Identifying Bridge Symptoms Between Borderline Personality Disorder and Posttraumatic Stress Disorder:

A Network Analysis From a National Cohort

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Abstract

Objective: Borderline personality disorder (BPD) and posttraumatic stress disorder (PTSD) share common risk factors, including exposure to traumatic events. We aim to estimate networks of *DSM-IV* BPD and PTSD to describe the interactions between the symptoms of these 2 disorders and identify bridging symptoms between the 2 diagnoses that may play critical roles in their co-occurrence.

Methods: We performed a network analysis of data from the second wave of the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC 2004–2005), a nationally representative sample of the US adult population. We calculated network stability using a bootstrap method and centrality measures for each symptom across 3 different network estimations.

Results: The networks were very stable. The symptom "chronic feelings of emptiness" was the most central in the BPD network. The symptoms "feeling of intense fear or horror" and "recurrent and intrusive memories of the traumatic event" were the most central in the PTSD network. The symptoms "self-aggression," "severe dissociation," "chronic feelings of emptiness," and "feelings of detachment" had significantly higher bridge expected influence than most other symptoms in the network in both the full sample and the subsample of participants who responded to all PTSD and BPD symptoms.

Conclusion: Self-aggression, chronic feelings of emptiness, dissociation symptoms, and feelings of detachment represent bridge symptoms between BPD and PTSD. These symptoms could potentially trigger and perpetuate the manifestations of one disorder in the presence of the other. Targeting these symptoms might allow better prevention and management of both disorders.

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Borderline personality disorder (BPD) is characterized by pervasive and persistent instability in affect regulation, interpersonal relationships, self-image, and impulse control. Exposure to traumatic events is highly prevalent among individuals with BPD, and most of them report a history of neglect, abuse, harassment, and rejection by peers.[1–4] Individuals with BPD also often present with co-occurring disorders, including mood, anxiety, substance use, and eating disorders.[5–8] Among these comorbidities, posttraumatic stress disorder (PTSD) is particularly frequent. Approximately 29–55% of individuals with BPD have comorbid PTSD,[9,10] and 24% of patients with PTSD have comorbid BPD.[11] Although BPD and PTSD are currently viewed as distinct nosographic entities, there is a substantial overlap between the symptoms that constitute their respective diagnostic frameworks.[12] Recent literature has also shown an increasing intrigue in complex PTSD (cPTSD), primarily due to the challenges in distinguishing it from BPD and its symptom convergence with PTSD. Although considered as different constructs, distinguishing the boundaries between these diagnoses and their co-occurrence may constitute a clinical challenge.[12–14]

Network theory is a promising tool for investigating the complexity of mental health diagnoses.[15] Network analysis aims to examine the relationships across disorder symptoms and to rank them according to their importance

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Clinical Points

- We sought to elucidate the relationships between borderline personality disorder (BPD) and posttraumatic stress disorder (PTSD) using a network analysis of a large general population sample.
- A specific focus on feelings of emptiness, detachment, self-aggression, and dissociation might improve treatment outcomes for patients with BPD/PTSD comorbidity.

within the network. This symptom hierarchy can be assessed by a variety of measures.[15,16] Network analysis can also be applied to multiple diagnoses jointly to describe the relationship between the symptoms of more than 1 disorder.[17] This approach may help examine comorbid diagnoses by allowing the identification of bridge symptoms, defined as symptoms linking 2 or more disorders. These bridge symptoms are considered to play critical roles in the co-occurrence of disorders.[17]

This report applied network analysis to outline the interactions between *DSM-IV* symptoms of BPD and PTSD and identify bridge symptoms between the 2 disorders. This knowledge is important because bridge symptoms could represent therapeutic targets in clinical practice, allowing for prevention and better management of co-occurring disorders.[17] By using a large, nationally representative sample, the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC), we aimed to obtain stable estimates that could be generalized beyond clinical samples.

MATERIALS AND METHODS

Sample

Data were obtained from the second wave (2004–2005) of the NESARC, a nationally representative, face-to-face, prospective survey of the US adult population, conducted by the National Institute on Alcohol Abuse and Alcoholism.[18] The study encompassed noninstitutionalized US residents aged at least 18 years. The overall response rate for the second wave was 70.2%, corresponding to 34,653 interviews.[18]

The NESARC research protocol, including written informed consent procedures, was fully approved by the US Census Bureau and the Office of Management and Budget. A total of 34,653 respondents were analyzed, regardless of meeting the diagnostic criteria for BPD or PTSD. As the study aimed to identify bridges between symptoms of the 2 diagnoses, we did not restrict the study to major disorders in order to encompass potential subsyndromal interactions[19] and to avoid Berkson bias.[5,20–22] In line with network analysis theory, we considered counterproductive to focus only on people who met the diagnostic criteria.[23]

Assessment of *DSM-IV* Disorder Symptoms and Diagnoses

Diagnoses were assessed using the *DSM-IV* version of the Alcohol Use Disorder and Associated Disabilities Interview Schedule (AUDADIS-IV), a structured diagnostic instrument administered by lay interviewers.[18]

The test-retest reliability of AUDADIS-IV BPD diagnosis is considered good ($\kappa = 0.71$, SE = 0.06), with the intraclass test-retest reliability coefficient falling within the good range (95% intraclass correlation coefficient [ICC] = [0.74–0.79], $\alpha = 0.83$).[24]

Similarly, the test-retest reliability of AUDADIS-IV PTSD diagnosis is also considered robust ($\kappa = 0.64$, SE = 0.11), with the intraclass test-retest reliability coefficient falling within the good range (95% ICC = [0.64–0.72], $\alpha = 0.84$).[24]

Statistical Analysis

First, we estimated the network of each diagnosis independently and computed centrality measures for each independent network. Then, we estimated the common network for BPD and PTSD symptoms and computed centrality measures to identify bridge symptoms. This step was conducted as it established a reference point, allowing us to discern the prominence of symptoms within their respective networks compared to their bridging role in the common network.

Network estimation. We applied the *Ising* model, suitable for binary data,[25] as described by van Loo et al[26] for all network estimations. Every node featured in a network is a *DSM-IV* symptom. The nodes, their corresponding abbreviation, and their prevalence among respondents are given in Supplementary Table 1. The hyperparameter γ, which controls how much the Extended Bayesian Information Criterion prefers simpler models, was set to 0.25. The parameter γ is usually set between 0 and 0.5, with higher values yielding simpler models and therefore fewer edges.[27,28] This method is considered to have good specificity and acceptable sensibility.[25] The symptoms featured in the networks were assigned colors based on the *DSM-IV* diagnostic criterion they belong to.

Edge weights. Edges between nodes are estimated using regularized logistic regressions, with each node being regressed over the others. The edge weights correspond to the mean of the coefficients obtained from the regularized logistic regression of node A over node B and node B over node A. Comparison of edge weights can be made visually by examining the thickness of the edges, where a thicker edge indicates a higher weight. Green edges represent positive correlations between nodes, while red edges represent negative correlations.

Centrality indices. Bridge strength indicates a node's total connectivity with another disorder, representing the sum of the absolute values of the edge weights between the node and all nodes from another disorder.[17] On the other hand,

bridge expected influence indicates a node's sum connectivity with another disorder but without considering edge weights as absolute values. Therefore, when negative edge weights exist in a network, bridge expected influence is the preferable metric, especially when clinicians aim to target specific symptoms for therapeutic deactivation.[29] Given the existence of a few negative edges in the BPD/PTSD network, we opted to use bridge expected influence over bridge strength, as this metric may better reflect the nature of diagnoses interconnectedness and help in elucidating connections among diagnostic categories.

Network stability. The network stability of each network was computed using nonparametric and case-drop bootstrap methods.[16,27] Stability coefficients ranging from 0.25 to 0.5 are considered acceptable, and those ranging from 0.5 to 0.75 are considered ideal and infer very stable networks.[16] Following prior recommendation,[16] we computed 1,000 bootstraps.

Addressing missing data. Two distinct types of missing data were present in the dataset. First, incomplete cases were observed when respondents chose not to respond to certain questions. These missing values were considered missing at random, and respondents were excluded from the main analysis to avoid imputation biases (n = 1,366). Second, missing data due to skip logic occurred as a structural aspect of the questionnaire design, where certain questions were intentionally bypassed based on respondents' prior answers. This was the case for respondents who did not meet the *DSM-IV* criterion A for PTSD, as they were not asked for the other PTSD symptoms. The missing values for those variables were therefore imputed as "0" or "No," as implied by the skip logic of the questionnaire. To address potential biases introduced by the imputation method used,[27] we conducted a sensitivity analysis that included only participants who responded to all questions (ie, the subpopulation of those who met the *DSM-IV* criterion A for PTSD).

Pandas[30]*(v2.1.4)* and *Numpy*[31]*(v1.26.3)* Python[32]*(v3.12.1)* libraries were used for data preprocessing. The network estimations, bootstraps, and visualizations were computed using R software version 3.6.3 (R Project for Statistical Computing, R Core Team, Vienna, Austria), *IsingFit*[33] *(v0.4)*, *qgraph*[34] *(v1.9.8)*, and *bootnet*[16] *(v1.5.6)* R libraries.

RESULTS

The description of the sample population is available in Table 1. The participant selection process for the main and sensitivity analyses is outlined in Supplementary Figure 1. Stability coefficients obtained after 1,000 bootstraps were ideal (correlation-stability [CS] coefficient = 0.75) for expected influence and bridge expected influence in all networks estimated, inferring reliable network estimations (Supplementary Figures 2–4).

Table 1.
Lifetime Diagnoses and Sociodemographic Characteristics of the Study Sample

Diagnosis	Prevalence (%)	Prevalence (N)
Major depressive disorder	22.9	7,940
Manic episode	5.3	1852
Hypomanic episode	5.6	1,338
Dysthymia	3.9	1939
Panic disorder without agoraphobia	6.0	2073
Panic disorder with agoraphobia	2.0	679
Social anxiety	7.1	2,448
Specific phobia	15.8	5,487
Generalized anxiety disorder	7.9	2,730
PTSD	10.4	3,621
Antisocial personality disorder	3.5	1,226
BPD	6.4	2,231
Schizotypal personality disorder	4.4	1,534
Narcissistic personality disorder	7.1	2,449
Alcohol abuse	18.4	6,389
Alcohol dependence	14.2	4,914
Nicotine dependence	13.7	4,764
Sociodemographic characteristics		
Ethnicity		
Caucasian	58.18	20,161
Non-Caucasian	41.82	14,492
Marital status		
Married	51.32	17,785
Not married	48.68	16,868
Age (mean)	49	
Sex		
Male	42.03	14,564
Female	57.97	20,089
Poverty (household income <$20,000)	43.83	15,189
Education		
College or superior	35.45	12,285
Secondary or inferior	64.55	22,368

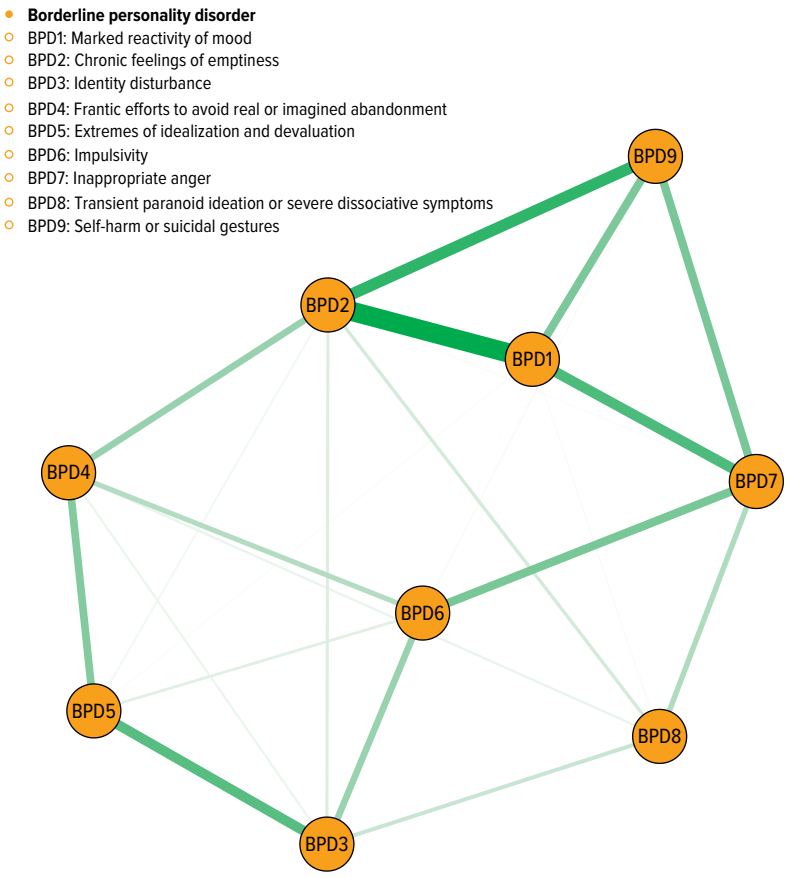
Abbreviations: BPD = borderline personality disorder, PTSD = posttraumatic stress disorder.

BPD Network

The estimated BPD network is presented in Figure 1. Lasso-penalized odds ratios (ORs) of nonparametric bootstrapped edge weights between pairs of nodes are presented in Supplementary Table 2, and edge weight intervals are presented in Supplementary Figure 5. The highest edge weights in this network were those between "Reactivity of mood" and "Chronic feelings of emptiness" (OR = 5.19, 95% CI = [4.57; 5.90]) and between "Chronic feelings of emptiness" and "Self-aggression" (OR = 3.30, 95% CI = [2.81; 3.89]). "Self-aggression" was mainly linked to symptoms of emotional dysregulation ("Chronic feelings of emptiness," "Marked reactivity of mood," and "Anger").

Expected influence of the BPD symptoms are shown in Supplementary Figure 6. The symptom "Chronic feelings of emptiness" scored highest, indicating its high importance within the network. "Reactivity of mood" and "Anger" were also central symptoms regarding expected influence. The expected influence of these

Figure 1.
Network Estimation of BPD Symptoms[a]



[a]The minimum argument has been set to 0.7.
Abbreviation: BPD = borderline personality disorder.

3 BPD symptoms was found to be significantly greater compared to that of all other BPD symptoms (Supplementary Figure 7).

PTSD Network

The estimated PTSD network is presented in Figure 2. ORs and edge weight intervals are presented in Supplementary Table 3 and Supplementary Figure 8, respectively. The highest edge weights in the network were those between "Feelings of detachment or estrangement" and "Restricted range of affect" (OR = 9.31, 95% CI = [8.01; 10.08]), between "Intense fear or horror during the event" and "Recurrent and intrusive distressing recollections of the event" (OR = 8.07, 95% CI = [7.53; 8.74]), and between "Hypervigilance" and "Exaggerated startle response" (OR = 7.27, 95% CI = [6.50; 8.09]).

Expected influence of PTSD symptoms are shown in Supplementary Figure 9. Symptoms "Recurrent and intrusive distressing recollections of the event," "Intense fear or horror during the event," and "Efforts to avoid thoughts, emotions, or conversations related to the event" scored significantly higher than all other symptoms, inferring high connectivity to the other symptoms in the network (Supplementary Figure 10).

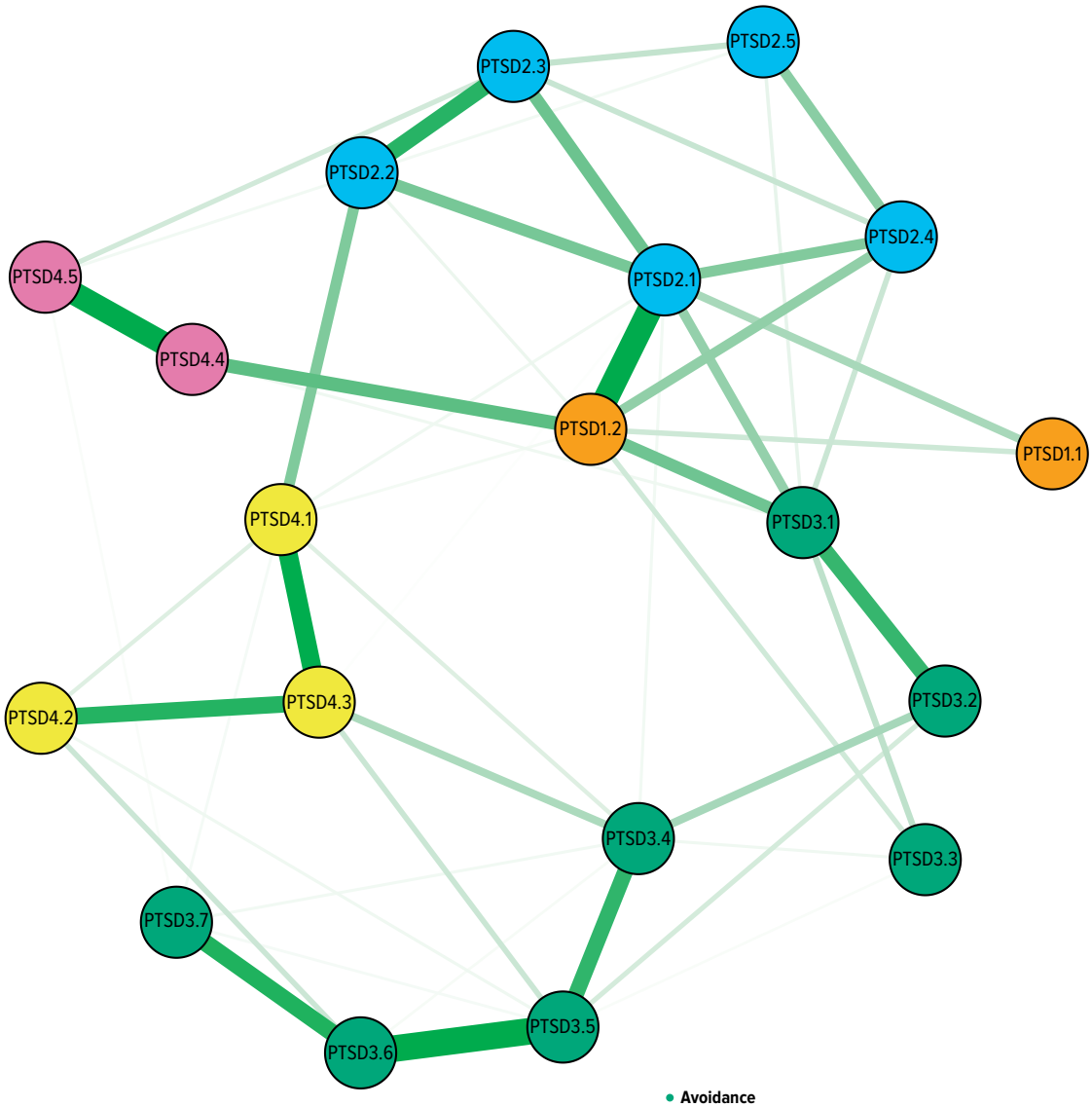
BPD/PTSD Network

The estimated BPD/PTSD network is presented in Figure 3. Between-diagnoses ORs and edge weight intervals are shown in Supplementary Table 4 and Supplementary Figure 11, respectively.

The highest edge weights in the network were those between symptoms "Self-harm and suicidal gestures" (BPD) and "Feelings of detachment or estrangement" (PTSD) (OR = 1.50, 95% CI = [1.26; 1.94]), symptoms "Inappropriate anger" (BPD) and "Irritability and anger" (PTSD) (OR = 1.50, 95% CI = [1.37; 1.94]), and symptoms "Chronic feelings of emptiness" (BPD) and "Restricted range of affect" (PTSD) (OR = 1.46, 95% CI = [1.23; 1.73]).

Bridge expected influence for the BPD and PTSD symptoms is shown in Figure 4. "Self-harm and suicidal gestures," "Transient paranoid ideation or severe dissociation symptoms," and "Chronic feelings of

Figure 2.
Network Estimation of PTSD Symptoms[a]

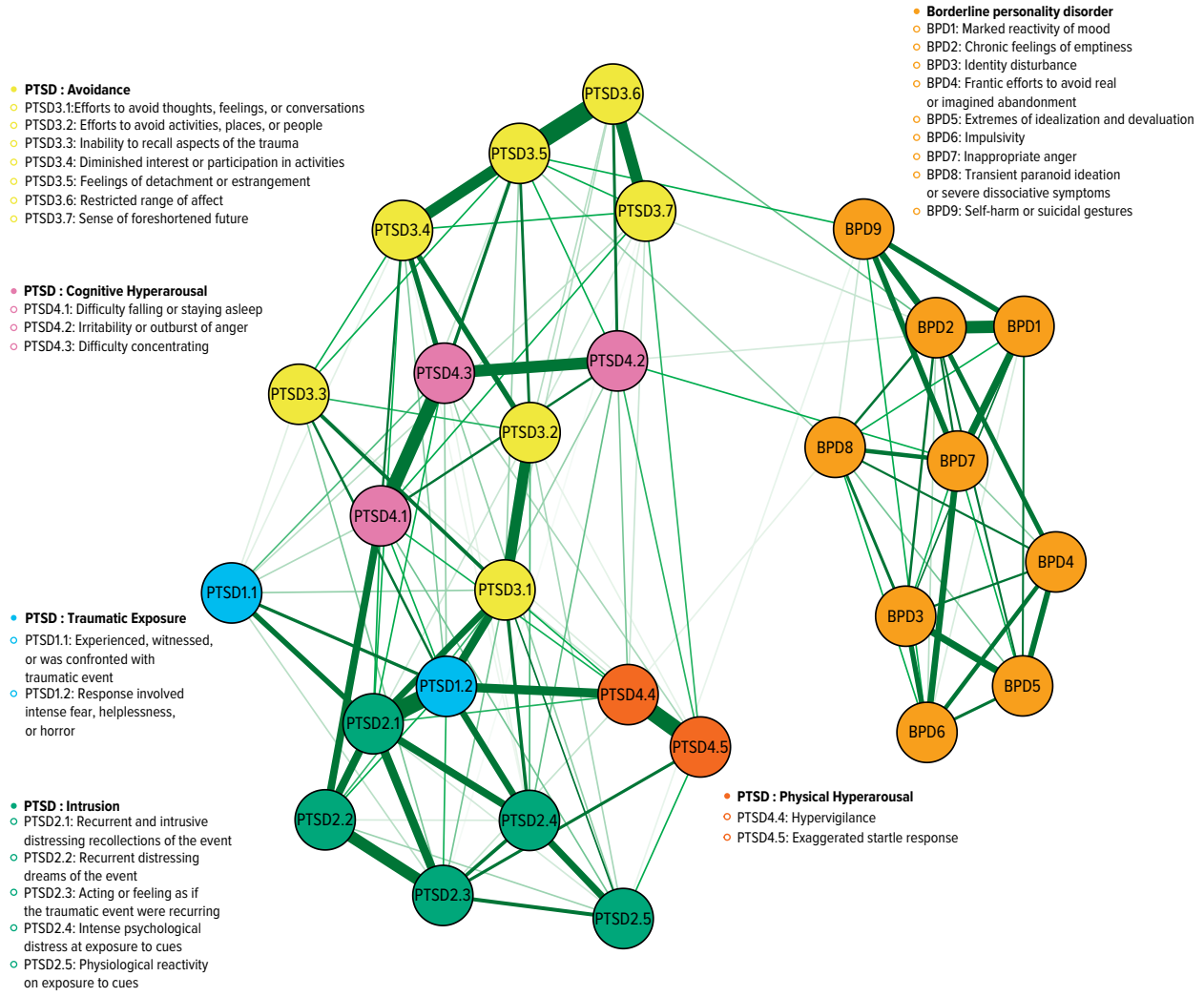


- **Exposure**
  - PTSD1.1: Experienced, witnessed, or was confronted with traumatic event
  - PTSD1.2: Response involved intense fear, helplessness, or horror
- **Intrusion**
  - PTSD2.1: Recurrent and intrusive distressing recollections of the event
  - PTSD2.2: Recurrent distressing dreams of the event
  - PTSD2.3: Acting or feeling as if the traumatic event were recurring
  - PTSD2.4: Intense psychological distress at exposure to cues
  - PTSD2.5: Physiological reactivity on exposure to cues
- **Avoidance**
  - PTSD3.1: Efforts to avoid thoughts, feelings, or conversations
  - PTSD3.2: Efforts to avoid activities, places, or people
  - PTSD3.3: Inability to recall aspects of the trauma
  - PTSD3.4: Diminished interest or participation in activities
  - PTSD3.5: Feelings of detachment or estrangement
  - PTSD3.6: Restricted range of affect
  - PTSD3.7: Sense of foreshortened future
- **Cognitive Hyperarousal**
  - PTSD4.1: Difficulty falling or staying asleep
  - PTSD4.2: Irritability or outburst of anger
  - PTSD4.3: Difficulty concentrating
- **Physical Hyperarousal**
  - PTSD4.4: Hypervigilance
  - PTSD4.5: Exaggerated startle response

[a]PTSD symptoms have been assigned colors based on the *DSM-IV* criterion they belong to. The minimum argument has been set to 0.4.
Abbreviation: PTSD = posttraumatic stress disorder.

emptiness" scored highest regarding bridge expected influence, along with PTSD symptom "Feeling of detachment or estrangement." Bridge expected influence for these 3 BPD symptoms was significantly higher than 21 of the 25 other symptoms in the network, while "Feelings of detachment or estrangement" scored significantly higher than 13 of the 17 other PTSD symptoms (Supplementary Figure 12). These results

Figure 3.
Network Estimation of BPD and PTSD Symptoms[a]



[a]PTSD symptoms have been assigned colors based on the *DSM-IV* criterion they belong to. The minimum argument has been set to 0.25.
Abbreviations: BPD = borderline personality disorder, PTSD = posttraumatic stress disorder.

held in the sensitivity analysis that included only the subpopulation of participants who responded to all PTSD questions (Supplementary Figure 13).

Symptoms belonging to the "Intrusion" PTSD criterion had lower bridge expected influence on average than the other PTSD symptoms.

DISCUSSION

In a large nationally representative sample, we examined network structures and bridging symptoms between BPD and PTSD. In the BPD network, "Chronic feelings of emptiness" displayed the greatest overall connectivity, suggesting its role in activating other BPD symptoms. Moreover, this symptom was strongly correlated to "Self-harm and suicidal gestures." This symptom has been associated with increased risk of suicide attempts,[4] and it has been suggested that focusing on feelings of emptiness reduces the risk of suicide among patients with BPD.[35,36] The strong correlation between "Chronic feelings of emptiness" and "Marked reactivity of mood" in the estimated network strengthens the importance of specific management of this symptom. "Marked reactivity of mood" is accountable for part of the functional impairment among BPD patients, especially social impairment,[37] which furthermore increases the suicidal risk.[38] Specific management of chronic feelings of emptiness and mood reactivity could be fruitful in reducing self-harm risk and suicidal behavior among BPD patients.

Figure 4.

Bridge Expected Influence (1-Step) of Symptoms in the BPD/PTSD Network[a]

[a]The bridge expected influence centrality measure indicates the global connectivity of a node with nodes of the other community. Communities defined were BPD and PTSD *DSM-IV* symptoms.

Abbreviations: BPD = borderline personality disorder, PTSD = posttraumatic stress disorder.

The estimated PTSD network shows that symptoms "Recurrent and intrusive distressing recollections of the event," "Intense fear or horror during the event," and "Efforts to avoid thoughts, emotions, and conversations related to the event" are central to the network.

Previous studies have also pointed out the centrality of thought and emotion avoidance[39] and recollections of the event.[40] Our results are reinforced by several studies focusing on intrusive recollections of traumatic events[41] and the specific management of these recollections by thought-control techniques.[42] For example, the formal practice of mindfulness meditation has decreased severity scores of PTSD and associated depressive cognitions.[43] Our results were also comparable to those described in a recent meta-analysis of PTSD networks,[44] indicating high expected influence of intrusion and internal avoidance symptoms but low expected influence for symptoms "Amnesia" and "Sense of foreshortened future."

In the BPD/PTSD network, the strongest interaction between symptoms of each disorder was between "Feelings of detachment or estrangement" and "Self-harm and suicidal gestures."

Prior work indicates that feelings of detachment were the most correlated with suicidal ideation among PTSD symptoms.[45] Specific targeting of this symptom might be useful to reduce suicidal risk in clinical practice. "Feelings of detachment or estrangement" is also associated with a higher risk of impaired social interactions among PTSD patients.[46] Its role as a bridging symptom between PTSD and BPD is therefore supported, as impaired social interactions are found among BPD criteria.[47] Personality disorders are frequently diagnosed among PTSD patients, and feelings of detachment or estrangement scores have the highest predictive value for correctly separating individuals with or without personality disorders.[48] This observation is consistent with our findings, as we described this symptom as the PTSD symptom with the highest bridge centrality. Therefore, the management of this symptom would be interesting for several reasons. First, its presence could encourage practitioners to search for comorbid personality disorders (especially BPD) among patients seeking health care for traumatic symptoms. Conversely, underlying trauma should be looked for when BPD patients express feelings of detachment or estrangement. It is also important to emphasize that feelings of detachment, and symptoms related to emotional dysregulation in general, were removed from the *International Classification of Diseases*, Eleventh Revision (ICD-11), criteria set for PTSD and introduced in the cPTSD criteria set.[49] Our findings support this modification, as we identified feelings of detachment as a bridge symptom between BPD and PTSD in this study, and cPTSD accounts for persistent difficulties in feeling close to others and sustaining relationships. Furthermore, while self-aggression is not explicitly included in the ICD-11 criteria for cPTSD, it has been previously suggested as being a potentially central symptom in cPTSD[50] and in recent models of cPTSD in children and adolescents.[51] These models, which include symptoms associated with externalizing/impulsive disorders, suggest a potential link to self-aggression, as seen in the concept of developmental trauma disorder.[52]

It is noteworthy that BPD symptoms constituting bridge symptoms in our study were comparable to the latent class analysis results of Cloitre et al[53] Feelings of emptiness, dissociation, and self-aggression did not discriminate BPD from cPTSD in their study, while the presence of symptoms "Identity disturbance," "Efforts to avoid abandonment," "Relational instability," and "Impulsivity" increased the likelihood of belonging to the BPD group rather than the cPTSD group.

"Chronic feelings of emptiness" was identified as the most central symptom in the BPD network while also constituting a bridge symptom between BPD and PTSD, strengthening the symptom's intra- and interdiagnostic importance. However, dissociation was identified as a key bridge symptom while only exhibiting moderate expected influence within the BPD network. This finding is in line with prior publications, describing correlations between traumatic experiences and dissociation severity.[54–56] Conversely, central symptoms identified in the PTSD network played marginal roles in bridging BPD and PTSD, as intrusion symptoms exhibited lower bridge expected influence than affect-related symptoms.

Finally, the bridge between BPD and PTSD symptoms may not be explained by the traumatic event itself but rather by its consequences, particularly by the affective symptoms. The strong link between chronic feelings of emptiness in BPD and the restricted range of affects in PTSD reflects this observation. The interdiagnostic importance of these affective symptoms is also supported by neuroimaging and neurocognitive evidence, including the hyperactivation of the limbic system in patients with BPD or PTSD as compared to healthy subjects[57] and the greater allocation of cognitive resources to affective information.[58]

This study has several limitations. First, the binary nature of the data is likely to have reduced the precision of the findings. Second, data were also cross-sectional, which does not allow for a causal interpretation of edges in the network.[16] Third, our results may not be generalizable to other countries or to clinical subgroups of patients with BPD or PTSD.[59,60] Future longitudinal studies are required to replicate our results and expand their potential clinical applications, especially regarding their generalizability to clinical samples, specific therapeutic targets, and symptom deactivation for disorder management.[16,17] Fourth, no

distinction was possible between simple and complex PTSD in this study, as the diagnostic construct was missing in the *DSM-IV*. cPTSD is especially relevant considering that one of its core symptoms of emotion dysregulation, ie emotional numbing, is comparable to the core BPD symptom of emotional emptiness. The bridge symptoms identified in this study seem related to the cPTSD symptoms of relational detachment, suggesting that cPTSD should be investigated as a potential bridge between BPD and PTSD. Furthermore, cognition and mood symptoms added to the *DSM-V* PTSD diagnostic criteria were also missing in our study. Fifth, imputation of skip-structure questionnaires is strongly advised against when conducting network analysis,[27] even though bridge symptoms identified in the study held in sensitivity analysis.

In this study, we highlighted the importance and centrality of chronic feelings of emptiness among BPD symptoms, both in the BPD network and as a bridge symptom to PTSD. Intrusive recollections of traumatic events, and more broadly symptoms of the "Intrusion" criterion, were among the most central symptoms of PTSD but exhibited marginal roles in bridging BPD and PTSD. Feelings of detachment or estrangement were strongly linked to self-harm and suicidal gestures, suggesting the importance of specific management of these bridge symptoms among patients with comorbid BPD and PTSD. Dissociation symptoms were also implicated in bridging the 2 disorders. Targeting these specific symptoms may be fruitful to reduce the burden and suffering associated with these disorders.

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Supplementary Material: Available at Psychiatrist.com.

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The Journal of Clinical Psychiatry

Supplementary Material

Article Title: Identifying Bridge Symptoms Between Borderline Personality Disorder and Posttraumatic Stress Disorder: A Network Analysis From a National Cohort

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LIST OF SUPPLEMENTARY MATERIAL FOR THE ARTICLE

The Journal of Clinical Psychiatry

DISCLAIMER

Supplementary material

Supplementary Table 1. DSM-IV criteria for BPD and PTSD, their corresponding abbreviations used in the present study and their prevalence among respondents in the study population.

Disorder	DSM-IV Criterion	Item Label	Symptom	Prevalence (%)	Prevalence (number of subjects)
BPD		BPD1	Marked reactivity of mood	7.09	2458
		BPD2	Chronic feelings of emptiness	10.46	3625
		BPD3	Identity disturbance	17.14	5939
		BPD4	Frantic efforts to avoid real or imagined abandonment	12.53	4341
		BPD5	Extremes of idealization and devaluation	18.42	6384
		BPD6	Impulsivity	28.65	9927
		BPD7	Inappropriate anger	15.63	5415
		BPD8	Transient paranoid ideation or severe dissociative symptoms	8.84	3063
		BPD9	Self-harm or suicidal gestures	4.04	1401
PTSD	Traumatic exposure	PTSD1.1	Experienced, witnessed, or was confronted with traumatic event	43,93	15222
		PTSD1.2	Response involved intense fear, helplessness, or horror	60.9	21105
	Intrusion	PTSD2.1	Recurrent and intrusive distressing recollections of the event	48.88	16939
		PTSD2.2	Recurrent distressing dreams of the event	22.65	7848
		PTSD2.3	Acting or feeling as if the traumatic event were recurring	18.4	6376
		PTSD2.4	Intense psychological distress at exposure to cues	27.6	9565
		PTSD2.5	Physiological reactivity on exposure to cues	19.41	6726
	Avoidance	PTSD3.1	Efforts to avoid thoughts, feelings, or conversations	34.97	12119
		PTSD3.2	Efforts to avoid activities, places, or people	11.68	4047
		PTSD3.3	Inability to recall aspects of the trauma	10.24	3549
		PTSD3.4	Diminished interest or participation in activities	13.96	4836
		PTSD3.5	Feelings of detachment or estrangement	12.6	4368
		PTSD3.6	Restricted range of affect	8.35	2893
		PTSD3.7	Sense of foreshortened future	4.98	1727
	Increased arousal	PTSD4.1	Difficulty falling or staying asleep	19.64	6806
		PTSD4.2	Irritability or outburst of anger	11.67	4043
		PTSD4.3	Difficulty concentrating	18.23	6318
		PTSD4.4	Hypervigilance	21.01	7280
		PTSD4.5	Exaggerated startle response	11.06	3834

Supplementary Table 2. Lasso penalized odds ratios of bootstrap edge weights in the BPD network.

	BPD1	BPD2	BPD3	BPD4	BPD5	BPD6	BPD7	BPD8	BPD9
BPD1		5.19	1.84	1.35	1.84	1.37	3.08	1.86	2.71
BPD2	5.19		2.02	2.49	1.89	1.41	1.85	2.06	3.30
BPD3	1.84	2.02		1.93	3.02	2.48	1.60	2.13	1.00
BPD4	1.35	2.49	1.93		2.64	2.28	1.44	1.93	1.26
BPD5	1.84	1.89	3.02	2.64		1.98	1.67	1.52	1.03
BPD6	1.37	1.41	2.48	2.28	1.98		2.75	1.66	1.84
BPD7	3.08	1.85	1.60	1.44	1.67	2.75		2.31	2.71
BPD8	1.86	2.06	2.13	1.93	1.52	1.66	2.31		1.56
BPD9	2.71	3.30	1.00	1.26	1.03	1.84	2.71	1.56	

BPD1 = 'Marked reactivity of mood', BPD2 = 'Chronic feelings of emptiness', BPD3 = 'Identity disturbance', BPD4 = 'Frantic efforts to avoid real or imagined abandonment', BPD5 = 'Extremes of idealization and devaluation', BPD6 = 'Impulsivity', BPD7 = 'Inappropriate anger', BPD8 = 'Transient paranoid ideation or severe dissociative symptoms', BPD9 = 'Self harm or suicidal gestures'

Supplementary Table 3. Lasso penalized odd ratios of bootstrap edge weights in the PTSD network

	PTSD 1.1	PTSD 1.2	PTSD 2.1	PTSD 2.2	PTSD 2.3	PTSD 2.4	PTSD 2.5	PTSD 3.1	PTSD 3.2	PTSD 3.3	PTSD 3.4	PTSD 3.5	PTSD 3.6	PTSD 3.7	PTSD 4.1	PTSD 4.2	PTSD 4.3	PTSD 4.4	PTSD 4.5
PTSD 1.1		1.99	2.42	1.21	1.35	1.13	1.15	1.42	0.98	1.35	1.38	1.00	0.90	1.41	1.42	1.00	1.52	1.12	1.14
PTSD 1.2	1.99		8.07	1.68	1.44	2.81	1.01	3.27	1.05	1.94	1.35	1.02	1.13	1.00	1.64	1.24	1.40	3.59	1.01
PTSD 2.1	2.42	8.07		3.11	3.29	3.00	1.26	2.72	1.06	0.99	1.65	1.07	1.00	0.99	1.67	1.01	1.58	1.52	0.98
PTSD 2.2	1.21	1.68	3.11		4.47	1.33	1.40	1.50	1.36	1.28	0.95	1.21	1.02	1.02	2.99	1.13	1.10	1.03	1.17
PTSD 2.3	1.35	1.44	3.29	4.47		2.05	2.10	1.44	1.21	1.42	1.16	1.02	1.14	1.30	1.23	1.00	1.03	1.33	1.95
PTSD 2.4	1.13	2.81	3.00	1.33	2.05		2.87	2.04	1.50	1.03	1.30	1.24	1.14	1.04	1.11	1.48	1.31	1.18	1.04
PTSD 2.5	1.15	1.01	1.26	1.40	2.10	2.87		1.74	1.39	1.16	1.09	1.09	1.20	1.03	1.45	1.10	1.42	1.25	1.67
PTSD 3.1	1.42	3.27	2.72	1.50	1.44	2.04	1.74		4.18	2.15	1.00	1.43	1.44	1.00	1.25	1.20	1.01	1.68	1.38
PTSD 3.2	0.98	1.05	1.06	1.36	1.21	1.50	1.39	4.18		1.54	2.43	1.93	1.41	1.36	1.08	1.09	1.00	1.26	1.33
PTSD 3.3	1.35	1.94	0.99	1.28	1.42	1.03	1.16	2.15	1.54		1.67	1.62	1.27	1.16	1.00	1.11	1.09	1.28	1.36
PTSD 3.4	1.38	1.35	1.65	0.95	1.16	1.30	1.09	1.00	2.43	1.67		4.24	1.62	1.66	1.83	1.23	2.39	1.00	1.02
PTSD 3.5	1.00	1.02	1.07	1.21	1.02	1.24	1.09	1.43	1.93	1.62	4.24		9.31	1.65	1.33	1.68	2.03	1.01	1.03
PTSD 3.6	0.90	1.13	1.00	1.02	1.14	1.14	1.20	1.44	1.41	1.27	1.62	9.31		4.70	1.03	2.01	1.21	1.25	1.17
PTSD 3.7	1.41	1.00	0.99	1.02	1.30	1.04	1.03	1.00	1.36	1.16	1.66	1.65	4.70		1.63	1.37	1.10	1.40	1.62
PTSD 4.1	1.42	1.64	1.67	2.99	1.23	1.11	1.45	1.25	1.08	1.00	1.83	1.33	1.03	1.63		1.82	5.33	1.23	1.55
PTSD 4.2	1.00	1.24	1.01	1.13	1.00	1.48	1.10	1.20	1.09	1.11	1.23	1.68	2.01	1.37	1.82		4.58	1.49	1.56
PTSD 4.3	1.52	1.40	1.58	1.10	1.03	1.31	1.42	1.01	1.00	1.09	2.39	2.03	1.21	1.10	5.33	4.58		1.18	1.39
PTSD 4.4	1.12	3.59	1.52	1.03	1.33	1.18	1.25	1.68	1.26	1.28	1.00	1.01	1.25	1.40	1.23	1.49	1.18		7.27
PTSD 4.5	1.14	1.01	0.98	1.17	1.95	1.04	1.67	1.38	1.33	1.36	1.02	1.03	1.17	1.62	1.55	1.56	1.39	7.27	

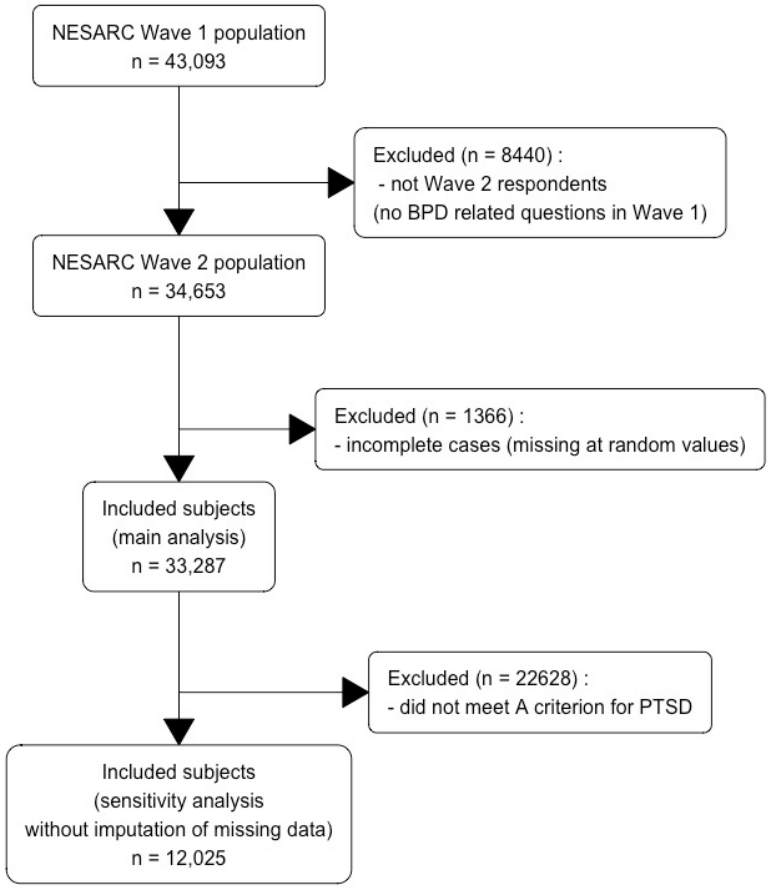
PTSD1.1 = 'Experienced, witnessed, or was confronted with traumatic event', PTSD1.2 = 'Response involved intense fear, helplessness, or horror', PTSD2.1 = 'Recurrent and intrusive distressing recollections of the event', PTSD2.2 = 'Recurrent distressing dreams of the event', PTSD2.3 = 'Acting or feeling as if the traumatic event were recurring', PTSD2.4 = 'Intense psychological distress at exposure to cues', PTSD2.5 = 'Physiological reactivity on exposure to cues', PTSD3.1 = 'Efforts to avoid thoughts, feelings, or conversations', PTSD3.2 = 'Efforts to avoid activities, places, or people ', PTSD3.3 = 'Inability to recall important aspects of the trauma', PTSD3.4 = 'Diminished interest or participation in activities', PTSD3.5 = 'Feelings of detachment or estrangement', PTSD3.6 = 'Restricted range of affect', PTSD3.7 = 'Sense of foreshortened future', PTSD4.1 = 'Difficulty falling or staying asleep', PTSD4.2 = 'Irritability or outbursts of anger', PTSD4.3 = 'Difficulty concentrating', PTSD4.4 = 'Hypervigilance', PTSD4.5 = 'Exaggerated startle response'

Supplementary Table 4. Lasso penalized odd ratios of bootstrap edge weights in the BPD/PTSD network

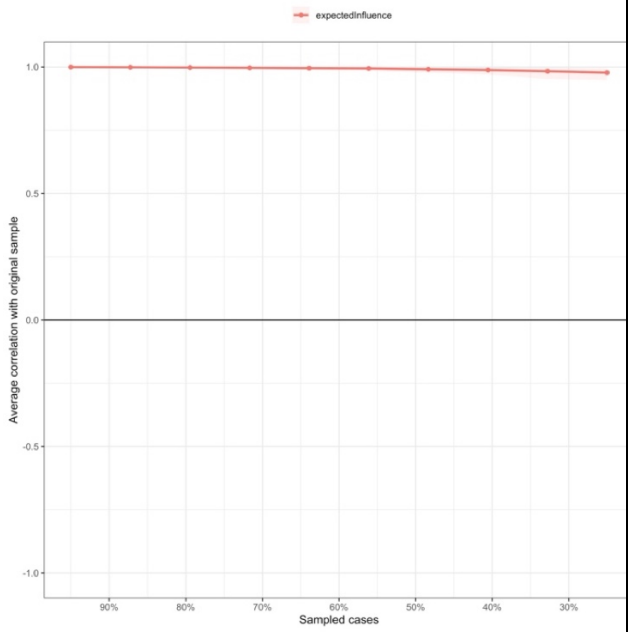
	BPD1	BPD2	BPD3	BPD4	BPD5	BPD6	BPD7	BPD8	BPD9
PTSD1.1	1.00	0.93	1.00	1.00	1.00	1.05	1.04	1.01	1.00
PTSD1.2	1.00	1.00	1.01	1.09	1.03	1.05	1.01	1.01	1.01
PTSD2.1	1.00	1.01	1.00	1.00	1.16	0.99	1.01	1.00	1.00
PTSD2.2	1.01	1.00	1.00	1.01	1.00	1.04	1.01	1.00	1.15
PTSD2.3	1.01	1.09	1.00	1.10	1.00	0.95	1.00	1.02	1.02
PTSD2.4	1.04	1.00	1.02	1.13	1.01	1.00	1.02	1.01	1.03
PTSD2.5	1.05	1.04	1.00	1.06	1.00	1.00	1.01	1.00	1.30
PTSD3.1	1.01	1.10	1.15	1.04	1.16	1.07	1.05	1.01	1.03
PTSD3.2	1.05	1.04	1.03	1.11	1.00	1.09	1.00	1.00	1.01
PTSD3.3	1.01	1.07	1.15	1.00	1.01	1.02	1.01	1.14	1.06
PTSD3.4	1.02	1.01	1.05	1.00	1.00	0.98	0.95	1.00	0.94
PTSD3.5	1.00	1.02	1.19	1.01	1.00	1.14	1.00	1.36	1.50
PTSD3.6	1.09	1.44	1.01	1.03	1.24	1.06	1.00	1.01	1.04
PTSD3.7	1.04	1.35	1.07	1.01	1.02	1.00	0.99	1.09	1.25
PTSD4.1	1.00	1.08	1.00	1.01	1.00	0.99	1.00	1.00	1.00
PTSD4.2	1.28	0.93	1.02	1.00	1.02	1.04	1.50	1.11	1.00
PTSD4.3	1.03	1.00	1.01	1.01	1.00	1.00	1.02	1.21	1.11
PTSD4.4	1.00	0.99	1.24	1.06	1.04	1.16	1.01	1.31	1.00
PTSD4.5	1.19	1.28	0.98	1.02	1.00	1.00	1.01	1.03	1.02

BPD1 = 'Marked reactivity of mood', BPD2 = 'Chronic feelings of emptiness', BPD3 = 'Identity disturbance', BPD4 = 'Frantic efforts to avoid real or imagined abandonment', BPD5 = 'Extremes of idealization and devaluation', BPD6 = 'Impulsivity', BPD7 = 'Inappropriate anger', BPD8 = 'Transient paranoid ideation or severe dissociative symptoms', BPD9 = 'Self harm or suicidal gestures', PTSD1.1 = 'Experienced, witnessed, or was confronted with traumatic event', PTSD1.2 = 'Response involved intense fear, helplessness, or horror', PTSD2.1 = 'Recurrent and intrusive distressing recollections of the event', PTSD2.2 = 'Recurrent distressing dreams of the event', PTSD2.3 = 'Acting or feeling as if the traumatic event were recurring', PTSD2.4 = 'Intense psychological distress at exposure to cues', PTSD2.5 = 'Physiological reactivity on exposure to cues', PTSD3.1 = 'Efforts to avoid thoughts, feelings, or conversations', PTSD3.2 = 'Efforts to avoid activities, places, or people ', PTSD3.3 = 'Inability to recall important aspects of the trauma', PTSD3.4 = 'Diminished interest or participation in activities', PTSD3.5 = 'Feelings of detachment or estrangement', PTSD3.6 = 'Restricted range of affect', PTSD3.7 = 'Sense of foreshortened future', PTSD4.1 = 'Difficulty falling or staying asleep', PTSD4.2 = 'Irritability or outbursts of anger', PTSD4.3 = 'Difficulty concentrating', PTSD4.4 = 'Hypervigilance', PTSD4.5 = 'Exaggerated startle response'

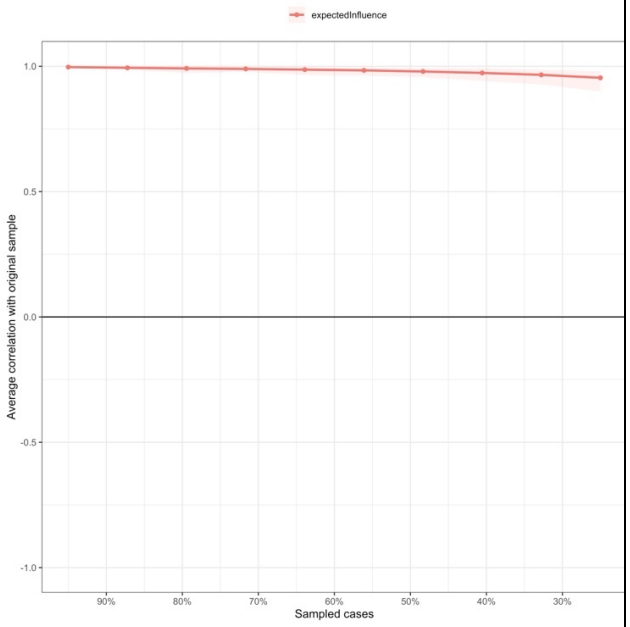
Supplementary Figure 1. Flowchart of study sample selection



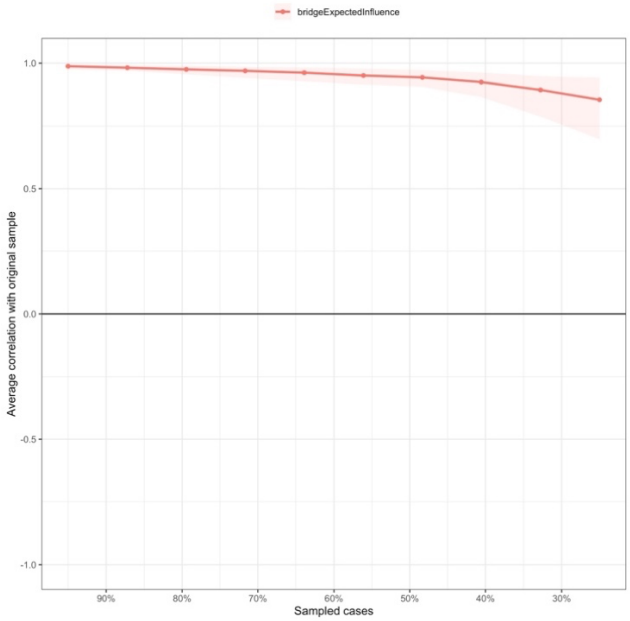
Supplementary Figure 2. Results of case-drop bootstrap (n=1000) for the BPD network



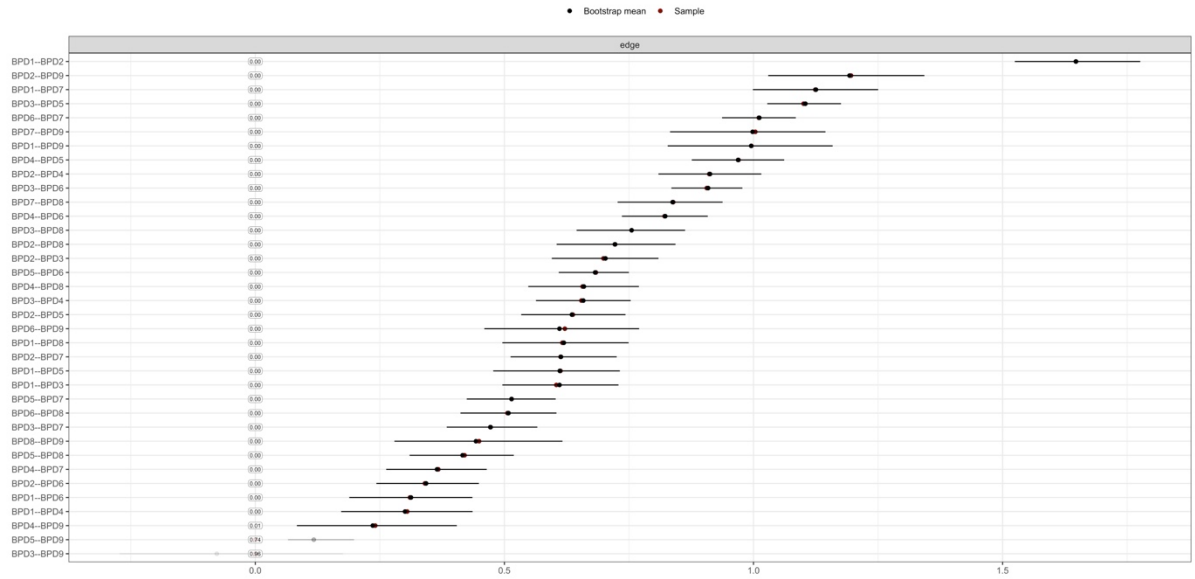
Supplementary Figure 3. Results of case-drop bootstrap (n=1000) for the PTSD network



Supplementary Figure 4. Results of case-drop bootstrap (n=1000) for the BPD/PTSD network

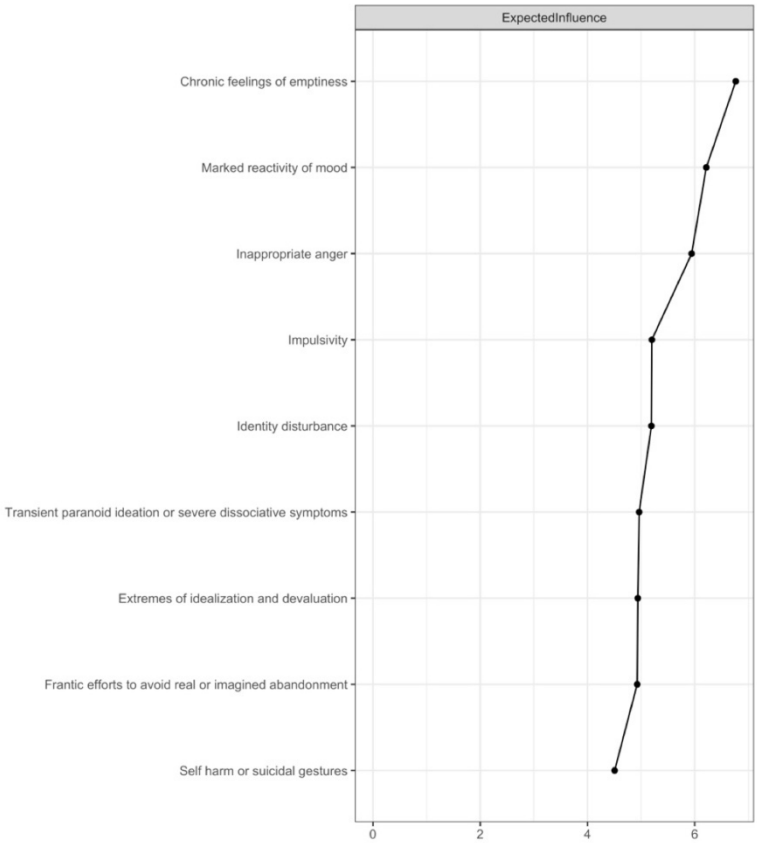


Supplementary Figure 5. Results of non-parametric bootstrap (n=1000) for the BPD network (edge weights)

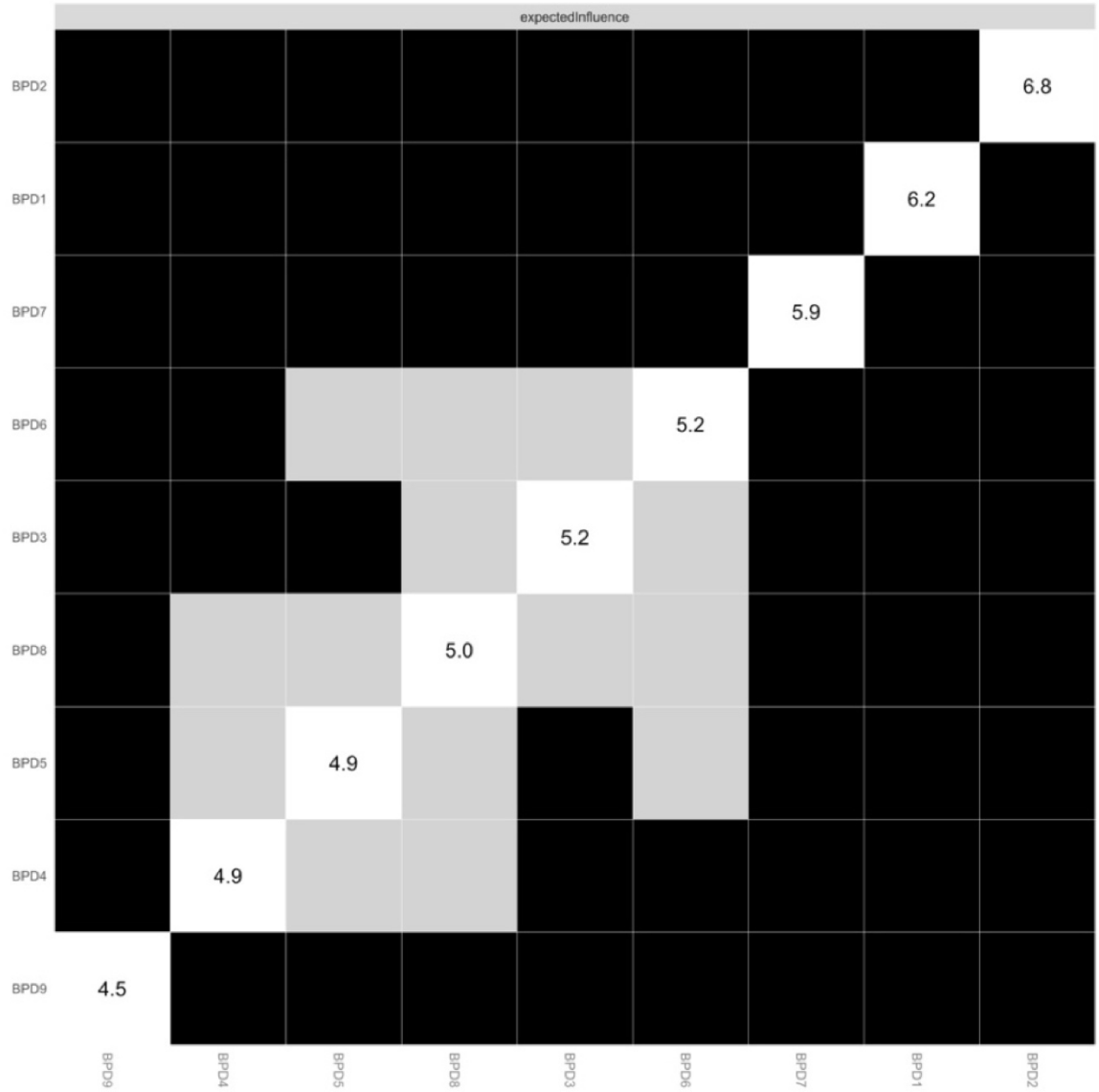


BPD1 = 'Marked reactivity of mood', BPD2 = 'Chronic feelings of emptiness', BPD3 = 'Identity disturbance', BPD4 = 'Frantic efforts to avoid real or imagined abandonment', BPD5 = 'Extremes of idealization and devaluation', BPD6 = 'Impulsivity', BPD7 = 'Inappropriate anger', BPD8 = 'Transient paranoid ideation or severe dissociative symptoms', BPD9 = 'Self harm or suicidal gestures'

Supplementary Figure 6. Expected influence of BPD symptoms in the estimated BPD network

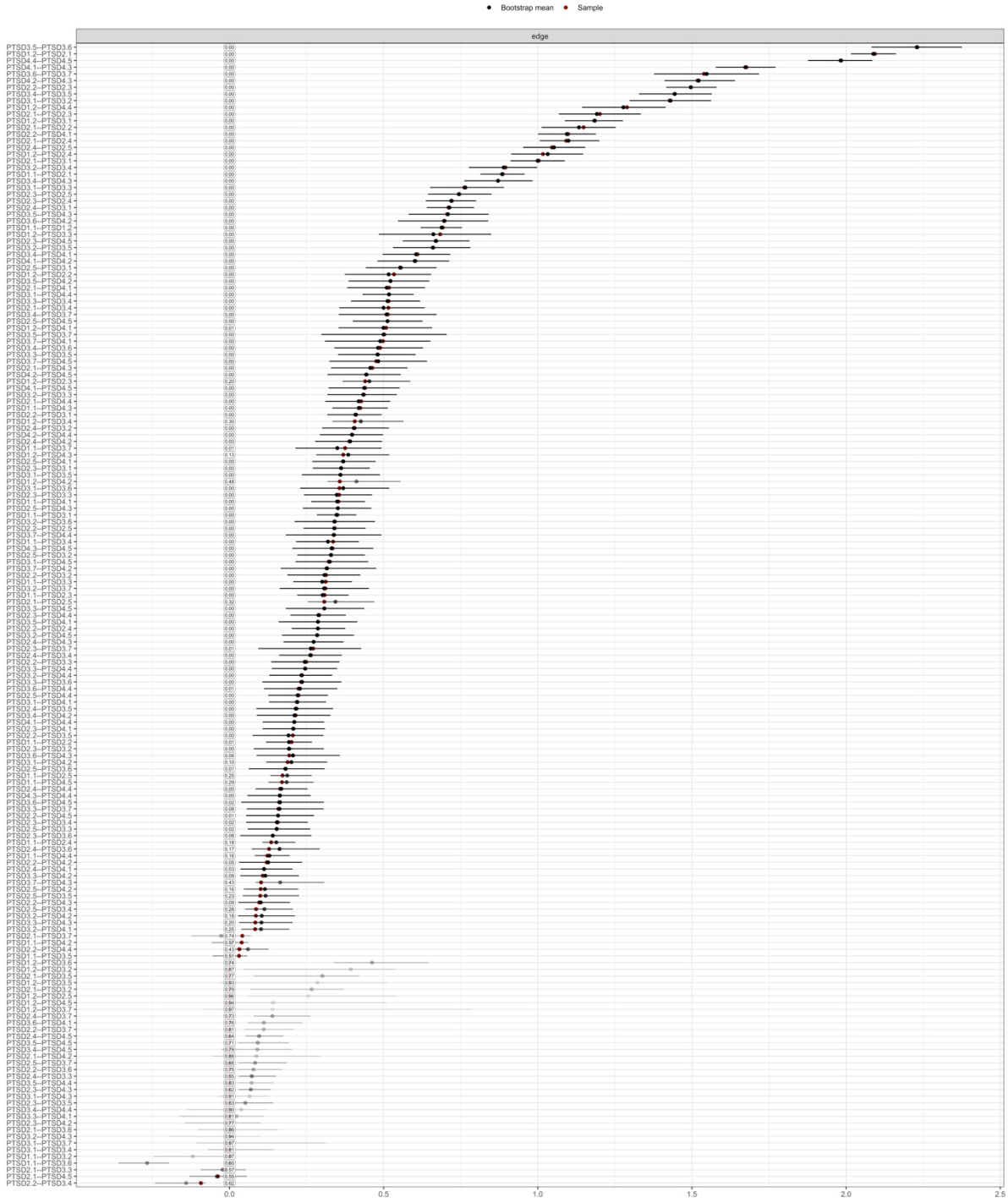


Supplementary Figure 7. Results of non-parametric bootstrap (n=1000) for the BPD network (expected influence)



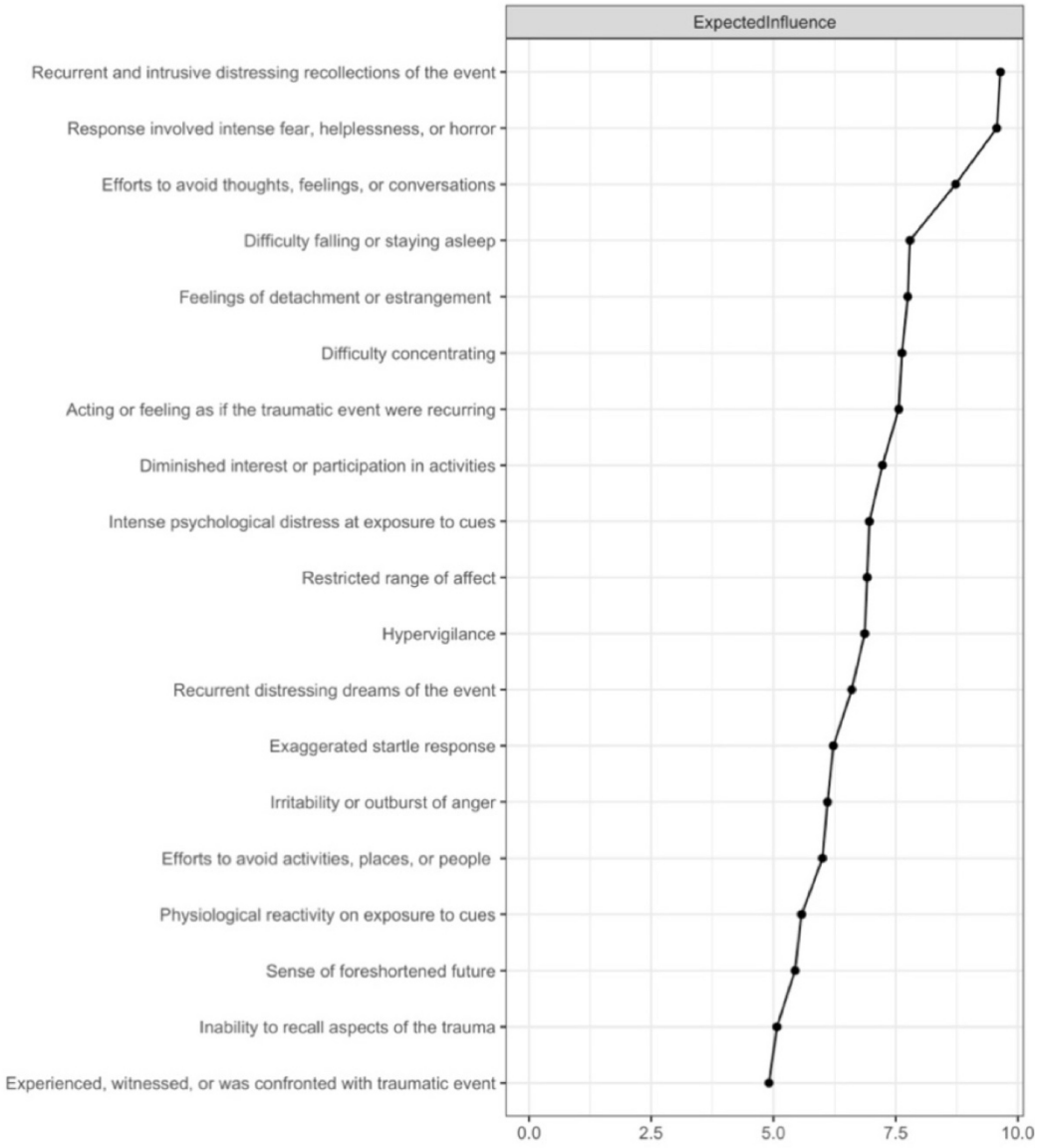
Black squares represent significant between-node differences for the centrality measure. Grey squares represent non-significant between-node differences for the centrality measure. Significance level of non-parametric bootstrap conducted was $p<0.05$.

Supplementary Figure 8. Results of non-parametric bootstrap (n=1000) for the PTSD network (edge weights)

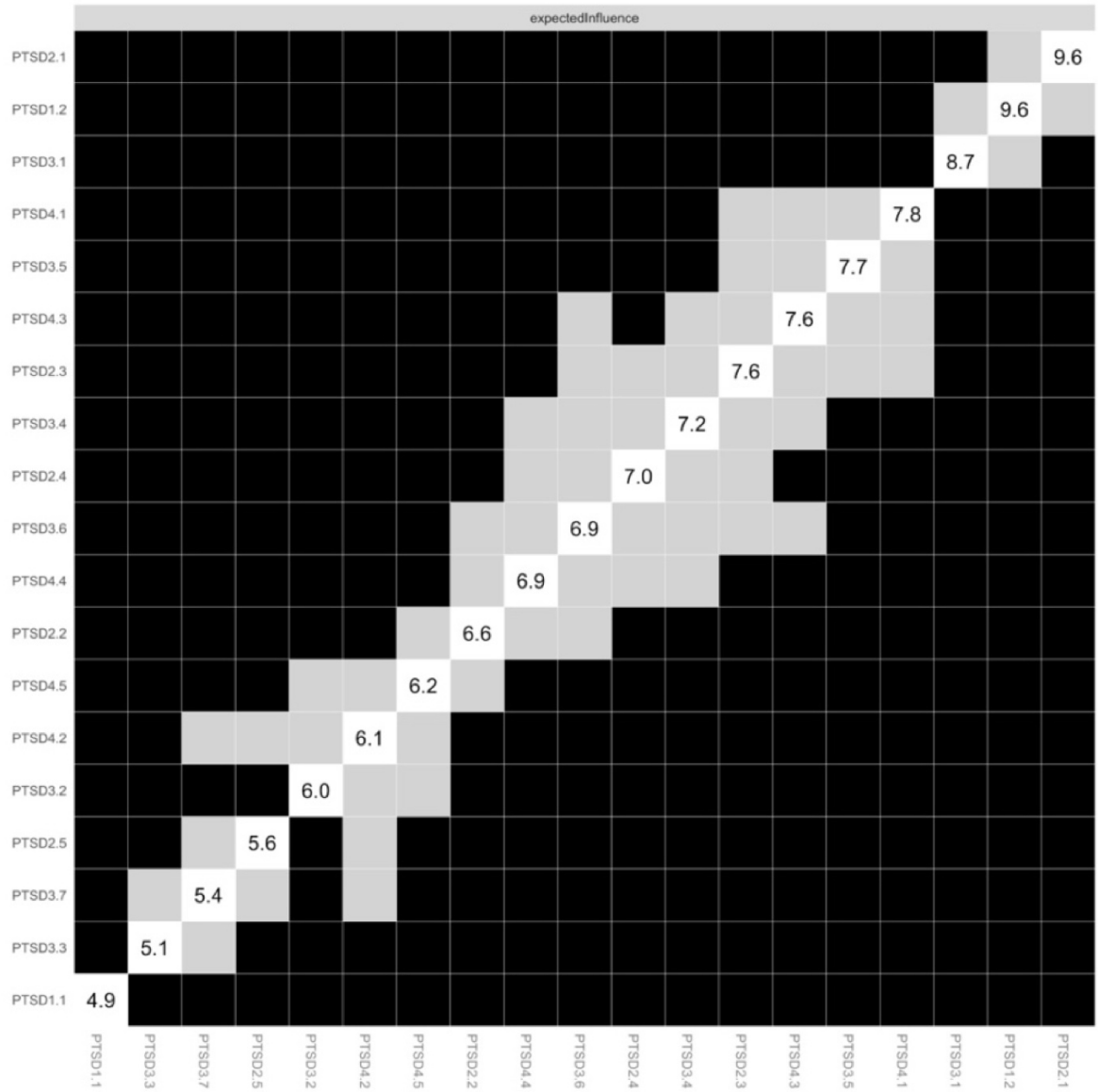


PTSD1.1 = 'Experienced, witnessed, or was confronted with traumatic event', PTSD1.2 = 'Response involved intense fear, helplessness, or horror', PTSD2.1 = 'Recurrent and intrusive distressing recollections of the event', PTSD2.2 = 'Recurrent distressing dreams of the event', PTSD2.3 = 'Acting or feeling as if the traumatic event were recurring', PTSD2.4 = 'Intense psychological distress at exposure to cues', PTSD2.5 = 'Physiological reactivity on exposure to cues', PTSD3.1 = 'Efforts to avoid thoughts, feelings, or conversations', PTSD3.2 = 'Efforts to avoid activities, places, or people ', PTSD3.3 = 'Inability to recall important aspects of the trauma', PTSD3.4 = 'Diminished interest or participation in activities', PTSD3.5 = 'Feelings of detachment or estrangement', PTSD3.6 = 'Restricted range of affect', PTSD3.7 = 'Sense of foreshortened future', PTSD4.1 = 'Difficulty falling or staying asleep', PTSD4.2 = 'Irritability or outbursts of anger', PTSD4.3 = 'Difficulty concentrating', PTSD4.4 = 'Hypervigilance', PTSD4.5 = 'Exaggerated startle response'

Supplementary Figure 9. Expected influence of PTSD symptoms in the estimated PTSD network

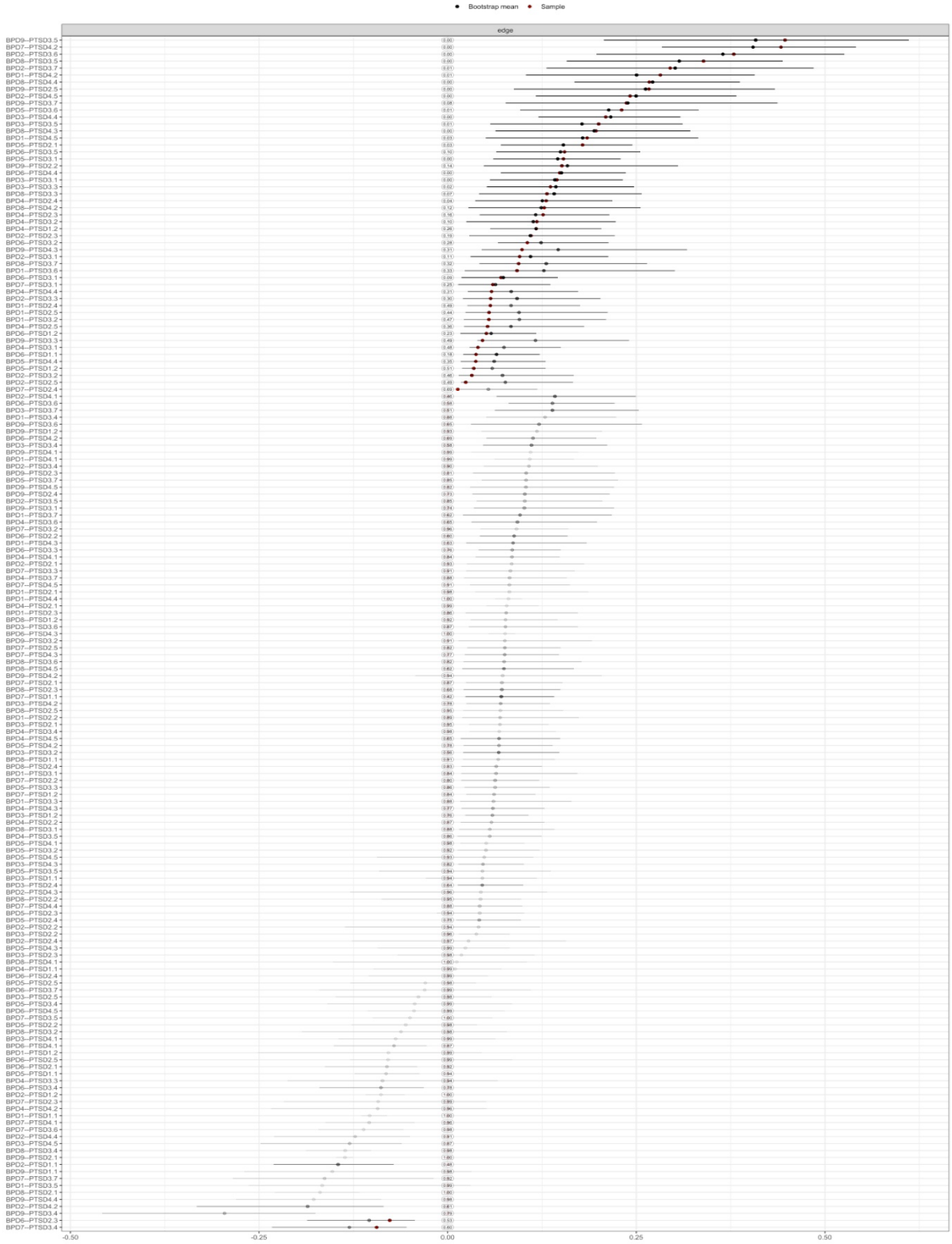


Supplementary Figure 10. Results of non-parametric bootstrap (n=1000) for the PTSD network (expected influence)

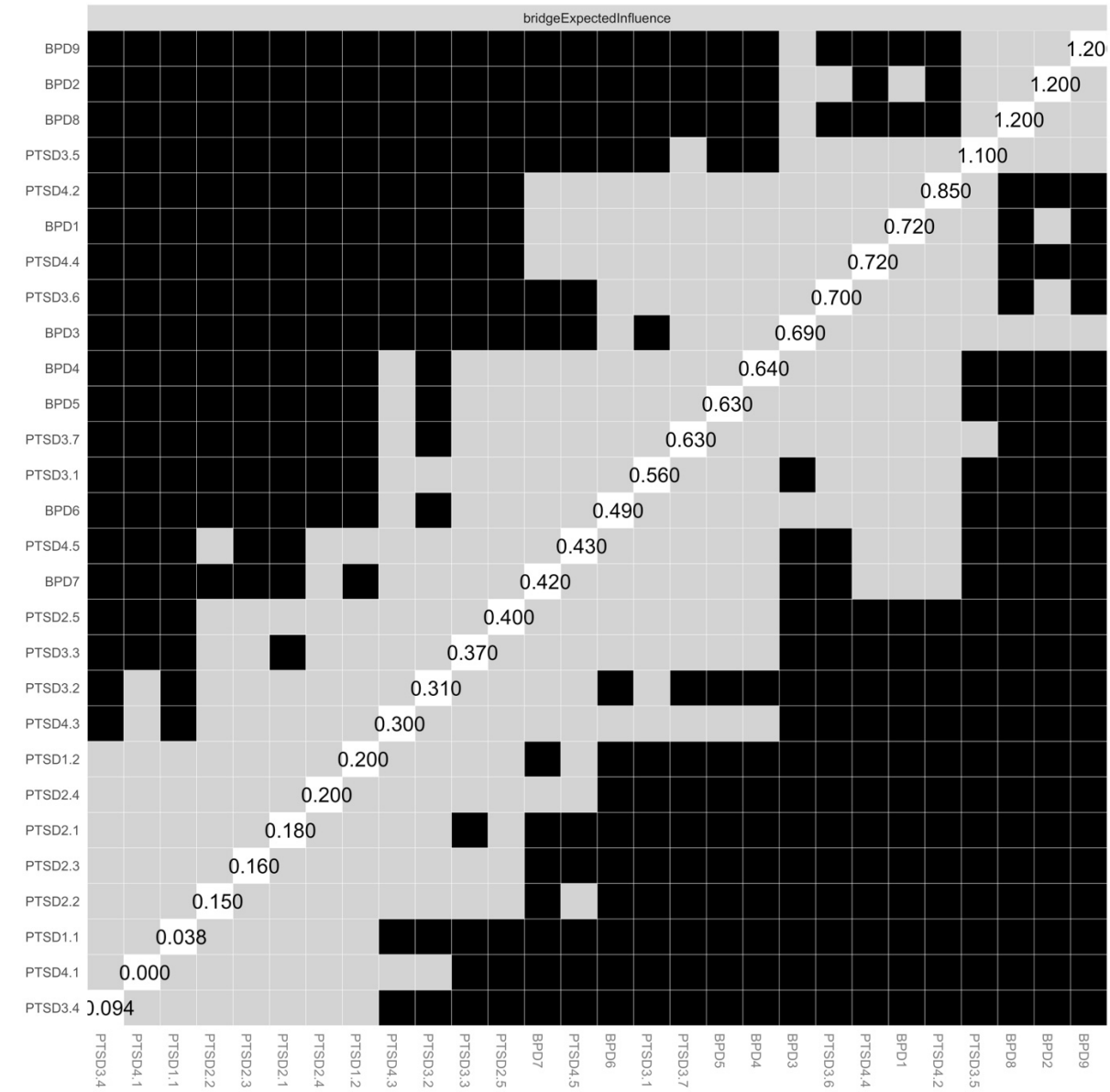


Black squares represent significant between-node differences for the centrality measure. Grey squares represent non-significant between-node differences for the centrality measure. Significance level of non-parametric bootstrap conducted was $p<0.05$.

Supplementary Figure 11. Results of non-parametric bootstrap (n=1000) for the BPD/PTSD network (edge weights)



Supplementary Figure 12. Results of non-parametric bootstrap (n=1000) for the BPD/PTSD network (bridge expected influence)



Black squares represent significant between-node differences for the centrality measure. Grey squares represent non-significant between-node differences for the centrality measure. Significance level of non-parametric bootstrap conducted was p<0.05. BPD1 = 'Marked reactivity of mood', BPD2 = 'Chronic feelings of emptiness', BPD3 = 'Identity disturbance', BPD4 = 'Frantic efforts to avoid real or imagined abandonment', BPD5 = 'Extremes of idealization and devaluation', BPD6 = 'Impulsivity', BPD7 = 'Inappropriate anger', BPD8 = 'Transient paranoid ideation or severe dissociative symptoms', BPD9 = 'Self harm or suicidal gestures', PTSD1.1 = 'Experienced, witnessed, or was confronted with traumatic event', PTSD1.2 = 'Response involved intense fear, helplessness, or horror', PTSD2.1 = 'Recurrent and intrusive distressing recollections of the event', PTSD2.2 = 'Recurrent distressing dreams of the event', PTSD2.3 = 'Acting or feeling as if the traumatic event were recurring', PTSD2.4 = 'Intense psychological distress at exposure to cues', PTSD2.5 = 'Physiological reactivity on exposure to cues', PTSD3.1 = 'Efforts to avoid thoughts, feelings, or conversations', PTSD3.2 = 'Efforts to avoid activities, places, or people ', PTSD3.3 = 'Inability to recall important aspects of the trauma', PTSD3.4 = 'Diminished interest or participation in activities', PTSD3.5 = 'Feelings of detachment or estrangement', PTSD3.6 = 'Restricted range of affect', PTSD3.7 = 'Sense of foreshortened future', PTSD4.1 = 'Difficulty falling or staying asleep', PTSD4.2 = 'Irritability or outbursts of anger', PTSD4.3 = 'Difficulty concentrating', PTSD4.4 = 'Hypervigilance', PTSD4.5 = 'Exaggerated startle response'

Supplementary Figure 13. Sensitivity analysis of Bridge Expected Influence (1-step) of nodes in the BPD/PTSD network

Sensitivity analysis was conducted by including participants with complete observations (i.e., participants who met the primary criterion for PTSD, without imputation of the skip-structure. The highest scoring symptoms are comparable to those obtained in the main analysis, with symptom « restricted range of affect » scoring higher in the sensitivity analysis.