



# Using Network Analysis to Identify the Relationship Between Cognitive Symptoms and Patient Variables in Patients who have Treatment-Resistant Depression

Mattias Yim<sup>1</sup>, Elizabeth Gregory<sup>1</sup>, Ivan Torres<sup>1</sup>, Fidel Vila-Rodriguez<sup>1</sup>

<sup>1</sup>Department of Psychiatry, The University of British Columbia

## Background

- Major depressive disorder (MDD) is a serious and debilitating disease<sup>1</sup>
- 30-50% of MDD patients do not respond to first line treatments and are considered to have treatment resistant depression<sup>2</sup> (TRD)
- Patients with TRD have worse cognitive functioning<sup>3</sup>
- MDD may be conceptualized as a complex dynamic system<sup>4</sup>

## What are Networks?

- Networks are many individual variables (*nodes*) that are interlinked (via *edges*)
- Networks allows researchers to study mental disorders symptoms and their interactions<sup>5</sup>
- Networks can be used to determine (visually and quantifiably) which variables are the most important, or *central* in the network

## Objective

- Analyze the centrality of cognitive symptoms in a network of demographic and clinical variables in patients with TRD

## Methods

### Participants

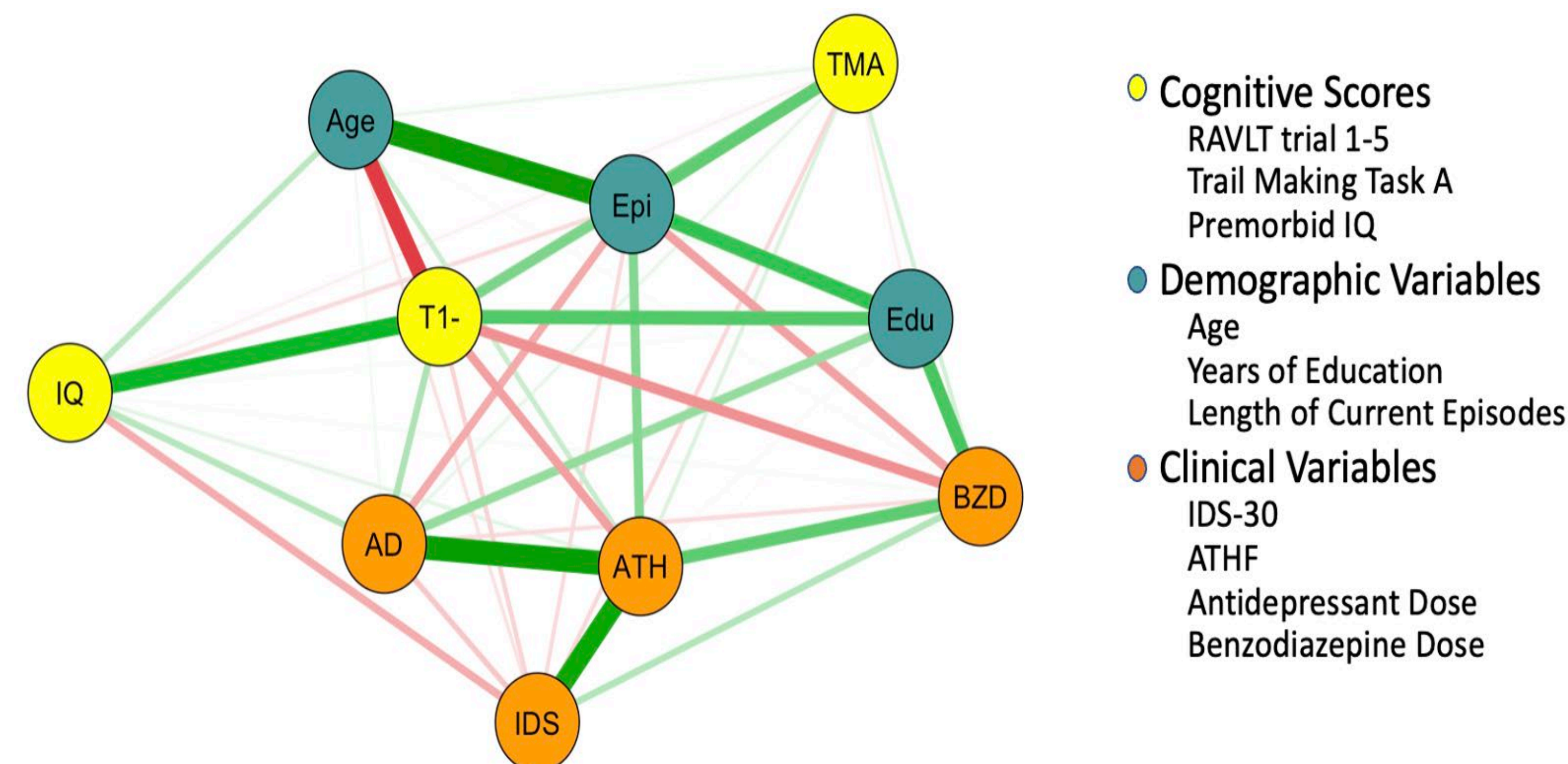
- The 120 participants in this study came from two clinical trials using rTMS for TRD with similar inclusion and exclusion criteria

### Statistical analyses

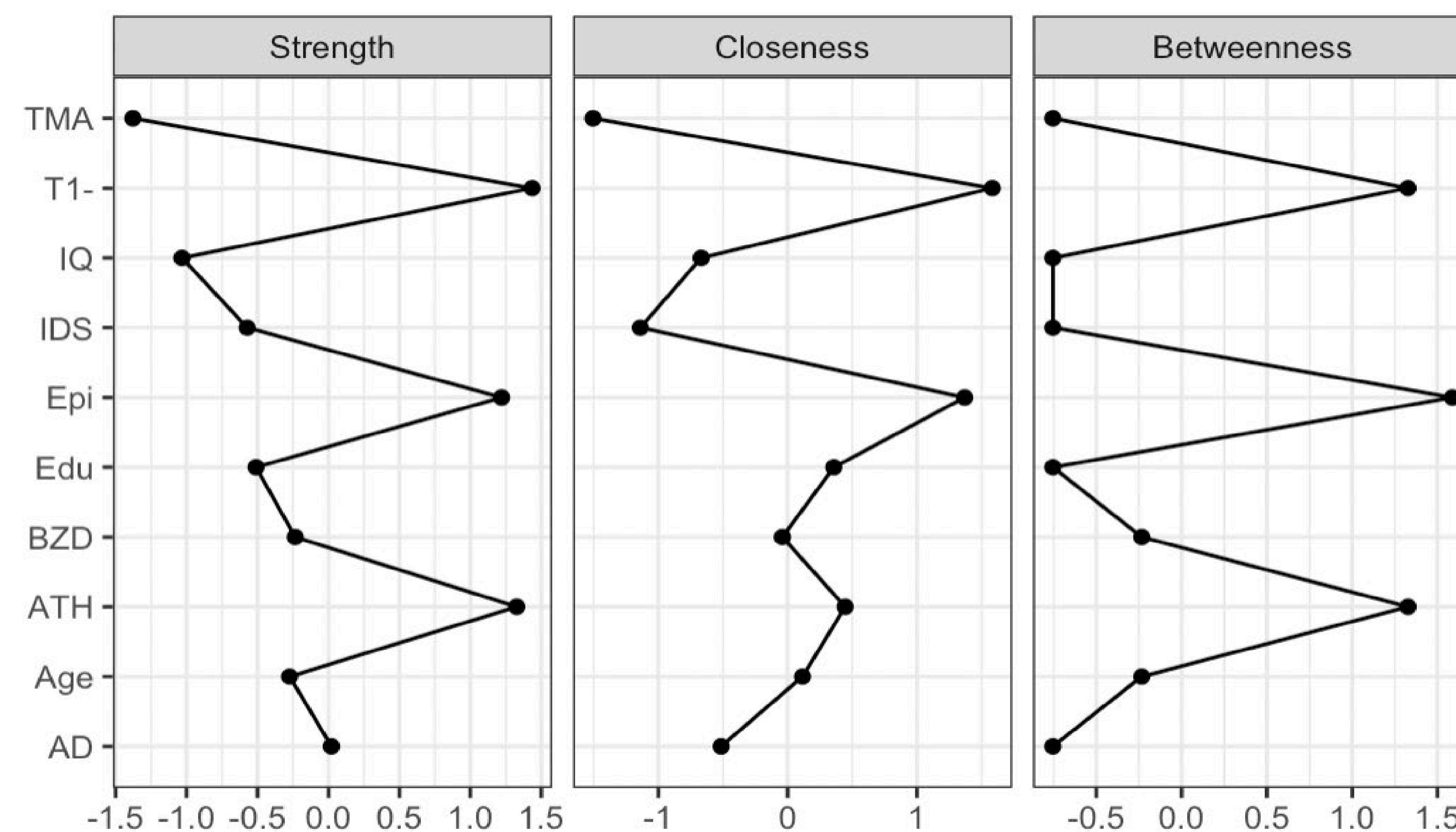
- Networks were made and analyzed using RStudio and the *qgraph* and *bootnet* packages<sup>6,7</sup>
- Network was estimated using partial correlations (edges estimated by controlling for all other information available)
- A non-parametric bootstrap was performed to assess the stability of the network

## Results

- RAVLT trial 1-5 score (verbal learning and memory), length of the current depressive episode, and antidepressant treatment history form (ATHF; a measure of treatment resistance) were central
- The trail-making test A (psychomotor speed), premorbid IQ (language), and the depression severity were not central



**Figure 1.** Partial correlation network of cognitive test scores (yellow), demographic variables (blue), and clinical variables (orange). *Green* edges represent positive Pearson's correlations and *red* edges represent negative Pearson's correlations. The thickness of the edge represents the relative strength of the correlation.



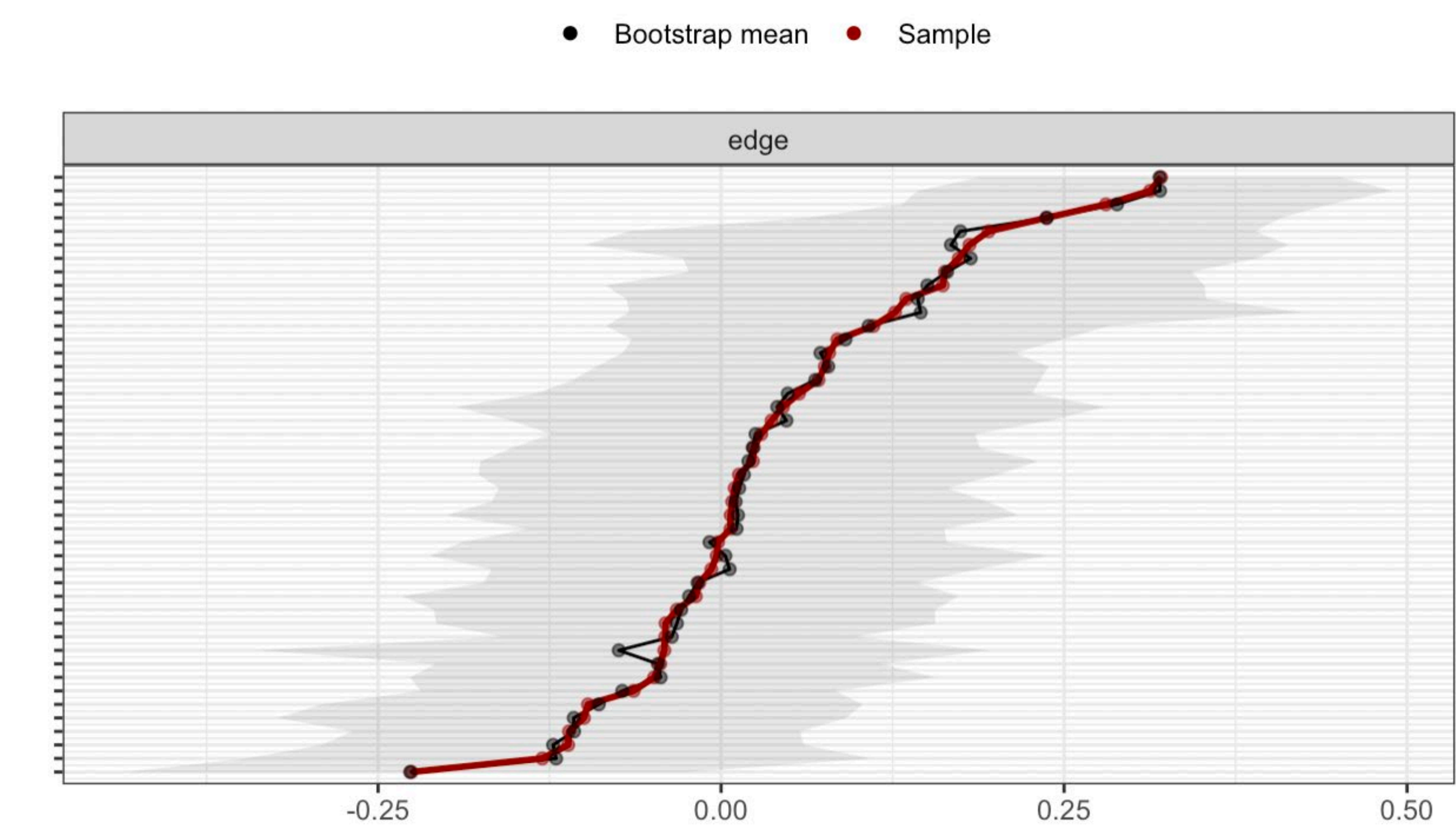
**Figure 2.** The centrality of each node using different measures of centrality. Strength relates to the number of other nodes that the node is connected to, closeness relates to the average number of nodes it takes to reach that node, and betweenness relates to the number of times the node is the shortest path between two other nodes. The x-axis represents standardized z-scores where a larger positive value means that the node is more central.

## Acknowledgements



## Results

- Bootstrap found edges had large confidence intervals



**Figure 3.** 95% confidence intervals estimated from a non-parametric bootstrap ( $N_B = 1000$ )

## Conclusion

- The RAVLT trial 1-5 score, length of current depressive episode, and ATHF were central variables in a network of the most common clinical and demographic characteristics
- Albeit exploratory and with limited inferential power, these results explore the clinical presentation of depression as a complex network

## References

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