Intraindividual Network Analysis: Using Centrality Indices for Personalized Treatment Planning

Sarah Jo David, Andrew J. Marshall, Emma K. Evanovich, Noelle Cavalier, & Gregory H. Mumma
Texas Tech University, Department of Psychological Sciences

Abstract

• The network analysis approach to psychopathology postulates that symptoms are causally connected.
• The present study conducted a network analysis of lead-lag relations in an individual with comorbid mood and anxiety disorders. The resulting network displayed directional relations of depressive, anxious, anhedonic, and positive affect symptoms.
• These results and similar networks may be helpful in selecting specific treatment components that may be effective for an individual with a complex symptom presentation or comorbid disorders.

Introduction

• Within a causal systems modeling approach, symptoms are not a result of a disorder or a manifestation of a latent variable (e.g., depression), but rather mutually interacting components of a multifaceted network (Borsboom & Cramer, 2013).
• A network analysis of lead-lag relations in the time-series data of a single individual may reveal dynamic, functional, and potentially causal relations between symptoms occurring within that individual over time. Although Borsboom & Cramer (2013) described the basic structure of an intraindividual network analysis, their description was limited to a hypothetical example.
• The present study conducted an intraindividual network analysis of lead-lag relations in a participant (age 44 years) diagnosed with major depressive disorder, dysthymia, and social anxiety disorder.

Method

• Daily data was collected during the assessment and initial treatment phases of tailored, case formulation based, cognitive-behavioral treatment (CBT) over a period of four months.
• Items included those based on the Mood and Anxiety Symptom Questionnaire (MASQ) related to depression, anxiety, anhedonia, and positive affectivity. The participant was instructed to fill in the questionnaire at approximately the same time every day, and completed 90 questionnaires.
• All items were detrended. Next, each symptom at time t was regressed on all other symptoms, including itself, at time t-1. The partial correlation matrix was regularized using LASSO (least absolute shrinkage selection operator) regularization.
• Regularization provides for a parsimonious network in which statistically unreliable parameters are shrunk to zero.
• The resulting network was created utilizing the qgraph package in R.

Results

• Of 484 possible lag-1 relations, 433 were reduced to zero due to LASSO regularization. The resulting network displayed the lead-lag relations of the participant’s symptoms across time.
• The strength of the relation between items is indicated by the thickness of the arrows. Green arrows indicate positive relation and red arrows indicate negative relations. The direction of the arrow indicates that an item at time (t) is predicted by an item the previous day (t-1).
• Indegree estimates for this person indicated that variability of depressive, anxious, and positive affect symptoms.
• Outdegree estimates indicated that “today’s” Tension (1.77), Worry, (1.40), Trouble Concentrating (1.31) and feeling Discouraged (1.22) had the greatest influence on other symptoms “tomorrow”, while controlling for all other symptoms.
• Trouble Concentrating (2.62) and feeling Discouraged (1.84) had the highest betweenness estimates, indicating these symptoms bridge the shortest lagged connections between other pairs of symptoms in the network when controlling for other symptoms.

Centrality Indices

• Indegree, a centrality index, estimates how much information a symptom receives directly from other symptoms (i.e., number of edges arriving at the node).
• Outdegree, another centrality index, estimates how much information a symptom sends directly to other symptoms (i.e., number of edges departing from the node).
• Betweenness indexes how often a symptom lies on the shortest path between two other symptoms over time.

Abbreviation | Symptom Item
--- | ---
Depression Items | Sad Felt sad.
Depressed | Felt depressed.
Discourage | Felt discouraged.
Disappoint | Was disappointed in myself.
Blame | Blamed myself for a lot of things.
Mixed Distress Items | Worry Worry a lot about things.
Teh Conc | Had trouble concentrating.
Confused | Felt confused.
Anxiety Items | Nervous Felt nervous.
Tense | Felt tense or “high strung”.
Uneasy | Felt uneasy.
Un Relax | Was unable to relax.
On Edge | Felt keyed up, “on edge”.
Anhedonia Items | Felt like nothing was very enjoyable.
Not Enjoy | Felt withdrawn from others.
Withdraw | Took extra effort to get started.
Extra Effort | Felt I had a lot of energy.
Positive Affect Items | Fun Felt I had a lot of fun.
Energy | Felt like I had a lot of energy.

Please feel free to contact Sarah Jo David at sarah.jo.david@ttu.edu or Gregory H. Mumma, Ph.D. (g.mumma@ttu.edu) with any questions.