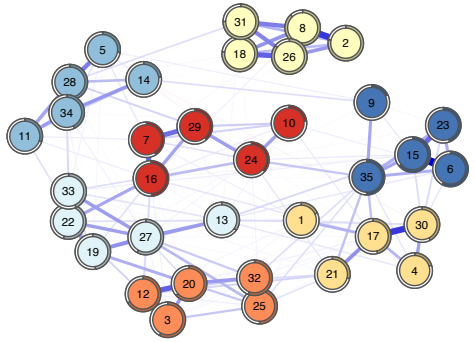


# Network analysis of empathy items from the Interpersonal Reactivity Index in 1973 young adults

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# The paper (open data, open code)

- https://www.psy-journal.com/article/S0165-1781(17)31682-7/fulltext

## Network analysis of empathy items from the interpersonal reactivity index in 1973 young adults

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ABSTRACT

The aim of this work is to perform a network analysis on the French adaptation of the interpersonal reactivity index (IRI) scale from a large Belgian database and provide additional information for the construct of empathy. We analyze a database of 1973 healthy young adults who were queried on the IRI scale. A regularized partial correlation network is estimated. In the visualization of the model, items are displayed as nodes, edges represent regularized partial correlations between the nodes. Centrality denotes a node's connectedness with other nodes in the network. The spinglass algorithm and the walktrap algorithm are used to identify communities of items, and state-of-the-art stability analyses are carried out. The spinglass algorithm identifies four communities, the walktrap algorithm five communities. Positive edges are found among nodes belonging to the same community as well as among nodes belonging to different communities. Item 14 ("Other people's misfortunes do not usually disturb me a great deal") shows the highest strength centrality score. The network edges and node centrality order are accurately estimated. Network analysis highlights interesting connections between indicators of empathy; how these results impact empathy models must be assessed in further studies.

# Introduction – why is empathy relevant?

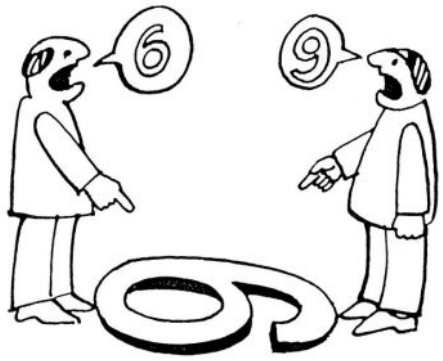
- **Empathy**: still to be defined
  - Perceive others' emotions (cognitive dimension)
  - Desire for their wellbeing (affective dimension)
- Interest for psychiatrists: psychopathy, autism
- Interest for other MDs: patient relationship
- Interest for therapists: good outcomes

# Introduction – Davis' model

- Cognitive dimension
  - **Fantasy**
  - **Perspective taking**
- Affective dimension
  - **Empathic concern**
  - **Personal distress**

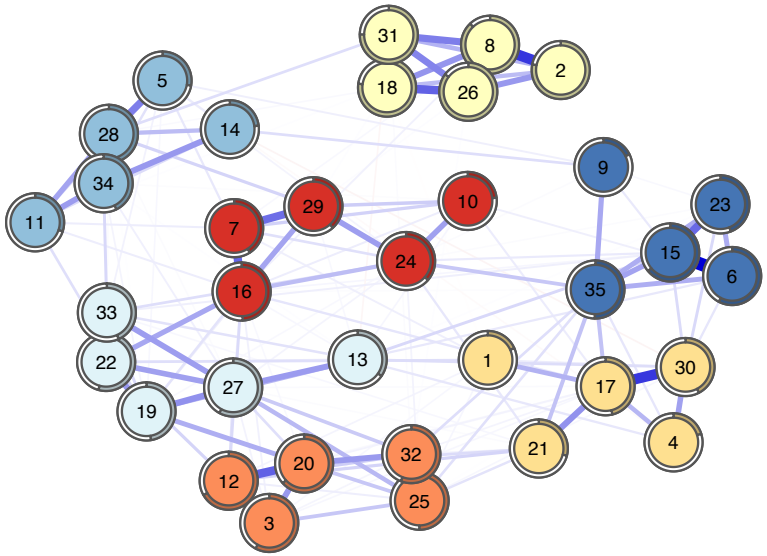
- Cliffordson's **pyramid**

Interpersonal Reactivity Index




# Introduction – psych networks

- Network **theory** of mental disorders
- Psychological constructs $<$ mutual interaction of items



# Introduction - aim

- Explore empathy as a network of items in a sample of university students
- Compare outcomes from community detection algorithms with a prior EFA and CFA analysis (Braun et al 2015)
- Open data & code: https://osf.io/zj4r3/

# Methods - dataset

- Dataset: 1973 university students
  - 17-25 years old; M 19.6; SD 1.6
  - 57% females; 43% males
- IRI: 28 items
  - 0: Doesn't describe me very well
  - 4: Describes me very well
  - Reverse-scored items are present
- Data analysis: R (3.4.0)
  - qgraph, glasso, igraph, bootnet

# Methods – network estimation

- Estimation: **spearman** correlations for 28 items
- Correlation matrix as input for regularized partial correlation network (**GGM** + **glasso**)
- Nodes → items from IRI
- Edges → regularized partial correlations
  - Interpret as: *Score high on A → Score high on B if A and B are connected, controlling for all other nodes*
- Node placement by Fruchterman-Reingold **algorithm**

# Methods – network inference

- Degree centrality (absolute sum of connections of a given node)
  - If item is central it might predict other items that are connected to it
  - Relative measure of interconnectedness
- Node predictability (shared variance with surrounding nodes)
  - Upper bound of **controllability**
  - Absolute measure of interconnectedness

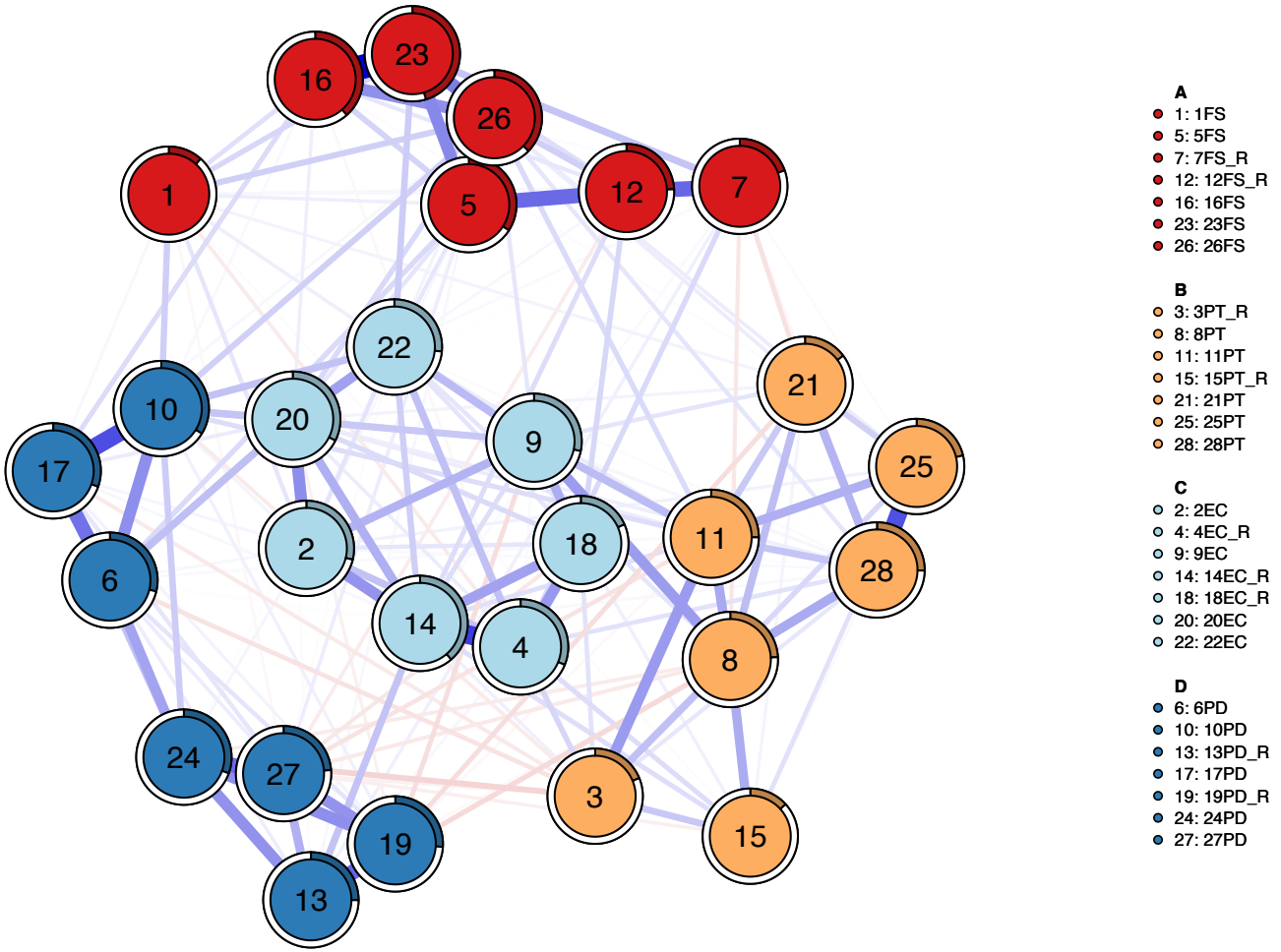
# Methods – community detection

- Spinglass algorithm → based on nodes' connections, but known stability issues
- Walktrap algorithm → short random walks tend to stay the same in a given community, high accuracy in simulation studies (Golino & Epskamp 2017)

# Methods – accuracy & stability

- Accuracy: **bootstrapping** edge weights 95% CIs (**are the edges accurately estimated**?) and edge weight difference test (**do edges differ significantly from each other?**)
- Stability: subsetting bootstrap (**is the centrality order stable?**), centrality stability coefficient, and centrality difference test (**do centrality estimates differ significantly from each other?**)

# Results – empathy network



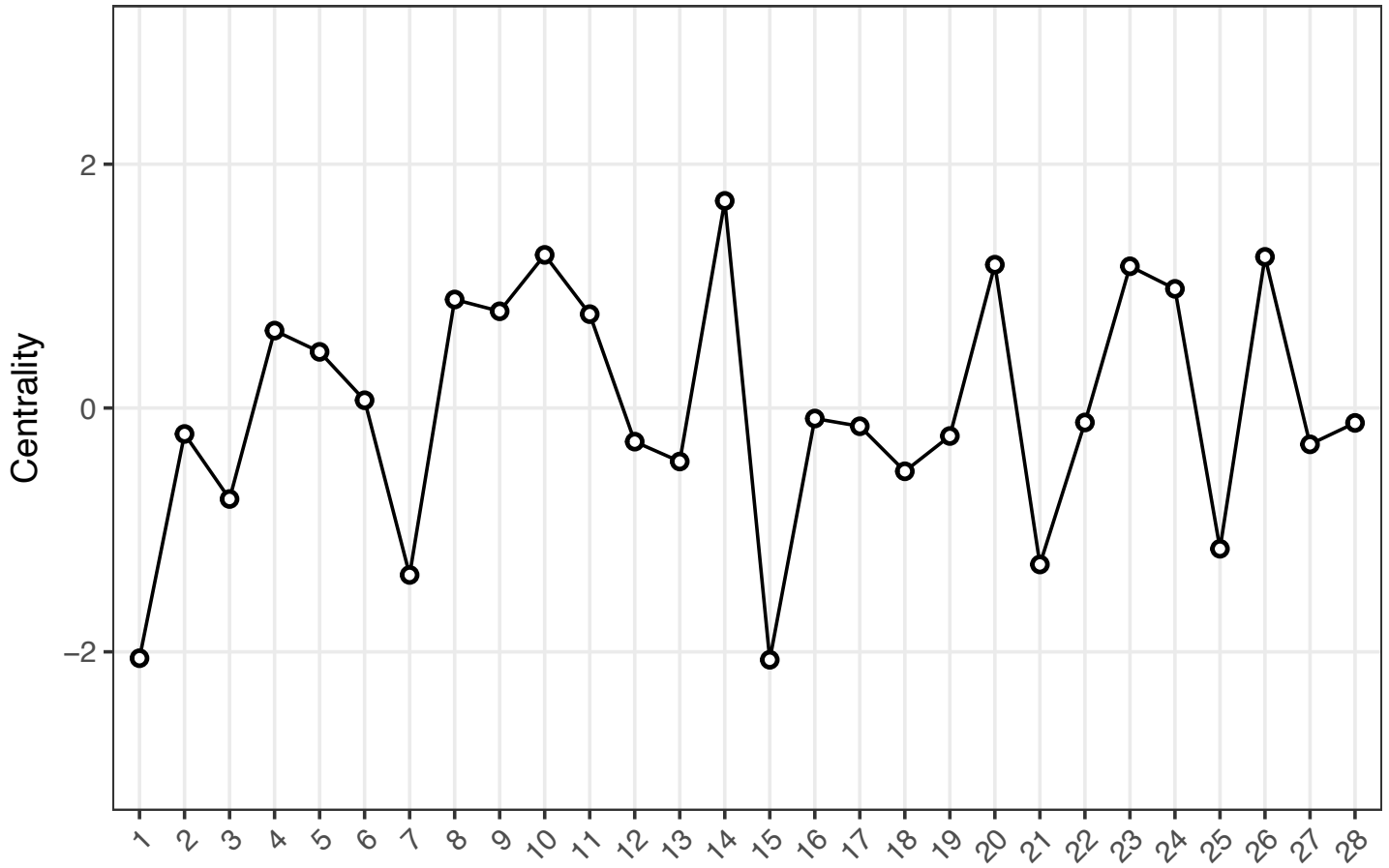
# Results – community detection

- Spinglass: 4 communities (as the four initial factors described by Davis)
- Walktrap: 5 communities (items 6, 10, 17)
  - 6 ("In emergency situations, I feel apprehensive and ill- at-ease"), 10 ("I sometimes feel helpless when I am in the middle of a very emotional situation"), 17 ("Being in a tense emotional situation scares me")

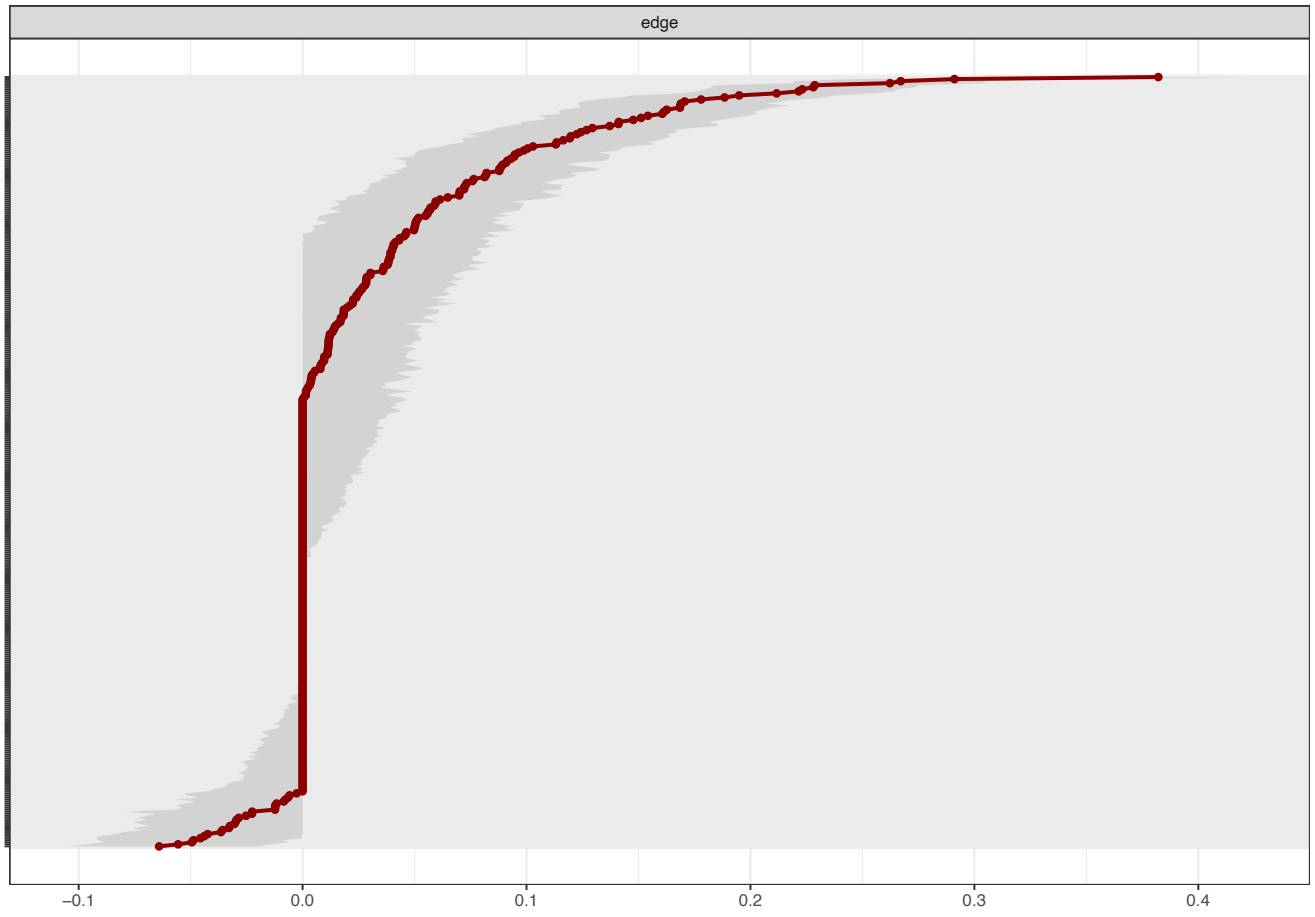
# Results - centrality

- Mean node predictability: 0.27
- Degree centrality: items from empathic concern emerge as more central (item 14 the most central – *other people's misfortunes do not usually disturb me a great deal*, reversed)

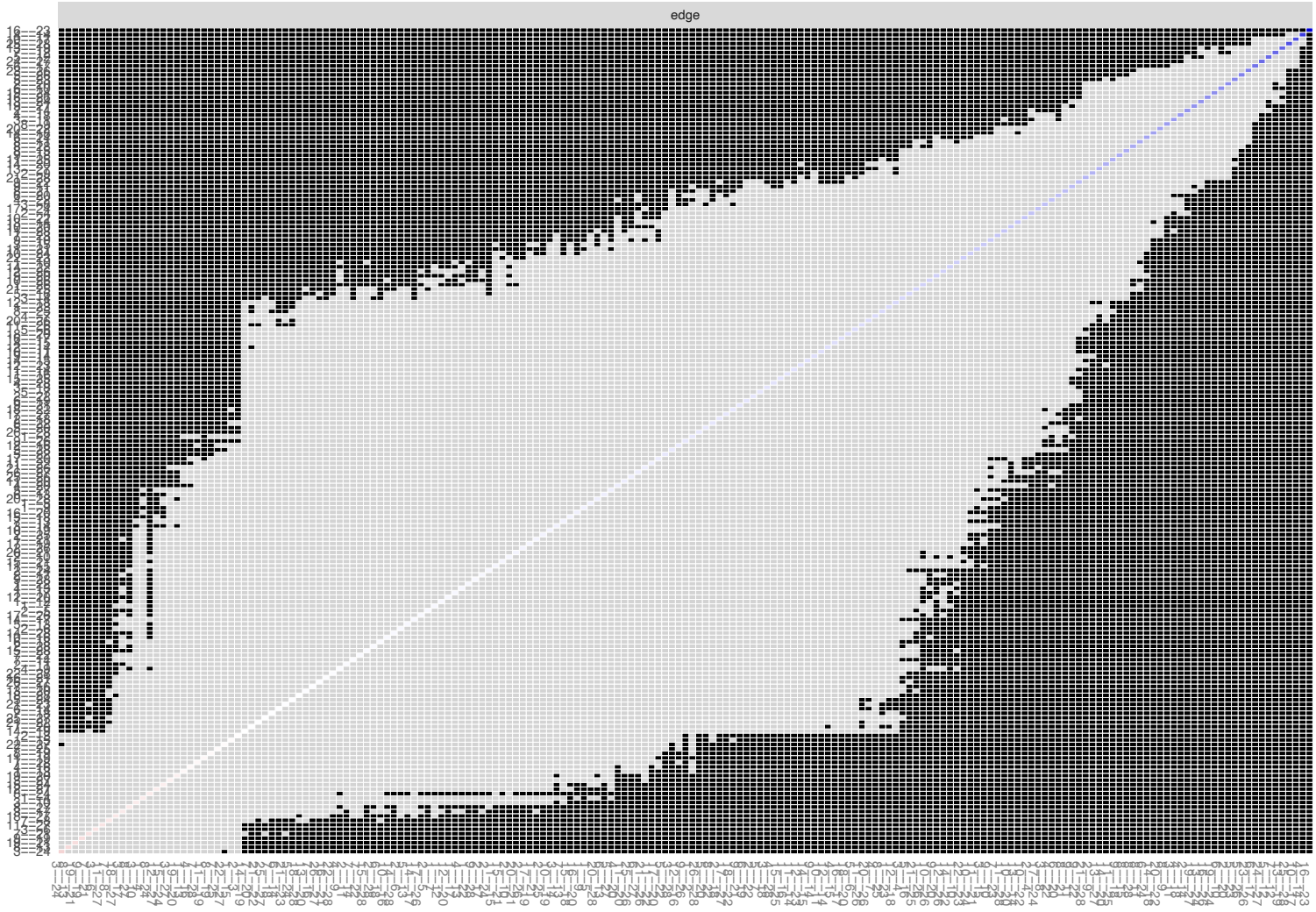
# Results - centrality



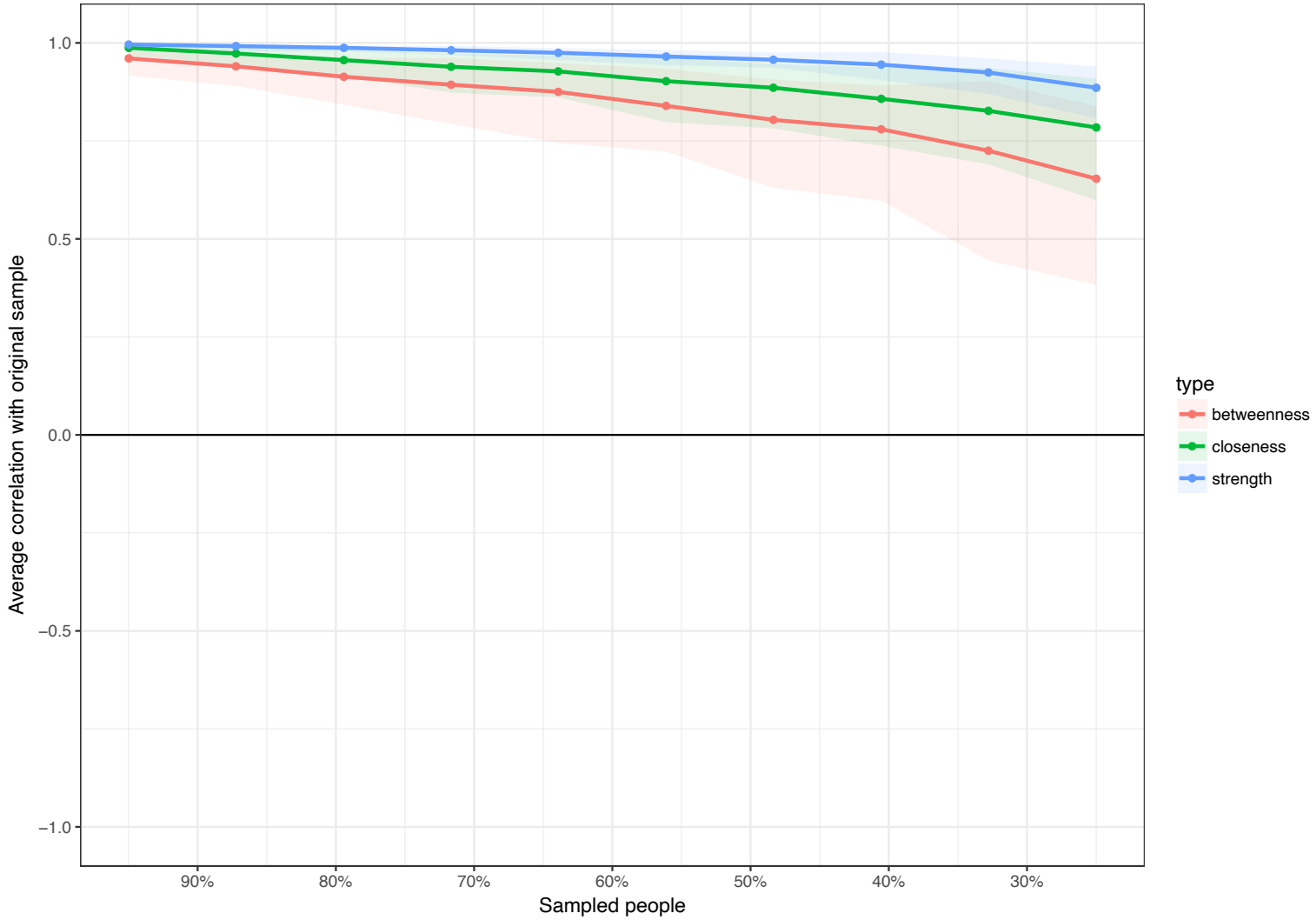
# Results – 95% CI edge weight bootstrap



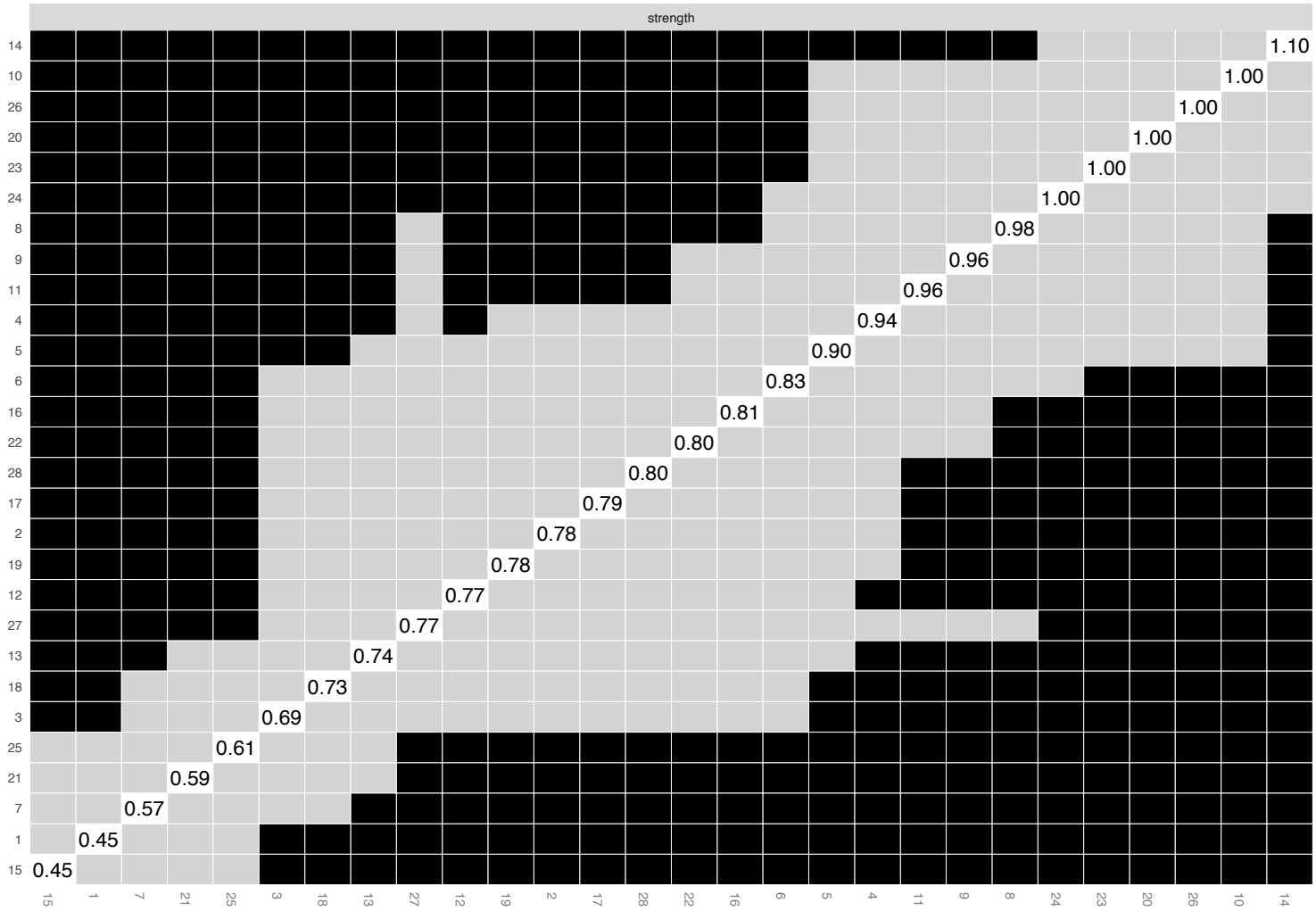
# Results – edge weight difference test



# Results – centrality stability (CS coefficient = 0.75 for degree)



# Results – centrality difference test

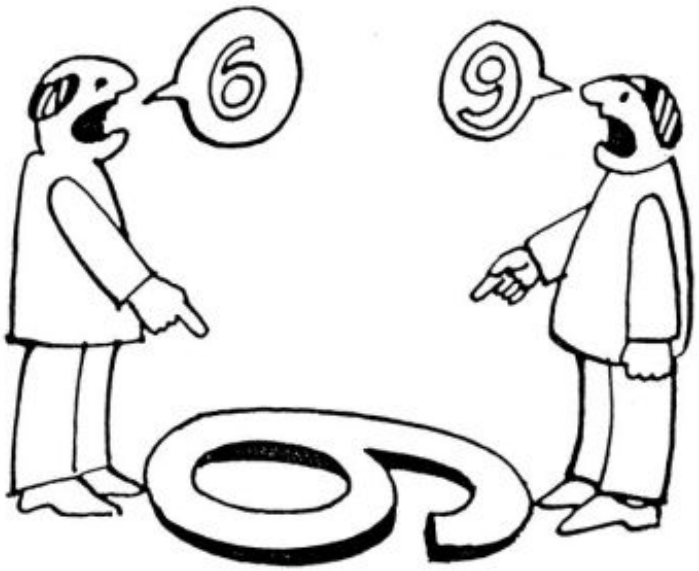


# Discussion

- Items from IRI connect in a network
- Between and within cluster connectivity → communities **interact** with each other
- 4 communities (spinglass), 5 (walktrap)
- Empathic concern as a central domain - revisiting *Cliffordson's Pyramid*
- Highest centrality estimates are not significantly different from each other (14, 10, 26, 20, 23)
- Strongest edges are significantly different from each other, and they are significantly stronger from weaker edges

# About SEM and Network analysis

- "What can network analysis bring more than SEM?"

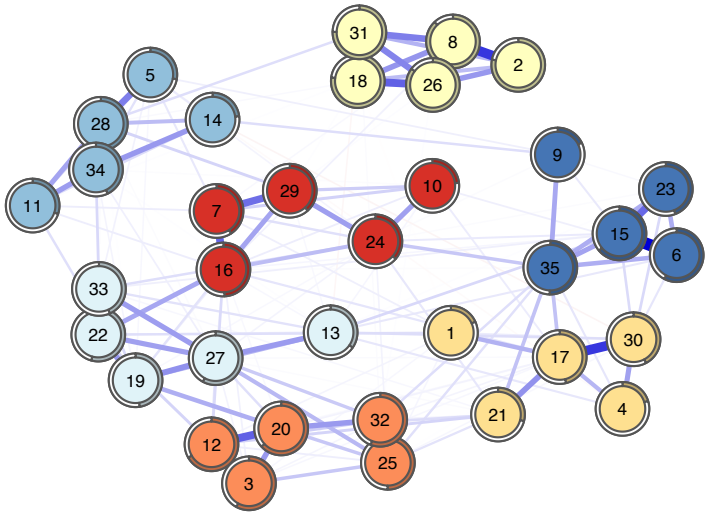


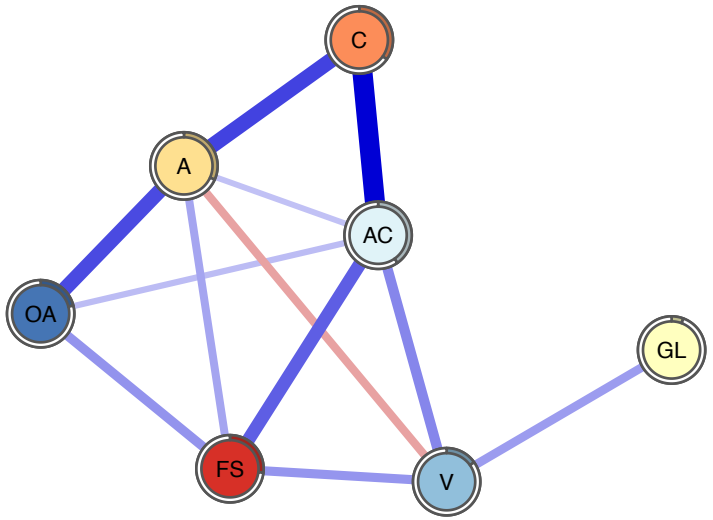
# Limitations

- Sample of university students (generalizability)
- Cross-sectional data (edges are not directed)
- Item **redundancy**
  - Edge meaning shift (→ shared variance)
  - Centrality corruption (sum of redundant connections makes for higher centrality estimates)

# What if we did this paper in 2019? – network estimation

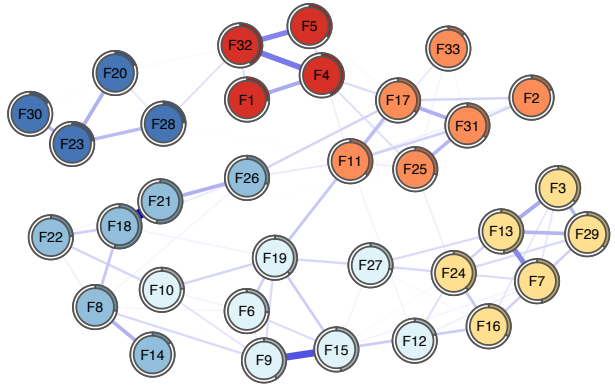
- Item redundancy
- Option 1: estimate network of factor scores per domain (see Briganti et al. 2019)

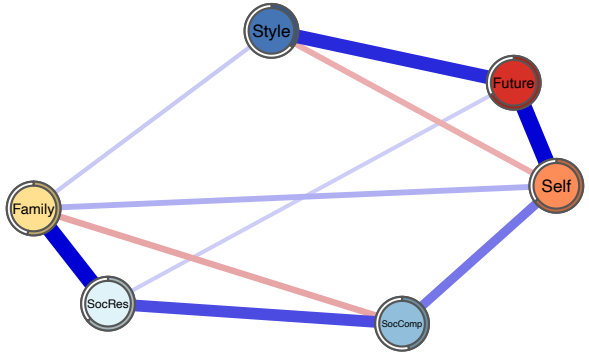


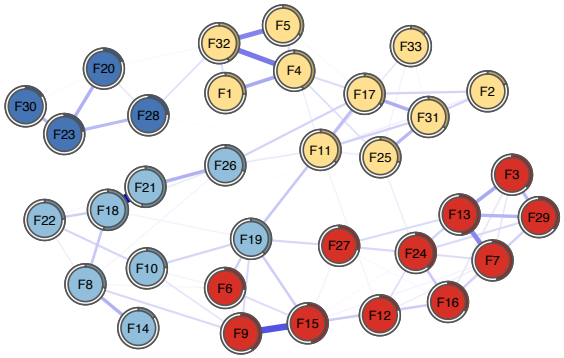



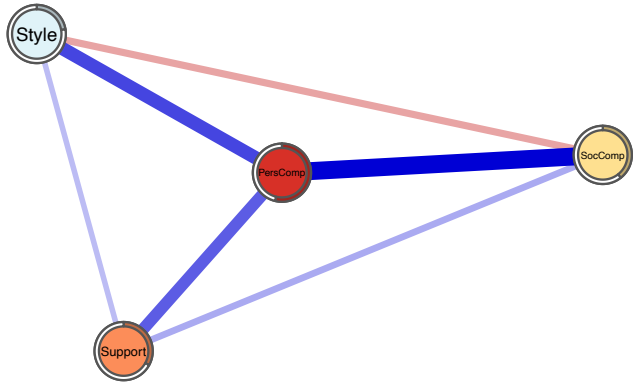
# What if we did this paper in 2019?

- Item redundancy
- Option 2: EGA + CFA (submitted)



Thank you!