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Posttraumatic Stress Disorder Symptoms and Reckless Behaviors: A Network Analysis Approach

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Abstract

Existing literature indicates a theoretical and empirical relation between engagement in reckless behaviors and posttraumatic stress disorder (PTSD). Thus, the *DSM-5* revision of the PTSD nosology added a new "reckless or self-destructive behavior" (RSDB) symptom (Criterion E2). The current study applied a network analytic approach to examine the item-level relations among a range of reckless behaviors and PTSD symptom clusters. Participants were recruited from Amazon's Mechanical Turk (N = 417), and network analysis was conducted with 20 variables: six PTSD symptom clusters, corresponding to the hybrid model of PTSD (Armour et al., 2015) and excluding the externalizing behavior cluster (Community 1), and 14 items related to reckless behavior (Community 2). The results showed that the network associations were strongest within each construct (i.e., within PTSD and within reckless behaviors), although several bridge connections (i.e., between PTSD clusters and reckless behaviors) were identified. Most reckless behavior items had direct associations with one or more PTSD symptom clusters. The present findings support the existence of close relation between a variety of reckless behaviors and PTSD symptom clusters beyond their relations with Criterion E2. The results provide testable hypotheses about the associations between specific reckless behaviors and PTSD symptom clusters, which may inform future research.

Posttraumatic Stress Disorder Symptoms and Reckless Behaviors: A Network Analysis Approach

The fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-5*; American Psychiatric Association [APA], 2013) introduced significant changes to the conceptualization and diagnosis of posttraumatic stress disorder (PTSD). One major change was the inclusion of a new "reckless or self-destructive behavior" symptom (Criterion E2), which stimulated interest in the associations between reckless behaviors and PTSD symptomatology; the examination of these associations is the focus of the current study. The *DSM-5* does not provide a clear definition of reckless or self-destructive behaviors. Instead, it provides a few examples of these behaviors, including "dangerous driving, excessive alcohol or drug use, or self-injurious or suicidal behavior" (APA, 2013; p. 275). In the current study, we define reckless and self-destructive behaviors as deliberate acts, with potentially negative consequences (Ben-Zur & Zeidner, 2009), in which an individual engages with the aim of avoiding, escaping, or distracting themselves from trauma-related emotional or cognitive states (Cooper, Agocha, & Sheldon, 2000; Pat-Horenczyk et al., 2007). Examples of reckless behaviors include substance use, disordered eating, self-harm and suicidal behavior, problematic technology use, risky sexual behavior, among others. Such reckless behaviors can arise, alongside other symptoms, in response to traumatic events (Green et al., 2005), and engagement in reckless behaviors can increase the risk an individual will experience subsequent traumatic events (Lusk, Sadeh, Wolf, & Miller, 2017). Research has supported the relation between reckless behaviors and PTSD diagnosis (Weiss, Tull, Viana, Anestis, & Gratz, 2012) as well as PTSD severity (Contractor, Weiss, Dranger, Ruggero, & Armour, 2017; Lusk et al., 2017; Pat-Horenczyk et al., 2007; Strom et al., 2012; Weiss, Tull, Borne, & Gratz, 2013). Different reckless behaviors serve different

functions, which could explain their heterogeneous associations with PTSD symptom clusters. For example, suicide attempts have been shown to be associated with reexperiencing and avoidance-related PTSD symptoms (Selaman, Chartrand, Bolton, & Sareen, 2014), whereas aggression and delinquency have been most strongly related to the arousal symptom cluster, specifically the symptoms related to externalizing behaviors, such as *DSM-5* Symptoms E1 and E2 (Cao, Wang, Cao, Zhang, & Elhai, 2017).

Several theories have been proposed to account for the associations among traumatic experiences, PTSD, and reckless behaviors. For example, the self-medication hypothesis posits that reckless behaviors such as substance use help to relieve PTSD symptoms (Bremner, Southwick, Darnell, & Charney, 1996; Leeies, Pagura, Sareen, & Bolton, 2010). Similarly, emotion dysregulation has been suggested to account for the relations between PTSD and reckless behaviors because engaging in reckless behaviors may serve to alleviate the distress related to aversive emotional states (Weiss et al., 2012) or elicit, maintain, or enhance positive emotional states (Ben-Zur & Zeidner, 2009). Additionally, the disinhibition view of impulsivity postulates that early, prolonged, or severe trauma and PTSD may disrupt inhibitory processes, thereby increasing the likelihood that an individual with PTSD will act out on impulses (Braquehais, Oquendo, Baca-García, & Sher, 2010). Finally, according to the compulsive reexposure hypothesis, trauma survivors may seek out risky situations, as they provide levels of arousal similar to those experienced during the original trauma (Joseph, Dalgleish, Thrasher, & Yule, 1997; van der Kolk, 1989). Indeed, preliminary evidence supports the existence of a "reckless behaviors" subtype of PTSD (Contractor & Weiss, 2019).

Despite this robust theoretical foundation for the association between PTSD and reckless behaviors, there is a gap in the literature regarding the examinations of the associations between

specific reckless behaviors and PTSD symptoms, particularly with PTSD symptoms beyond the Criterion E2. Given the heterogeneity in reckless behaviors and PTSD symptoms, it is critical to understand the fine-grained associations within and between both constructs. Specifically, it is important to examine whether specific reckless behaviors are related to specific PTSD symptoms and/or symptom clusters as well as whether the associations between reckless behaviors and PTSD are solely due to their overlap with PTSD's Criterion E2 or if reckless behaviors are also related to other PTSD symptoms and/or symptom clusters. This has important implications for clinical practice, in which patients who present with high elevations of specific PTSD symptomatology could be further assessed for their engagement in reckless behaviors, as the elimination or reduction of these behaviors could potentially contribute to reduced functional impairment as well as reduced chances of bodily harm to the self and others. Further, a detailed examination of reckless behaviors related to PTSD is important, as the engagement in these behaviors may be associated with more comorbidity (Contractor, Weiss, Dranger, et al., 2017), decreased effectiveness of PTSD interventions (Tarrier, Sommerfield, Pilgrim, & Faragher, 2000), and even threat to one's life through dangerous driving, substance overdose, and suicidal behaviors.

Such important questions can be addressed using the network analytic approach to psychopathology (Armour, Fried, & Olff, 2017). A network consists of nodes that represent individual variables (i.e., symptoms or constructs), and these are connected by edges representing the strength of the associations between variables (Borsboom & Cramer, 2013). By utilizing a network approach, it becomes possible to identify specific connections between symptoms and/or symptom clusters of a disorder, such as PTSD, and related external constructs, such as reckless behaviors, while controlling for the effects of all other variables in the network.

To date, no network analytic study of which we are aware has examined the relations between a variety of reckless behaviors and specific PTSD symptoms and/or symptom clusters. One study examined the association between PTSD and one form of reckless behaviors—risky sexual behavior (Choi, Batchelder, Ehlinger, Safren, & O'Cleirigh, 2017). In a United States–based sample of 296 men who have sex with other men, the authors found that the strongest connection between PTSD, as diagnosed using criteria from the fourth edition of the *DSM* (*DSM-IV*), and risky sexual behavior was through PTSD Symptom C1: avoidance of memories, thoughts, and feelings related to the traumatic event. The authors concluded that these results underscored the importance of including skills that increase mindfulness and tolerance of distressing memories in interventions for PTSD (Choi et al., 2017).

Addressing the knowledge gap in the existing literature, the current study utilized network analysis to explore the associations among different types of reckless behaviors and PTSD symptom clusters. Due to the relatively small sample size and to facilitate meaningful interpretation of findings, we utilized PTSD symptom clusters, as opposed to PTSD symptoms, as nodes in the network. To date, the most heterogeneous model of PTSD with good empirical support has been the seven-factor hybrid model (Armour et al., 2015), which consists of intrusions, avoidance, negative affect, anhedonia, externalizing behaviors, anxious arousal, and dysphoric arousal symptom clusters (see Table 1). In several factor analytic studies, the hybrid model has outperformed other models, including the four-factor *DSM-5* model (e.g., Contractor et al., 2018; Ito, Takebayashi, Suzuki, & Horikoshi, 2019), and several studies have shown the hybrid model's factors to have differential associations with external variables (e.g., Liu, Wang, Cao, Qing, & Armour, 2016; Zelazny & Simms, 2015) and substantial construct equivalence across compared subgroups (Contractor, Caldas, et al., 2019). Utilizing the seven-factor hybrid

model of PTSD rather than the 20 individual PTSD items reduces the number of parameters to be estimated in the network, which may increase the accuracy and stability of the estimated network when sample sizes are small (Epskamp, Borsboom, & Fried, 2018; Epskamp, Kruis, & Marsman, 2017). At the same time, compared with models that consist of fewer symptom clusters (e.g., the four-factor *DSM-5* model; APA, 2013), the hybrid model, with its seven symptom clusters, provides an opportunity to examine the more fine-grained associations between PTSD and reckless behaviors. When examining the relations among reckless behaviors and PTSD in the current study, we looked specifically at bridge connections between PTSD and reckless behaviors by examining bridge centrality of the individual items in the network. Bridge connections are the direct pathways between specific variables that belong to different constructs or disorders (e.g., PTSD and reckless behaviors). They are commonly used to examine comorbidity between disorders. Items with the highest bridge strength values are the ones with the most and/or the strongest interconstruct connections. To the best of our knowledge, this study represents the first network analysis of PTSD and a comprehensive set of items related to reckless behaviors.

Method

Participants and Procedure

Participants were recruited using Amazon's (Seattle, Washington) Mechanical Turk (MTurk) platform. Research has indicated that the MTurk subject pool is quite diverse when compared with traditional internet-recruited samples (Buhrmester, Kwang, & Gosling, 2011), is representative of the general population in terms of demographic characteristics (Mischra & Carleton, 2017), and generates reliable data (Shapiro, Chandler, & Mueller, 2013). Potential participants aged 18 years and older were screened for three inclusionary criteria: (a) living in

North America; (b) working knowledge of the English language; and (c) having experienced a traumatic event, as screened using the Criterion A question of the Primary Care PTSD Screen for *DSM-5* (Prins et al., 2015). Eligible participants who provided informed consent and completed the survey, which was hosted on the Qualtrics data collection platform, were compensated $1.25 (USD) for study participation. The institutional review board of the University of North Texas approved the current study.

We initially obtained 891 responses. There were 18 potential participants attempted to answer the questionnaire more than once, and duplicate responses were excluded (47 responses; effective n = 844). We further excluded 150 participants who did not meet inclusionary criteria as well as 122 participants who failed any of the four validity checks that were interspersed in the questionnaire to ensure attentive responding and comprehension (Meade & Craig, 2012; Oppenheimer, Meyvis, & Davidenko, 2009; Thomas & Clifford, 2017). Additionally, we excluded 97 participants who were missing data on all measures and 11 participants who did not endorse a traumatic event on the Life Event Checklist for *DSM-5* (LEC-5; Weathers, Blake, et al., 2013). Finally, we excluded 47 participants who were missing more than 30% of item-level data on the PTSD Checklist for *DSM-5* ([PCL-5] i.e., six items or more; Weathers, Litz, et al., 2013) or the Posttrauma Risky Behaviors Questionnaire ([PRBQ] i.e., five items or more; Contractor, Weiss, Kearns, Caldas, & Dixon-Gordon, 2019). The final effective sample size was 417 participants. See Table 2 for descriptive demographic information.

Measures

Demographic information. Information regarding age, gender, income, educational attainment, employment status, relationship status, and racial/ethnic status was obtained.

Traumatic event exposure. The LEC-5 (Weathers, Blake, et al., 2013) is a 17-item self-report measure used to assess exposure to traumatic experiences. Individuals can endorse items on a 6-point nominal scale by indicating their degree of exposure to the event using responses including *happened to me*, *witnessed it*, *learned about it*, *part of my job*, *not sure*, or *doesn't apply*.

PTSD symptoms. The PCL-5 (Weathers, Litz, et al., 2013) is a 20-item self-report measure used to assess the severity of past-month PTSD symptoms related to the most distressing traumatic event endorsed on the LEC-5. Response options range from 0 (*not at all*) to 4 (*extremely*). The PCL-5 has demonstrated excellent psychometric properties (Blevins, Weathers, Davis, Witte, & Domino, 2015; Bovin et al., 2016; Wortmann et al., 2016), and a cutoff score 33 has been suggested to indicate probable PTSD diagnosis (Weathers, Litz, et al., 2013). In the current sample, the internal consistency of the PCL-5 was excellent, Cronbach's $\alpha = .96$. We calculated the mean scores for each of the hybrid model factors, and these were used as nodes in the network.

Risky behaviors. The PRBQ (Contractor, Weiss, et al., 2019) is a 16-item self-report measure developed to assess PTSD Criterion E2. The current study utilized the first 14 items of the PRBQ, which assess the extent to which an individual has engaged in specific reckless behaviors in the past month, including problematic alcohol use, drug use, gambling, technology use, disordered eating behaviors; impulsive or risky sexual behaviors; illegal behaviors (e.g., arson, burglary, illegal prostitution); reckless spending; physically or verbally aggressive behaviors; property destruction (e.g., deliberately smashing dishes, breaking furniture, or wrecking someone's cellphone, car, home, or other personal belongings); reckless driving (e.g., road rage, excessive speeding); deliberate nonsuicidal self-harm; and suicidal behaviors. The

stem instruction for the PRBQ is "In the past 30 days, how often have you engaged in the following behaviors?", and various example items are listed within each main category as shown above. The response options range from 0 (*never*) to 4 (*very frequently*), and the 14 items can be summed for a total score. The PRBQ has demonstrated excellent internal consistency and good convergent and construct validity (Contractor, Weiss, et al., 2019). In the current study, the Cronbach's alpha value was .94.

Data Analysis

Network models depict the estimated links, known as "edges," between variables, known as "nodes." The edge weight depicts the strength of these associations by the thickness of the edge, with thicker edges indicating a stronger association. In the current study, the 20 nodes in the network comprised six of the seven symptom clusters in the hybrid model of PTSD (see Table 1) and 14 different items related to reckless behaviors. We excluded the externalizing behaviors PTSD cluster as this comprises aggressive behavior (Criterion E1) and reckless behavior (Criterion E2), both of which are captured and expanded upon by the 14-item PRBQ. We also estimated an expanded network of 18 individual PTSD symptoms, excluding Criteria E1 and E2, and 14 reckless behaviors (see Supplementary Materials). For this expanded network, there were 528 parameters that needed to be estimated, and, given that the current sample size was 417 (i.e., fewer than one observation per parameter), we did not include these results in the main manuscript.

We used the *bootnet* package in R to estimate a regularized partial correlation network structure (EBIC Glasso: codes available in the Supplementary Materials), in which the associations between pairs of nodes are estimated after having controlled for the effects of all other nodes in the network (Epskamp & Fried, 2018). We computed Spearman correlations due

to the skewed distribution of some of the variables. We used graphical LASSO and extended Bayesian information criterion (BIC) to select the optimal regularization parameter to estimate a sparse network and reduce the chances of identifying spurious correlations. The layout of the network was based on the Fruchterman-Reingold algorithm, which places strongly correlated nodes more closely together and more weakly connected nodes further apart (Fruchterman & Reingold, 1991). The network was estimated using all pairwise observations (i.e., all available data). Edge weights refer to the regularized partial correlation coefficients between pairs of nodes.

In the current study, we focused on the edges that connected the PTSD symptom clusters to reckless behavior–related items; these intercommunity connections are known as bridge connections (Jones, Mair, Riemann, Mugno, & McNally, 2018). We use the term "communities" to indicate a conceptual group rather than a statistical group. We used the *networktools* R package to calculate the bridge strength for these networks. The bridge strength of a given node refers to the sum of the absolute edge weight values of all the intercommunity edges that node has. For example, if a PTSD item is connected to (i.e., has direct edges with) two reckless behavior items, its bridge strength value will be the sum of the absolute values of these two edge weights. As there were six PTSD cluster nodes, compared with 14 reckless behavior nodes, the range of potential bridge strength values between these two communities of nodes is not equivalent—the PTSD clusters have more than twice the potential bridge connections with reckless behavior items (14 possible connections) versus the reverse (six possible connections of reckless behavior items with the PTSD clusters). To be able to directly compare bridge strengths, we therefore adjusted the bridge strength values for the PTSD factor nodes by multiplying them by 6/14 (Greene, Gelkopf, Fried, Robinaugh, & Lapid Pickman, 2019).

To check the accuracy and stability of the network, we conducted additional analyses as recommended by Epskamp et al. (2018). First, we bootstrapped the edge weights (Supplementary Figure 1) and tested for significant differences between edge weights (Supplementary Figure 2). In addition, we investigated the stability of the strength centrality index (Supplementary Figure 3) and found it to have a correlation stability coefficient of .59, which is above the recommended threshold of .5 for the interpretation of differences in centrality.

Results

The most commonly endorsed trauma type was transportation accident, which was endorsed with a rating of *happened to me* by 200 participants (48.0%). This was followed by natural disaster (n = 149, 35.7%) and physical assault (n = 141, 33.8%). When considering only directly experienced traumas (i.e., *happened to me*), 53 (12.7%) participants endorsed no LEC-5 trauma types, 88 (21.1%) endorsed one, 80 (19.2%) endorsed two, and 196 (47.0%) endorsed three or more trauma types. Scores on the PCL-5 ranged from 0 to 80, with a mean score of 25.16 (SD = 20.34). Of the 53 participants who did not endorse having directly experienced trauma, all endorsed an indirect trauma (*witnessed it*, *learned about it*, or *part of my job)*; thus, their responses were included in the analyses. A total of 150 participants (36.0%) scored above the cutoff for probable PTSD. The means and standard deviations for the individual items included in the network are presented in Table 3.

Figure 1 shows the full network, and Figure 2 indicates the network containing only the bridge connections. Figure 3 shows the adjusted bridge strength values for each node. The regularized partial correlation matrix is presented in Supplementary Table 1. The network model shown in Figures 1 and 2 indicates that the two communities of nodes, or constructs, each cluster

together reasonably well, with the strongest connections in the network demonstrated within constructs rather than between the two constructs. Nevertheless, there were many bridge connections in this network (see Supplementary Table 1); the pairs of nodes with the strongest relative bridge connections were: dysphoric arousal and problematic use of technology, edge weight = 0.08; anhedonia and suicidal behavior, edge weight = 0.07; dysphoric arousal and avoidance, edge weight = 0.06; dysphoric arousal and verbal aggression, edge weight = 0.06; anxious arousal and problematic technology usage, edge weight = 0.06; dysphoric arousal and problematic spending, edge weight = 0.05; and anxious arousal and problematic spending, edge weight = 0.05. The results of the edge weight bootstrap (Supplementary Figure 1) and tests of significant differences between edge weights (Supplementary Figure 2) indicated that many of the intercommunity edge weights did not significantly differ from each other. Therefore, the order of the bridge connections should be interpreted somewhat cautiously.

Although most of the bridge connections in the network were positive, the association between avoidance and illegal behavior was negative, edge weight = -0.05. In other words, having conditioned on all other nodes, the association was such that lower levels of avoidance were associated with higher levels of illegal behavior and vice versa. One other weaker negative bridge connection was found: between reckless driving and avoidance, edge weight = -0.01.

As shown in Figure 3, there were some reckless behaviors with relatively high adjusted bridge strengths. Notably, these were (in descending order of strength): reckless spending, adjusted bridge strength (ABS) = 0.16; problematic use of technology, ABS = 0.14; and verbal aggression, ABS = 0.12. The PTSD symptom cluster with the highest adjusted bridge strength was dysphoric arousal, ABS = 0.10, which was followed by avoidance, ABS = 0.06; anxious arousal, ABS = 0.05; intrusions, ABS = 0.05; negative affect, ABS = 0.04; and anhedonia, ABS

= 0.04. Of all the nodes, only property destruction, deliberate nonsuicidal self-harm, and impulsive or risky sexual behavior had no bridge connections; however, these nodes had strong intracommunity connections to other reckless behaviors in the network, so it could be that their associations with PTSD are indirect and mediated through other nodes.

Discussion

In the current study, we examined the network structure of PTSD and reckless behaviors to identify specific pathways between PTSD symptom clusters and a variety of reckless behaviors. The results showed that although PTSD and reckless behaviors clustered primarily within their respective communities, several bridge connections were identified. Reckless behaviors with the highest adjusted bridge strength included reckless spending, problematic use of technology, and verbal aggression. The PTSD symptom cluster with the highest bridge strength was dysphoric arousal. This means that of the 14 different reckless behaviors included, the three noted herein had the most or strongest direct associations with PTSD items. Similarly, out of the PTSD symptom clusters (excluding externalizing behaviors), the dysphoric arousal cluster had the most direct or strongest associations with the reckless behavior items.

Although our study was not designed to directly test the previously discussed theories that link PTSD and reckless behaviors, the present results are indeed consistent with these theories. For example, our finding of bridge connections between drug use and the two arousal symptom clusters supports the self-medication hypothesis, whereby substance use is thought to be employed as a coping strategy to alleviate symptoms of PTSD. In a previous study conducted with veterans of the Persian Gulf war, Shipherd, Stafford, and Tanner (2005) similarly found that arousal symptoms assessed at one time significantly predicted substance use assessed 6 months later. Our findings are also consistent with the emotion dysregulation theory, which similarly

postulates that reckless behaviors serve to alleviate distress and negative emotional states. We found several bridge connections between reckless behaviors and all six PTSD symptom clusters. Both the anhedonia and negative affect symptom clusters, which could be considered to comprise the "mood-based" PTSD symptoms, had bridge connections with reckless spending and suicidal behaviors. Reckless spending could serve as a temporary distraction from negative mood, whereas suicidal behaviors would constitute an extreme case of dealing with the negative emotional state. This latter finding is consistent with prior evidence of the association between suicidal ideation and the PTSD emotional numbing cluster (Brown, Contractor, & Benhamou, 2018; Carragher et al., 2016) and stresses the importance of querying about suicidal ideation and behaviors, particularly if patients present with elevated symptoms of emotional numbing. Finally, some support for the compulsive reexposure theory of the association between PTSD and reckless behaviors, which states that individuals seek out risky situations in order to approximate the levels of arousal experienced during the original trauma exposure, comes from our finding of several bridge connections between the arousal symptom clusters and different reckless behaviors. It would be useful for future studies to be designed in ways that provide more direct tests of these theories. Looking at the more fine-grained associations among PTSD and reckless behaviors, our results showed that the dysphoric arousal symptom cluster, which had the highest bridge strength, had direct intercommunity connections with problematic use of technology, verbal aggression, reckless spending, and problematic drug use, with the strongest connection being with problematic technology use. This finding is not surprising, considering the well-established relation between screen time and sleep disruption, which is a symptom found within the dysphoric arousal cluster (Levenson, Shensa, Sidani, Colditz, & Primack, 2016; Twenge, Krizan, & Hisler, 2017). This finding also has important clinical implications: Patients

presenting with elevations of the dysphoric arousal symptoms (*DSM-5* PTSD Criteria E5 and E6) should be further assessed in relation to their engagement in a variety of reckless behaviors, as high levels of dysphoric arousal symptoms could suggest the likely presence of such reckless behaviors. Some of these behaviors could, in turn, potentially decrease the effectiveness of PTSD interventions (Perconte & Griger, 1991; Tarrier et al., 2000) or even endanger the patient's life.

Reckless spending, problematic technology use, and verbal aggression were the reckless behaviors with the highest bridge strength centrality. These findings concur with previous research that identified strong relations between PTSD severity and problematic technology use, specifically smartphone addiction (Contractor, Weiss, Tull, & Elhai, 2017). It has been suggested that PTSD and problematic smartphone use share common risk factors (Contractor, Frankfurt, Weiss, & Elhai, 2017), such as low self-esteem, impulsivity, and neuroticism. A strong association has also been reported between PTSD severity and verbal aggression (Byrne & Riggs, 1996), and levels of verbal aggression have been found to be higher in women with compared to without PTSD (Kirby et al., 2012). Reckless spending, on the other hand, could be a way of coping with the emotional distress associated with PTSD, as impulsive or self-indulgent behaviors have been found to be conscious efforts aimed at affect regulation (Tice, Bratslavsky, & Baumeister, 2001).

Another noteworthy finding is the relatively strong negative bridge connection between the avoidance symptom cluster and the illegal behaviors item, meaning that after controlling for the effect of the other PTSD clusters, individuals with high rather than low ratings of avoidance symptoms were less likely to engage in illegal behavior. This finding contrasts with previous research that has shown a history of illegal activity to be linked with higher levels of avoidance (Donley et al., 2012). It is possible that this unexpected association reflects sex differences, as

women are more likely to report higher levels of avoidance (Guina, Nahhas, Kawalex, & Farnsworth, 2016) and less likely to engage in illegal behaviors compared to men (Snyder, 2011). It is also possible that different reckless behaviors serve different functions (Weiss, Tull, Dixon-Gordon, & Gratz, 2018), which is supported in our results by different bridge connections between different reckless behaviors and PTSD symptom clusters.

All reckless behavior items except for property destruction, deliberate nonsuicidal self-harm, and impulsive or risky sexual behavior had direct bridge connections with one or more PTSD symptom clusters. These three behaviors, however, had strong intracommunity connections with other reckless behaviors, and some of these behaviors may therefore be associated with PTSD indirectly through other reckless behaviors. The strong intracommunity connections support previous literature showing that reckless behaviors rarely occur in isolation (Calvert, Bucholz, & Steger-May, 2010; Huang, Lanza, Murphy, & Hser, 2012; Vassallo et al., 2008).

Another important note is that the original PRBQ was developed with the idea that a latent construct of reckless behaviors underlies the different types (i.e., levels) as indicated by the different PRBQ items. In line with this notion, there is evidence for a unidimensional construct of reckless behaviors as measured by the PRBQ (Contractor , Weiss, et al., 2019) as well as other measures (Shaw, Wagner, Arnett, & Aber, 1992; Weiss et al., 2018). The results of the current study also provide further evidence of the potential unified nature of the reckless behaviors construct as indicated by the large number of strong intercommunity associations between the PRBQ items.

The current study was cross-sectional in nature, and it will be important to replicate the results with time-series data to learn more about the temporal interactions between reckless

behaviors and PTSD symptoms; however, in the meantime, the findings may inform future research by generating testable hypotheses about the close relations between specific risky behaviors and PTSD symptom clusters. For example, studies could examine whether the association between PTSD and risky sexual behavior, which had no direct bridge connection, is fully mediated by other reckless behaviors, such as problematic alcohol and drug use, which did have direct bridge connections to PTSD.

The present findings must be considered in light of study limitations. As previously mentioned, we used cross-sectional data to examine the association between PTSD and reckless behaviors, which did not allow us to identify potentially causal relations. Indeed, previous studies have shown that the relation between trauma exposure and engagement in reckless behaviors may be bidirectional (Green et al., 2005; Lusk et al., 2017). Second, data were collected using self-report measures and should be replicated with clinical interviews. Third, due to the relatively small sample size, we focused on PTSD symptom clusters rather than the individual PTSD symptoms, which precluded us from establishing the specific PTSD symptom-level–reckless behavior associations. Fourth, to improve the MTurk data quality, we used validity checks and excluded individuals who were missing too much data (Aust, Diedenhofen, Ullrich, & Musch, 2013; Buhrmester et al., 2011; Oppenheimer et al., 2009). Further, the extent of our sample truncation (48%) is comparable to what has been reported in other MTurk trauma studies (i.e., 57%; van Stolk-Cooke et al, 2018). However, such procedures could have created a potential selection bias in our study, which may limit the generalizability of findings. Additionally, due to the nature of the exclusion procedures, we were unable to compare the subsample of excluded individuals to those included in the study on demographics and psychopathology variables because the subsample of excluded individuals may have been

missing complete data or part of the data. We acknowledge that we were unable to examine the influence of exclusion on the study findings. Fifth, our sample was heterogeneous in terms of traumatic exposure, and the relatively small sample size did not allow us to look at the potential role of different types of traumatic experiences in the associations among PTSD symptom clusters and reckless behavior. One previous study found some differences in the PTSD network structure across three different trauma types: motor vehicle accident, sexual assault, and sudden accidental or violent death of a loved one (Benfer et al., 2018). It is possible that differences in trauma history could explain the specific bridge connections between PTSD and reckless behaviors. Finally, endorsement rates for each construct could influence why some associations that might have been expected did not emerge (e.g., self-harm).

The current study was the first to use network analysis to examine the relations among PTSD and reckless behaviors. Eleven of the 14 assessed reckless behaviors had direct bridge connections to at least one PTSD symptom cluster, and all PTSD symptom clusters were connected to at least one type of reckless behavior. Such findings suggest that several different PTSD symptoms are associated with several different reckless behaviors. Reckless behavior items with the highest bridge strength included reckless spending, problematic technology use, and verbal aggression. The PTSD symptom cluster with the highest bridge strength was dysphoric arousal. Future research focusing specifically on these behaviors and on the dysphoric arousal symptom cluster could be invaluable when designing interventions for patients who present with PTSD and reckless behaviors.

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Table 1

Symptom clusters in the DSM-5 Seven-Factor Hybrid Model (Armour et al., 2015) of Posttraumatic Stress Disorder

Symptom Cluster and Symptom
Intrusions
B1: Intrusive memories
B2: Nightmares
B3: Flashbacks
B4: Emotional reactivity
B5: Physical reactivity
Avoidance
C1: Avoiding memories, thoughts, or feelings
C2: Avoiding external reminders
Negative affect
D1: Amnesia
D2: Negative cognitions
D3: Blame
D4: Negative emotions
Anhedonia
D5: Loss of interest
D6: Detachment
D7: Anhedonia
Externalizing behaviors[a]

E1: Anger

E2: Risky behaviors

Anxious arousal

E3: Hypervigilance

E4: Exaggerated startle

Dysphoric arousal

E5: Concentration difficulties

E6: Sleep difficulties

Note. [a]Excluded from analyses.

Table 2

Sample Characteristics

Variable	*M*	*SD*	*n*	%[a]
Age (years)[b]	35.92	11.14		
Educational attainment (years)	15.27	2.38		
PCL-5 score	25.16	20.34		
Risky behaviors score	7.04	9.79		
Gender				
Female			236	56.6
Male			174	41.7
Transgender or other			7	1.3
Employment status				
Part time			65	15.6
Full time			297	71.2
Unemployed			34	8.2
Unemployed student			8	1.9
Retired			13	3.1
Relationship status				
Not in a committed relationship			97	23.6
In a committed relationship (not married)			104	24.9
Married			183	43.9
Divorced, separated, or widowed			33	7.9
Race				

White	320	76.7
Asian	45	10.8
African American	40	9.6
American Indian or Alaskan Native	19	4.6
Native Hawaiian/other Pacific Islander	3	0.7
Ethnicity		
Hispanic or Latino	56	13.4
Not Hispanic or Latino	354	84.9
Unknown	79	1.7
Income (USD)		
< $15,000	41	9.8
$15,000–$24,999	54	12.9
$25,000–$34,999	64	15.3
$35,000–$49,999	56	13.4
$50,000–$64,999	79	18.9
$65,000–$79,999	37	8.9
≥ $80,000	86	20.6

Note. PCL-5 = Posttraumatic Stress Disorder Checklist for *DSM-5*. [a]All reported percentages are valid percentages to account for missing data. [b]Age range: 18–72 years.

Table 3

Means and Standard Deviations of the Items in the Network

Item in the network	*M*	*SD*
Reckless behavior		
Problematic alcohol use	0.72	1.10
Problematic drug use	0.56	1.09
Problematic gambling	0.35	0.82
Problematic technology use	0.91	1.14
Impulsive or risky sexual behavior	0.36	0.83
Problematic eating behavior	0.83	1.14
Illegal behaviors	0.32	0.84
Reckless spending	0.71	1.04
Physically aggressive behavior	0.35	0.81
Verbally aggressive behavior	0.58	1.00
Property destruction	0.30	0.78
Reckless driving	0.39	0.87
Deliberate non-suicidal self-harm	0.38	0.92
Suicidal behavior	0.29	0.76
PTSD symptom cluster		
Intrusions	1.33	1.10
Avoidance	1.50	1.28
Negative affect	1.24	1.11
Anhedonia	1.18	1.24

Anxious arousal	0.43	0.42
Dysphoric arousal	1.28	1.22

Note. PTSD = posttraumatic stress disorder.

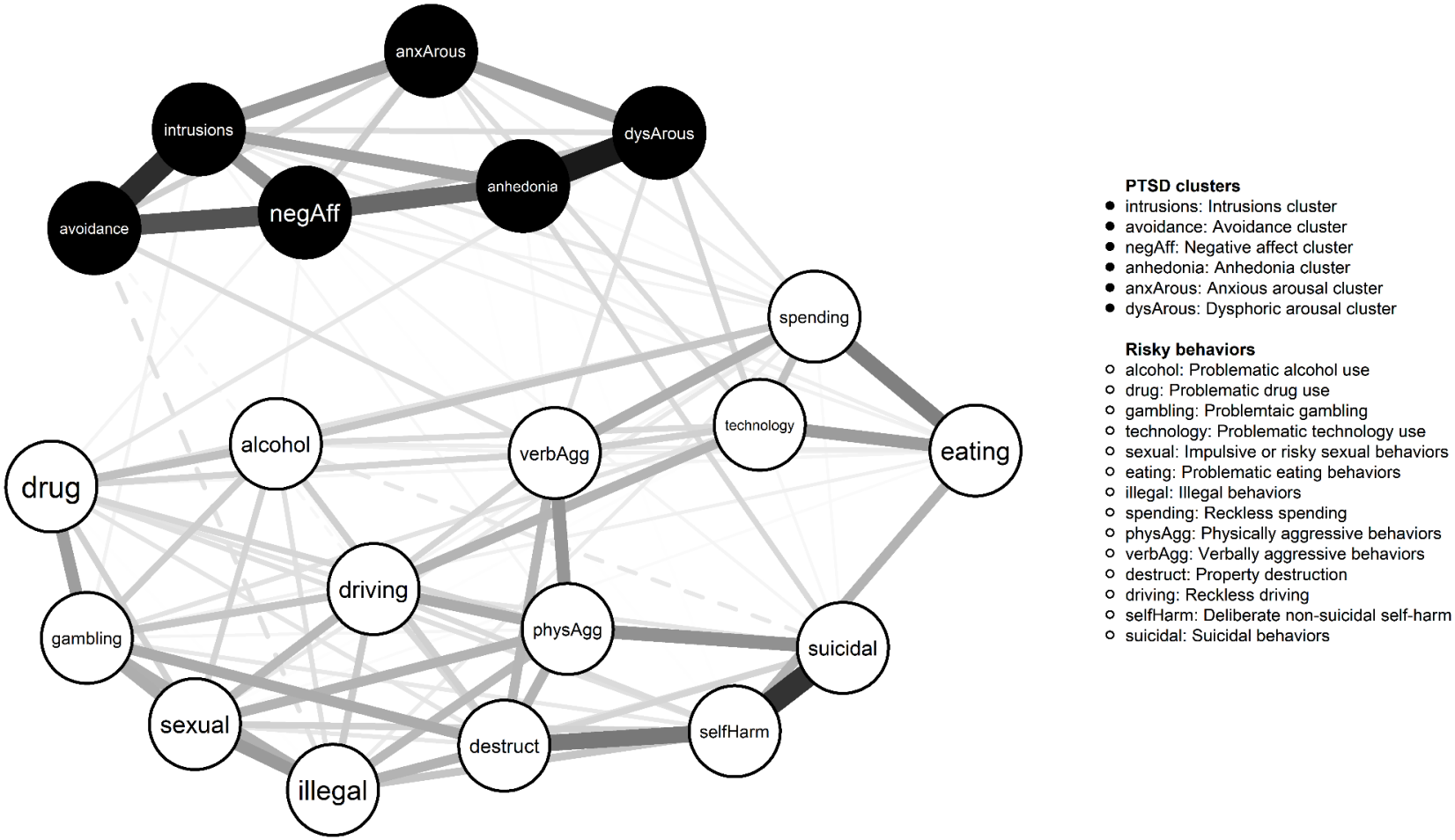

Figure 1. Full regularized partial correlation network. Posttraumatic stress disorder (PTSD) clusters are depicted in black, and reckless behavior items are depicted in white. Solid lines represent positive associations, and dashed lines represent negative associations. Line thickness represents association strength.

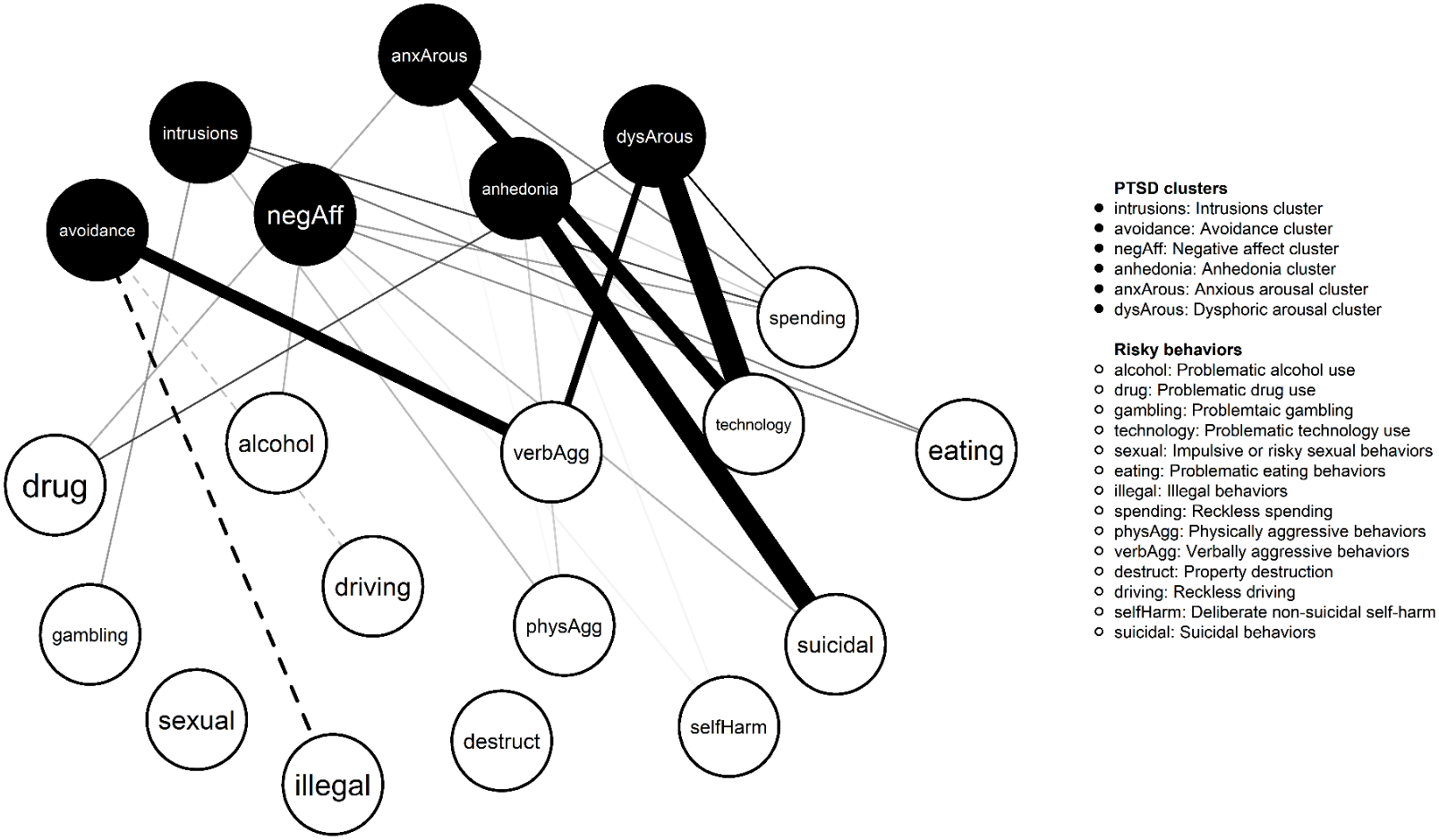

Figure 2. Network depicting only bridge connections. Posttraumatic stress disorder (PTSD) clusters are depicted in black, and reckless behavior items are depicted in white. Solid lines represent positive associations, and dashed lines represent negative associations. Line thickness represents association strength.

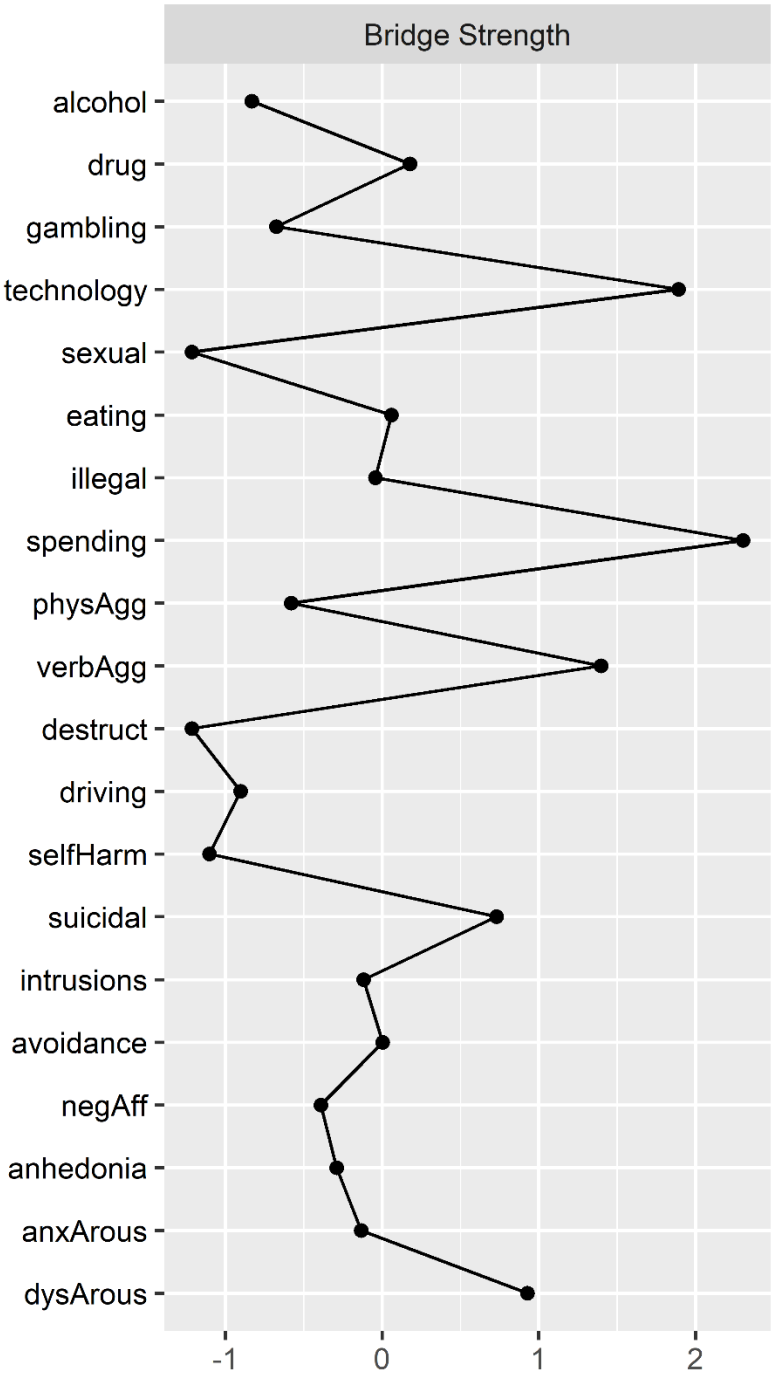

Figure 3. Adjusted bridge strength (standardized scores). alcohol = Problematic alcohol use; drug = Problematic drug use; gambling = Problematic gambling; technology = Problematic technology use; sexual = Impulsive or risky sexual behaviors; eating = Problematic eating

behaviors; illegal = Illegal behaviors; spending = Reckless spending; physAgg = Physically aggressive behaviors; verbAgg = Verbally aggressive behaviors; destruct = Property destruction; driving = Reckless driving; selfHarm = Deliberate non-suicidal self-harm; suicidal = Suicidal behaviors