



**HAL**  
open science

# Exploratory network analysis of the French Wechsler Intelligence Scale for children-Fourth Edition (WISC-IV)

Thierry Lecerf, Jean-Luc Kop, Bruno Dauvier

## ► To cite this version:

Thierry Lecerf, Jean-Luc Kop, Bruno Dauvier. Exploratory network analysis of the French Wechsler Intelligence Scale for children-Fourth Edition (WISC-IV). 15th SPS SGP SSP conference, Sep 2017, Lausanne, Switzerland. hal-02276568

**HAL Id: hal-02276568**

**<https://hal.univ-lorraine.fr/hal-02276568>**

Submitted on 2 Sep 2019

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

## INTRODUCTION

- 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).

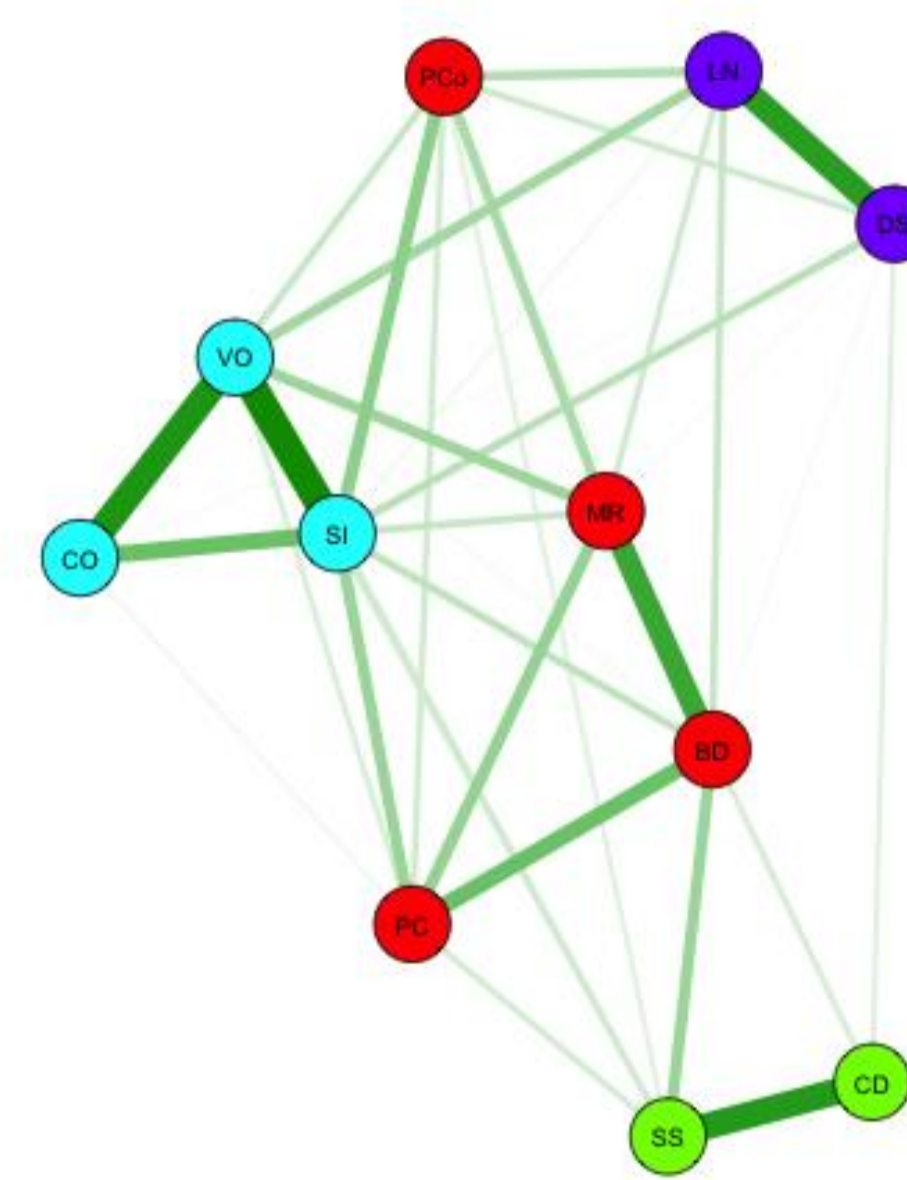
VC: Verbal Comprehension	PR: Perceptual Reasoning	WM: Working Memory	PS: Processing Speed
SI: Similarities	BD: Block Design	DS: Digit Span	CD: Coding
VO: Vocabulary	MR: Matrix Reasoning	LN: Letter-number	SS: Symbol Search
CO: Comprehension	PCo: Picture Concepts (PC: Picture Completion)		

### 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.

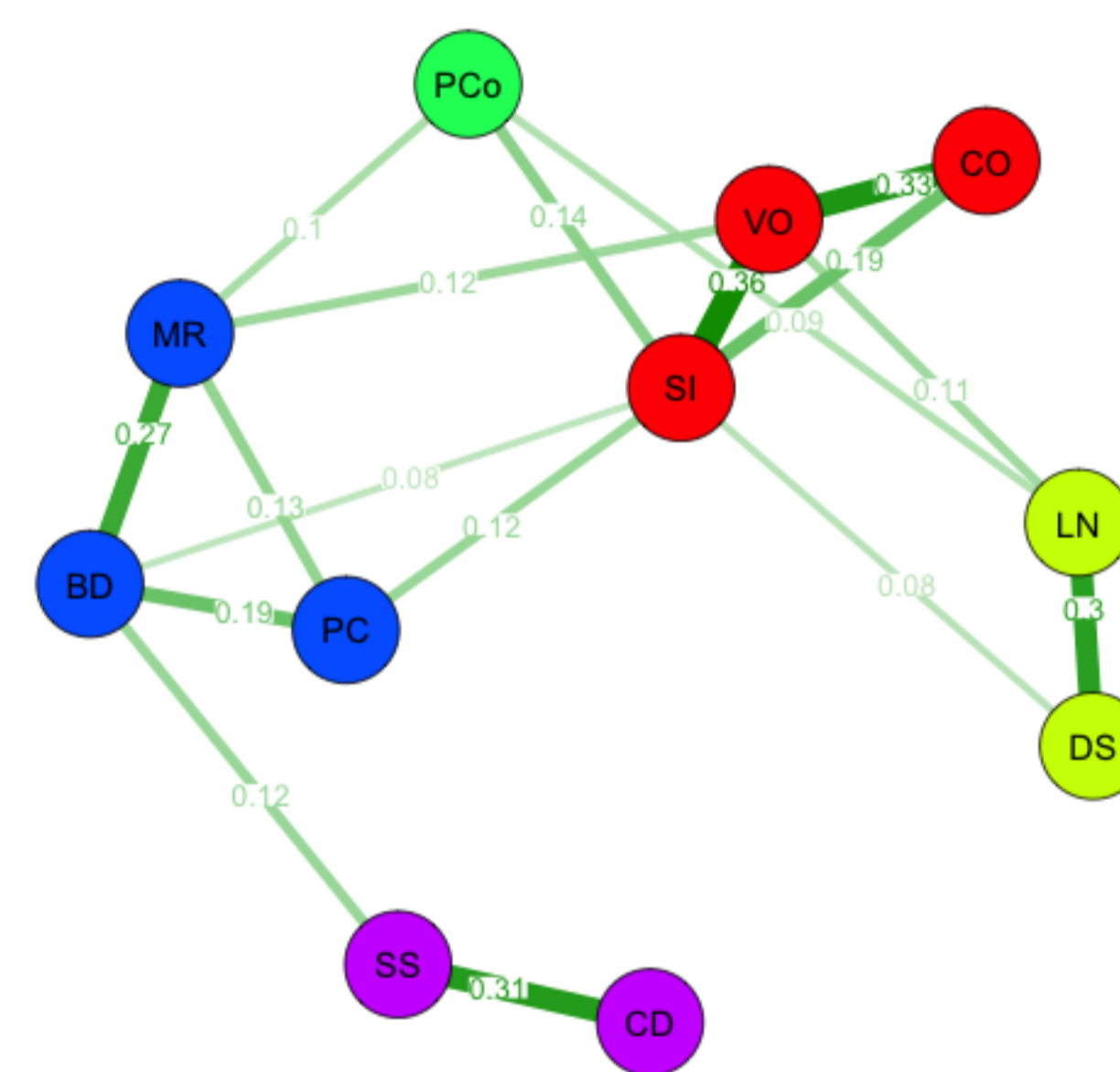
## RESULTS

### 1. Estimation of the number of dimensions



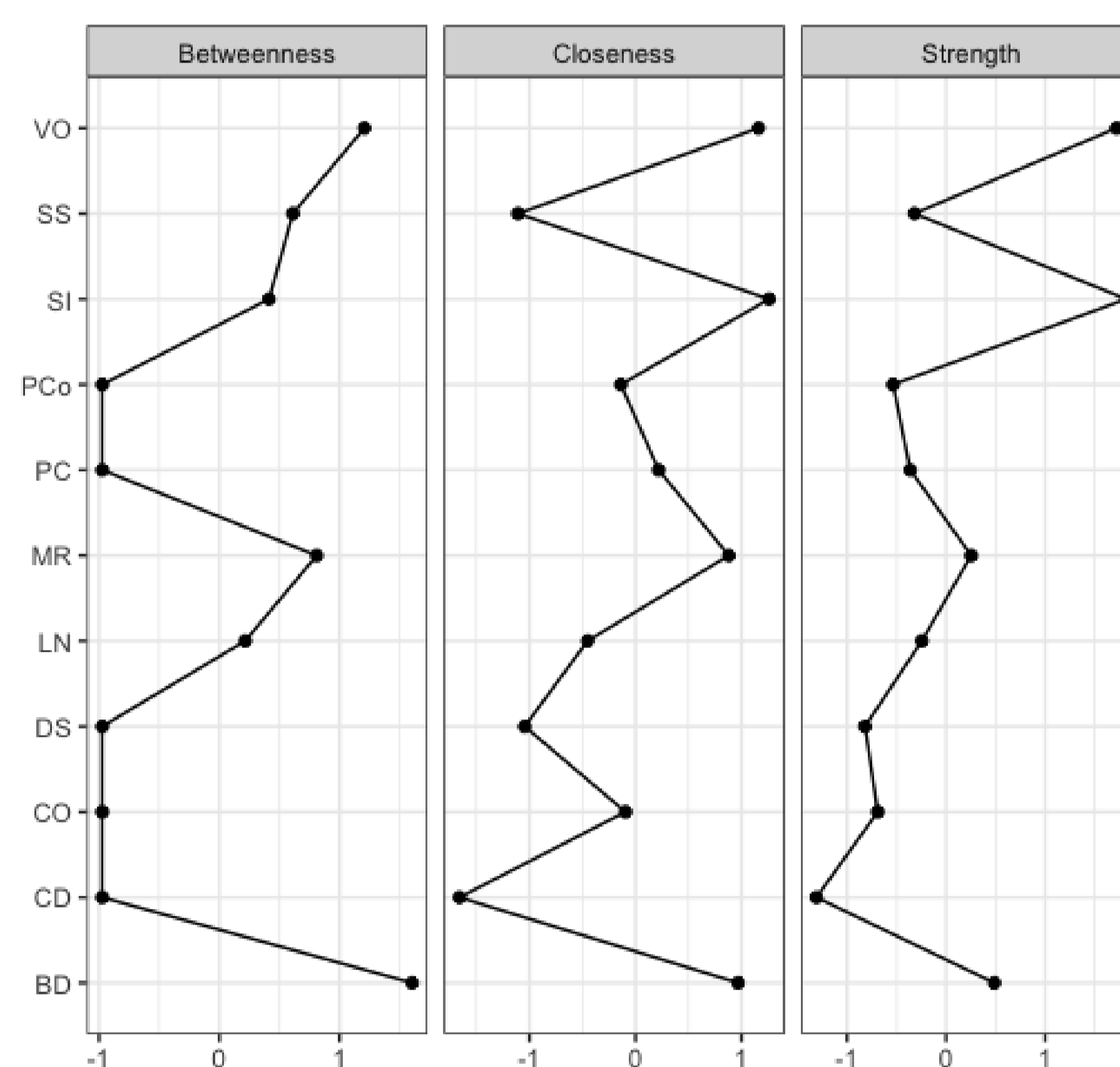
- EGA suggested to retain 4 dimensions.
- Green lines = positive correlations
- Thicker edge = larger correlation

### 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



- Betweenness:** how many 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.