

# Exploratory network analysis of the French Wechsler Intelligence

# Scale for children-Fourth Edition (WISC-IV)

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#### INTRODUCTION

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- □ Exploratory and Confirmatory Factor Analysis are frequently used to uncover underlying latent variables that explain the structural covariation in the data.
- WISC-IV: 4 latent variables are considered to be responsible of the structural covariation between subtest scores: Verbal Comprehension [VC], Perceptual Reasoning [PR], Processing Speed [PS], and Working Memory [WM].
- ☐ The *psychometric network modeling* suggests to move away from the latent variable perspective, and considers that dimensions arise from the interactions between *entities* in a network.
- Network includes nodes (psychological variables) connected by edges (statistical relationships).
- Models focused on the estimation of direct relationships between observed variables.

#### **OBJECTIVE**

- ☐ Analysis of the structure of the French WISC-IV by applying a network approach.
  - Estimation of the number of dimensions underlying the WISC-IV using network psychometrics.
  - Estimation of the network; edges represent the relations between the subtests of the WISC-IV.
  - Estimation of the centrality of each variable, to determine the overall connectivity of a subtest, and the importance of each score.

## **METHOD**

#### ☐ Sample:

483 French-speaking Swiss children aged from 7 to 12 years. The sample included 230 males (mean age = 9.50, SD=1.30) and 253 females (mean age = 9.54, SD=1.29).

#### ☐ Material:

 The 10 core subtests of the WISC-IV and the optional subtest Picture Completion were administered to children (PC was not administered to 19 children).

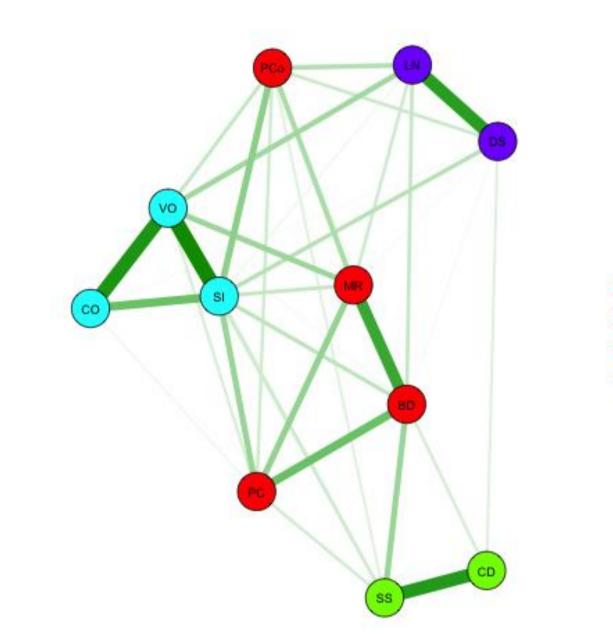
VC: Verbal Comprehension	PR: Perceptual Reasoning	WM: Working Memory	PS: Processing Speed
SI: Similarities	BD: Block Design	DS: Digit Span	CD: Coding
VO: Vocabulary	MR: Matrix Reasoning	LN: Letter-number	SS: Symbol Search
CO: Comprehension	PCo: Picture Concepts		
	(PC: Picture Completion)		

#### ☐ Analyses:

- ☐ Within the network approach, we used the R-package *exploratory* graph analysis (EGA) to estimate the number of dimensions.
- ☐ A Gaussian Graphical Model (GGM) was used to model the undirected network between subtests. Centrality indices were computed from the network.
- In GGM, an edge is the partial correlations between 2 variables, controlling for all other associations in the network.
- We used the R-package qgraph that includes the LASSO regularization to return a sparse network model.
- We used the R-package bootnet to assess the stability of the network structure and centrality indices.

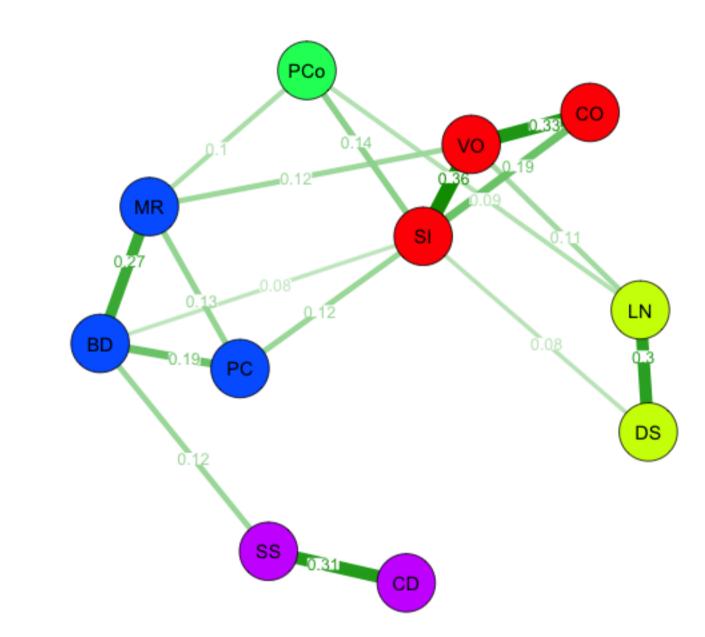
#### **RESULTS**

1. Estimation of the number of dimensions



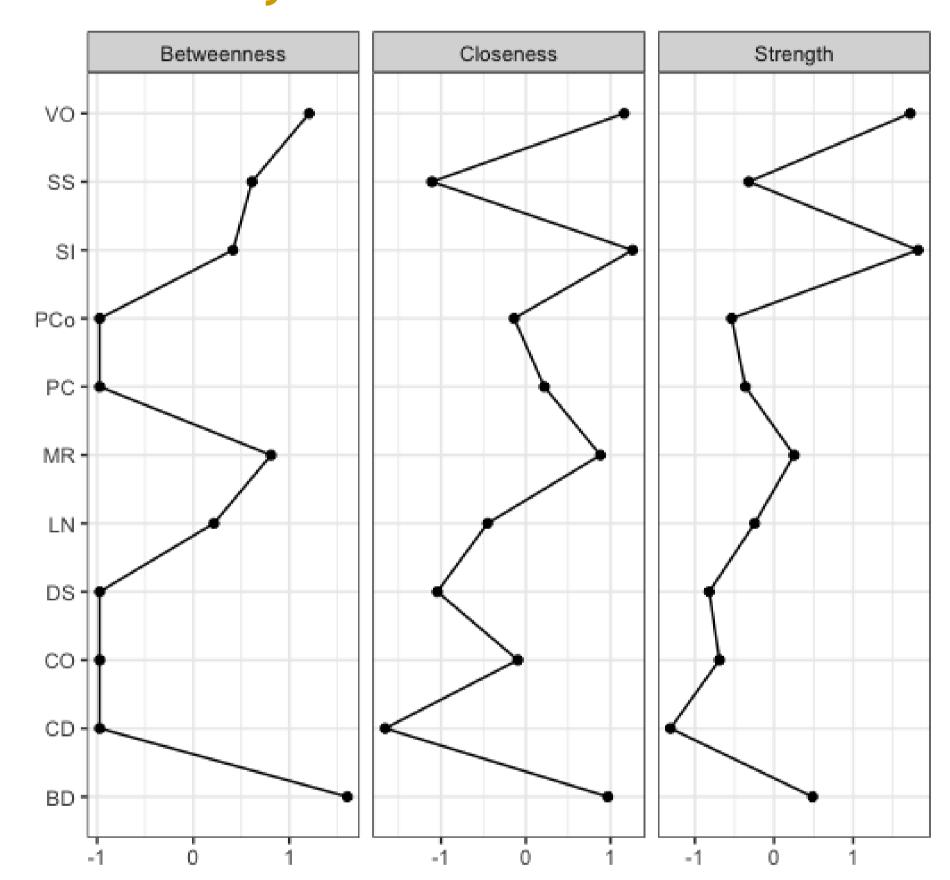
- □ *EGA* suggested to retain 4 dimensions.
- ☐ Green lines = positive correlations
- ☐ Thicker edge = larger correlation

### 2. Network structure (with significant edges only)



- □ Four clusters emerged: VC (SI, VO, CO); WM (LN, DS); PS (SS, CD); and VisuoSpatial (VS with BD, PC, MR)
  - Cluster: group of connected nodes
- ☐ PCo is related with VC, WM, and VS.

#### Centrality indices



- shortest paths between 2 nodes go through the node in question. Includes direct and indirect connections of a subtests. A subtest with high betweenness is more important in connecting nodes.
- Closeness: how strongly a node is indirectly connected to other nodes in the network.
- Node strength: how strongly a node is directly connected to other nodes in the network.

#### **CONCLUSIONS**

- ☐ Network approach conceptualizes psychological dimensions as networks of psychological variables that directly interact with one another (without assuming a latent variable).
- ☐ Exploratory Graph Analysis (EGA) revealed 4 clusters.
- ☐ The clusters of nodes VC, WM, and PS in the network are equal with the 3 latent variables with factor analysis. Network analysis showed that the fourth dimension is more "VisuoSpatial" than "Perceptual Reasoning".
- The three most central node in the network are Similarities,
  Vocabulary and Block Design. This finding is partially consistent
  with factor analysis that showed that g loadings of Similarities and
  Vocabulary tasks were the highest.
- ☐ In sum, broad abilities and general intelligence can be conceptualized as networks of basic components.