & Shea, 2016; Jakupcak et al., 2010), we speculated that problematic smartphone use may aid to cope with PTSD-related distress represented by the NACM symptoms. Further, feelings of detachment (Criteria D6 of NACM cluster) could be associated with excessive smartphone use (Billieux, 2012; van Deursen et al., 2015; Yang & Tung, 2007); smartphone use may either enhance social detachment or serve to compensate for the lack in social relationships. The remainder of the analyses were exploratory. Results of the current study could highlight mechanisms linking PTSD severity and problematic smartphone use, and inform treatment-related targets for co-occurring PTSD and problematic smartphone use.

2. Method

2.1. Procedure/participants

Participants were recruited from Amazon's Mechanical Turk (MTurk) platform (Buhrmester, Kwang, & Gosling, 2011). The study was described as a 30-min survey of an examination of the nature and extent of smartphone use among people who have experienced stressful life events. We screened participants 18 years and older for four inclusionary criteria: (1) living in North America; (2) working knowledge of the English language; (3) using a smartphone; and (4) experiencing a PTE. Participants who met eligibility criteria provided informed consent and completed the survey, which was hosted on Psychdata.com (data collection platform). We employed checks to ensure the validity of the data (e.g., excluded data entered by those attempting the survey multiple times in an effort to meet inclusionary criteria; removed duplicate responses). The study was approved by the Institutional Review Board of University of North Texas. Participants were compensated 75 cents for study participation.

2.2. Exclusions and missing data

A total of 499 respondents completed the survey through the MTurk platform. Nineteen participants who attempted to answer the questionnaire twice/thrice were excluded (resulting $n = 480$). The sample was further truncated by excluding those (1) not meeting one or more of the inclusionary criteria ($n = 120$), and (2) missing data on all measures ($n = 11$). The final sample thus included 349 participants.

For the current study, we further restricted our sample to those not missing more than 30% item-level data on the PTSD Checklist for *DSM-5* (≥ 6 items; $n = 1$; PCL-5; Weathers et al., 2013) or the Smartphone Addiction Scale-Short Version (≥ 3 items, $n = 1$; Kwon, Kim, Cho, & Yang, 2013). In the effective sample of 347 participants, 45 participants were missing one to three PTSD checklist for *DSM-5* (PCL-5) items, and 20 participants were missing one Smartphone Addiction Scale-Short Version (SAS-SV) item.

2.3. Sample characteristics

Average age of participants was 33.60 years of age ($SD = 9.52$), and approximately half were female ($n = 199$, 57.70%). Most were employed full time ($n = 227$, 65.80%), and averaged 15.31 years of schooling ($SD = 2.43$). A majority identified themselves as Caucasian ($n = 288$, 83.20%) and not Hispanic/Latino ($n = 296$, 86%). In terms of the annual household income, 40 participants reported less than \$15,000 (11.60%); 47 participants reported between \$15,000–\$24,999 (13.60%); 55 participants reported between \$25,000–\$34,999 (15.90%); 53 participants reported between \$35,000–\$49,999 (15.30%); 53 participants reported between \$50,000–\$64,999 (15.30%); 34 participants reported between \$65,000–\$79,999 (9.80%); and 64 participants reported greater than \$80,000 (18.50%). The most prevalent worst traumatic events (upon which PTSD ratings were assigned) were unexpected death of a family member/close friend ($n = 111$, 32%), life-threatening accident ($n = 48$, 13.80%), and life-threatening illness ($n = 33$, 9.50%). Additional descriptive information is provided in Table 1.

2.4. Measures

Demographic information—Information regarding age, gender, income, educational level, and racial and ethnic status was obtained.

2.4.1. Stressful Life Events Screening Questionnaire (SLESQ; Goodman, Corcoran, Turner, Yuan, & Green, 1998)—It is a 13-item self-report measure that assesses exposure to PTEs (e.g., life-threatening accidents, sexual assault). Response options are dichotomous (yes/no). We added three additional items to address changes in *DSM-5* criteria for a Criterion A PTE. These items were: clarifying whether the participant directly witnessed the PTE rather than observing the PTE via media, whether there was repeated exposure to PTE details, and whether those details were obtained via the person's job or via the media (Elhai et al., 2012). The SLESQ had good psychometric properties (Goodman et al., 1998). Participants endorsing more than one PTE specified the most distressing PTE.

2.4.2. PTSD checklist for DSM-5 (PCL-5; Weathers et al., 2013)—The PCL-5 is a 20-item self-report measure that assesses severity of PTSD symptoms referencing the past

month. Response options range from 0 (Not at all) to 4 (Extremely). The PCL-5 has a recommended cut-off score of 31 or higher to identify probable PTSD diagnosis (Blevins, Weathers, Davis, Witte, & Domino, 2015; Bovin et al., 2016). The PCL-5 has excellent internal consistency reliability, good test-retest reliability, and good convergent and discriminant validity (Blevins et al., 2015; Bovin et al., 2016; Wortmann et al., 2016). In the current study, the Cronbach's α for the entire scale, and for the subscales of intrusions, avoidance, NACM, and AAR was 0.96, 0.90, 0.89, 0.92, and 0.87 respectively.

2.4.3. Smartphone Addiction Scale-Short Version (SAS-SV; Kwon, Kim, et al., 2013)—The SAS-SV is a 10-item self-report measure assessing problematic smartphone use. Response options range from 1 (Strongly disagree) to 6 (Strongly agree). The SAS-SV has a recommended cut of score of 31 and higher for males, and 33 and higher for females to identify smartphone addiction (Kwon, Kim, et al., 2013). The scale has good internal consistency, good concurrent validity, and value in identifying people with clinical levels of smartphone addiction (Akin, Altunda, Turan, & Akin, 2014; Kwon, Kim, et al., 2013). The item-level responses were summed to create a total SAS-SV score. Cronbach's α in the present sample was 0.91.

2.5. Data analyses

Primary analyses were conducted with Mplus 7.31 software and entailed two steps. First, we used Confirmatory Factor Analyses (CFA) to estimate fit of (1) the 4-factor *DSM-5* PTSD model consisting of intrusions, avoidance, NACM, and alterations in arousal and reactivity (AAR) using the PCL-5 items; and (2) combined PTSD - SAS-SV model. The SAS-SV items were modeled as an observed variable (summed score). Factor variances and error terms were scaled to 1. We used two-tailed tests and alpha was set to 0.05. We treated the PCL-5 items as continuously scaled. Based on benchmarks of skewness >2 and kurtosis >7 (Curran, West, & Finch, 1996), item-level PCL-5 and SAS-SV scores were normally distributed. Hence, we used the Maximum Likelihood (ML) estimator in Mplus. A well-fitting (adequate) model had a comparative fit index (CFI) and Tucker Lewis Index (TLI) values 0.95 (0.90–0.94), standardized root mean squared residual (SRMR) value 0.05 (0.06–0.08) and root mean square error of approximation (RMSEA) value 0.06 (0.07–0.08) (Hu & Bentler, 1999).

The next step entailed computing Wald chi-square tests of parameter constraints to test hypothesized relations between *DSM-5* PTSD factors and the SAS-SV variable. This test assesses the null hypothesis that the difference between two correlation paths is zero. We controlled for age and gender in regards to their relation with problematic smartphone use. Research has shown that problematic smartphone use is associated with younger age (Demirci et al., 2015; van Deursen et al., 2015) and being female (Jeong et al., 2016). To correct for multiple comparisons, we used the alpha of 0.01 to determine significance ($0.05/6 = 0.008$).

3. Results

In the current sample, total PCL-5 scores averaged 32.51 ($SD = 20.47$), and 47% of trauma-exposed participants ($n = 163$) met or exceeded the cut-off score for a possible diagnosis of

PTSD (Blevins et al., 2015; Bovin et al., 2016). CFA indicated an adequately-fitting *DSM-5* PTSD model per the majority of the fit indices, $\chi^2(164, N = 347) = 566.38, p < 0.001$, CFI = 0.92, TLI = 0.91, RMSEA = 0.08, SRMR = 0.04. Further, CFA indicated an adequately-fitting combined PTSD and SAS-SV model according to majority of the fit indices, $\chi^2(220, N = 347) = 690.27, p < 0.001$, CFI = 0.91, TLI = 0.90, RMSEA = 0.08, SRMR = 0.06.

Table 2 presents the correlations between PTSD symptom clusters and SAS-SV summed score; and results of Wald tests of parameter constraints. Overall, the SAS-SV summed score was significantly correlated with all PTSD symptom cluster scores; however, differences in the strength of the associations were found. The SAS-SV summed score was more related to PTSD's NAMC factor ($r = 0.39, p < 0.001$) than to PTSD's avoidance factor ($r = 0.23, p < 0.001$), Wald $\chi^2(1, N = 347) = 12.51, p = 0.0004$. Further, the SAS-SV summed score was more related to PTSD's AAR factor ($r = 0.41, p < 0.001$) compared to PTSD's avoidance factor, Wald $\chi^2(1, N = 347) = 14.89, p = 0.0001$. However, the strength of the association between SAS-SV summed score and the NAMC factor compared to the AAR factor was not statistically different.

Further, the SAS-SV summed score was marginally more related to PTSD's intrusions factor ($r = 0.32, p < 0.001$) compared to PTSD's avoidance factor, Wald $\chi^2(1, N = 347) = 5.61, p = 0.02$. Additionally, the SAS-SV summed score was marginally more related to PTSD's AAR factor compared to PTSD's intrusions factor, Wald $\chi^2(1, N = 347) = 4.97, p = 0.03$. Lastly, the strength of the association between the SAS-SV summed score and PTSD's NACM factor compared to PTSD's intrusions factor was not statistically different.

4. Discussion

Theoretical and empirical literature supports a link between PTSD symptoms and problematic smartphone use. The current study is the first study to quantify and compare the strength of latent-level associations between PTSD symptom clusters and problematic smartphone use. While the study is primarily exploratory, we did hypothesize that problematic smartphone use would have the strongest association with PTSD's NAMC symptom cluster compared to other PTSD symptom clusters. We found partial support for our hypothesis. Both the NAMC and the AAR factors had the strongest associations with problematic smartphone use compared to PTSD's avoidance factor. Additionally, our results probably support the negative reinforcement perspective linking excessive smartphone use and PTSD, and in particular the *impulsive pathway perspective*, which we discuss in detail below.

Results, first and foremost, indicated that all PTSD symptom clusters were significantly associated with problematic smart-phone use. These results are consistent with previous research indicating a relation between problematic smartphone use and different manifestations of psychopathology. As an example, previous studies have found that smartphone overuse may exacerbate the negative impact of stress by disrupting sleep (Rosen, Carrier, et al., 2016), or exacerbating baseline anxiety when the cellphone is out of reach (Cheever et al., 2014). It may be that both excessive smartphone use and PTSD are

driven by a common underlying liability towards anxiety (Lepp, Barkely, & Karpinski, 2013).

Excessive smartphone use may also function similar to other addictive behaviors in relation to PTSD subscale severity. For instance, problematic smartphone use may function to manage emotional dysregulation (Elhai, Levine, Dvorak, & Hall, 2016) especially associated with PTSD severity (Weiss, Tull, Viana, Anestis, & Gratz, 2012), and may serve as a strategy to experientially avoid negative emotions and thoughts related to traumatic events (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004). Problematic smartphone use may be used to dampen distressing intrusive memories of the traumatic events; or may be used to ease physiological arousal (Stewart, Pihl, Conrod, & Dongier, 1998). However, in the long-run problematic smartphone use may exacerbate PTSD symptom severity, similar to the relation between excessive alcohol use and *DSM-IV* PTSD's dysphoria symptoms (akin to *DSM-5* NACM symptoms) (Biehn et al., 2016). Thus, smartphone use may interface with PTSD symptom severity in complex ways. Alternatively, the significant correlations between PTSD and smartphone misuse may be due to common underlying shared risk factors such as impulsivity, neuroticism, low self-esteem (Billieux, 2012; Elhai, Dvorak, et al., 2017), and sleep-related difficulties (Germain, 2013; Rosen, Carrier, et al., 2016). Future work is needed to test the potential mediating and moderating factors in the relation between PTSD symptom clusters and problematic smartphone use.

Prominently, the NACM symptoms demonstrated a strong association with problematic smartphone use. These findings probably align best with the *impulsive pathway perspective* (Billieux, 2012). Individuals experiencing NACM severity may react impulsively by excessively using their smartphones to mitigate their painful negative emotional states. We speculate that problematic smartphone use may be an impulsive act when experiencing NACM symptoms of negative emotional states (D4 criterion), social detachment (D6 criterion), and diminished interest in activities (D5 criterion) in particular. Such a coping strategy would parallel how depressed individuals use smartphones to cope with their low mood (Elhai et al., 2017). Previous literature that investigated the latent-level relations between NACM and impulsivity facets further supports the *impulsive pathway perspective*. The NACM symptom cluster was significantly correlated with negative urgency, a dimension of impulsivity characterized by the tendency to engage in impulsive behaviors in the context of intense negative emotions (Contractor, Armour, Forbes, et al., 2016).

The strong association between AAR symptoms and problematic smartphone, although unexpected, may be understood in terms of the *impulsive pathway perspective* as well. Individuals who are hypervigilant or easily startled because of their traumatic experiences may withdraw from potentially anxiety-provoking stimuli by over-focusing on their smartphones (Roberts, Pullig, & Manolis, 2015). Thus, smartphone misuse may be an externalized and distraction-based coping method to help traumatized individuals cope with physiological arousal and unpleasant internal/external stimuli (Baker et al., 2004). Further, the tendency to engage in impulsive sensation-seeking experiences is related to AAR symptom severity (Contractor, Armour, Forbes, et al., 2016) as well as problematic smartphone use (Roberts et al., 2015), suggesting these constructs may be related. Additionally, attention impulsiveness (i.e., AAR symptoms of difficulty concentrating) is

shown to facilitate cellphone addiction (Roberts et al., 2015). However, similar to other addictive behaviors (Stewart et al., 1998), it is possible that excessive use of smartphones may lead to other AAR symptoms such as sleep difficulties (Demirci et al., 2015). The causal nature of such a relationship is unknown and an important area of future research.

Noteworthy is that problematic smartphone use was not differentially related to intrusion symptoms compared to NACM and AAR symptoms. From the reinforcement model perspective, smartphone use may serve to deal with the stress of intrusive memories and physiological/psychological reactivity in response to trauma reminders. Supporting our results are findings from the addiction literature; addictive behaviors such as alcohol use strongly relate to intrusion symptoms of PTSD (Capone, McGrath, Reddy, & Shea, 2013; Contractor, Presseau, et al., 2016).

4.1. Implications

The current study results have several theoretical and clinical implications. First, our findings indicate that problematic smart-phone use is common among trauma survivors. Second, our findings suggest that different PTSD symptom clusters may differentially relate to problematic smartphone use; the strongest associations were found with the NACM and AAR symptom clusters. Thus, it would be helpful for clinicians to assess the nature and extent of smartphone use among trauma-exposed clients, especially those presenting with NACM and AAR symptom severity. Trauma-focused treatments may benefit from targeting the addictive nature of smartphone use similar to treatment targets for co-occurring PTSD-addictive behaviors including Seeking Safety (Najavits, 2002). Clients with co-occurring PTSD symptoms and problematic smartphone use may benefit from learning emotion regulation and distress tolerance skills (Skills Training in Affect and Interpersonal Regulation/Prolonged Exposure; Cloitre, Koenen, Cohen, & Han, 2002), as well as more effective coping strategies such as biofeedback to manage autonomic arousal and dysregulation (Zucker, Samuelson, Muench, Greenberg, & Gevirtz, 2009). It would be helpful for clinicians to be mindful of the potentially addictive nature of smartphone use, especially when ‘prescribing’ PTSD smartphone apps, such as PTSD coach for patient use. More research is needed to understand the potential unintended negative consequences of therapeutic smartphone use for patients with higher NACM and AAR severity. Lastly, results of the current study probably provide preliminary support for the impulsive pathway perspective underlying PTSD and problematic smartphone use; testing this model empirically is an area of future research.

4.2. Limitations and future research

The current study had a few limitations. First, data were self-reported which may result in over-estimated smartphone use (Boase & Ling, 2013; Kobayashi & Boase, 2012). Second, the MTurk subject pool has been criticized for being smaller and less diverse (Stewart et al., 2015). Third, data were cross-sectional, which precludes drawing conclusions about causal nature of the relationships between PTSD severity and smartphone misuse. Fourth, other relevant mental health constructs such as comorbid anxiety or neuroticism were not assessed.

Despite the aforementioned limitations, the current study is the first to explicate the relations among problematic smartphone use and PTSD symptom clusters, and thus provides preliminary data that may inform the development of targeted prevention and intervention efforts for reducing smartphone addiction in a trauma-exposed population. More information about potential mediating and moderating variables, such as emotion dysregulation and impulsivity, may further refine such treatments. We need future studies with multiple time points and examination of mediation and moderation models to untangle the potential bidirectional associations between PTSD severity and problematic smartphone use.

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Table 1Descriptive information on demographics and psychopathology constructs ($n = 347$).

Mean (SD)	
Age	33.60 (9.52)
Years of schooling	15.31 (2.43)
PTSD severity	32.51 (20.47)
SAS score	29.16 (11.99)
n (%)	
<i>Gender</i>	
Female	199 (57.70%)
Male	146 (42.30%)
<i>Employment status</i>	
Part time	59 (17.10%)
Full time	227 (65.80%)
Retired	7 (2%)
Unemployed	44 (12.80%)
Unemployed student	8 (2.30%)
<i>Relationship status</i>	
Single	123 (35.50%)
Living with significant other	51 (14.70%)
Married	149 (43.10%)
Divorced, separated, or widowed	23 (6.60%)
<i>Ethnicity</i>	
Hispanic or Latino	39 (11.30%)
Not Hispanic or Latino	296 (86%)
Unknown	9 (2.60%)
<i>Racial status</i>	
White	288 (83.20%)
Asian	36 (10.40%)
African American	22 (6.40%)
American Indian	16 (4.60%)
Native Hawaiian/other Pacific Islander	5 (1.40%)
Unknown	4 (1.20%)
<i>Annual Household Income</i>	
Less than \$15,000	40 (11.60%)
\$15,000 to \$24,999	47 (13.60%)

\$25,000 to \$34,999	55 (15.90%)
\$35,000 to \$49,999	53 (15.30%)
\$50,000 to \$64,999	53 (15.30%)
\$65,000 to \$79,999	34 (9.80%)
\$80,000 or higher	64 (18.50%)
<hr/>	
Probable PTSD (31)	163 (47%)
<hr/>	

Note.

* All reported percentages are *valid percentages* to account for missing data.

Table 2

Results of the Wald tests of Parameter Constraints.

Path	<i>r</i> (<i>p</i> value)	Path	<i>r</i> (<i>p</i> value)	Wald test (<i>p</i> value)
Intrusions with SAS-SV	0.32 *	Avoid with SAS-SV	0.23 *	5.61 (<i>p</i> = 0.02) ***
Intrusions with SAS-SV	0.32 *	NACM with SAS-SV	0.39 *	2.99 (<i>p</i> = 0.08)
Intrusions with SAS-SV	0.32 *	AAR with SAS-SV	0.41 *	4.97 (<i>p</i> = 0.03) ***
Avoid with SAS-SV	0.23 *	NACM with SAS-SV	0.39 *	12.51 (<i>p</i> = 0.0004) *
Avoid with SAS-SV	0.23 *	AAR with SAS-SV	0.41 *	14.89 (<i>p</i> = 0.0001) *
NACM with SAS-SV	0.39 *	AAR with SAS-SV	0.41 *	0.56 (<i>p</i> = 0.45)

Note.

*
p < 0.001;**
p < 0.01;***
p < 0.05; NACM = PTSD - negative alterations in mood and cognitions factor; Avoid = PTSD - avoidance factor; AAR = PTSD's alterations in arousal and reactivity factor; SAS-SV = Smartphone Addiction Scale-Short Version summed score.