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# A network approach to the comorbidity between posttraumatic stress disorder and major depressive disorder: The role of overlapping symptoms

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ABSTRACT

*Background:* The role of symptom overlap between major depressive disorder and posttraumatic stress disorder in comorbidity between two disorders is unclear. The current study applied network analysis to map the structure of symptom associations between these disorders.
*Methods:* Data comes from a sample of 909 Australian adults with a lifetime history of trauma and depressive symptoms. Data analysis consisted of the construction of two comorbidity networks of PTSD/MDD with and without overlapping symptoms, identification of the bridging symptoms, and computation of the centrality measures.
*Results:* The prominent bridging role of four overlapping symptoms (i.e., sleep problems, irritability, concentration problems, and loss of interest) and five non-overlapping symptoms (i.e., feeling sad, feelings of guilt, psychomotor retardation, foreshortened future, and experiencing flashbacks) is highlighted.
*Limitations:* The current study uses DSM-IV criteria for PTSD and does not take into consideration significant changes made to PTSD criteria in DSM-5. Moreover, due to cross-sectional nature of the data, network estimates do not provide information on whether a symptom actively triggers other symptoms or whether a symptom mostly is triggered by other symptoms.
*Conclusion:* The results support the role of dysphoria-related symptoms in PTSD/MDD comorbidity. Moreover, Identification of central symptoms and bridge symptoms will provide useful targets for interventions that seek to intervene early in the development of comorbidity.

## 1. Introduction

The high prevalence of major depressive disorder (MDD) among individuals with a history of trauma and posttraumatic stress disorder (PTSD) is well-established in the literature. Using data from National Comorbidity Survey Replication (NCS-R) Elhai et al. (2008) reported that among individuals with lifetime PTSD – diagnosed by the Diagnostic and Statistical Manual of Mental Disorders–4th Edition–criteria (DSM-IV; APA, 2000) –, 55% have also been diagnosed with MDD at some point in their lives. The comorbidity between these disorders is associated with increased burden, poorer therapeutic outcome, and increased suicidal behaviours in comparison to patients with MDD or PTSD without comorbidity (Frayne et al., 2004; Green et al., 2006; Oquendo et al., 2003). Therefore, understanding the underlying structure of comorbidity between these disorders has important implications in terms of assessment, harm-reduction, and treatment. Symptom-overlap between PTSD and other disorders has been suggested as the origin of the high prevalence of comorbidity among PTSD patients (see Spitzer et al., 2007). Cramer et al. (2010) suggest that symptom-level associations between two disorders can provide substantial insights into the underlying structure of comorbidity. The current study uses a novel approach, network analysis, to clarify the role of symptom-overlap in the constellation of PTSD and MDD comorbidity.

Prior literature has highlighted a substantial overlap in content between four PTSD and MDD symptoms (Elhai et al., 2011, 2008). There is substantial overlap between symptom C4 of PTSD in DSM-IV, described as "markedly diminished interest or markedly diminished participation in significant activities" and symptom A2 of MDD, described as "markedly diminished interest or pleasure in all, or almost all activities most of the day, nearly every day". Similarly, there is overlap in the content between three DSM-IV Cluster-D PTSD symp-

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toms, namely poor sleep (D1), irritability (D2), and concentration difficulties (D3), with three counterpart symptoms in depression, namely irritability (specified as a part of A1 symptom), concentration difficulties (specified as a part of A8 symptom), and poor sleep (specified as a part of A4 symptom). It is noteworthy that none of these overlapping symptoms have been changed or removed from DSM-5.

Spitzer et al. (2007) proposed that the exclusion of these overlapping (non-specific) symptoms might lead to a more parsimonious diagnosis of PTSD. Since then, several studies examined the utility of the more parsimonious diagnostic criteria of PTSD and have examined the role of overlapping symptoms in the prevalence rates of PTSD and PTSD/MDD comorbidity. These studies have generally compared the prevalence of each disorder and their comorbidity with and without overlapping symptoms. For example, using data from the NCS-R, Elhai et al. (2008) reported minimal difference in the lifetime prevalence rate of MDD among patients with PTSD; 54.72%when using the full PTSD diagnostic criteria and 54.41% when removing PTSD/MDD overlapping symptoms. Similarly, using adolescent data from the American National Survey of Adolescents, Ford et al. (2009) highlighted stable incidence rates across the full DSM-IV PTSD diagnostic criteria (75.7%) and Spitzer et al.'s (2007) alternative diagnostic algorithm without non-specific symptoms (76.6%).

Other studies suggest that a plausible explanation for the high prevalence of PTSD/MDD comorbidity is the existence of one or more shared common underlying dimensions. This theory has been empirically investigated through the use of factor analysis. For example, using self-report measures in a sample of treatment-seeking veterans, Gros et al. (2010) identified a two-factor model representing symptoms of MDD and PTSD; however, a subset of PTSD symptoms, including loss of interest, sense of foreshortened future, being emotionally distant, and emotional numbing loaded onto the depression factor, while none of the depression symptoms loaded onto the PTSD factor. The non-specific PTSD symptoms were predictive of comorbid MDD and increased depression symptomatology in patients with PTSD. This is consistent with other factor analysis studies suggesting that PTSD and MDD might be best conceptualized as two dimensions with a number of overlapping indicators (Blanchard et al., 1998; Grant et al., 2008). In contrast, an item response theory study of trauma-exposed individuals in the NCS-R highlighted that items representing PTSD and MDD symptoms can represent one underlying latent variable. The unidimensionality of PTSD/MDD remained intact even after removing overlapping symptoms (Elhai et al., 2011). The disparity between these results may be due, at least in part, to different analytic strategies (item response theory versus exploratory factor analyses) and the nature of the study samples (treatment-seeking veterans versus trauma-exposed individuals from the general population). Higher severity among treatment-seeking patients and the high co-occurrence of symptoms within each disorder (i.e. higher correlation of the symptoms within each disorder) might lead to a bidimensional structure. However, the unidimensional structure in the trauma-exposed individuals from the general population might be the representation of the non-specific patterns of symptom co-occurrence and broader range of distress reactions.

Another possible explanation for comorbidity between PTSD and MDD may relate to the dimensional communality between depression and the PTSD dysphoria factor (Simms et al., 2002), comprised of an inability to recall important aspects of trauma, loss of interest, detachment, restricted affect, sense of foreshortened future, sleep disturbance, irritability, and concentration difficulties. Some studies suggest that depression measures are more strongly correlated with the dysphoria factor than with the other PTSD symptom factors, which can be explained by overlapping symptoms between the two (Armour and Shevlin, 2009; Gootzeit and Markon, 2011; Simms et al., 2002). However, others suggest that the explained variance of MDD symptoms can not solely be attributed to the dysphoria factor (Armour and Shevlin, 2013; Elhai et al., 2008; Marshall et al., 2010; Miller et al., 2010).

In all of the above reviewed literature, symptoms are considered as passive indicators of disorders or dimensions. In other words, studies either focused on the count of endorsed symptoms to establish the diagnoses and the prevalence rate of comorbidity, or considered symptoms as the indicators of latent dimensions, while the between-symptom associations are regarded as a byproduct of dimensional communality (for a review of these appaoches see Borsboom, 2008). Therefore, the current literature overlooks the role of symptom-level associations in comorbidity of PTSD and MDD.

An alternative approach to conceptualizing comorbidity is the network approach. In this approach, comorbidity is considered as a constellation of symptom-level associations (Cramer et al., 2010). From the network perspective, each mental disorder represents a complex constellation of symptoms, clustered by pairwise relations (Borsboom et al., 2011a). Therefore, comorbidity is regarded as a set of direct relationships between symptoms of distinct disorders (Borsboom et al., 2011b). These between-cluster symptom-level connections are considered as *"bridges"* in the comorbidity network structure. The presence of bridging symptoms drives the co-occurrence of comorbid diagnoses and increases the probability of the presence of other symptoms in the constellation. Furthermore their absence may lead to a substantial decrease in symptom-level associations both within-disorders and between-disorders.

Symptom network studies are only beginning to emerge. Some studies have attempted to map the network structure of mental disorders using the symptoms from ICD-10 and DSM-IV (Boschloo et al., 2015; Tio et al., 2016), while others have focused on the specificities of the symptom constellation of individual mental disorders such as MDD (Bringmann et al., 2013; Fried et al., 2016), PTSD (McNally et al., 2015), and autism (Ruzzano et al., 2015). The network approach has also been used to examine the symptom-level structure of MDD and generalised anxiety disorder comorbidity, and the bridging role of the overlapping symptoms between the two disorders (Borsboom et al., 2011b; Cramer et al., 2010; Tio et al., 2016).

Concerning the network constellation of PTSD symptoms, McNally et al. (2015) highlighted the central role of hypervigilance, sense of foreshortened future, and concentration problems and suggested that treatment should focus on these symptoms in order to prevent relapse. With regard to PTSD/MDD comorbidity, Boschloo et al. (2015) reported 11 symptom-level associations between PTSD and MDD in their network structure, with four of these associations due to overlapping symptoms (i.e., loss of interest, concentration difficulties, and sleep problems).

The current study investigates the network structure of the comorbidity between PTSD and MDD using data from a community sample who reported a traumatic event and at least one period of two weeks when most of the day they felt sad, discouraged, or uninterested. The main goal is to examine the comorbidity network, constructed based on pairwise connections among PTSD and MDD symptoms, and describe the bridging characteristics of each symptom. In order to achieve this goal we examine two different network constellations. The first network investigates the bridging role of each symptom in a comorbidity network *with overlapping symptoms*. For the first network, we hypothesise that the mutual relations between four overlapping symptoms (i.e., sleep problems, irritability, concentration difficulties, and loss of interest) bridge the two disorders. The second network evaluates the bridging role of each symptom in a comorbidity network *without overlapping symptoms*. This network will reveal whether the bridges between two disorders are circumscribed to the mutual relations between overlapping symptoms. For the second network, we hypothesise that the comorbidity network will not disintegrate in the absence of the overlapping symptoms and other symptoms will take over the bridging role between two disorders. The results from this network will indicate which symptoms characterize the bridging role