



# ANÁLISES DE REDE EM CIÊNCIAS DA SAÚDE

## PROGRAMAÇÃO:

03 de Dezembro de 2018

- 09h às 12h - Redes Frequentistas

Palestrante: Dr. Wagner de Lara Machado (PUCRS)

- 14h às 17h - Redes Bayesianas

Palestrante: Dra. Carmen Moret Tatay (UCV - Espanha)

LOCAL: PUCRS - Escola da Negócios, prédio 50, 9º andar - Lab. LACE

INSCRIÇÕES PELO LINK: <https://goo.gl/forms/9rAEcGiDigAykRvq1>



# Redes Frequentistas

Prof. Dr. Wagner de Lara Machado

Escola de Ciências da Saúde – PPG Psicologia

# Análise de rede aplicada à psicometria e a avaliação psicológica



Sacha Epskamp

Assistant Professor in Psychological Methods and  
Psychometrics at the University of Amsterdam

Wagner de Lara Machado

Pontifícia Universidade Católica de Campinas

João Ricardo Nickenig Vissoci

Faculdade Ingá e Duke University

Sacha Epskamp

Universiteit van Amsterdam



João Vissoci

Pesquisador na divisão de Emergency Medicine do departamento de Cirurgia, e  
na divisão Duke Global Neurosurgery and Neuroscience (DGNN) do departamento  
de Neurocirurgia, na Duke University

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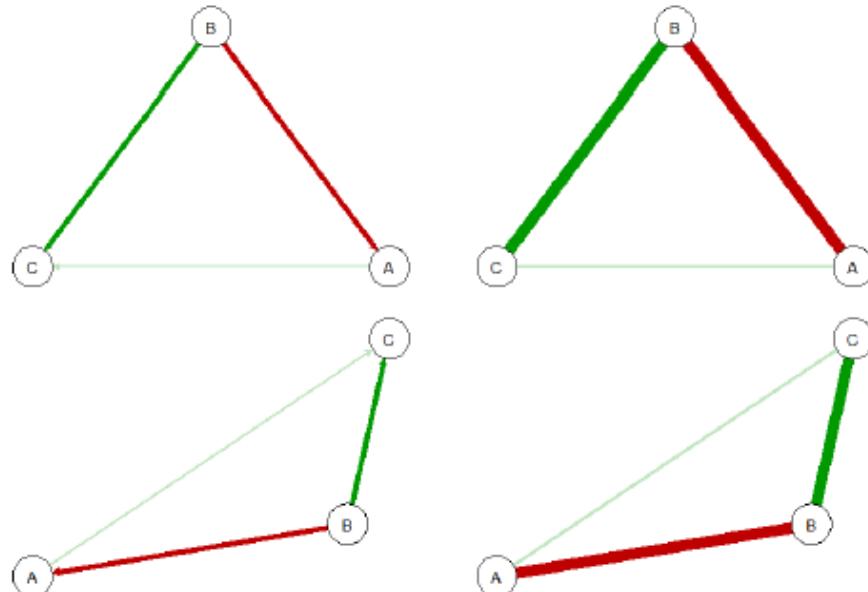


Figura 5. Redes ponderadas, direcionais e não-direcionais, sem (acima) e com (abaixo) o emprego do algoritmo de posicionamento.

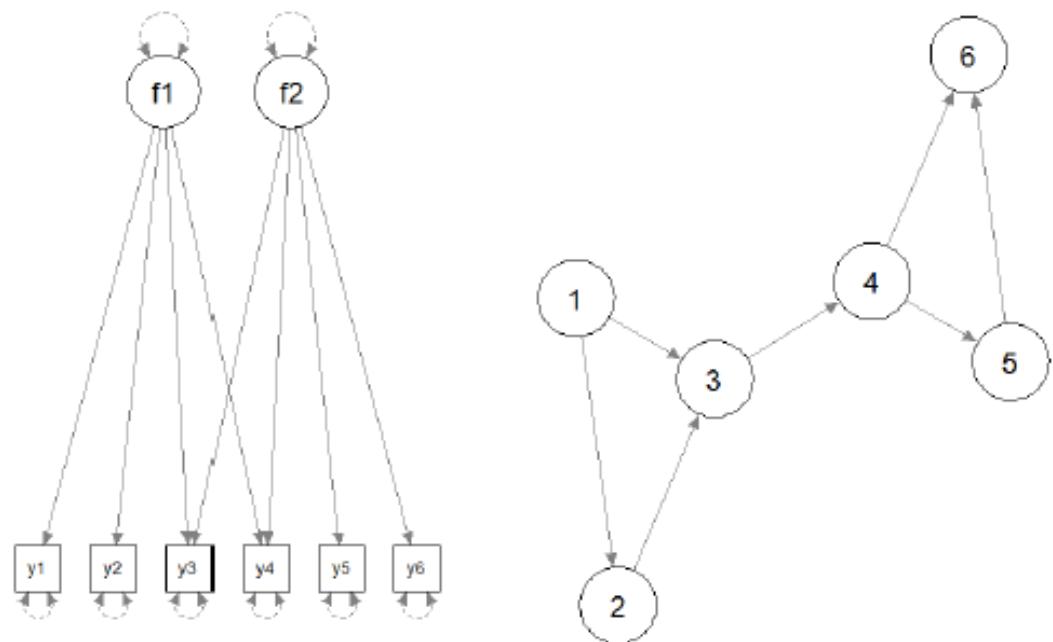


Figura 13. Modelo de traço latente (esquerda) e de rede (direita) da comorbidade.

# Iniciando...

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- Baixe no curso\_redes, o script em:  
[https://github.com/wagnerLM/curso\\_redes/blob/master/link\\_script\\_curso\\_redes](https://github.com/wagnerLM/curso_redes/blob/master/link_script_curso_redes)
- Abra o arquivo de script via o RStudio

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● R

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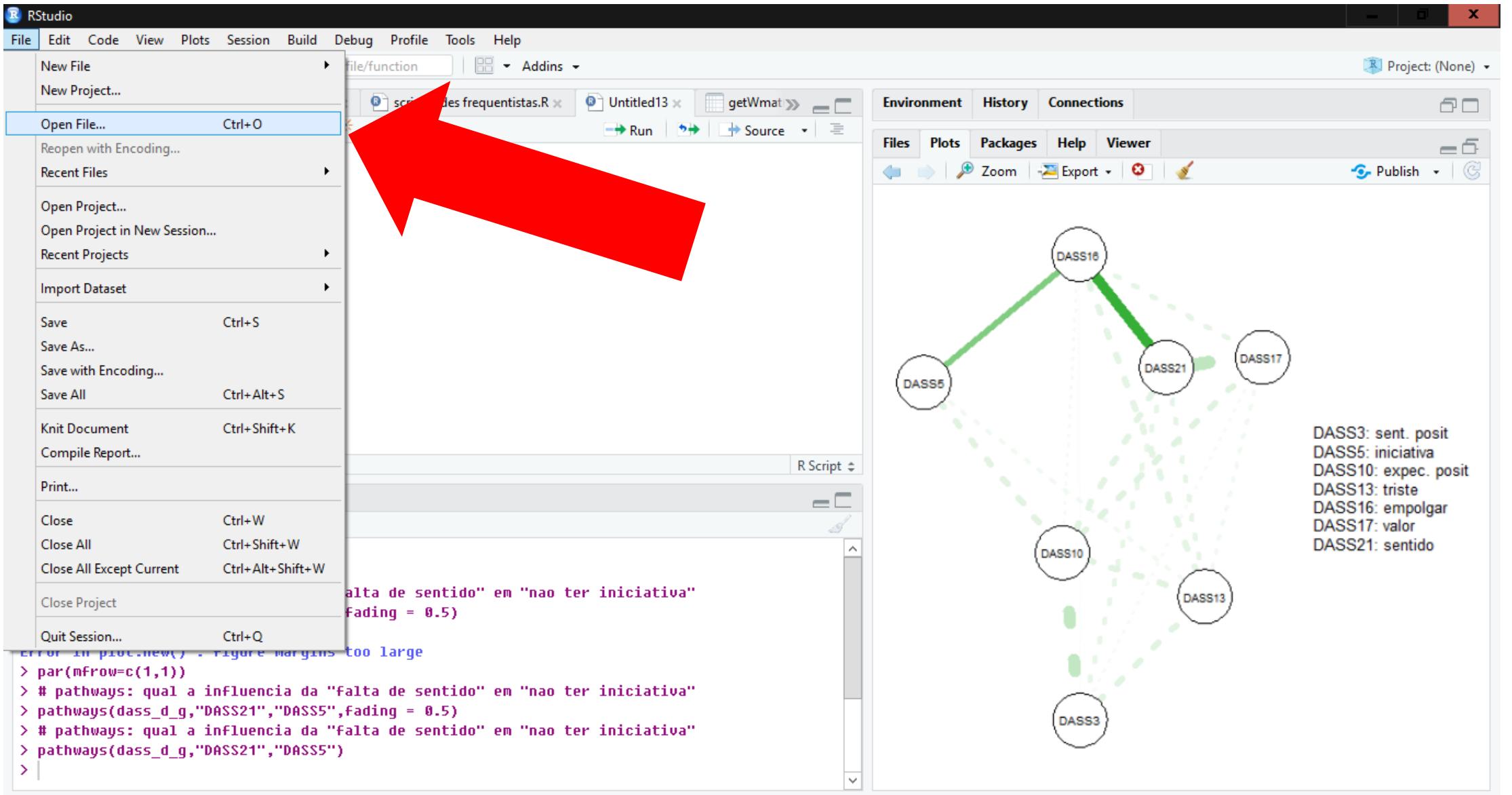
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# curso\_redes

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“Reductionism, as a paradigm, is expired, and complexity, as a field, is tired. Data-based mathematical models of complex systems are offering a fresh perspective, rapidly developing into a new discipline: network science.”

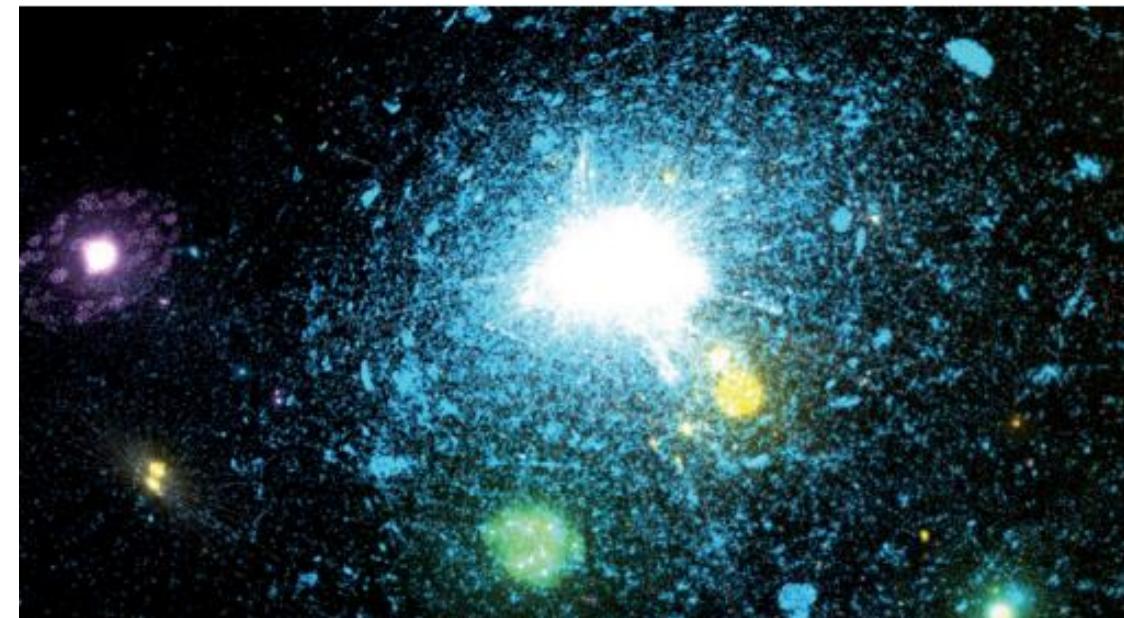
NATURE PHYSICS | COMMENTARY

## The network takeover

Albert-László Barabási

*Nature Physics* 8, 14–16 (2012) | doi:10.1038/nphys2188

Published online 22 December 2011



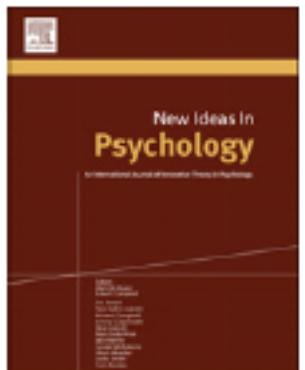


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## New Ideas in Psychology

journal homepage: [www.elsevier.com/locate/newideapsych](http://www.elsevier.com/locate/newideapsych)



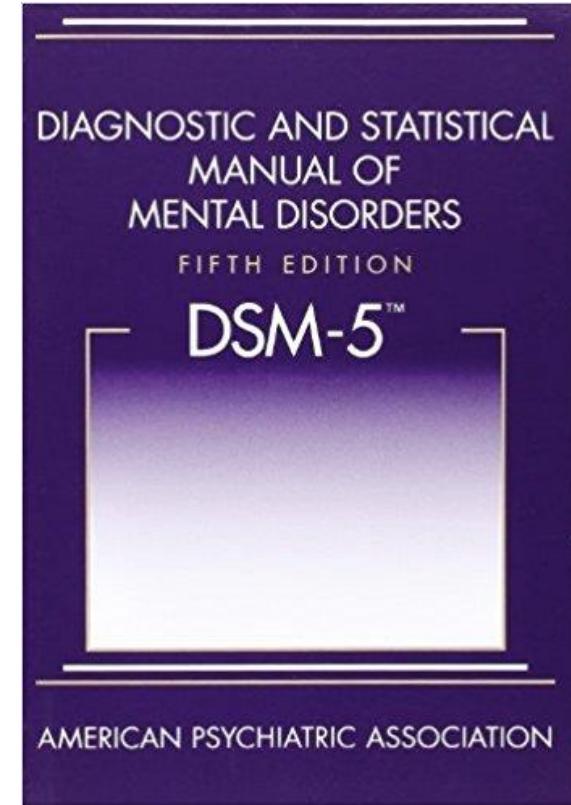
# Deconstructing the construct: A network perspective on psychological phenomena

Verena D. Schmittmann, Angélique O.J. Cramer, Lourens J. Waldorp, Sacha Epskamp,  
Rogier A. Kievit, Denny Borsboom\*

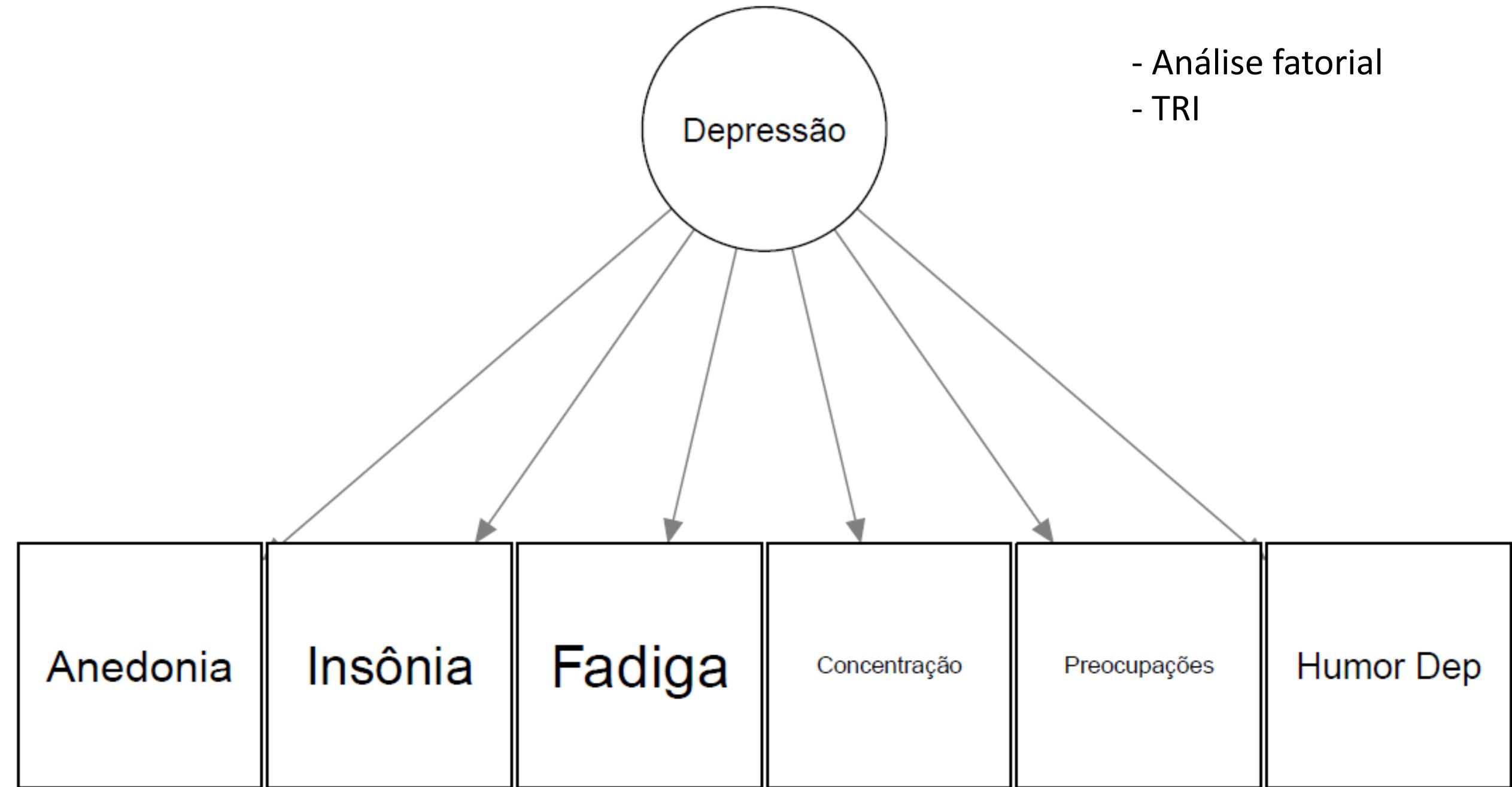
# Avaliação em saúde mental: traços latentes e redes

- **Transtorno depressivo maior:**

- Humor deprimido
- Diminuição do interesse ou prazer
- Perda ou ganho significativo de peso
- Insônia ou hipersonia
- Agitação ou retardo psicomotor
- Fadiga ou perda de energia
- Sentimentos de inutilidade ou culpa
- Capacidade diminuída para pensar ou se concentrar
- Pensamentos recorrentes de morte



- Análise factorial
- TRI



# Measuring Depression Over Time . . . or not? Lack of Unidimensionality and Longitudinal Measurement Invariance in Four Common Rating Scales of Depression

Eiko I. Fried  
University of Leuven

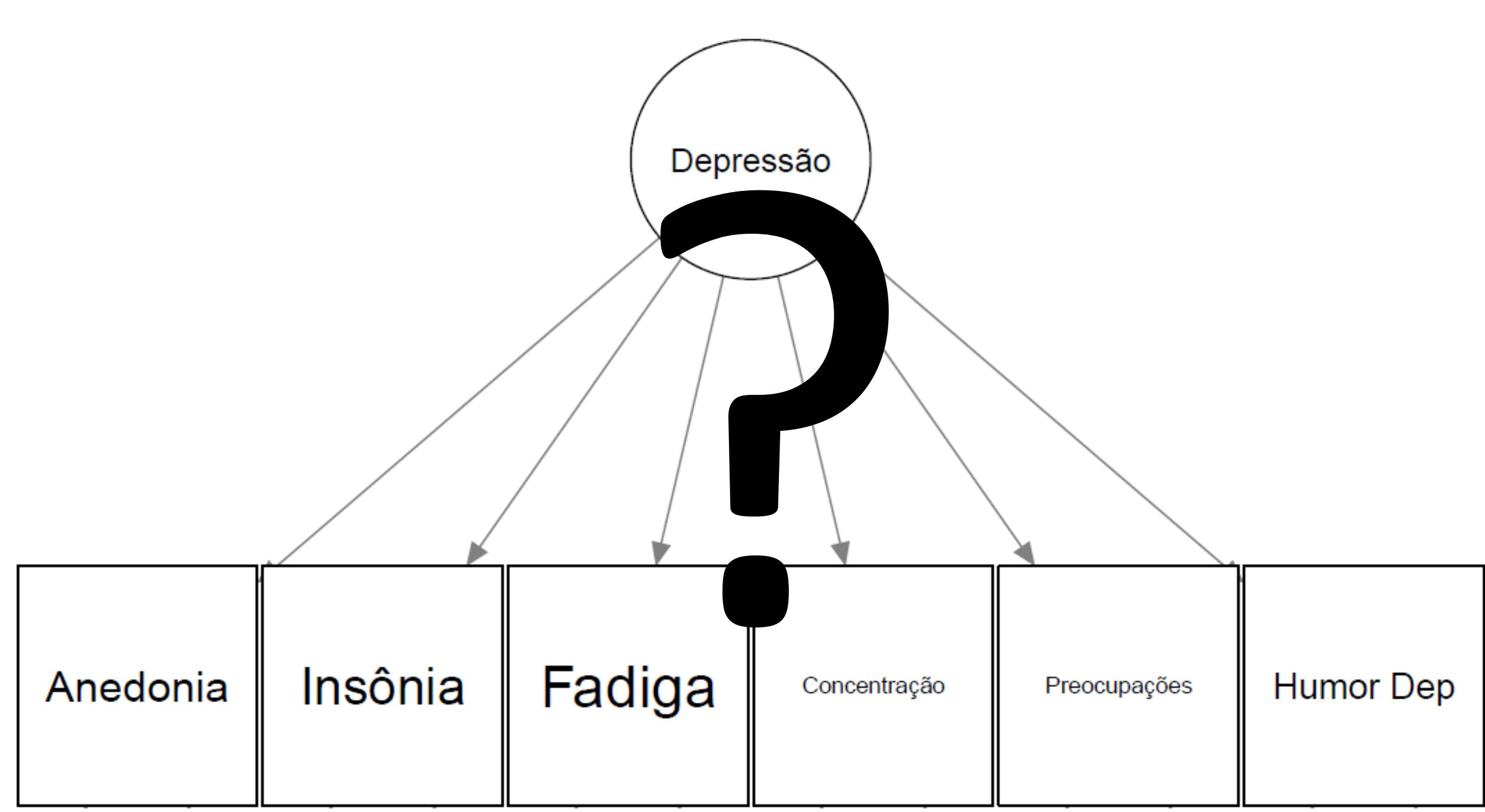
Sacha Epskamp  
University of Amsterdam

Francis Tuerlinckx  
University of Leuven

Claudia D. van Borkulo  
University of Groningen and University of Amsterdam

Robert A. Schoevers  
University of Groningen

Denny Borsboom  
University of Amsterdam

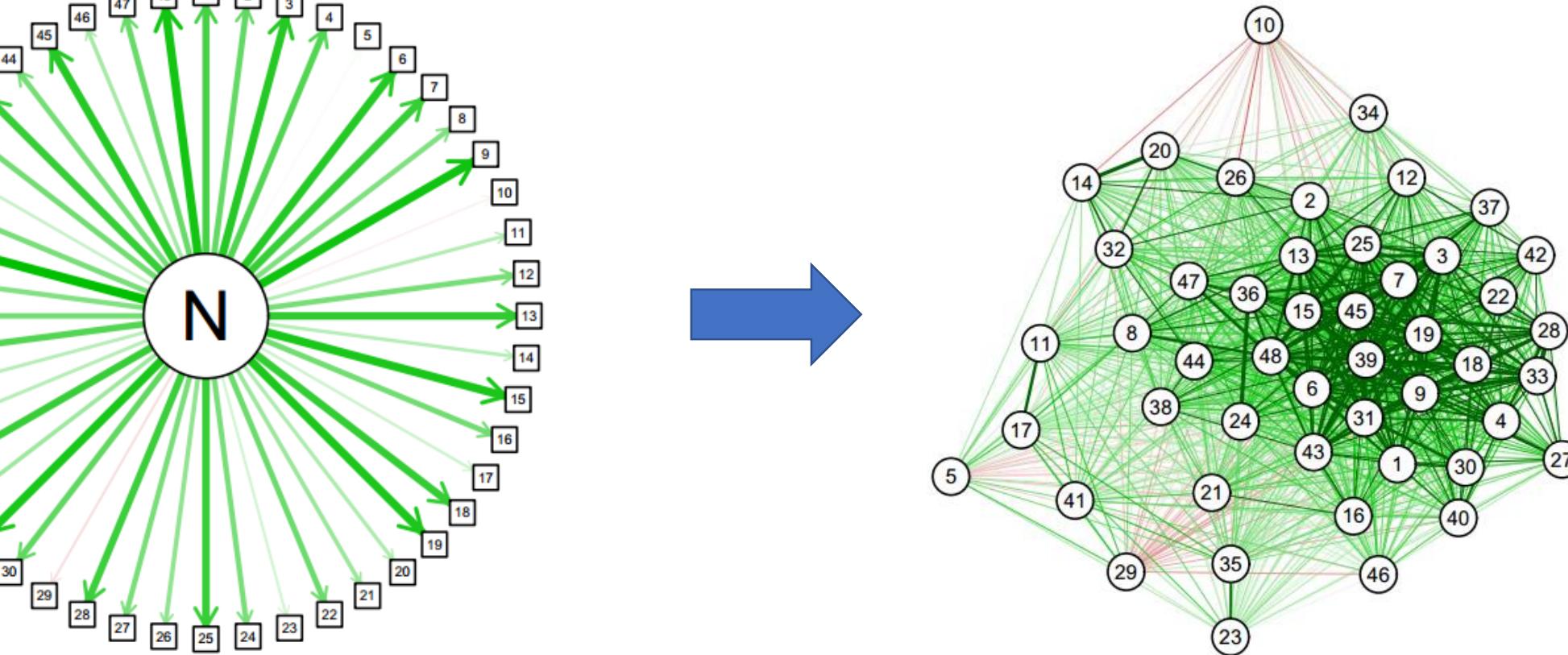




## Deconstructing the construct: A network perspective on psychological phenomena

Verena D. Schmittmann, Angélique O.J. Cramer, Lourens J. Waldorp, Sacha Epskamp,  
Rogier A. Kievit, Denny Borsboom\*

Department of Psychology, University of Amsterdam, Roetersstraat 15, 1018 WB Amsterdam, The Netherlands





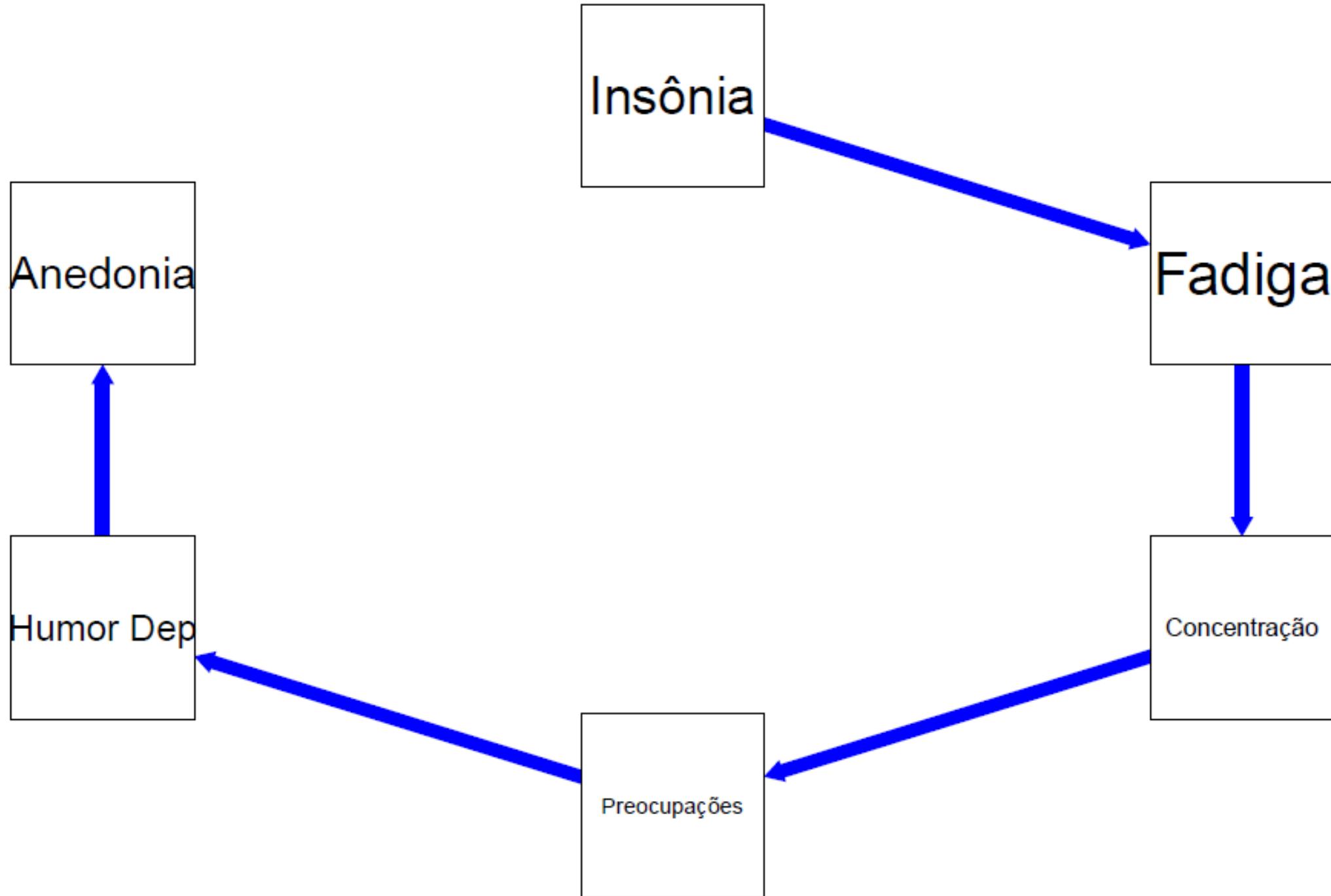
## Deconstructing the construct: A network perspective on psychological phenomena

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Department of Psychology, University of Amsterdam, Roetersstraat 15, 1018 WB Amsterdam, The Netherlands

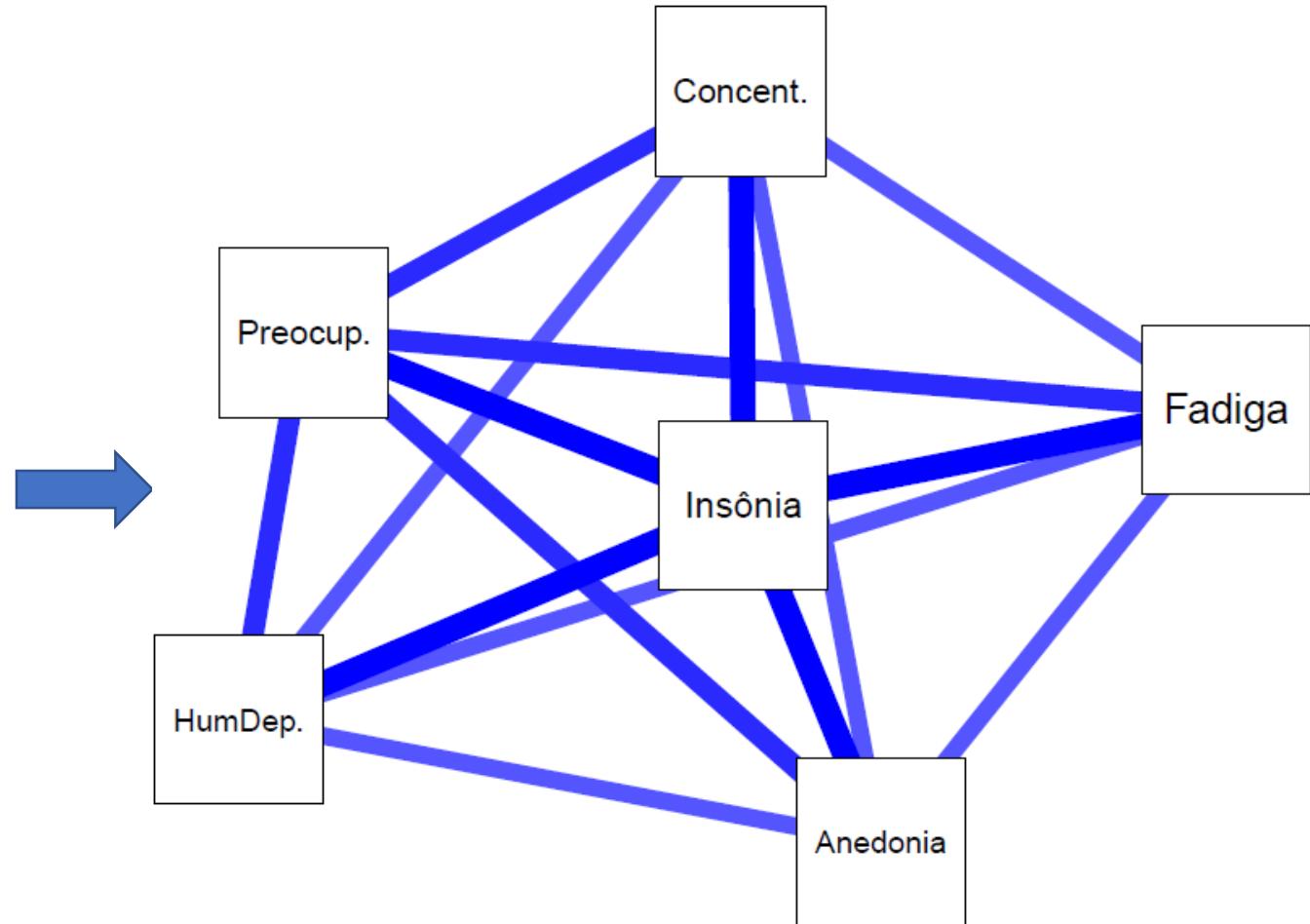


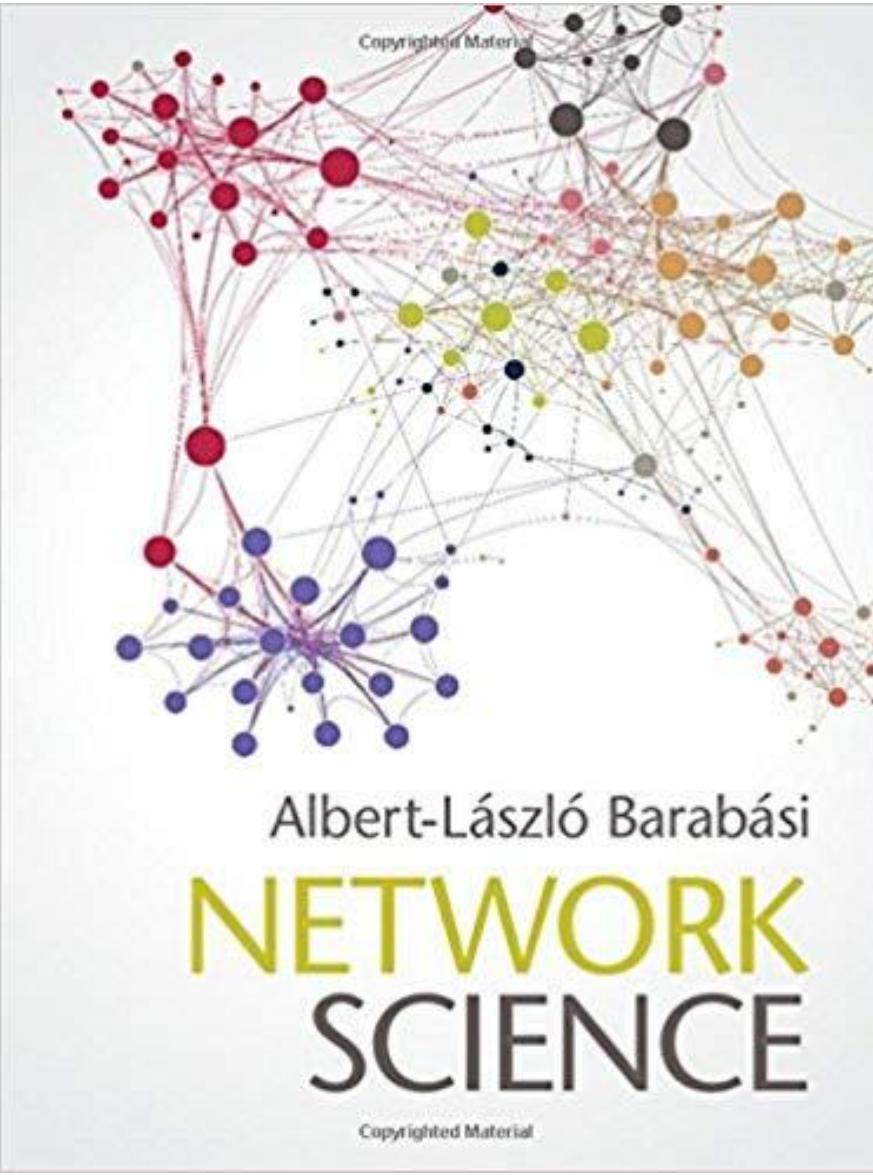
**Fig. 6.** The best fitting confirmative time series model of the following five constituents of depression: tiredness; concentration difficulties (concentration); self-content; sad mood; pleasure in current activity (activity).



# Depressão: estrutura e dinâmica de um sistema

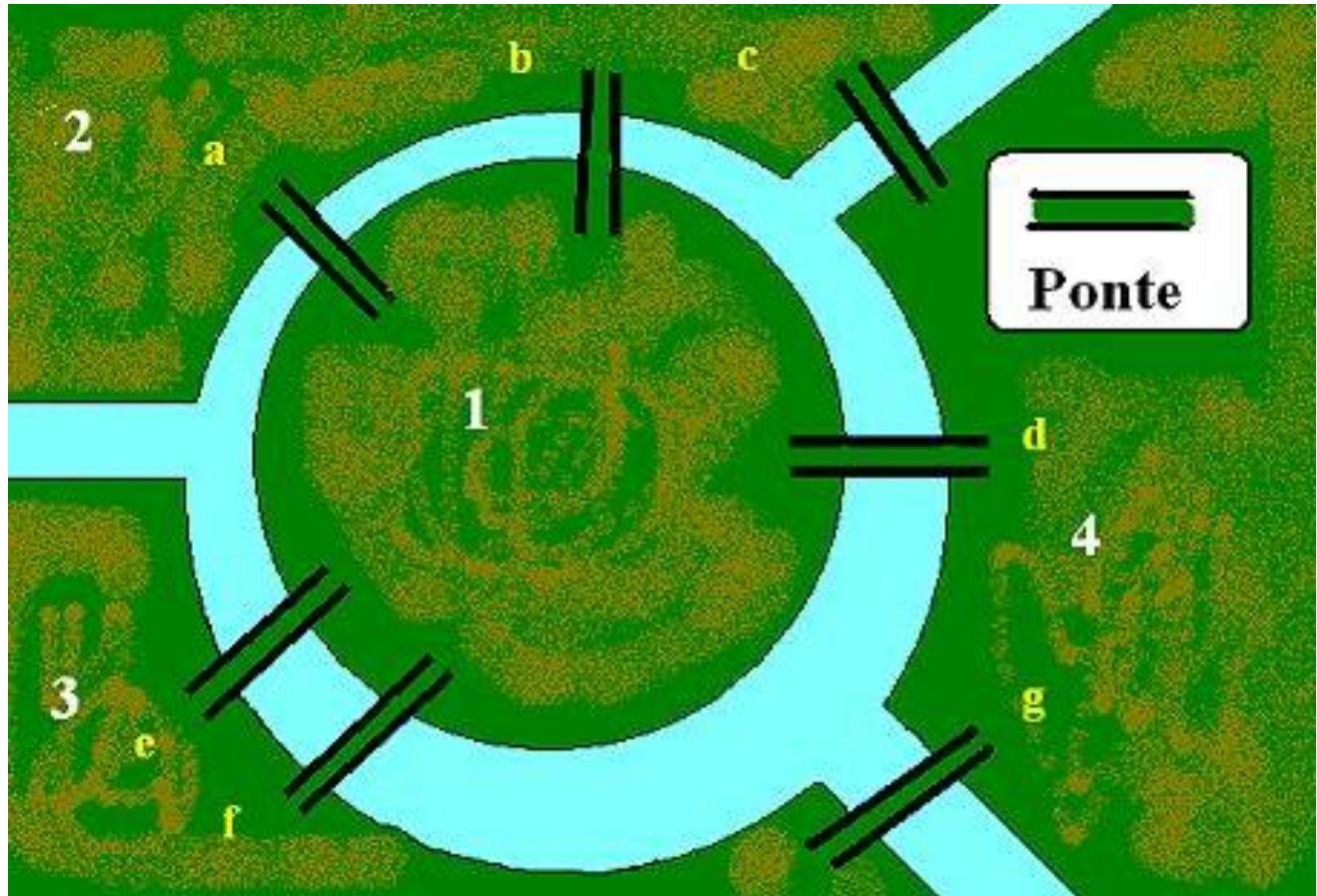
	Insônia	Fadiga	Concent.	Preocup.	HumDep.	Anedonia
Insônia	1.0	0.6	0.6	0.6	0.6	0.6
Fadiga	0.6	1.0	0.4	0.5	0.4	0.4
Concent.	0.6	0.4	1.0	0.5	0.4	0.4
Preocup.	0.6	0.5	0.5	1.0	0.5	0.5
HumDep.	0.6	0.4	0.4	0.5	1.0	0.4
Anedonia	0.6	0.4	0.4	0.5	0.4	1.0





# Teoria dos grafos

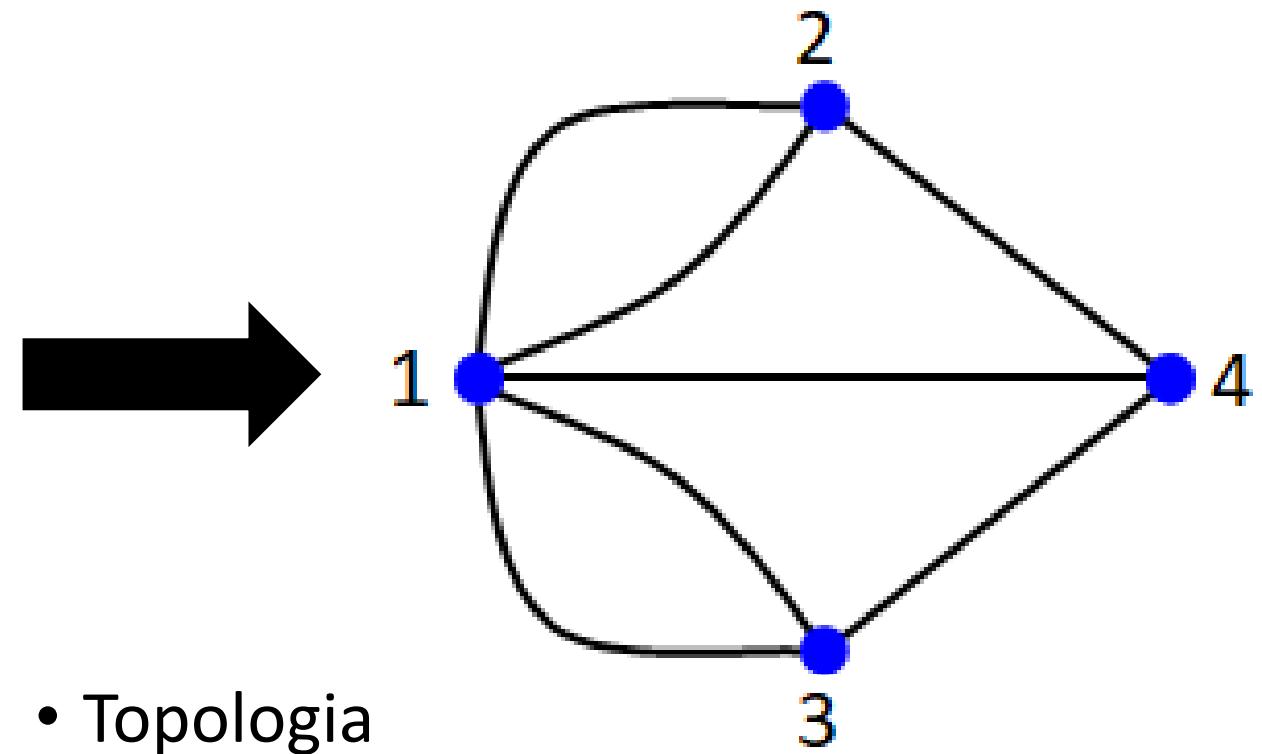
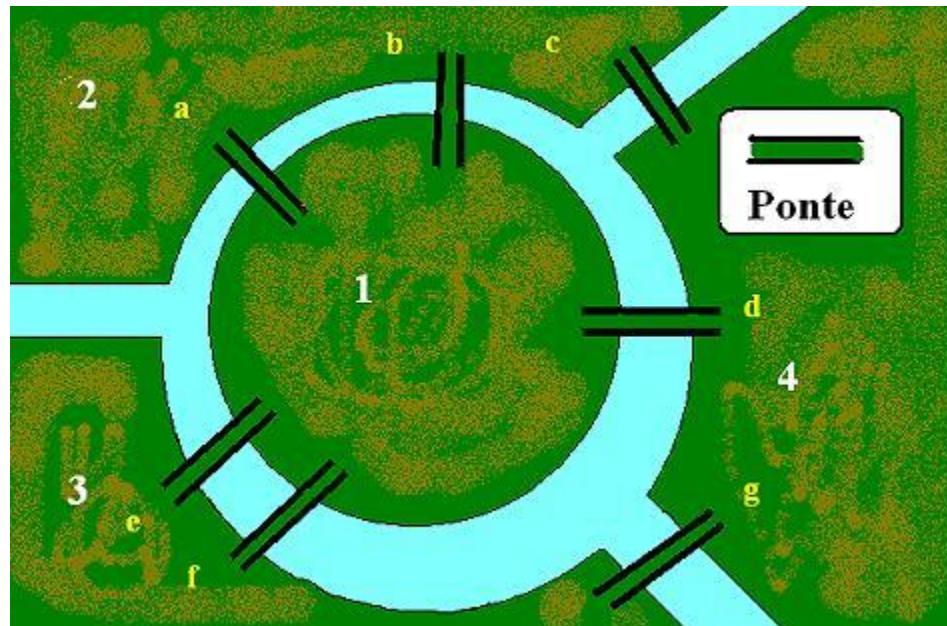
- O problema das pontes de Königsberg
- Discutia-se nas ruas da cidade a possibilidade de atravessar todas as pontes sem repetir nenhuma



[https://pt.wikipedia.org/wiki/Sete\\_pontes\\_de\\_K%C3%B6nigsberg](https://pt.wikipedia.org/wiki/Sete_pontes_de_K%C3%B6nigsberg)

# Teoria dos grafos

- Havia uma lenda popular sobre a possibilidade de resolução, quando Leonhard Euler , em 1736, provou que não existia caminho que possibilitasse tais restrições.



# O que é uma rede?

- Vértices (nodos) e arestas (linhas)
- Nodos representam variáveis
- As linhas representam a relação entre os nodos

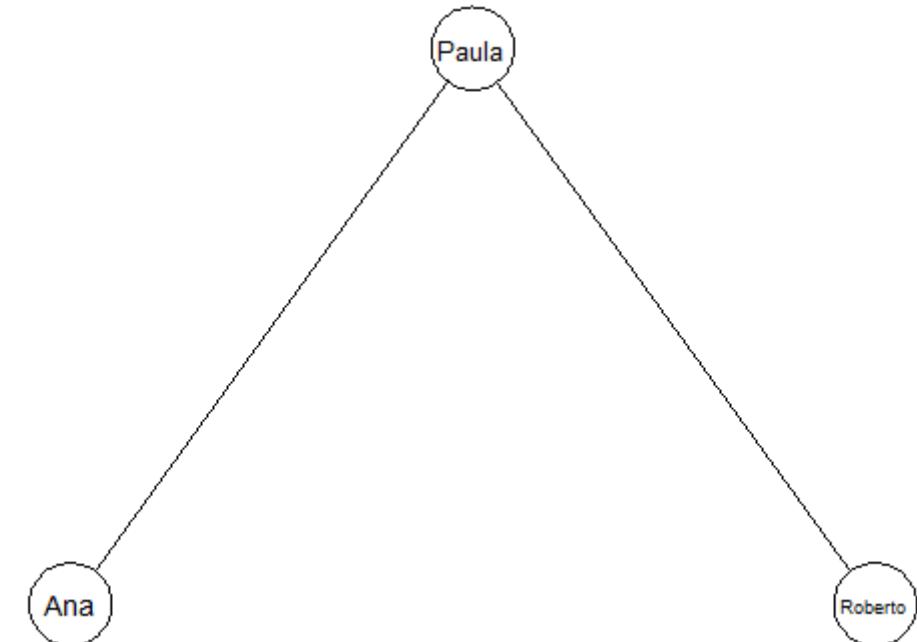
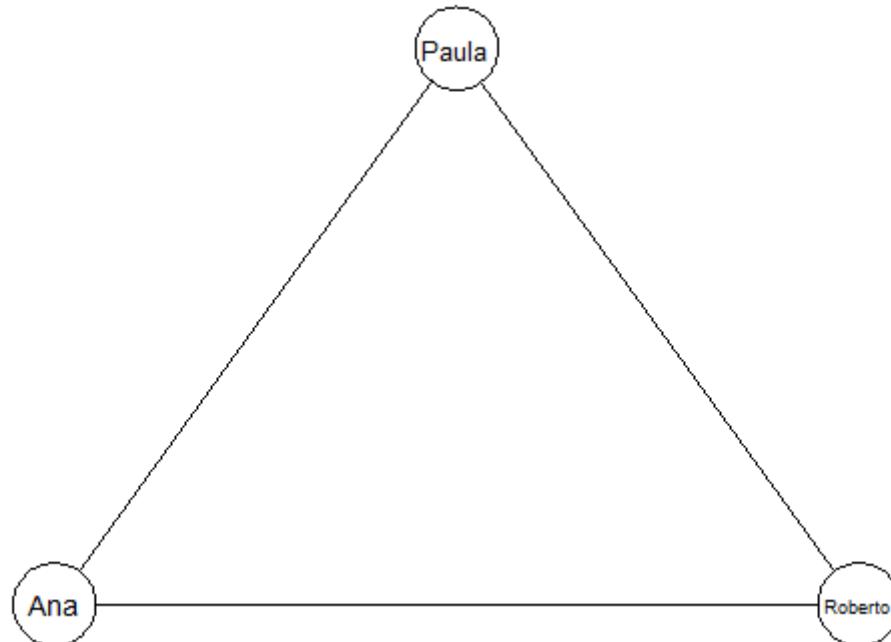


# Amizades

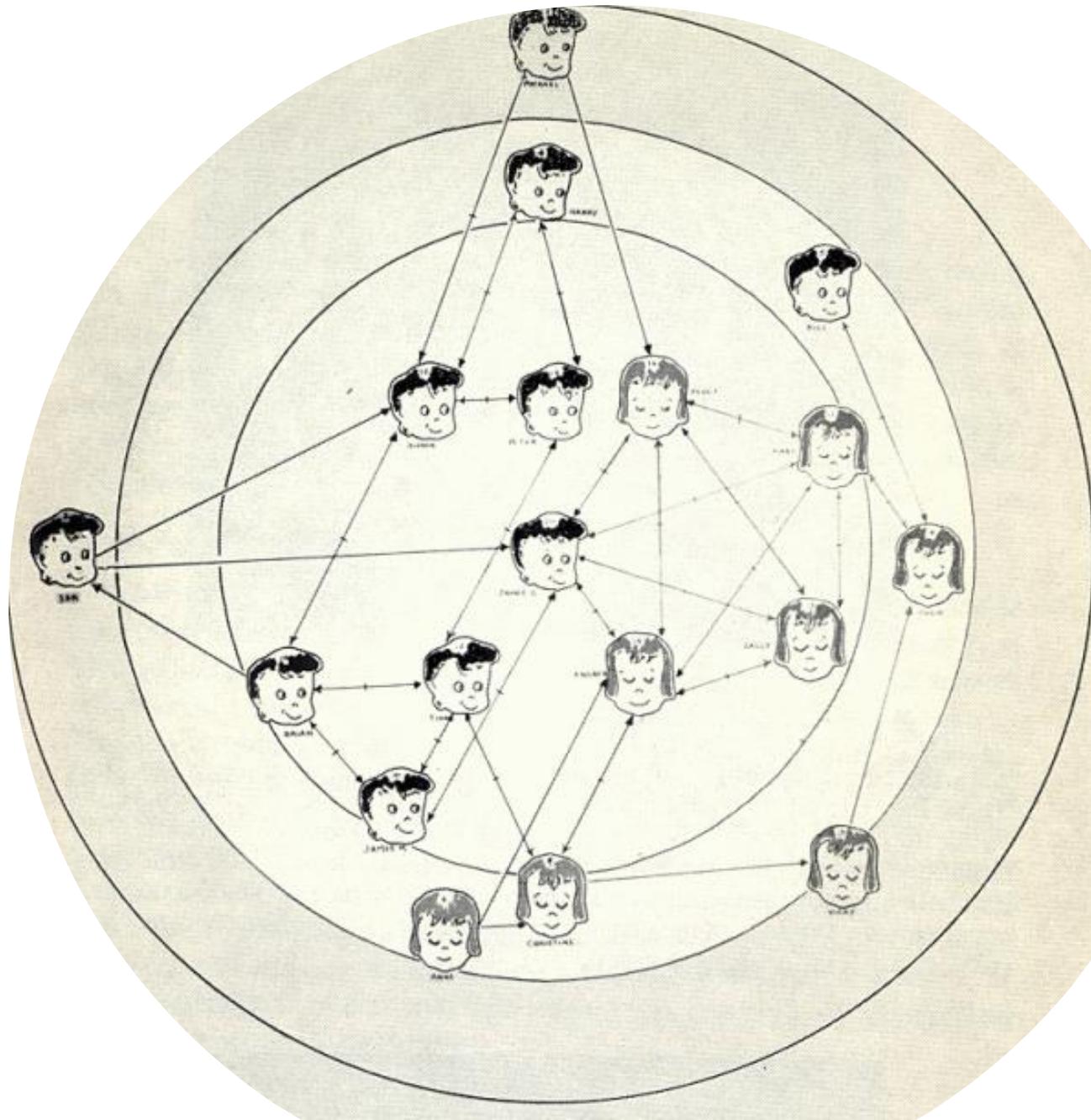
	Paula	Roberto	Ana
Paula	0	1	1
Roberto	1	0	0
Ana	1	0	0

Cenário 1: Paula, Ana e Roberto são amigos

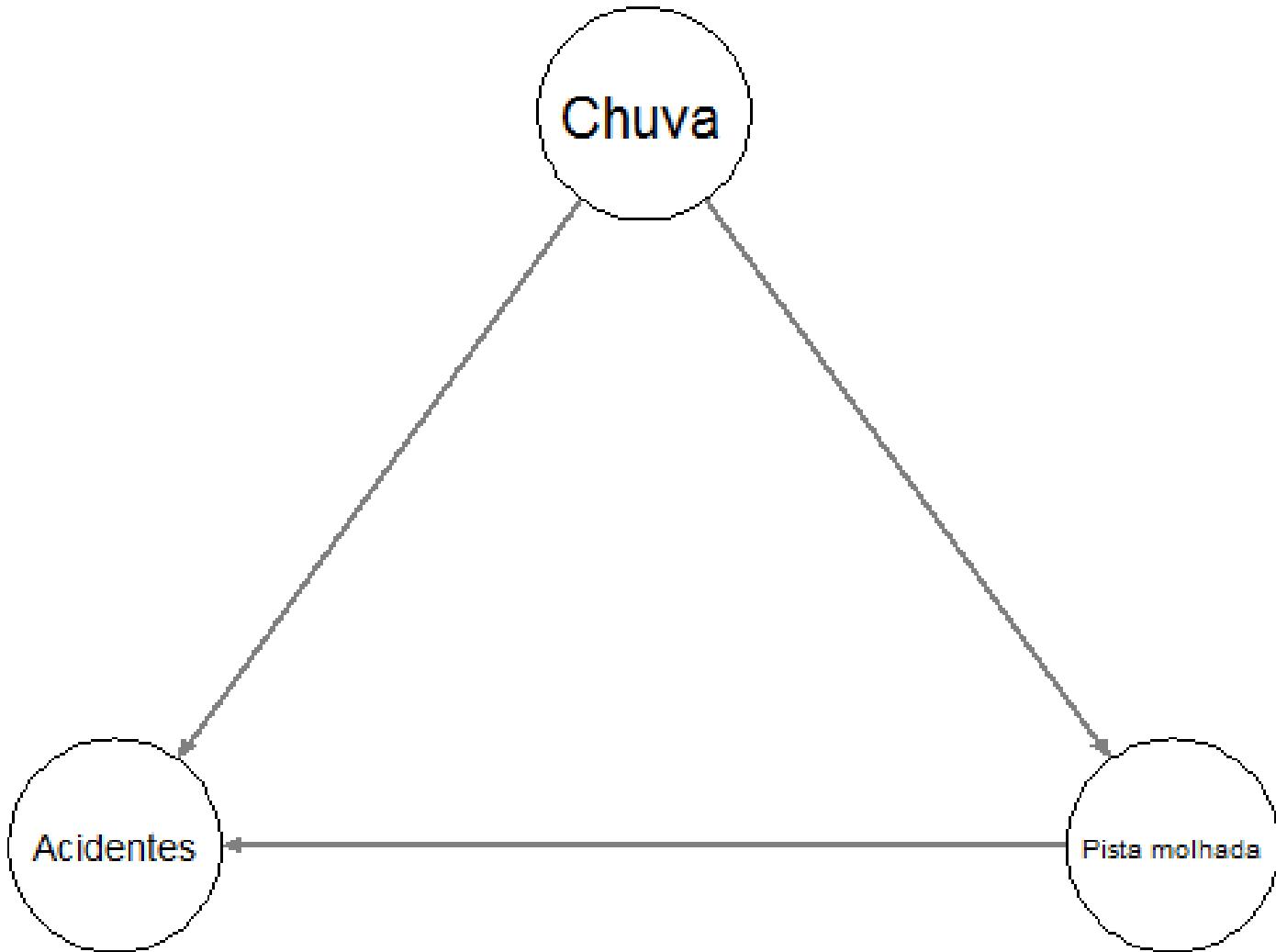
Cenário 2: Paula é amiga de Ana, Paula é amiga de Roberto, Ana e Roberto não são amigos



# Jacob Moreno Sociogramma



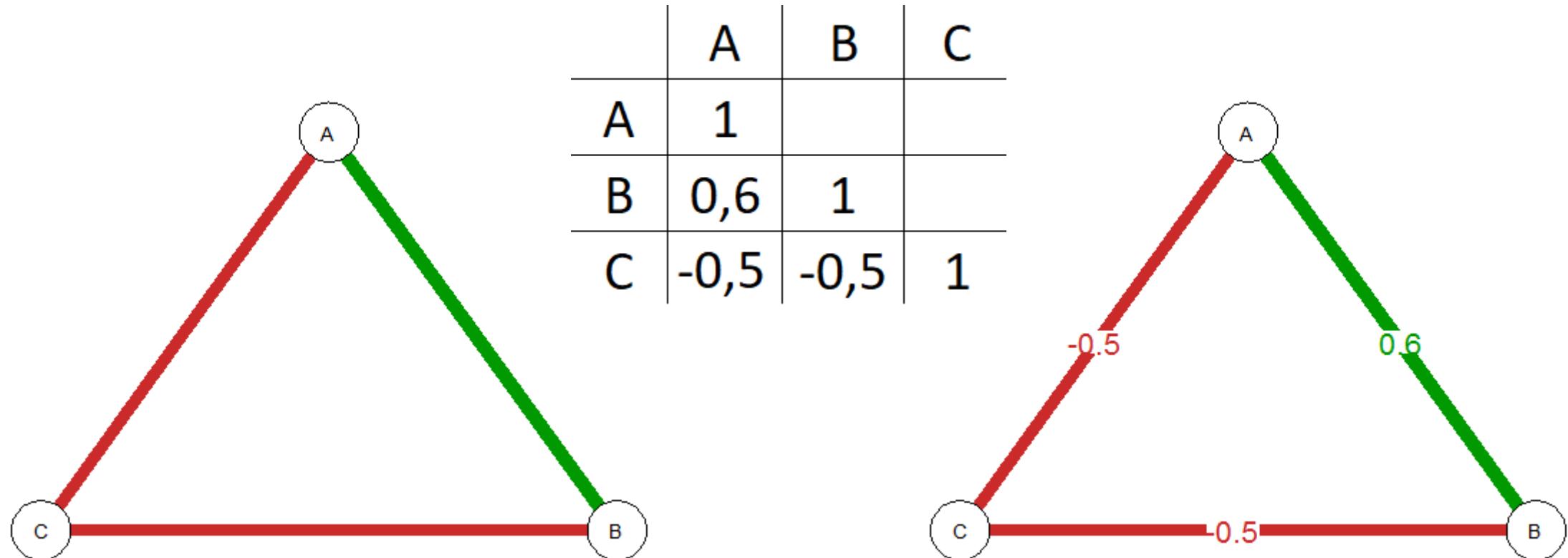
Redes causais  
ou  
probabilísticas



**Bayesian networks -> Direct Acyclic Graphs**

# Medidas de associação entre variáveis

- Relação entre bem-estar (A), suporte social (B) e depressão (C)



**Table 2** Means, standard deviation and Pearson correlation matrix for continuous variables ( $n = 228$ )

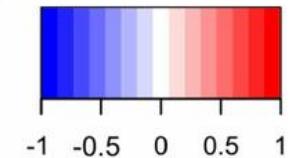
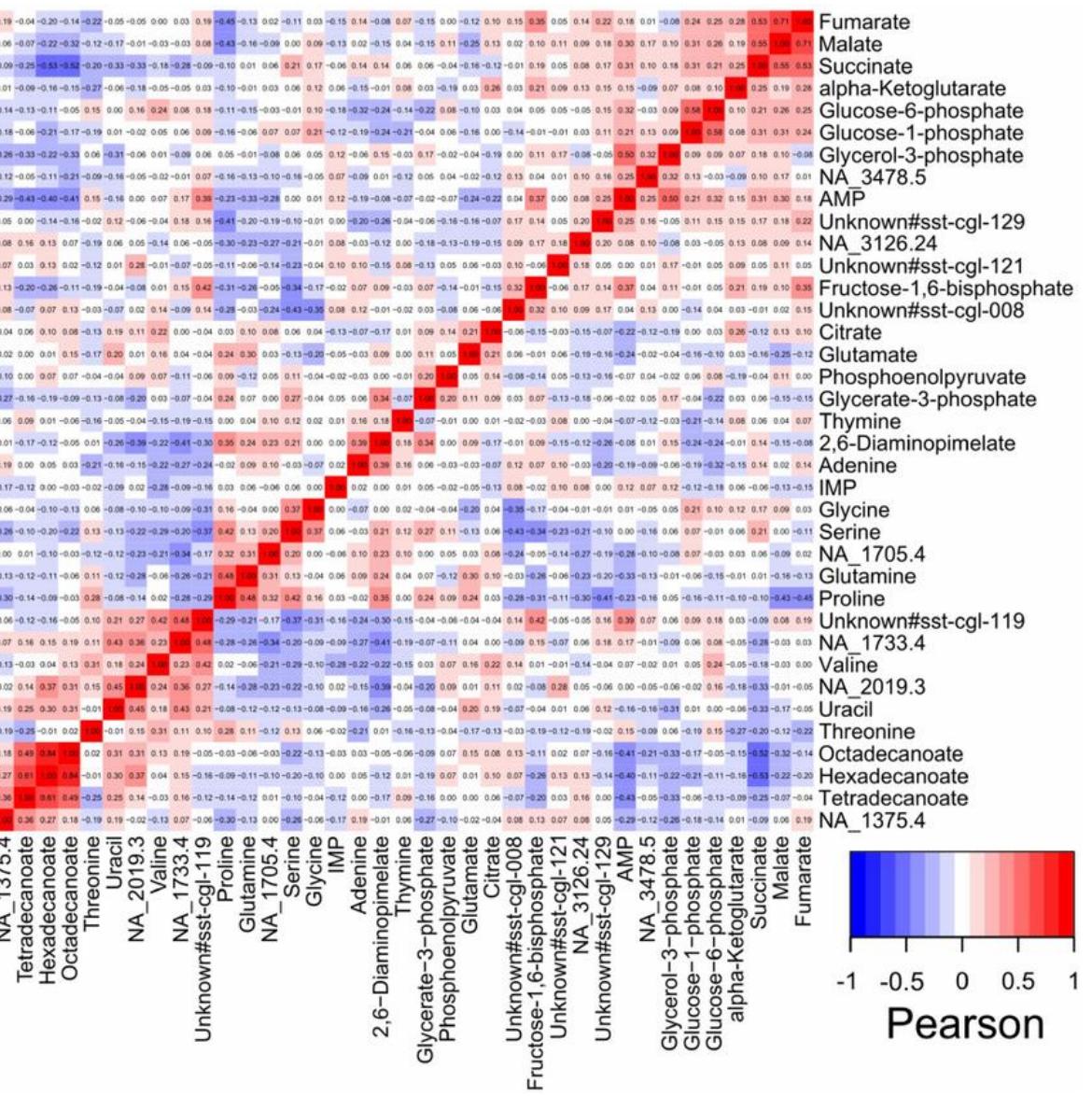
	M	SD	1	2	3	4	5	6	7	8	9	10	11
1. Age	22.75	4.81	—										
2. Extroversion	3.26	.42	.03	(.80)									
3. Emotional stability	2.77	.57	.04	-.04	(.90)								
4. Agreeableness	3.56	.34	.05	.19 <sup>a</sup>	.13 <sup>b</sup>	(.74)							
5. Conscientiousness	3.40	.40	.10	.42 <sup>a</sup>	.02	.12	(.80)						
6. Openness	3.44	.39	.16 <sup>b</sup>	.43 <sup>a</sup>	.15 <sup>b</sup>	.28 <sup>a</sup>	.24 <sup>a</sup>	(.76)					
7. EA	3.27	.77	-.13	.06	-.43 <sup>a</sup>	.11	-.05	.05	(.89)				
8. EC	3.12	.67	.16 <sup>b</sup>	.36 <sup>a</sup>	.18 <sup>a</sup>	.18 <sup>a</sup>	.20 <sup>a</sup>	.40 <sup>a</sup>	.13 <sup>b</sup>	(.84)			
9. ER	3.23	.78	.06	.32 <sup>a</sup>	.35 <sup>a</sup>	.28 <sup>a</sup>	.16 <sup>b</sup>	.32 <sup>a</sup>	-.04	.30 <sup>a</sup>	(.83)		
10. Trust in leader T1	2.91	.85	-.18 <sup>a</sup>	.09	.09	.15 <sup>b</sup>	-.01	-.06	.17 <sup>b</sup>	.13	.11	(.74)	
11. Trust in leader T2	2.90	.83	-.21 <sup>a</sup>	.05	.03	.08	.07	-.16 <sup>b</sup>	.19 <sup>a</sup>	.02	.06	.59 <sup>a</sup>	(.82)

EA: emotional attention; EC: emotional clarity; ER: emotional repair; T1: work session 1; T2: work session 2.

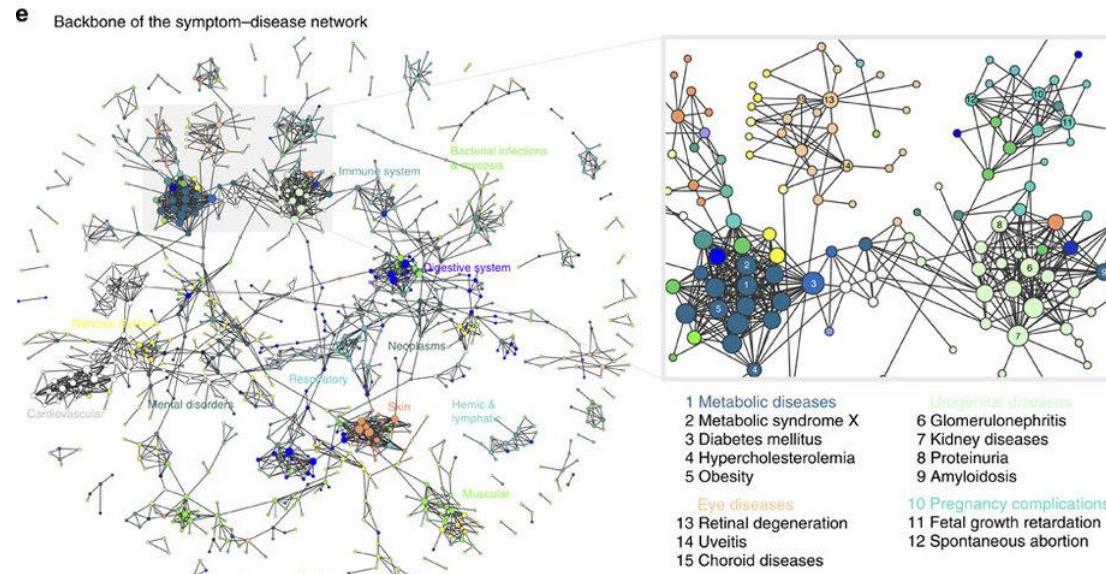
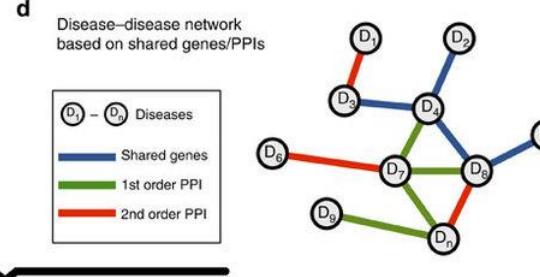
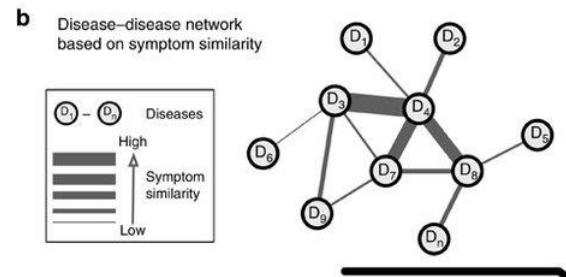
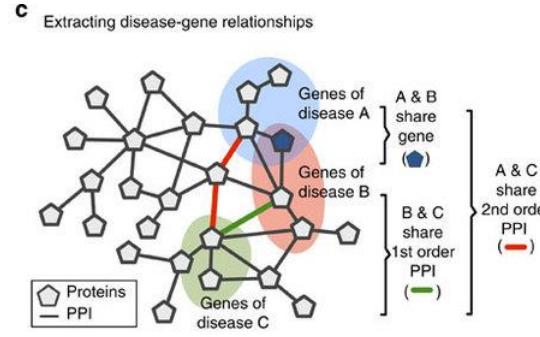
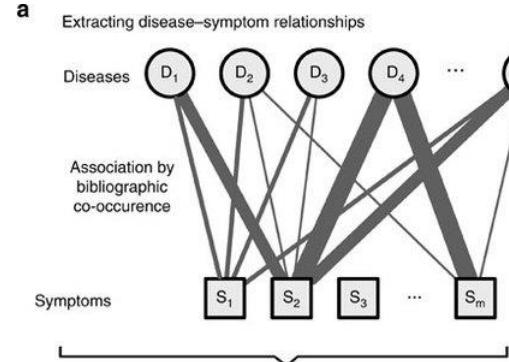
<sup>a</sup> $p < .05$ .

<sup>b</sup> $p < .01$ .

Cronbach's alphas are shown in the diagonal.



Pearson



Article

## Human symptoms–disease network

XueZhong Zhou ✉, Jörg Menche, Albert-László Barabási & Amitabh Sharma ✉

Nature Communications 5,

Article number: 4212 (2014)

doi:10.1038/ncomms5212

Received: 07 November 2013

Accepted: 27 May 2014

Published online: 26 June 2014

We extracted **7,109,429** (about 35.5% in over twenty million records) PubMed bibliographic records with one or more disease/symptom terms in the MeSH metadata field (see Methods), yielding a total of 4,442 disease terms and 322 symptom terms

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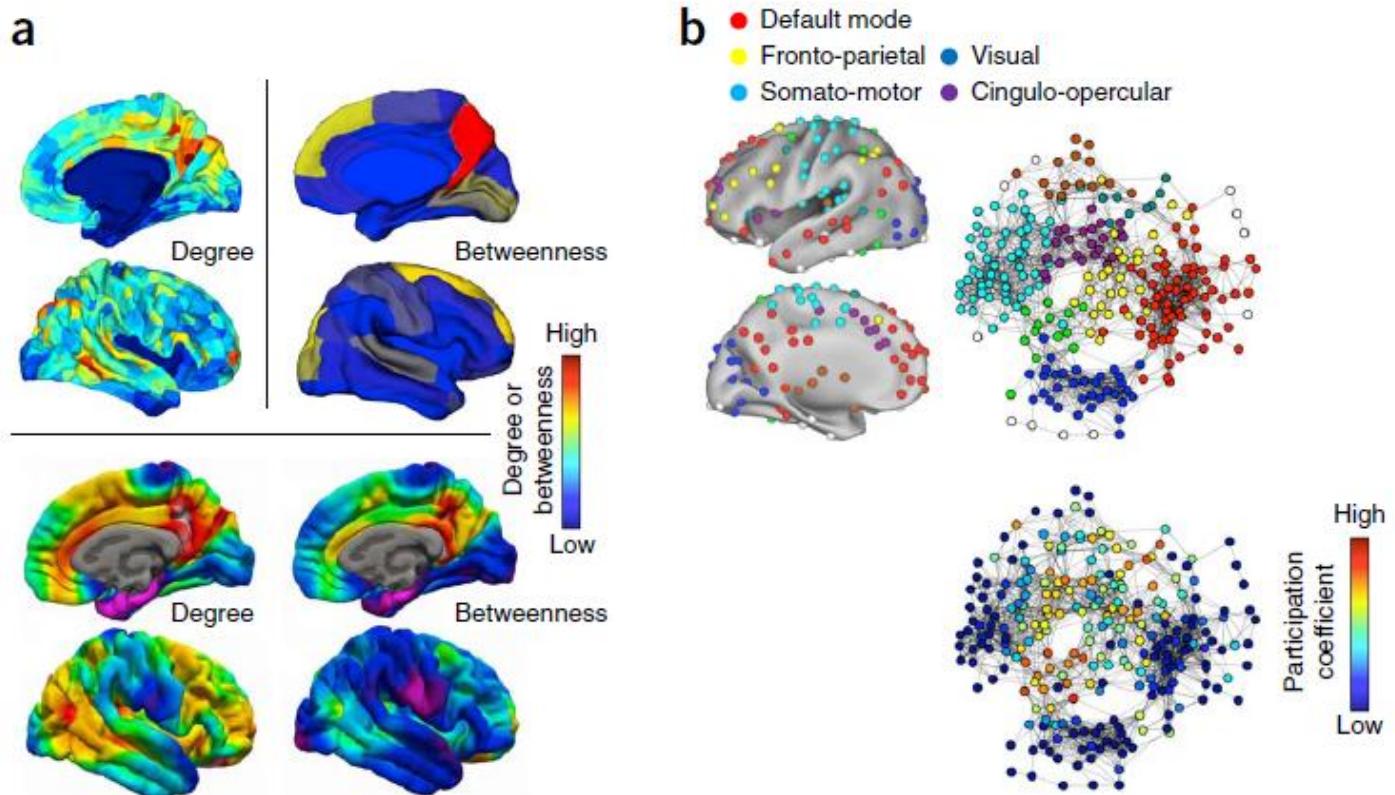


# Contributions and challenges for network models in cognitive neuroscience

Olaf Sporns

*Nature Neuroscience* 17, 652–660 (2014) | doi:10.1038/nn.3690

Received 06 October 2013 | Accepted 03 March 2014 | Published online 30 March 2014



# The dynamical structure of political corruption networks

Haroldo V. Ribeiro,<sup>1,\*</sup> Luiz G. A. Alves,<sup>2</sup>

Alvaro F. Martins,<sup>1</sup> Ervin K. Lenzi,<sup>3</sup> and Matjaž Perc<sup>4,5,6,†</sup>

<sup>1</sup>Departamento de Física, Universidade Estadual de Maringá, Maringá, PR 87020-900, Brazil

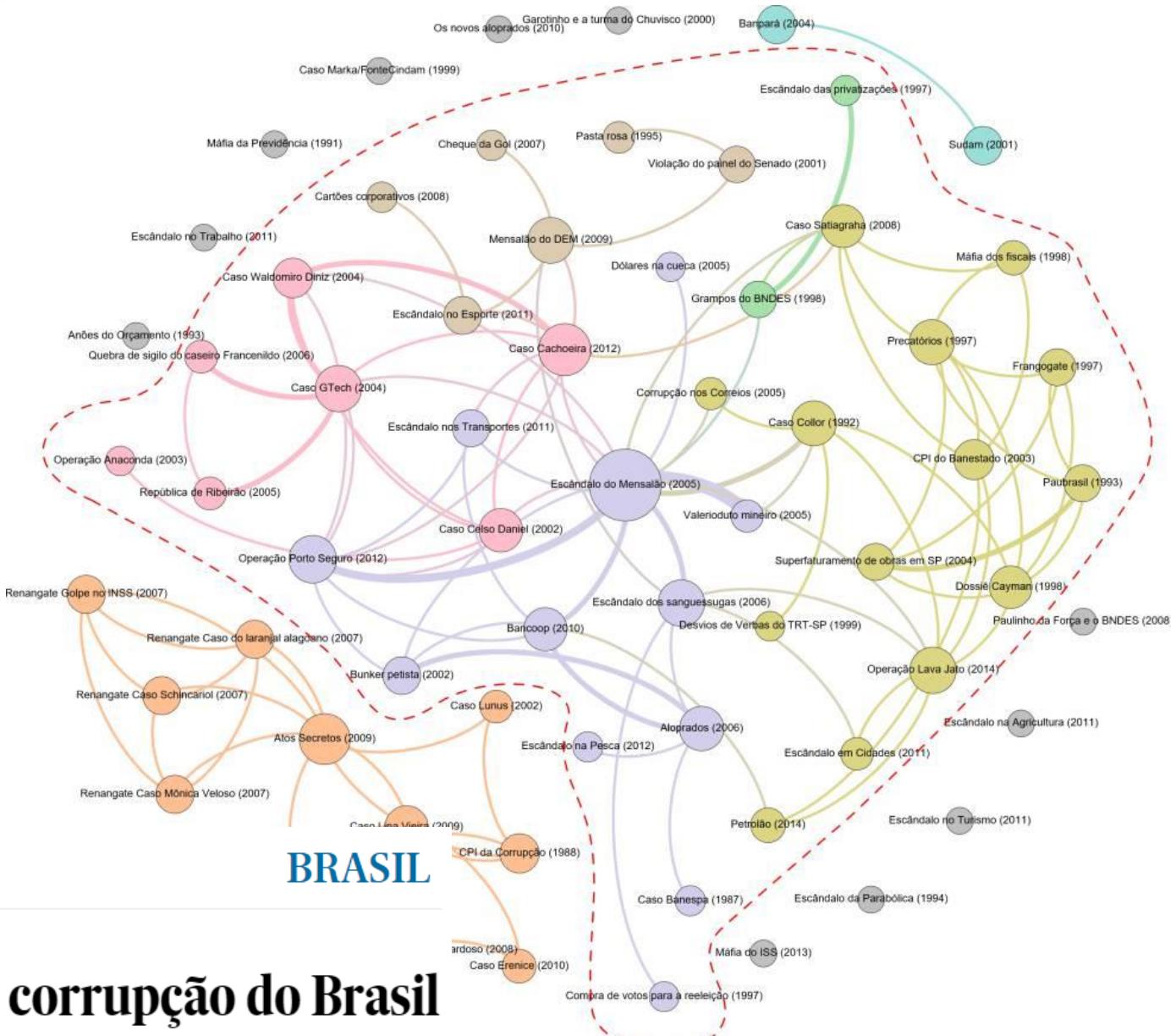
<sup>2</sup>Institute of Mathematics and Computer Science, University of São Paulo, São Carlos, SP 13566-590, Brazil

<sup>3</sup>Departamento de Física, Universidade Estadual de Ponta Grossa, Ponta Grossa, PR 84030-900, Brazil

<sup>4</sup>Faculty of Natural Sciences and Mathematics, University of Maribor, Koroška cesta 160, SI-2000 Maribor, Slovenia

<sup>5</sup>CAMTP – Center for Applied Mathematics and Theoretical Physics, University of Maribor, Mladinska 3, SI-2000 Maribor, Slovenia

<sup>6</sup>Complexity Science Hub, Josefstadtterstraße 39, A-1080 Vienna, Austria



≡ EL PAÍS

CORRUPÇÃO >

## Por trás do verdadeiro mecanismo de corrupção do Brasil

Pesquisadores mapeiam as redes de relacionamento entre os escândalos de desvio de dinheiro público que assolaram o Brasil após a redemocratização

# Network Psychometrics

Sacha Epskamp, Gunter Maris, Lourens J. Waldorp,  
and Denny Borsboom

## Introduction

“In fact, statistical field theory may have even more to offer. It always struck me that there appears to be a close connection between the basic expressions underlying item-response theory and the solutions of elementary lattice fields in statistical physics. For instance, there is almost a one-to-one formal correspondence of the solution of the Ising model (a lattice with nearest neighbor interaction between binary-valued sites; e.g., Kindermann & Snell (1980), Chapter 1) and the Rasch model Fischer

# Revealing the dynamic network structure of the Beck Depression Inventory-II

L. F. Bringmann<sup>1\*</sup>, L. H. J. M. Lemmens<sup>2</sup>, M. J. H. Huibers<sup>2,3</sup>, D. Borsboom<sup>4</sup> and F. Tuerlinckx<sup>1</sup>

<sup>1</sup> Faculty of Psychology and Educational Sciences, University of Leuven, Leuven, Belgium

<sup>2</sup> Department of Clinical Psychological Science, Maastricht University, Maastricht, The Netherlands

<sup>3</sup> Department of Clinical Psychology, VU University of Amsterdam, Amsterdam, The Netherlands

<sup>4</sup> Department of Psychology, University of Amsterdam, Amsterdam, The Netherlands

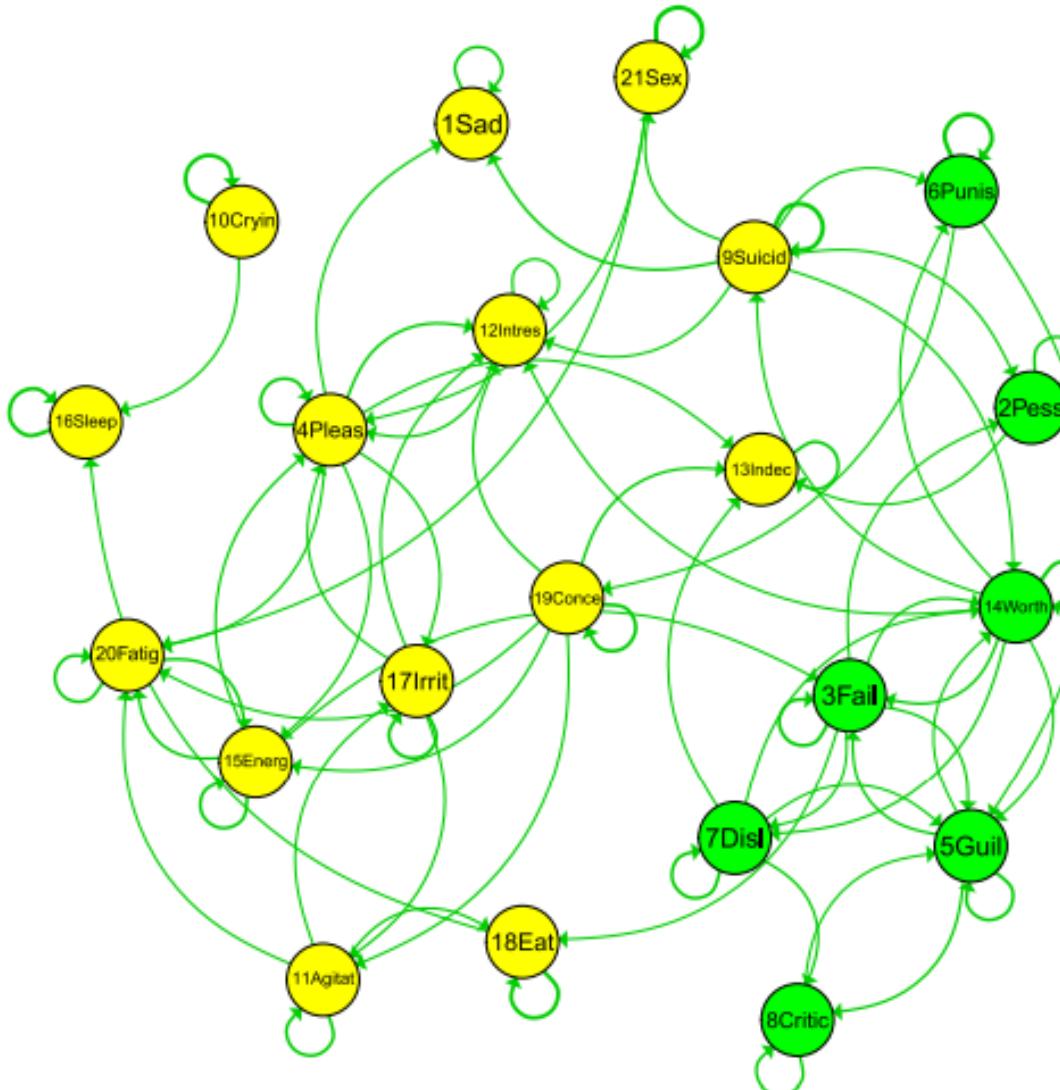


Fig. 3. Community structure of the BDI-II network with the two clusters indicated by two different colours.



## SPECIAL ARTICLE

# A network theory of mental disorders

Denny Borsboom

Department of Psychology, University of Amsterdam, Amsterdam 1018 XA, The Netherlands

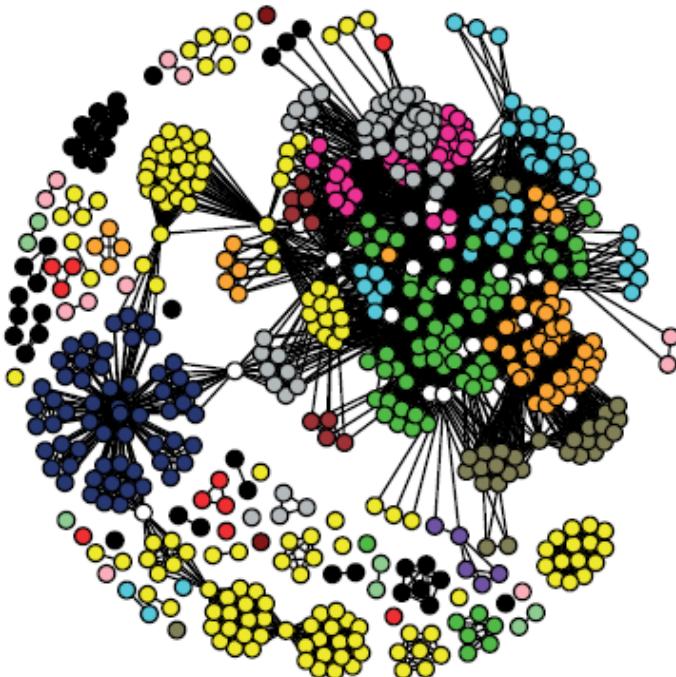
*In recent years, the network approach to psychopathology has been advanced as an alternative way of conceptualizing mental disorders. In this approach, mental disorders arise from direct interactions between symptoms. Although the network approach has led to many novel methodologies and substantive applications, it has not yet been fully articulated as a scientific theory of mental disorders. The present paper aims to develop such a theory, by postulating a limited set of theoretical principles regarding the structure and dynamics of symptom networks. At the heart of the theory lies the notion that symptoms of psychopathology are causally connected through myriads of biological, psychological and societal mechanisms. If these causal relations are sufficiently strong, symptoms can generate a level of feedback that renders them self-sustaining. In this case, the network can get stuck in a disorder state. The network theory holds that this is a general feature of mental disorders, which can therefore be understood as alternative stable states of strongly connected symptom networks. This idea naturally leads to a comprehensive model of psychopathology, encompassing a common explanatory model for mental disorders, as well as novel definitions of associated concepts such as mental health, resilience, vulnerability and liability. In addition, the network theory has direct implications for how to understand diagnosis and treatment, and suggests a clear agenda for future research in psychiatry and associated disciplines.*

**Key words:** Psychopathology, network approach, mental disorders, symptom networks, mental health, resilience, vulnerability, diagnosis, treatment

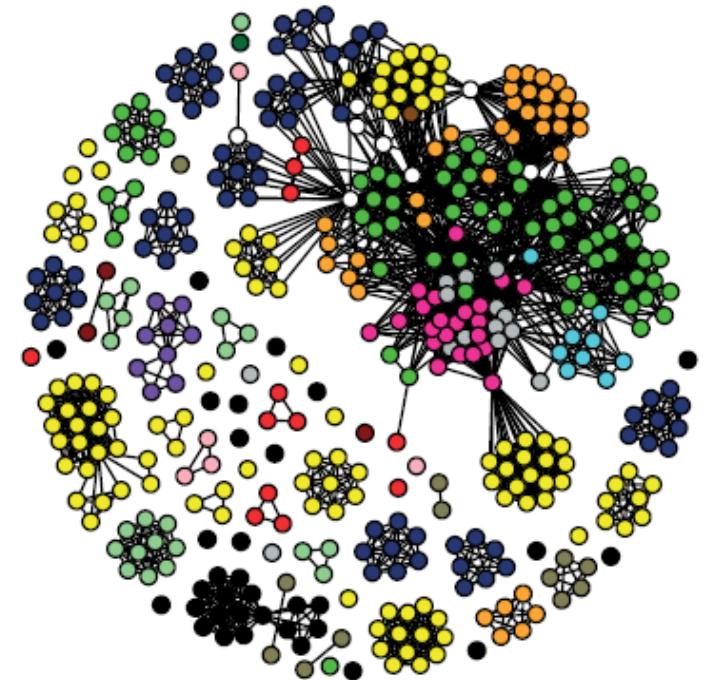
*(World Psychiatry 2017;16:5–13)*

# Mapping the manuals of madness: Comparing the ICD-10 and DSM-IV-TR using a network approach

PIA TIO,<sup>1</sup> SACHA EPSKAMP,<sup>1</sup> ARJEN NOORDHOF<sup>2</sup> & DENNY BORSBOOM<sup>1</sup>



- Disorders of infancy, childhood, and adolescence
- Delirium, dementia, and other cognitive disorders
- Mental disorders due to a medical condition
- Substance-related disorders
- Schizophrenia and other psychotic disorders
- Mood disorders
- Anxiety disorders
- Somatoform disorders
- Facitious disorders
- Dissociative disorders
- Sexual and gender identity disorders
- Eating disorders
- Sleep disorders
- Habit and impulse disorders
- Adjustment disorders
- Personality disorders
- Enduring personality change
- Symptom is featured equally in multiple classes



**Table 2.** Top 10 criteria with the highest degree for ICD-10 and DSM-IV-TR network

	ICD-10	DSM-IV-TR
1	Insomnia <sup>1</sup>	Insomnia <sup>1</sup>
2	Irritability <sup>1</sup>	Psychomotor agitation
3	Apathy	Psychomotor retardation <sup>1</sup>
4	Difficulty in concentrating <sup>1</sup>	Depressed
5	Nausea	Accelerated heart rate
6	Emotional lability	Distractibility
7	Sweating <sup>1</sup>	Irritability <sup>1</sup>
8	Chest pain	Anxiety and Hypersomnia
9	Restless sleep	Sweating <sup>1</sup> and Weight loss Difficulty in concentrating <sup>1</sup>
10	Psychomotor retardation <sup>1</sup>	and Hallucinations/illusions

<sup>1</sup>Criteria that occur in the top 10 of both networks. Places 8 through 10 in the DSM-IV-TR hold multiple symptoms.

# Análise de rede

- Técnica de aprendizado de máquina (machine learning)
- Dar sentido a dados complexos
- Representação gráfica para integração e leitura mais “intuitiva” dos dados

# Exemplos “hands on” (mão na massa)

- Personalidade
- Depressão
- DASS-21 (depressão, ansiedade e estresse) – comorbidade
- Predição – tratamento de autismo e qualidade de vida

# Porquê usar a linguagem r?

- Capacidades gráficas muito sofisticadas e melhores que muitos softwares
- Linguagem de programação que possibilita o desenvolvimento de novas ferramentas
- Comunidade de usuários muito ativa e participativa

The collage includes:

- RStudio logo (blue circle with white 'R')
- Stack Overflow logo (orange and grey stylized text)
- Github logo (white cat icon and 'GitHub' text)
- Screenshot of a Facebook group page for "Psicometristas BRASIL" (Psychoanalysts Brazil) with a blue gradient background and white text.
- Screenshot of the "Personality Project" website with a dark background and white text.
- Quick-R logo (blue background with white owl icon and 'Quick-R' text)
- DataCamp logo (blue hexagon with white brain icon and 'DataCamp' text)



# Getting Started



- É o sistema básico – feito de forma colaborativa – Possui funções básicas que podem ser combinadas em pacotes mais avançados
- R Studio – Uma interface mais amigável para o uso do R. Permite análise, escrita (tem gente que escreve a tese por aqui), e publicações.

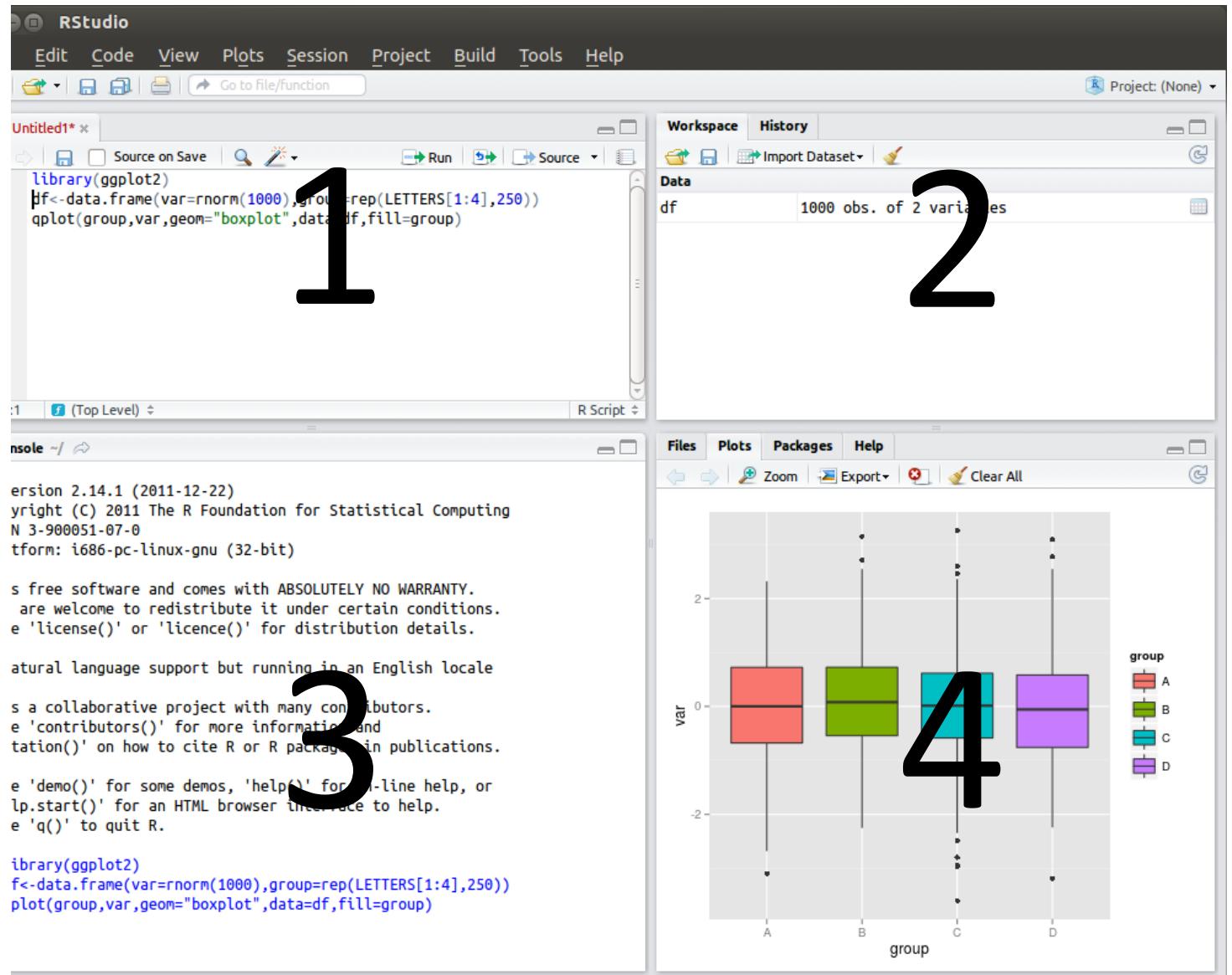
# RStudio

1 – script ou comandos; visualização de bancos de dados ou texto

2 – repositório de objetos e funções

3 – log de atividade

4 – gráficos e documentação



# Personalidade

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Behav Genet (2014) 44:591–604  
DOI 10.1007/s10519-013-9625-7

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ORIGINAL RESEARCH

## The Big Five Personality Traits: Psychological Entities or Statistical Constructs?

Sanja Franić · Denny Borsboom · Conor V. Dolan ·  
Dorret I. Boomsma

## Dimensions of Normal Personality as Networks in Search of Equilibrium: You Can't Like Parties if You Don't Like People

ANGÉLIQUE O. J. CRAMER<sup>1\*</sup>, SOPHIE VAN DER SLUIS<sup>1,2</sup>, ARJEN NOORDHOF<sup>1</sup>, MARIEKE WICHERS<sup>3</sup>, NICOLE GESCHWIND<sup>3,4</sup>, STEVEN H. AGGEN<sup>5,6</sup>, KENNETH S. KENDLER<sup>5,6</sup> and DENNY BORSBOOM<sup>1</sup>

<sup>1</sup>Department of Psychology, University of Amsterdam, The Netherlands

<sup>2</sup>Complex Trait Genetics, Department of Functional Genomics and Department Clinical Genetics, Center for Neurogenomics and Cognitive Research (CNCR), FALW-VUA, Neuroscience Campus Amsterdam, VU University Medical Center (VUmc), The Netherlands

<sup>3</sup>European Graduate School for Neuroscience, SEARCH, Department of Psychiatry and Psychology, Maastricht University Medical Centre, The Netherlands

<sup>4</sup>Research Group on Health Psychology, Centre for the Psychology of Learning and Experimental Psychopathology, University of Leuven, Belgium

<sup>5</sup>Virginia Institute for Psychiatric and Behavioral Genetics, USA

<sup>6</sup>Department of Psychiatry, Virginia Commonwealth University, USA

## Author's Response

### Measurable Like Temperature or Mereological Like Flocking? On the Nature of Personality Traits

ANGÉLIQUE O. J. CRAMER<sup>1\*</sup>, SOPHIE VAN DER SLUIS<sup>1,2</sup>, ARJEN NOORDHOF<sup>1</sup>, MARIEKE WICHERS<sup>3</sup>, NICOLE GESCHWIND<sup>3,4</sup>, STEVEN H. AGGEN<sup>5,6</sup>, KENNETH S. KENDLER<sup>5,6</sup> and DENNY BORSBOOM<sup>1</sup>

<sup>1</sup>Department of Psychology, University of Amsterdam, The Netherlands

<sup>2</sup>Complex Trait Genetics, Department Functional Genomics & Dept. Clinical Genetics, Center for Neurogenomics and Cognitive Research (CNCR), FALW-VUA, Neuroscience Campus Amsterdam, VU University Medical Center (VUmc), The Netherlands

<sup>3</sup>European Graduate School for Neuroscience, SEARCH, Department of Psychiatry and Psychology, Maastricht University Medical Centre, The Netherlands

<sup>4</sup>Research Group on Health Psychology, Centre for the Psychology of Learning and Experimental Psychopathology, University of Leuven, Belgium

<sup>5</sup>Virginia Institute for Psychiatric and Behavioral Genetics, USA

<sup>6</sup>Department of Psychiatry, Virginia Commonwealth University, USA

Contents lists available at [ScienceDirect](#)



Journal of Research in Personality

journal homepage: [www.elsevier.com/locate/jrp](http://www.elsevier.com/locate/jrp)



## State of the aRt personality research: A tutorial on network analysis of personality data in R

Giulio Costantini <sup>a,\*<sup>1</sup></sup>, Sacha Epskamp <sup>b,<sup>1</sup></sup>, Denny Borsboom <sup>b</sup>, Marco Perugini <sup>a</sup>, René Möttus <sup>c,d</sup>, Lourens J. Waldorp <sup>b</sup>, Angélique O.J. Cramer <sup>b</sup>

<sup>a</sup>Department of Psychology, University of Milan-Bicocca, Piazza dell'Ateneo Nuovo 1 (U6), 20126 Milan, Italy

<sup>b</sup>Department of Psychological Methods, University of Amsterdam, Weesperplein 4, 1018 XA Amsterdam, The Netherlands

<sup>c</sup>Department of Psychology, University of Edinburgh, George Square 7, EH8 9JZ Edinburgh, Scotland, UK

<sup>d</sup>Department of Psychology, University of Tartu, Näituse 2, 50409 Tartu, Estonia



---

# *Journal of Statistical Software*

*May 2012, Volume 48, Issue 4.*

<http://www.jstatsoft.org/>

---

## **qgraph: Network Visualizations of Relationships in Psychometric Data**

**Sacha Epskamp**

University of Amsterdam

**Angélique O. J. Cramer**

University of Amsterdam

**Lourens J. Waldorp**

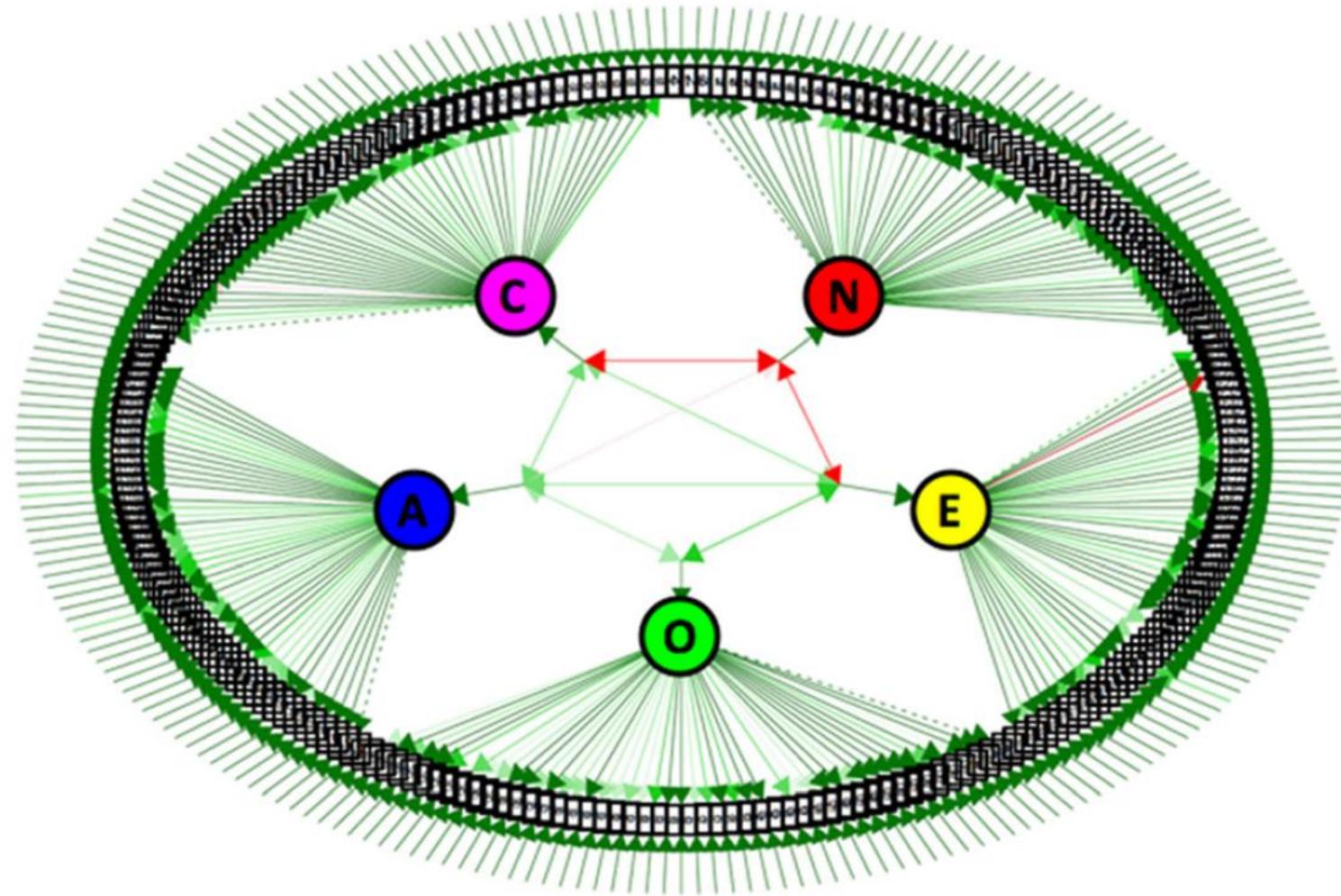
University of Amsterdam

**Verena D. Schmittmann**

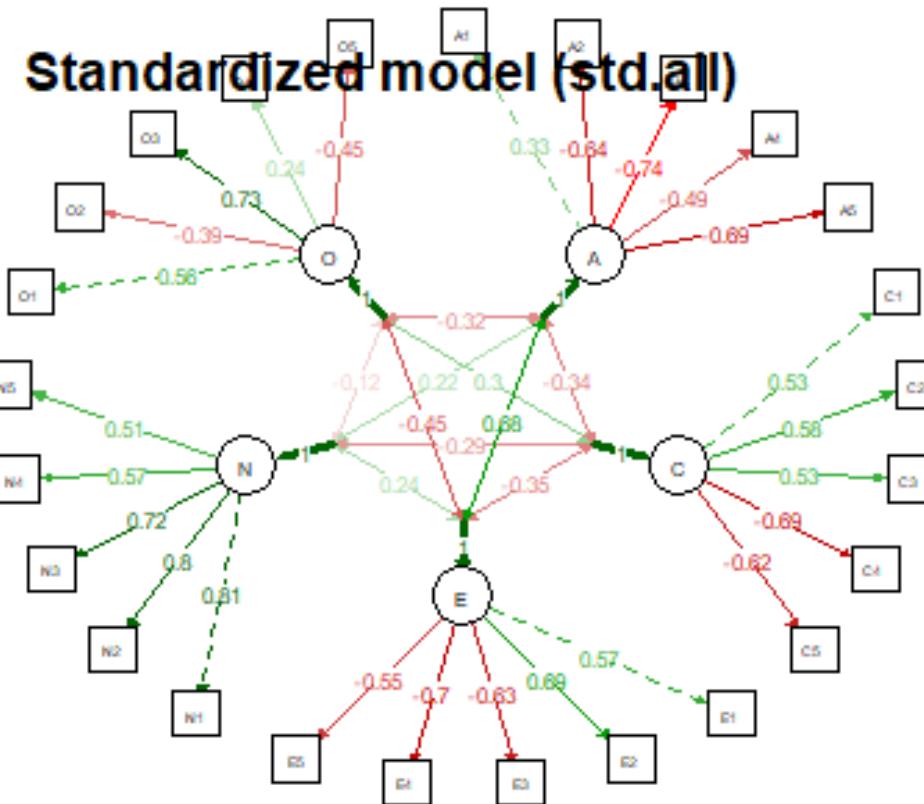
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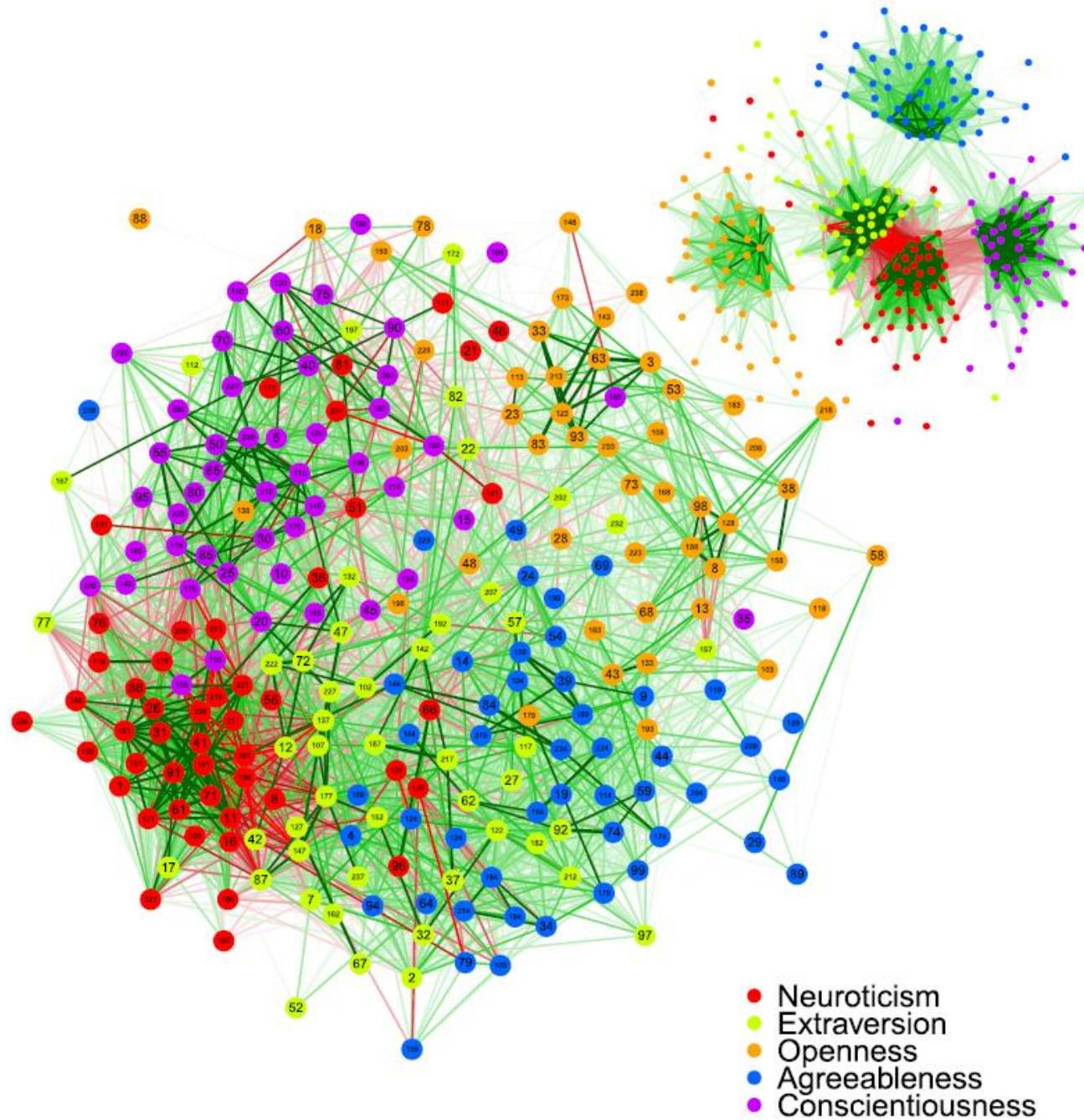
**Denny Borsboom**

University of Amsterdam

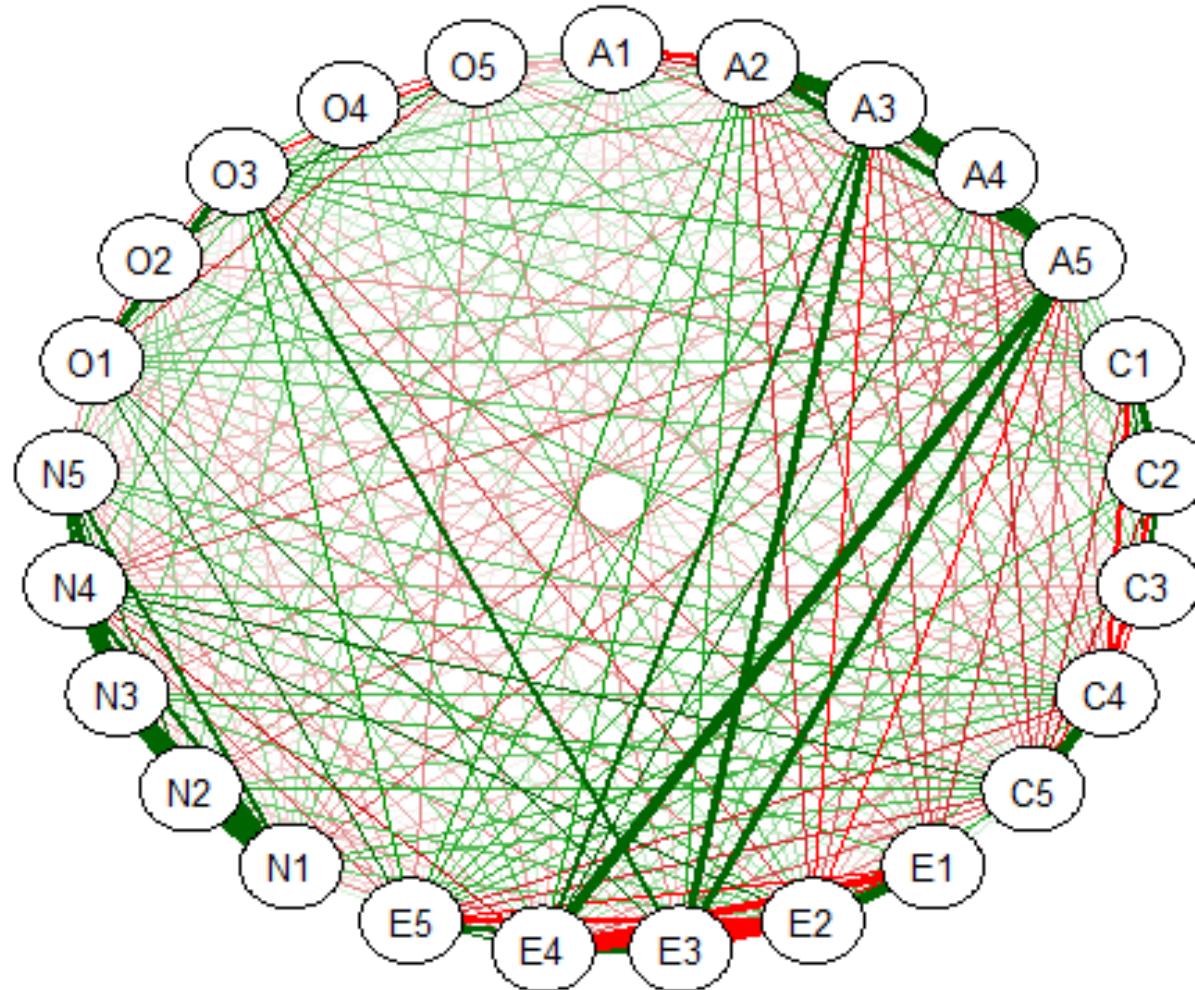


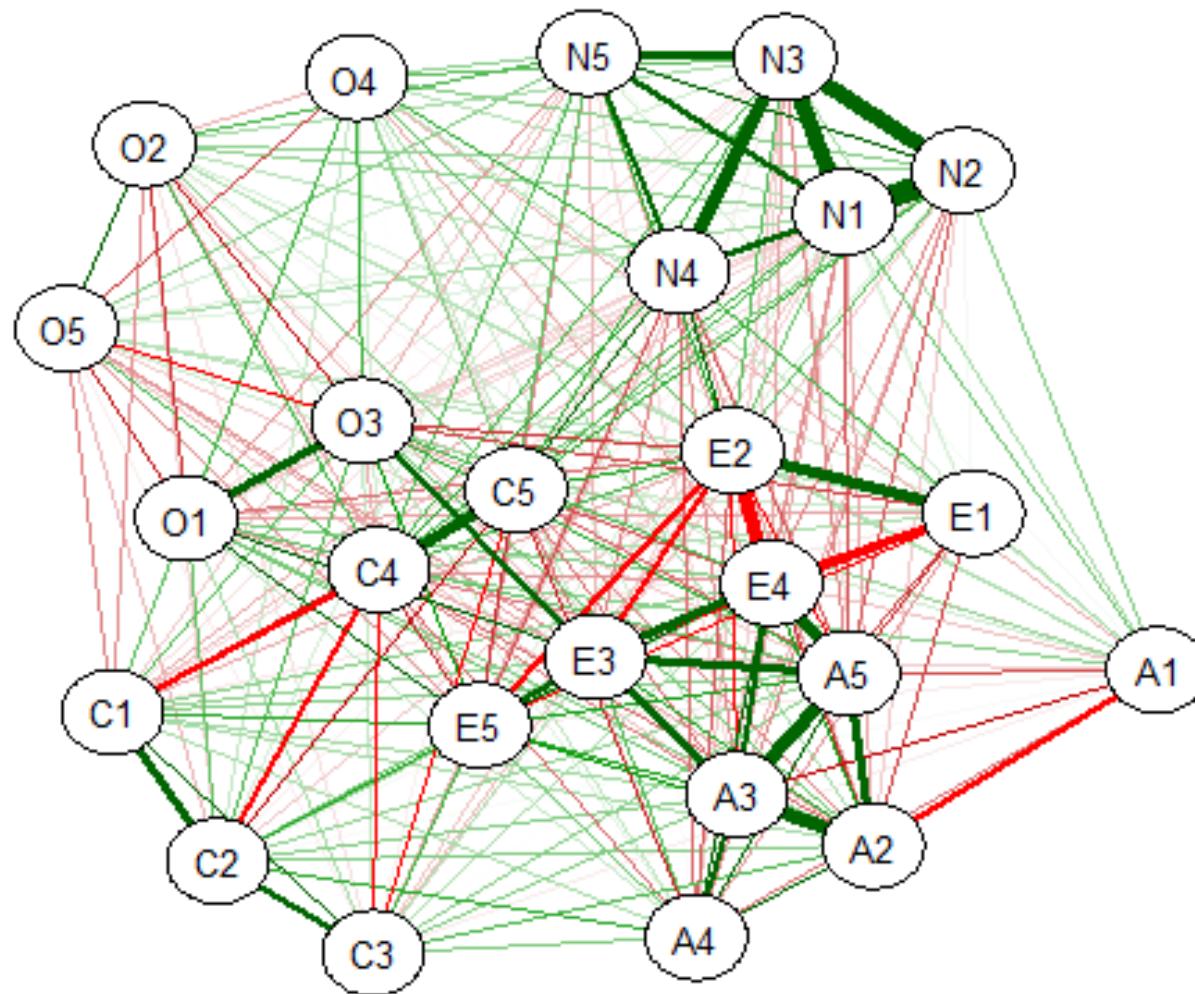
## CFA

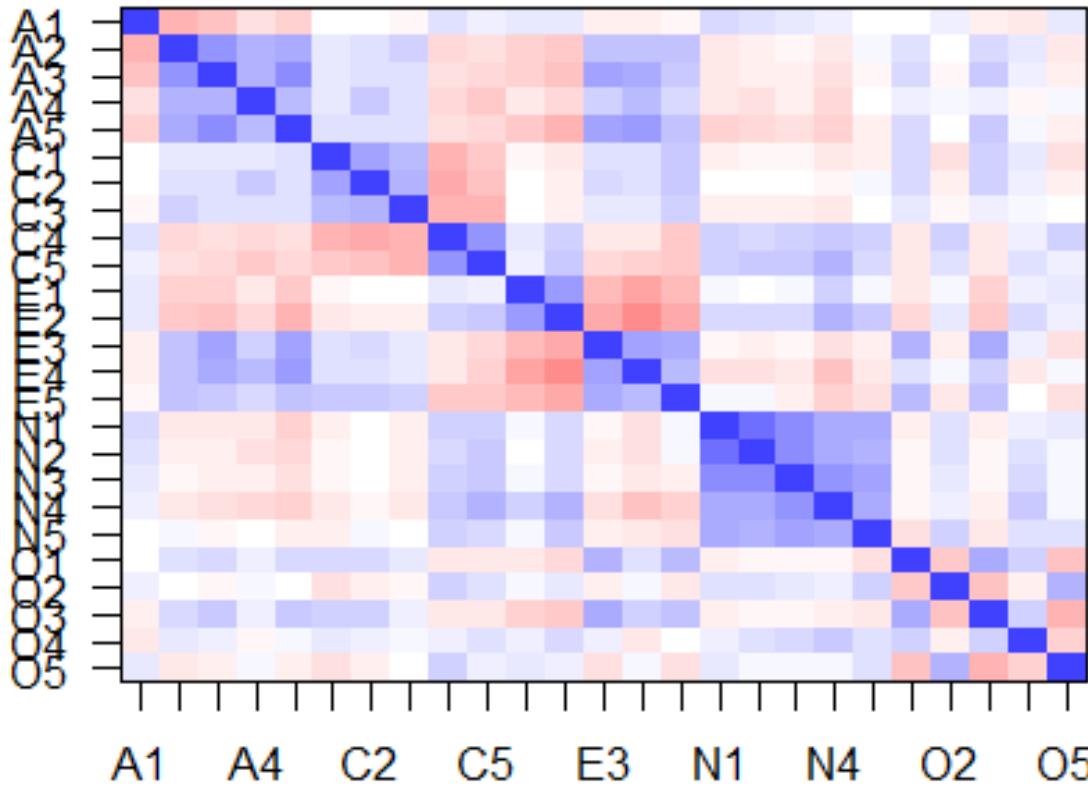




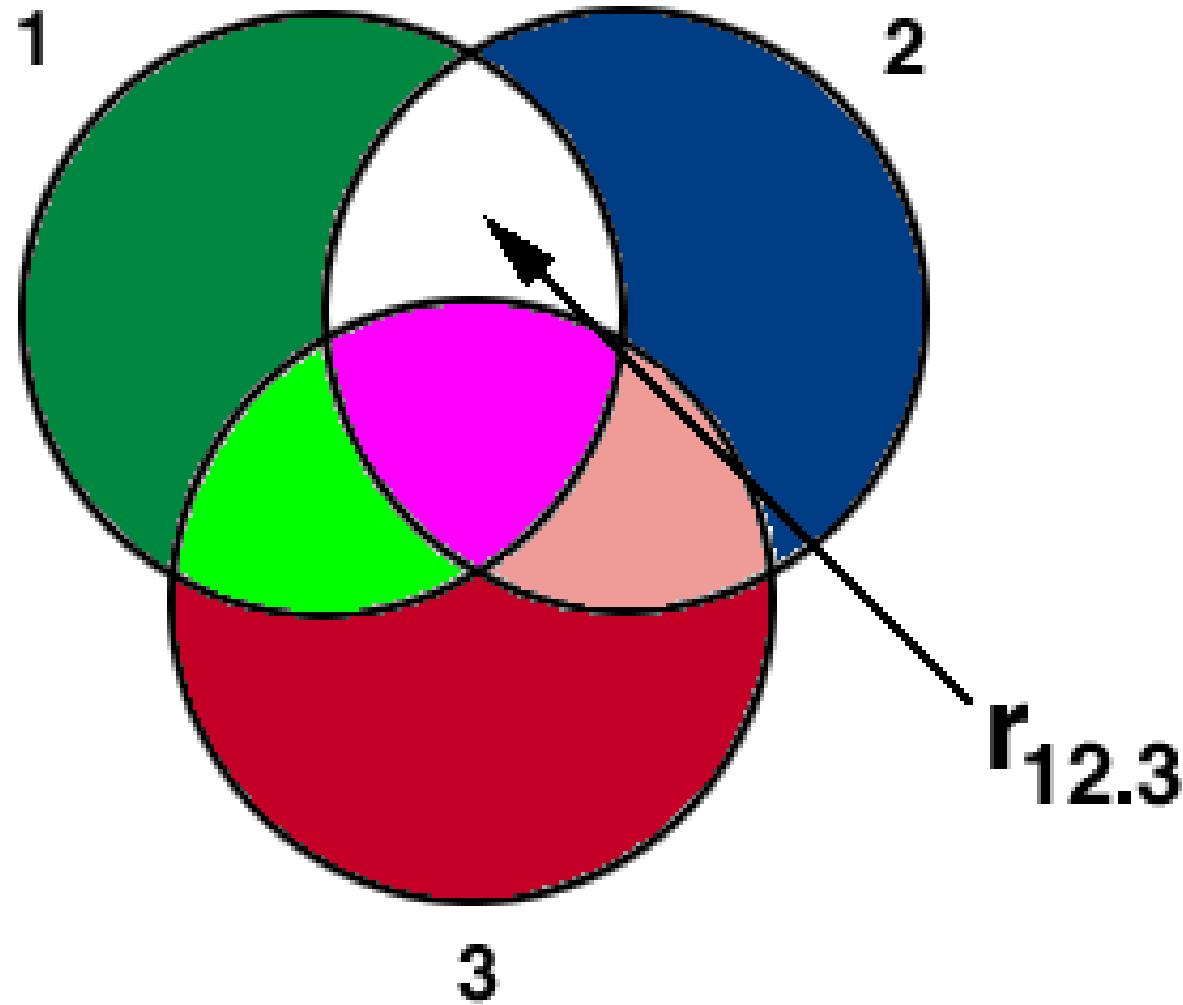
Para o RStudio!!!

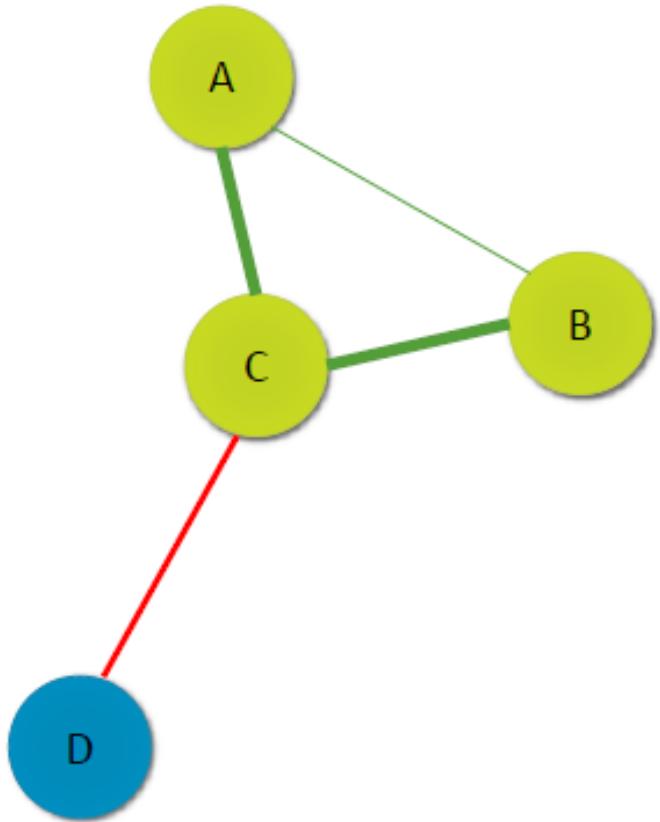




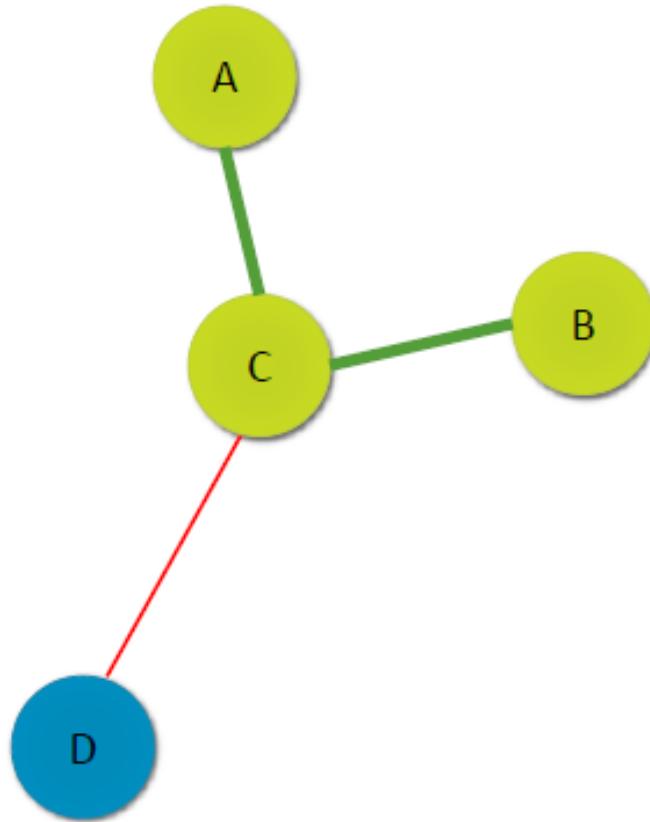


Correlação  
parcial

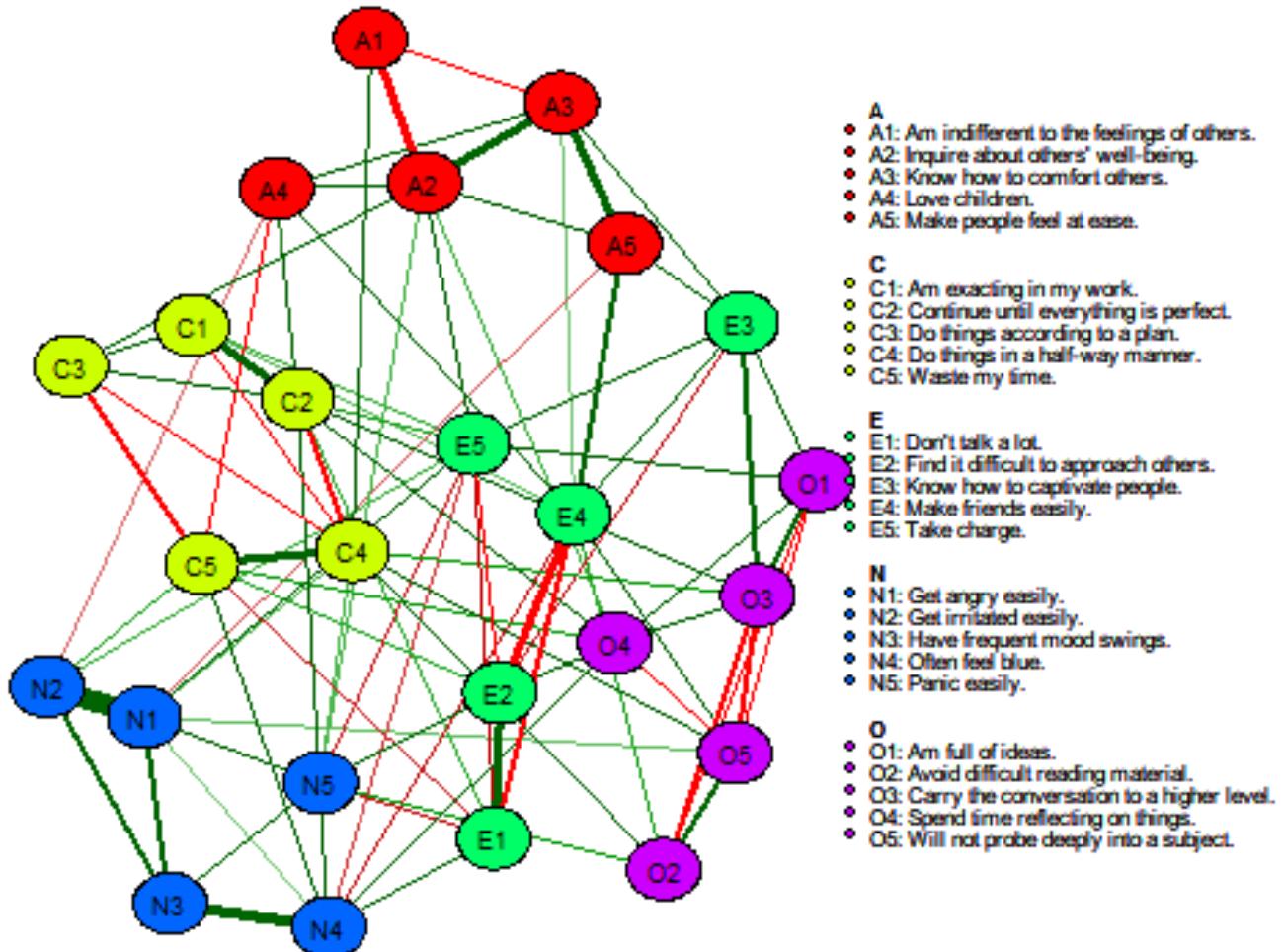


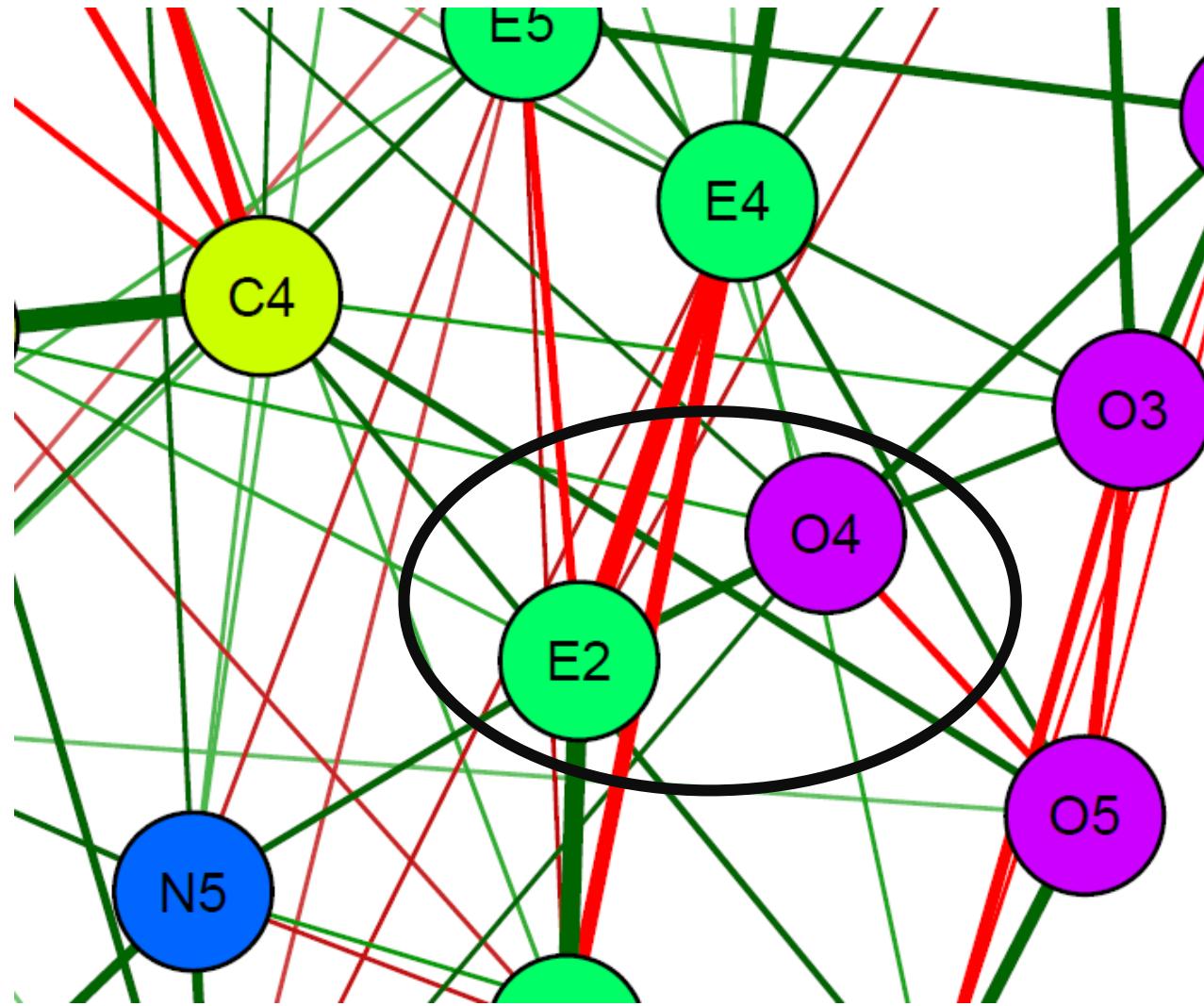


*Rede esparsa, na qual os  
valores de baixa magnitude  
são fixados em zero*



Friedman, Hastie & Tibshirani (2008)





• E1: DON'T TALK A LOT.

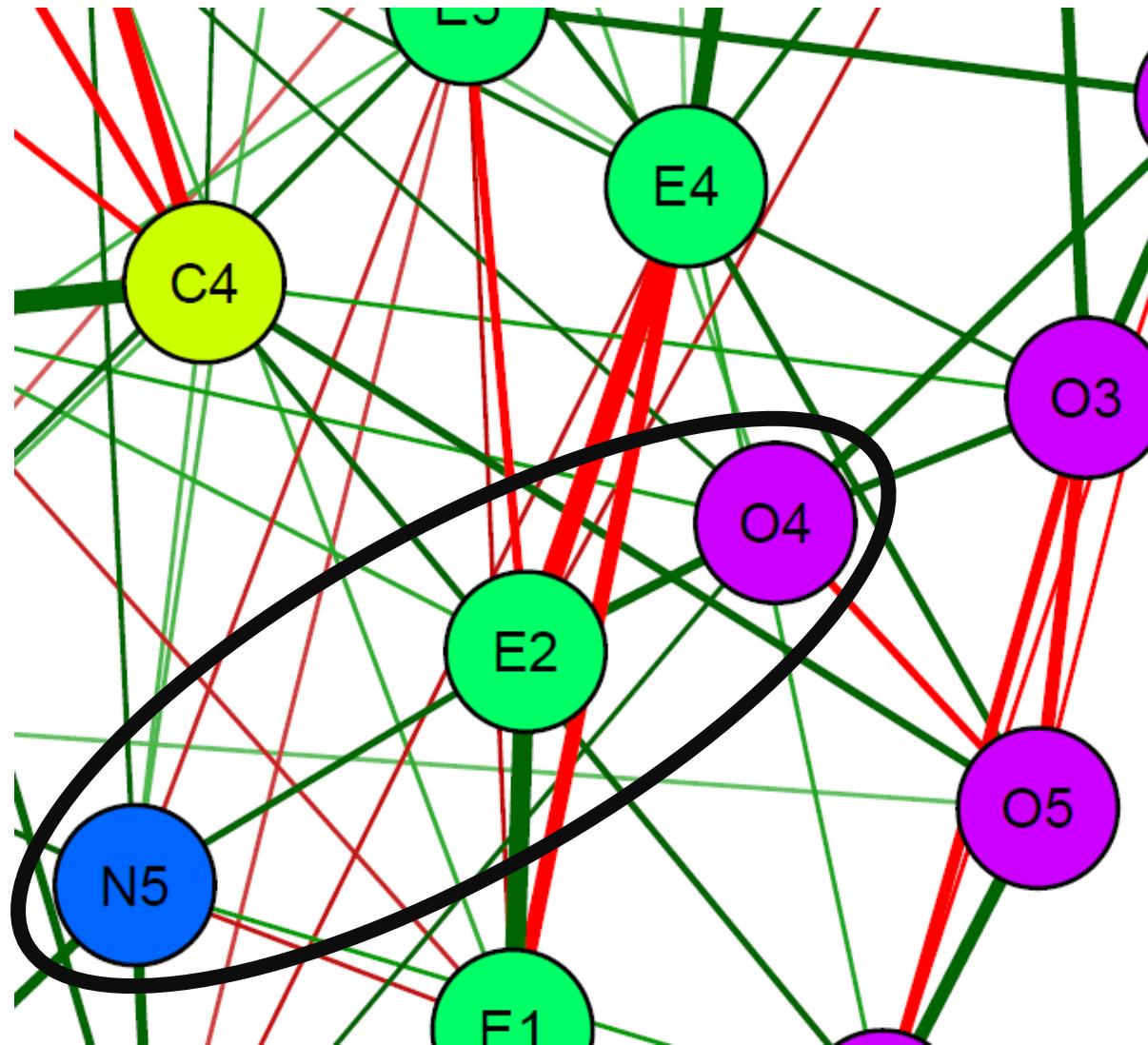
- E2: Find it difficult to approach others.
- E3: Know how to captivate people.
- E4: Make friends easily.
- E5: Take charge.

N

- N1: Get angry easily.
- N2: Get irritated easily.
- N3: Have frequent mood swings.
- N4: Often feel blue.
- N5: Panic easily.

O

- O1: Am full of ideas.
- O2: Avoid difficult reading material.
- O3: Carry the conversation to a higher level.
- O4: Spend time reflecting on things.



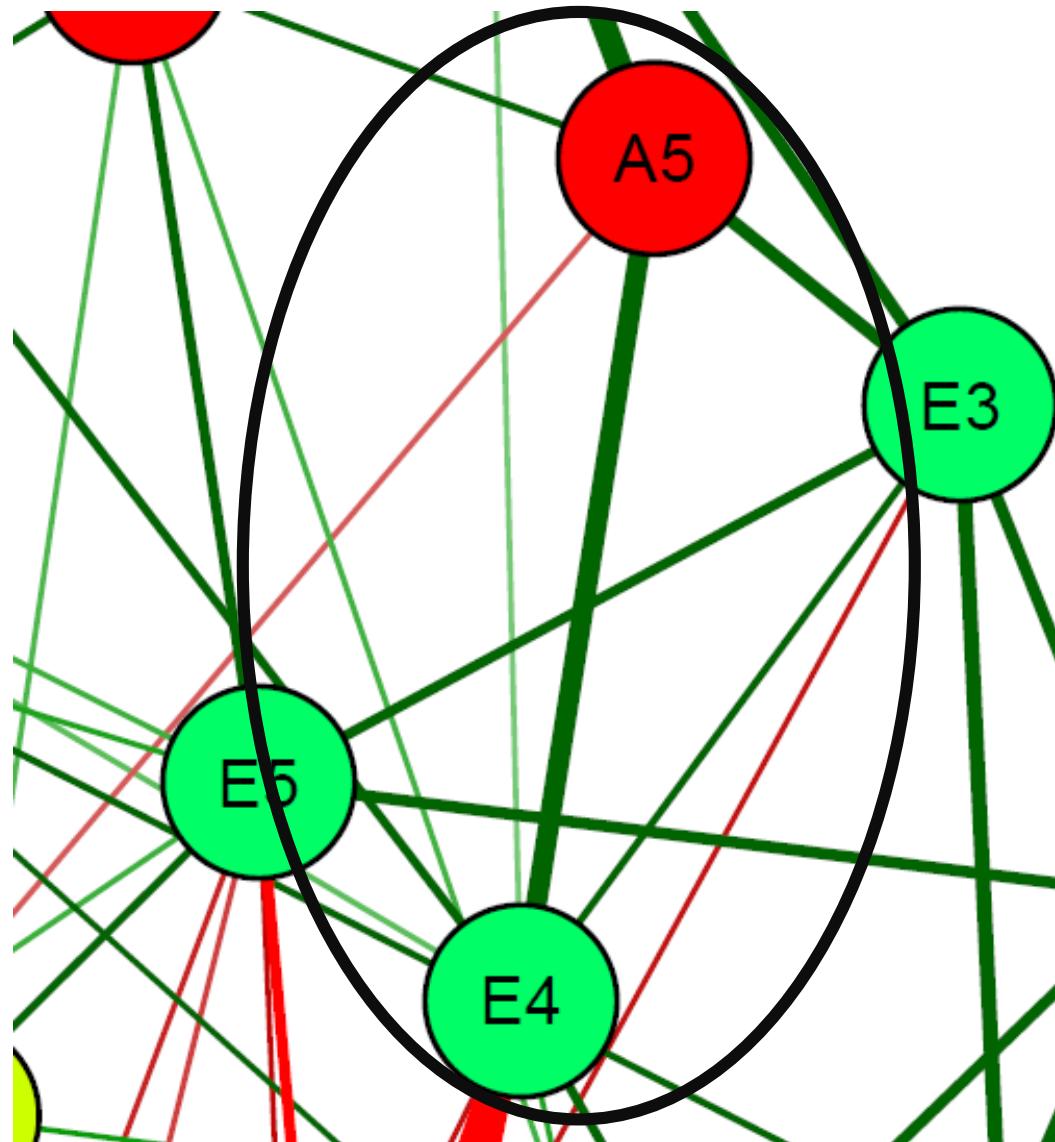
- E2: Find it difficult to approach others.
- E3: Know how to captivate people.
- E4: Make friends easily.
- E5: Take charge.

### N

- N1: Get angry easily.
- N2: Get irritated easily.
- N3: Have frequent mood swings.
- N4: Often feel blue.
- N5: Panic easily.

### O

- O1: Am full of ideas.
- O2: Avoid difficult reading material.
- O3: Carry the conversation to a higher level.
- O4: Spend time reflecting on things.
- O5: Will not probe deeply into a subject.



● A4: Love criticism.

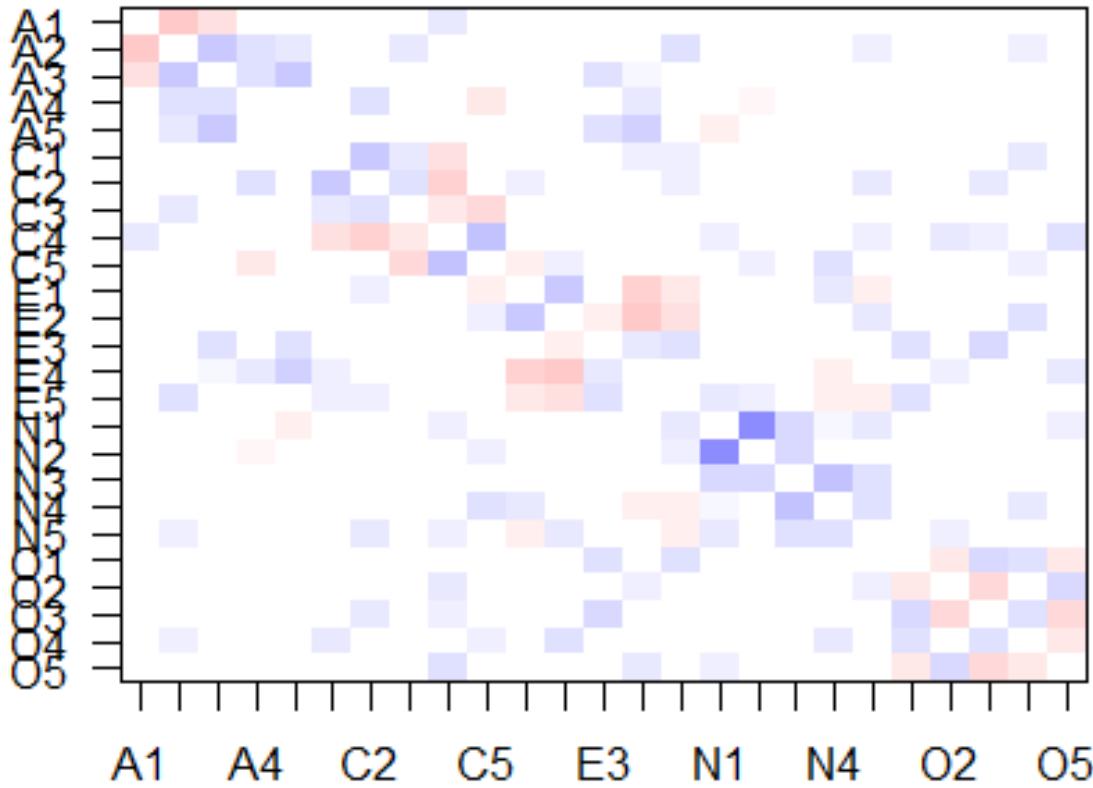
● A5: Make people feel at ease.

## C

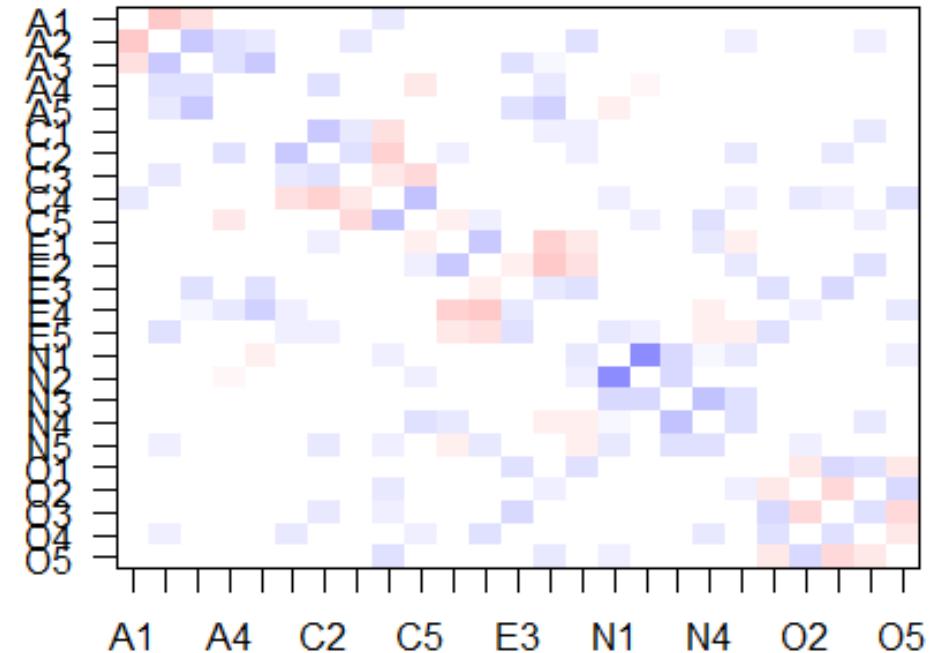
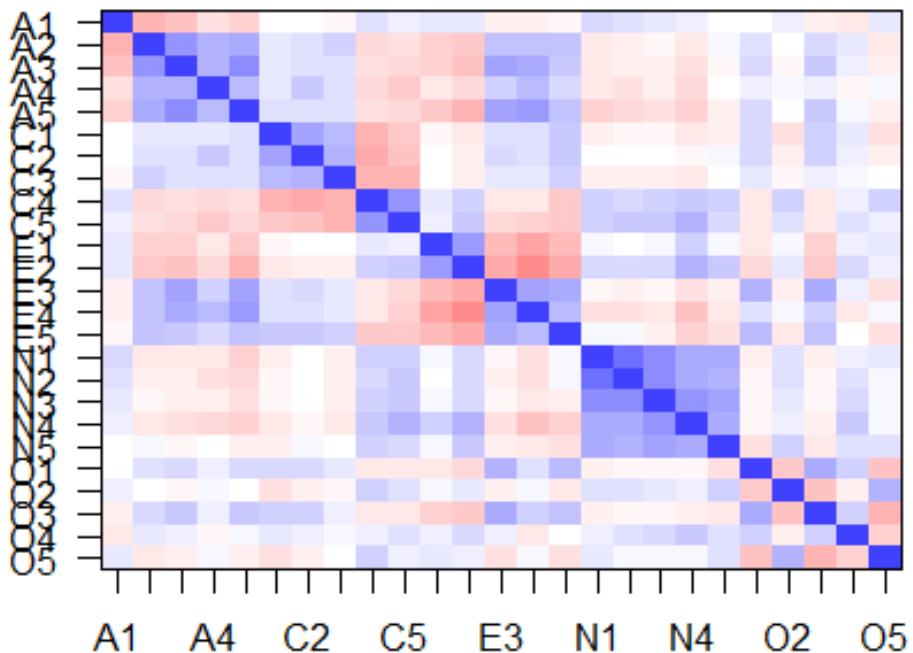
- C1: Am exacting in my work.
- C2: Continue until everything is perfect.
- C3: Do things according to a plan.
- C4: Do things in a half-way manner.
- C5: Waste my time.

## E

- E1: Don't talk a lot.
- E2: Find it difficult to approach others.
- E3: Know how to captivate people.
- E4: Make friends easily.
- E5: Take charge.



# Diferença entre correlações bivariadas e parciais



# Depressão

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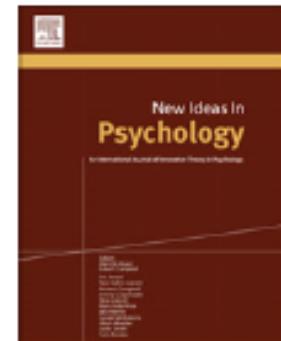


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journal homepage: [www.elsevier.com/locate/newideapsych](http://www.elsevier.com/locate/newideapsych)



Deconstructing the construct: A network perspective  
on psychological phenomena

Verena D. Schmittmann, Angélique O.J. Cramer, Lourens J. Waldorp, Sacha Epskamp,  
Rogier A. Kievit, Denny Borsboom\*

# Psychometric Perspectives on Diagnostic Systems

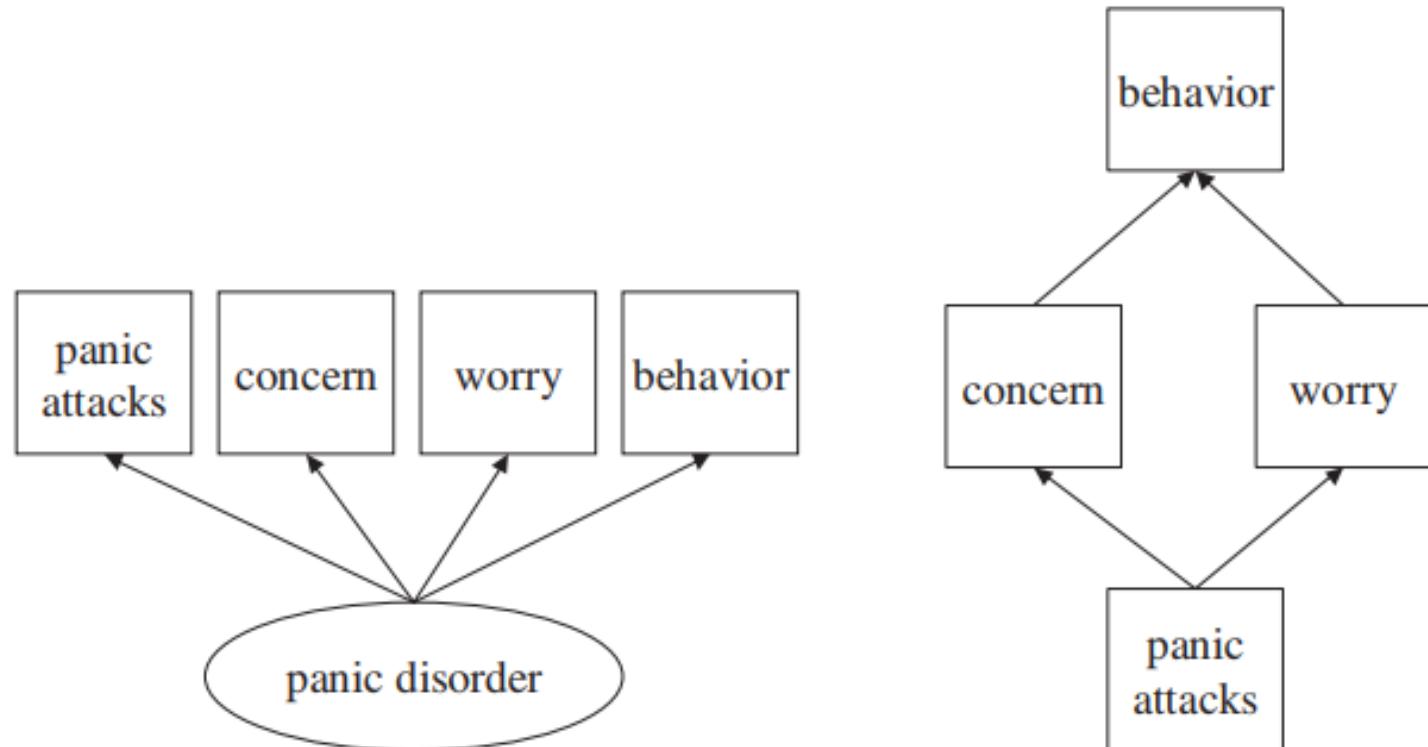


Denny Borsboom

*University of Amsterdam*

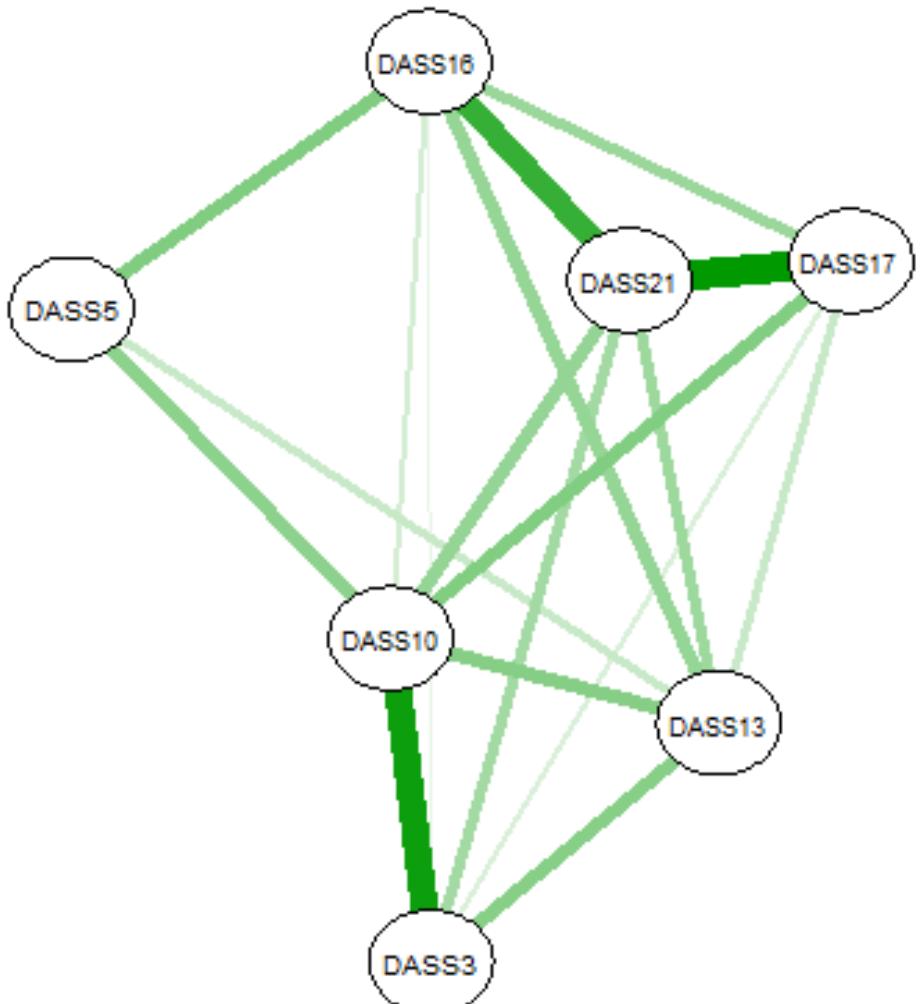
1102

*Journal of Clinical Psychology, September 2008*

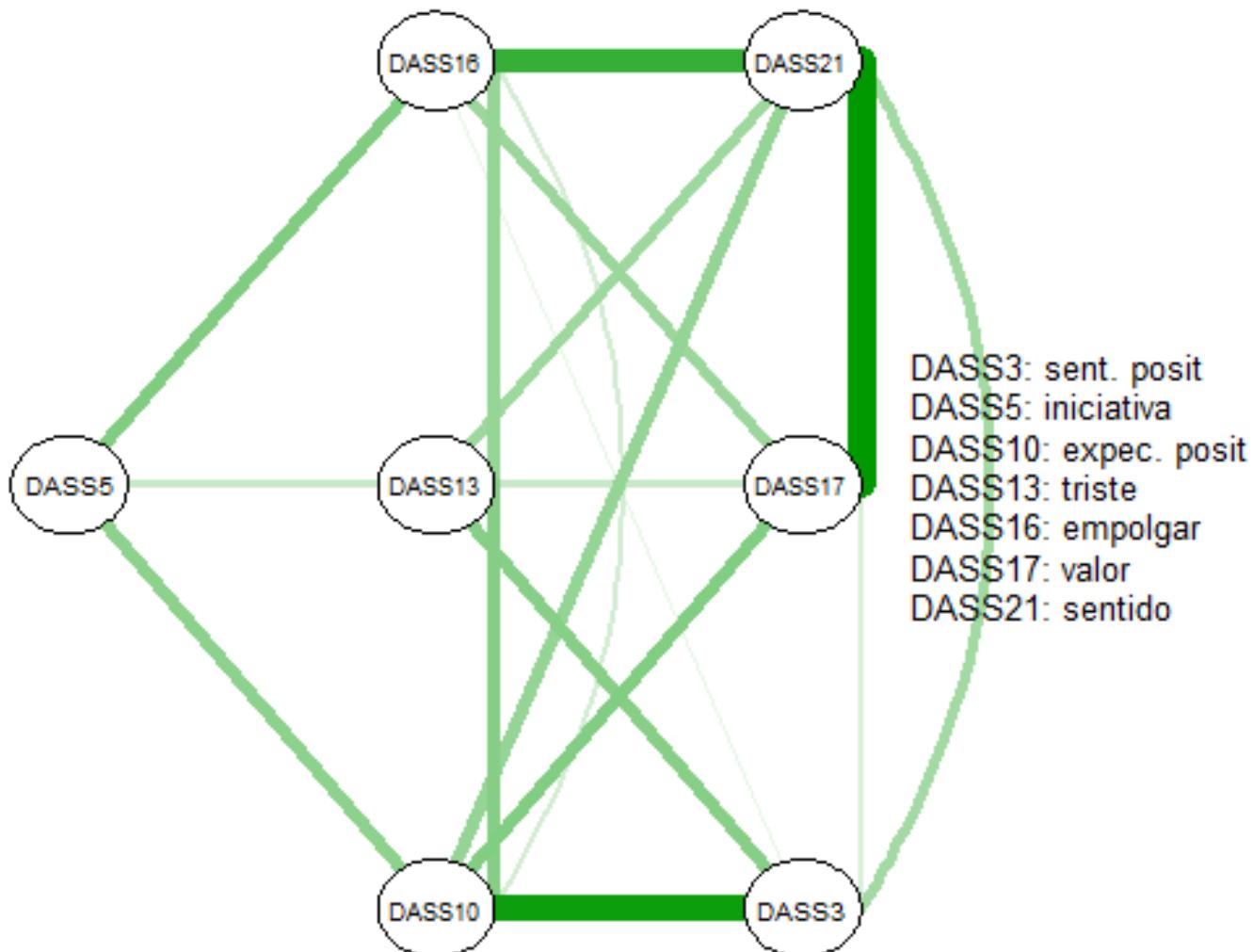


*Figure 1.* The left panel shows the relation between panic disorder and its symptoms from a latent variable modeling point of view. The right panel shows a representation of these symptoms as a causal system.

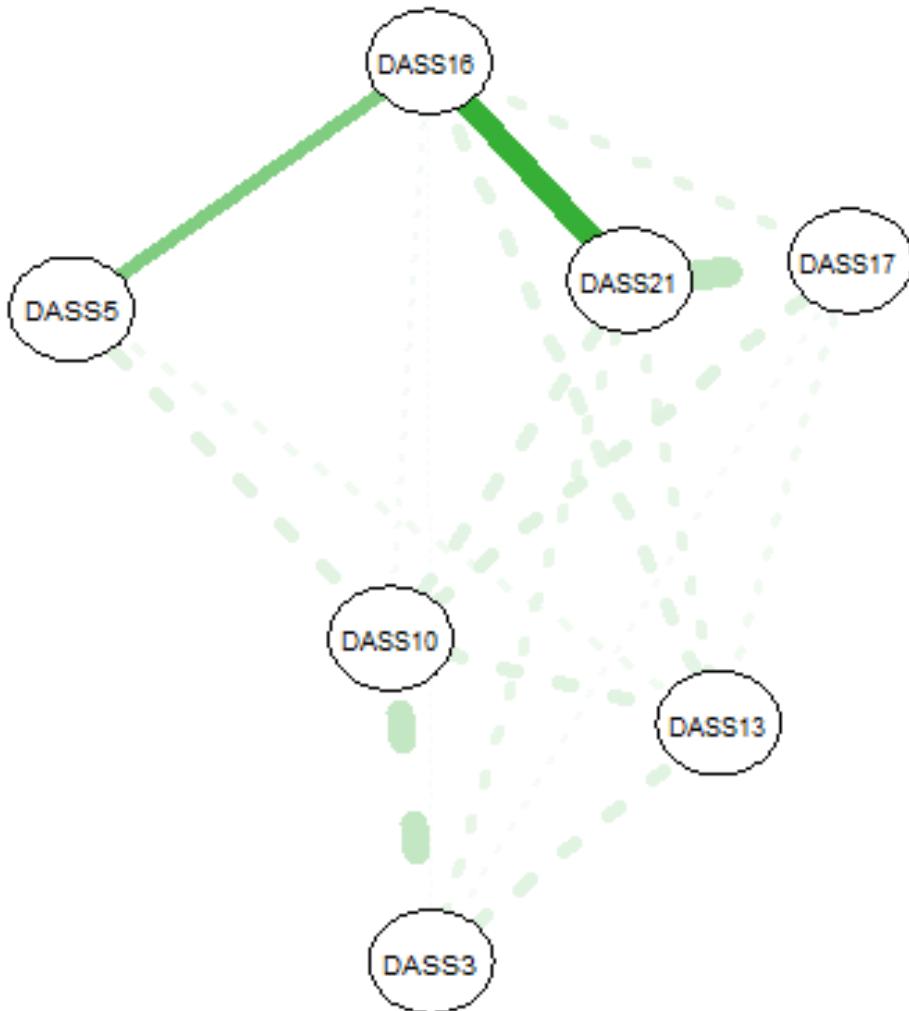
Para o RStudio!!!



DASS3: sent. posit  
DASS5: iniciativa  
DASS10: expec. posit  
DASS13: triste  
DASS16: empolgar  
DASS17: valor  
DASS21: sentido



DASS3: sent. posit  
DASS5: iniciativa  
DASS10: expec. posit  
DASS13: triste  
DASS16: empolgar  
DASS17: valor  
DASS21: sentido



DASS3: sent. posit  
DASS5: iniciativa  
DASS10: expec. posit  
DASS13: triste  
DASS16: empolgar  
DASS17: valor  
DASS21: sentido

DASS-21

# Comorbidity: A network perspective

**Angélique O. J. Cramer**

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The Netherlands*

[A.O.J.Cramer@uva.nl](mailto:A.O.J.Cramer@uva.nl)  
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[H.L.J.vanderMaas@uva.nl](mailto:H.L.J.vanderMaas@uva.nl)  
<http://users.fmg.uva.nl/hvandermaas/>

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[D.Borsboom@uva.nl](mailto:D.Borsboom@uva.nl)  
<http://sites.google.com/site/borsboombenny/dennymborsboom>

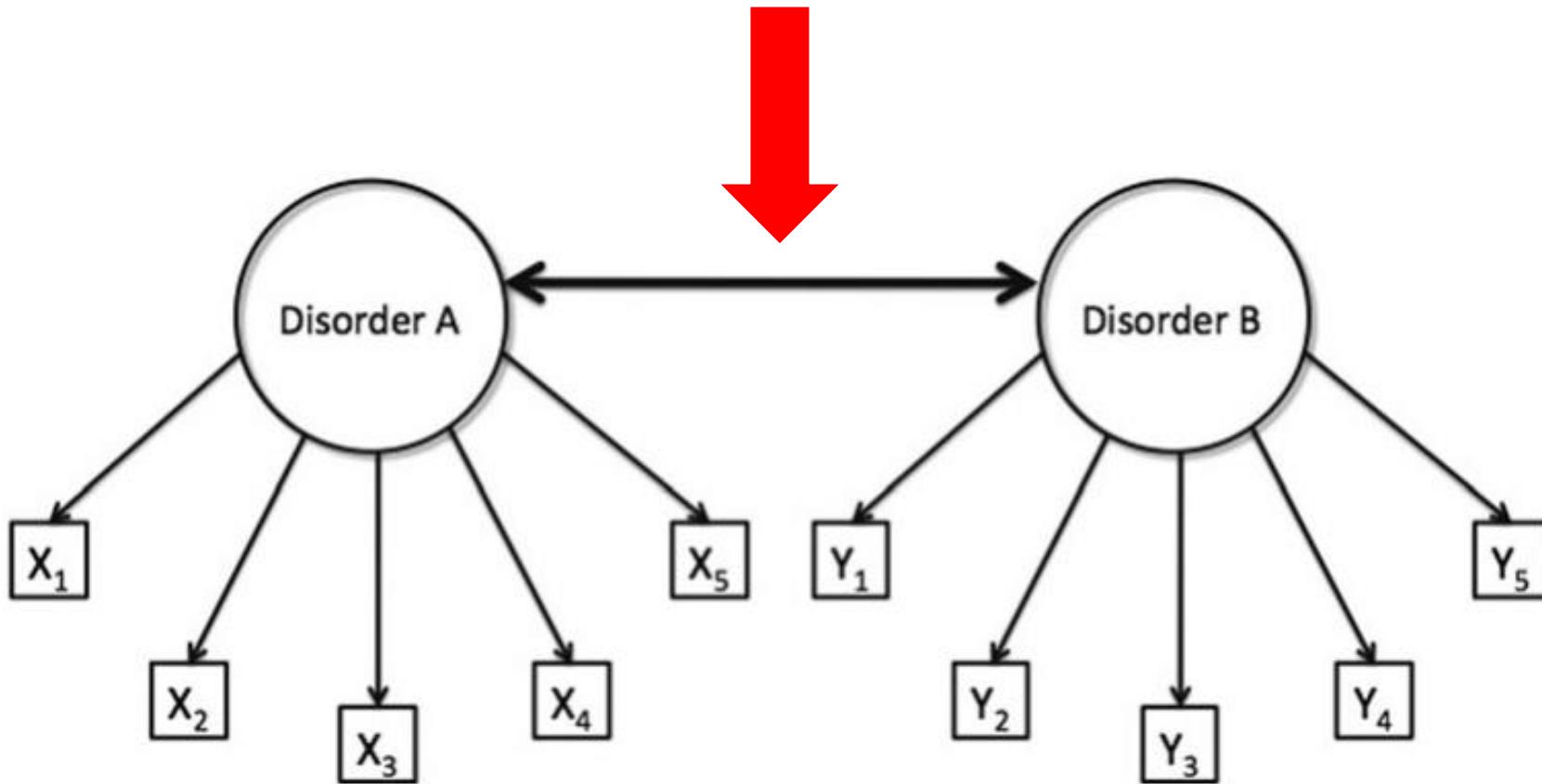
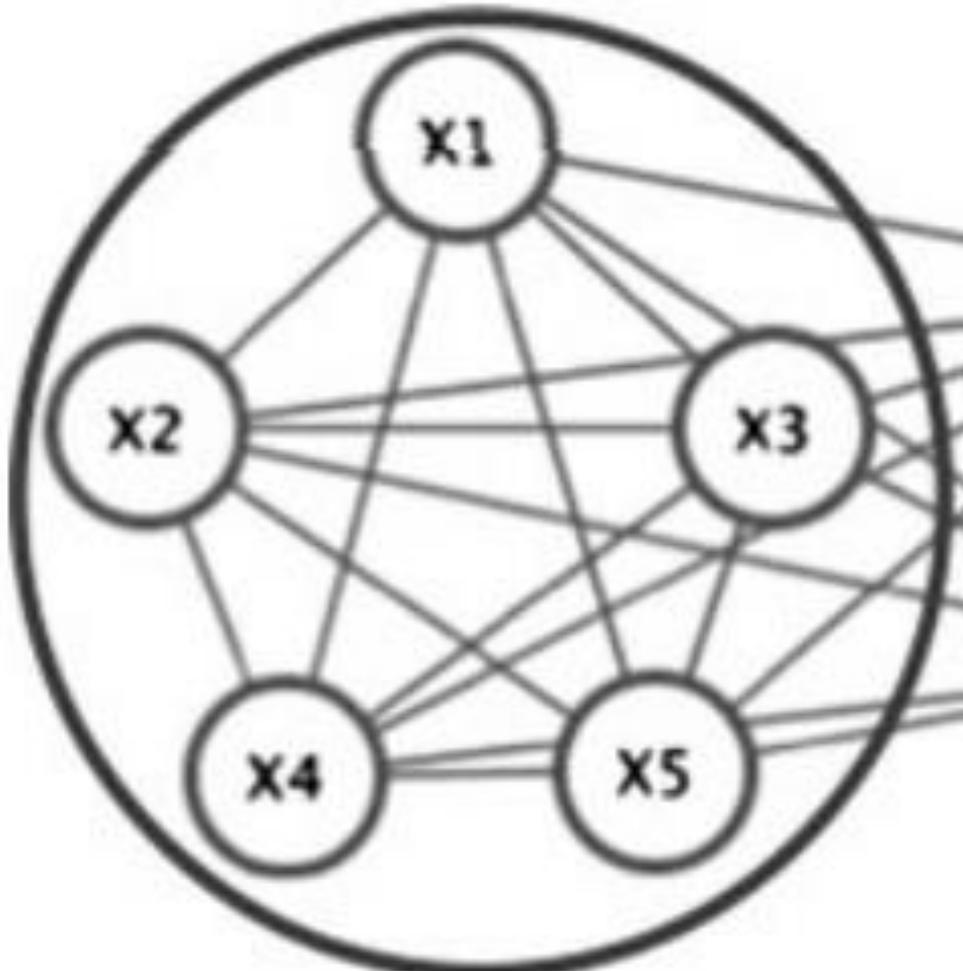
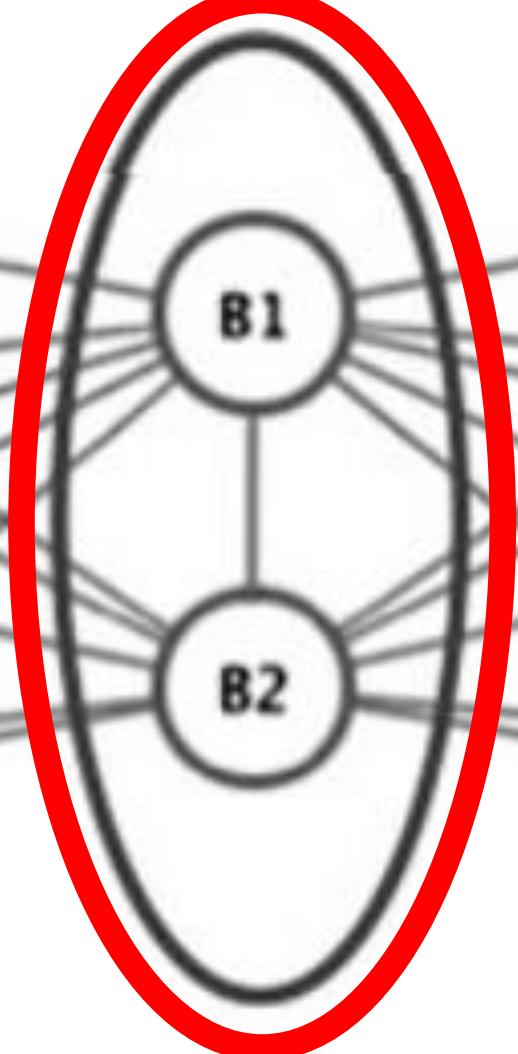


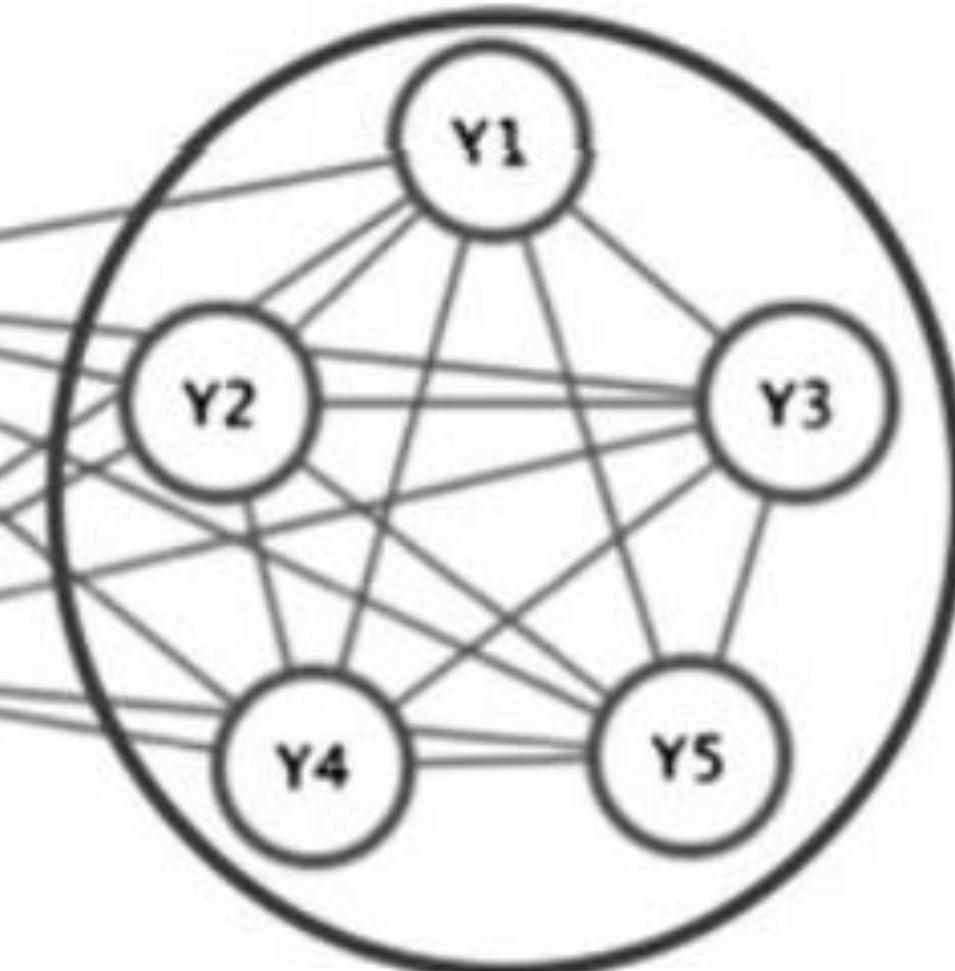
Figure 1. A model of comorbidity between disorders A and B, under the standard assumptions of latent variable modeling. The *circles* represent the disorders (i.e., latent variables) and the *rectangles* represent the observable core symptoms of those disorders (i.e.,  $X_1 - X_5$  for disorder A, and  $Y_1 - Y_5$  for disorder B). In this model, comorbidity is viewed as a correlation between the latent variables, visualized by the *thick bidirectional edge* between disorders A and B.



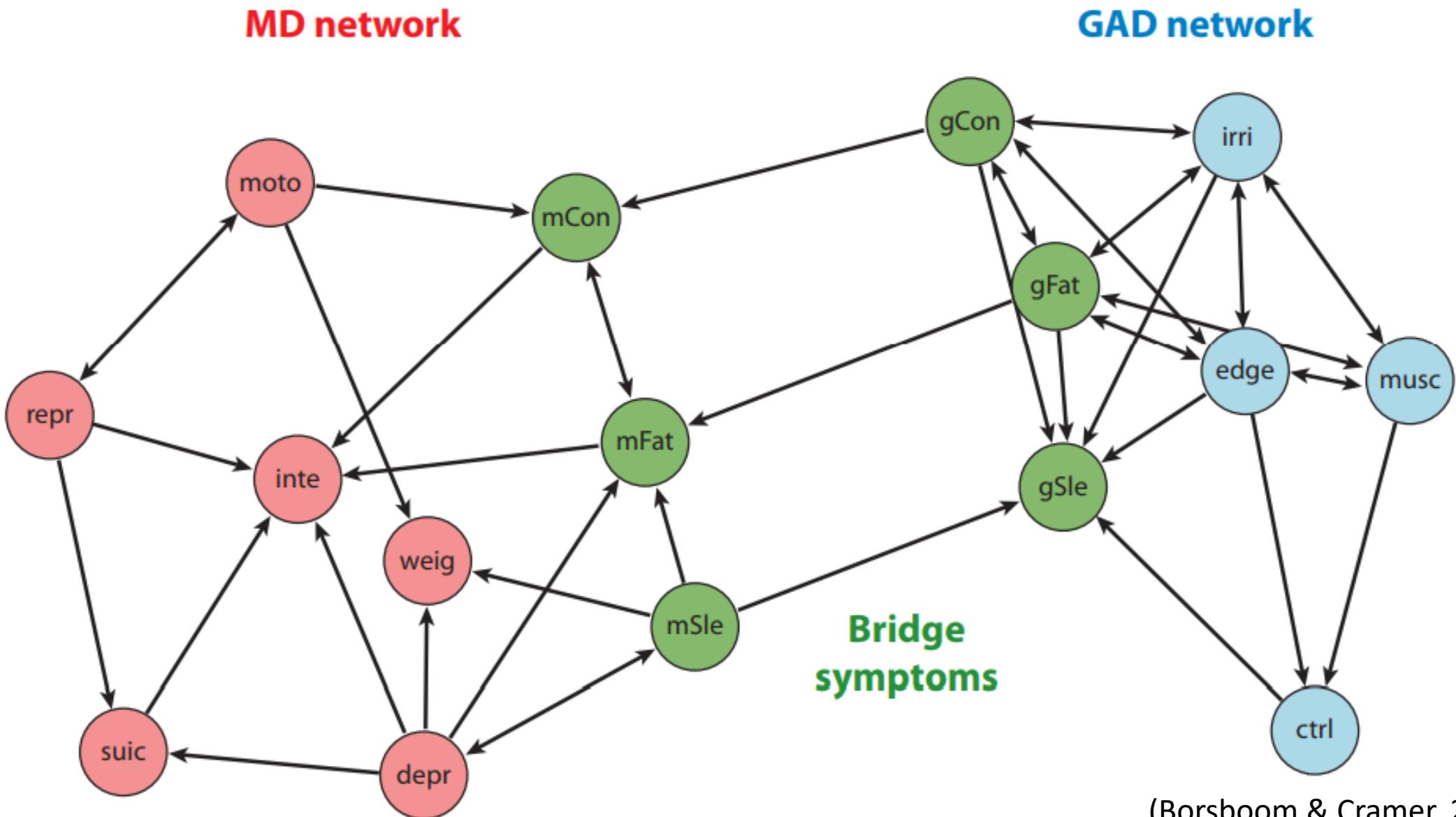
Disorder A

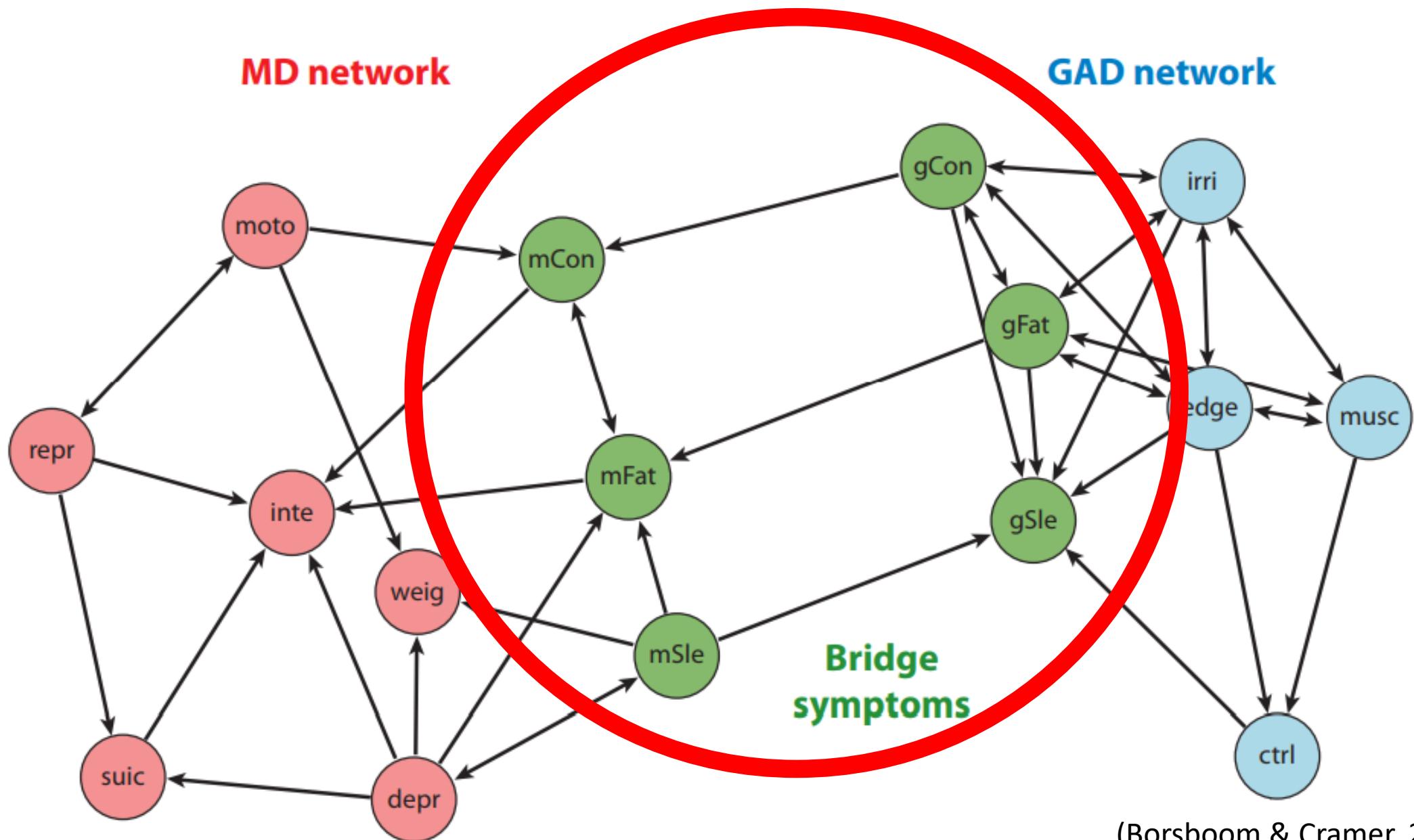


Bridge  
symptoms

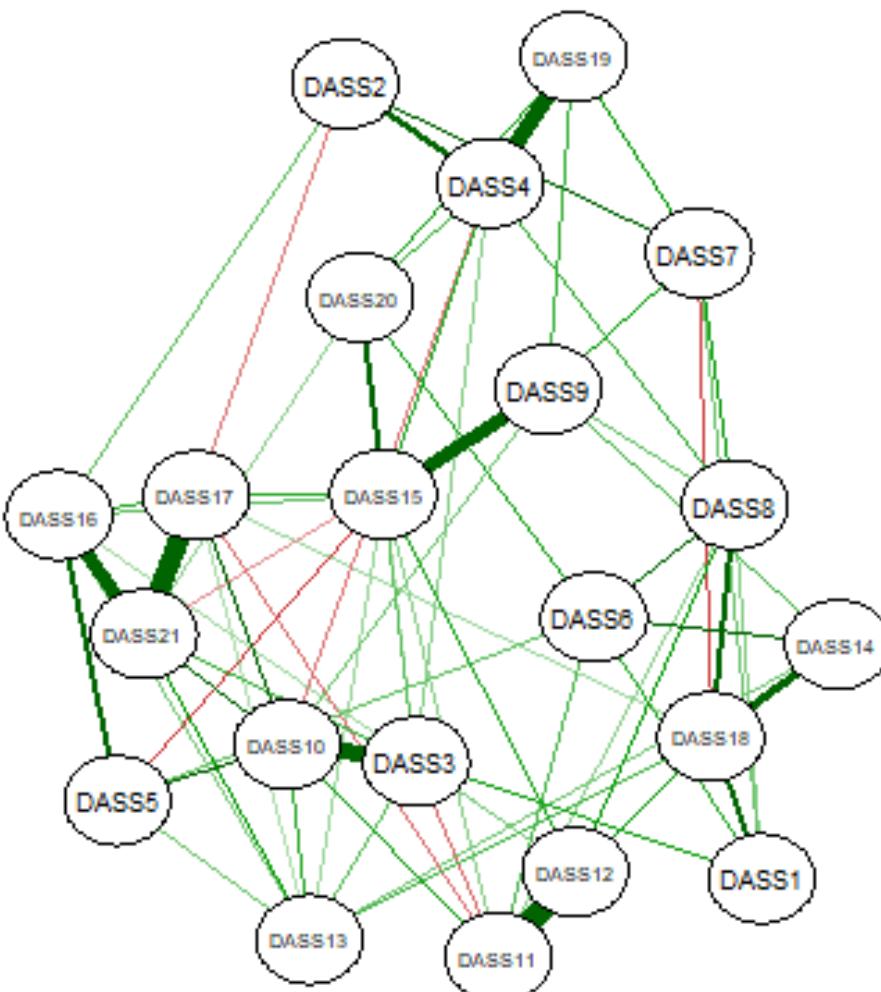


Disorder B



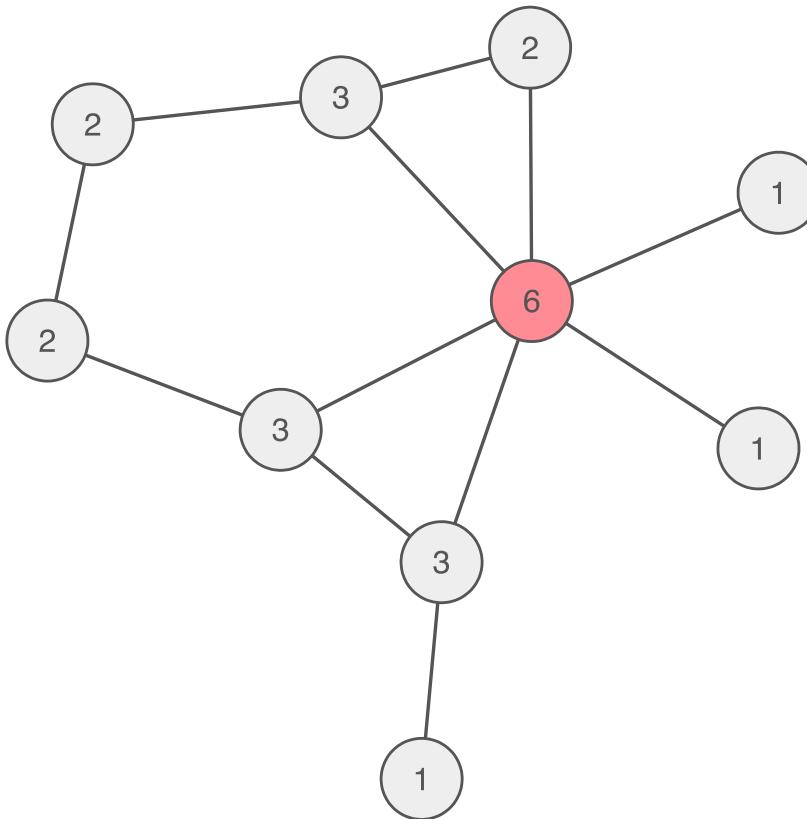


(Borsboom & Cramer, 2013)



DASS1: acalmar  
DASS2: boca seca  
DASS3: sent. posit  
DASS4: respirar  
DASS5: iniciativa  
DASS6: reac. exager  
DASS7: tremores  
DASS8: nervoso(a)  
DASS9: preoc panico  
DASS10: expec. posit  
DASS11: agitado(a)  
DASS12: relaxar  
DASS13: triste  
DASS14: pacienza  
DASS15: panico  
DASS16: empolgar  
DASS17: valor  
DASS18: irritado(a)  
DASS19: batidas  
DASS20: assustado(a)  
DASS21: sentido

# Centralidade

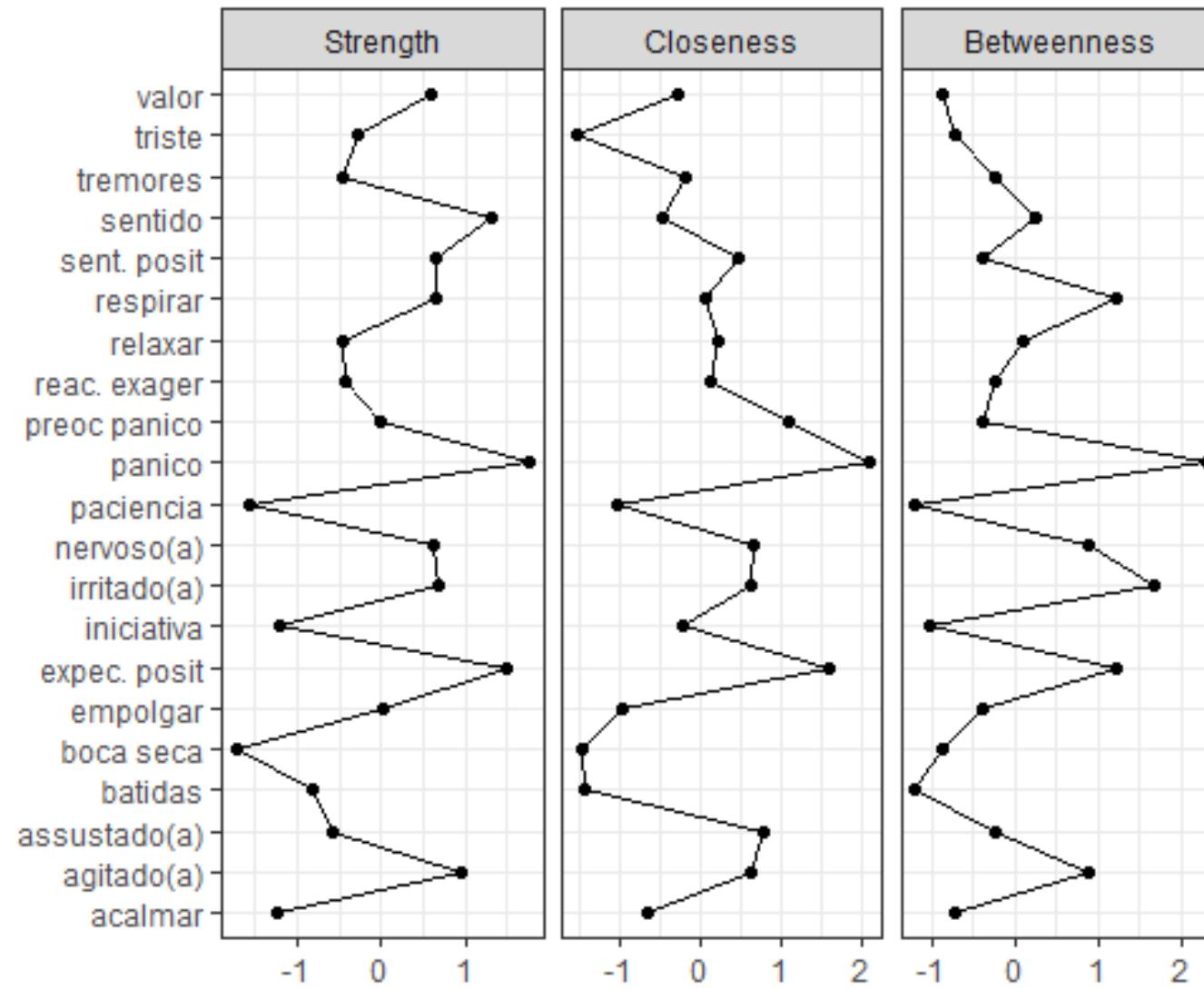


Opsahl, T., Agneessens, F., & Skvoretz, J. (2010). Node centrality in weighted networks: Generalizing degree and shortest paths. *Social Networks*, 23, 245-251.

# Centralidade

- Força (strength): soma modular ponderada das arestas de um nodo
- Proximidade (closeness): distância dos vértices adjacentes (inverso da associação)
- Conectividade (betweenness): vezes pelas quais o vértice é a menor distância entre outros dois vértices

Opsahl, T., Agneessens, F., & Skvoretz, J. (2010). Node centrality in weighted networks: Generalizing degree and shortest paths. *Social Networks*, 23, 245-251.



# Expected Influence

- Influência esperada: soma das arestas dos nodos adjacentes em primeiro e segundo graus



Published in final edited form as:

*J Abnorm Psychol.* 2016 August ; 125(6): 747–757. doi:10.1037/abn0000181.

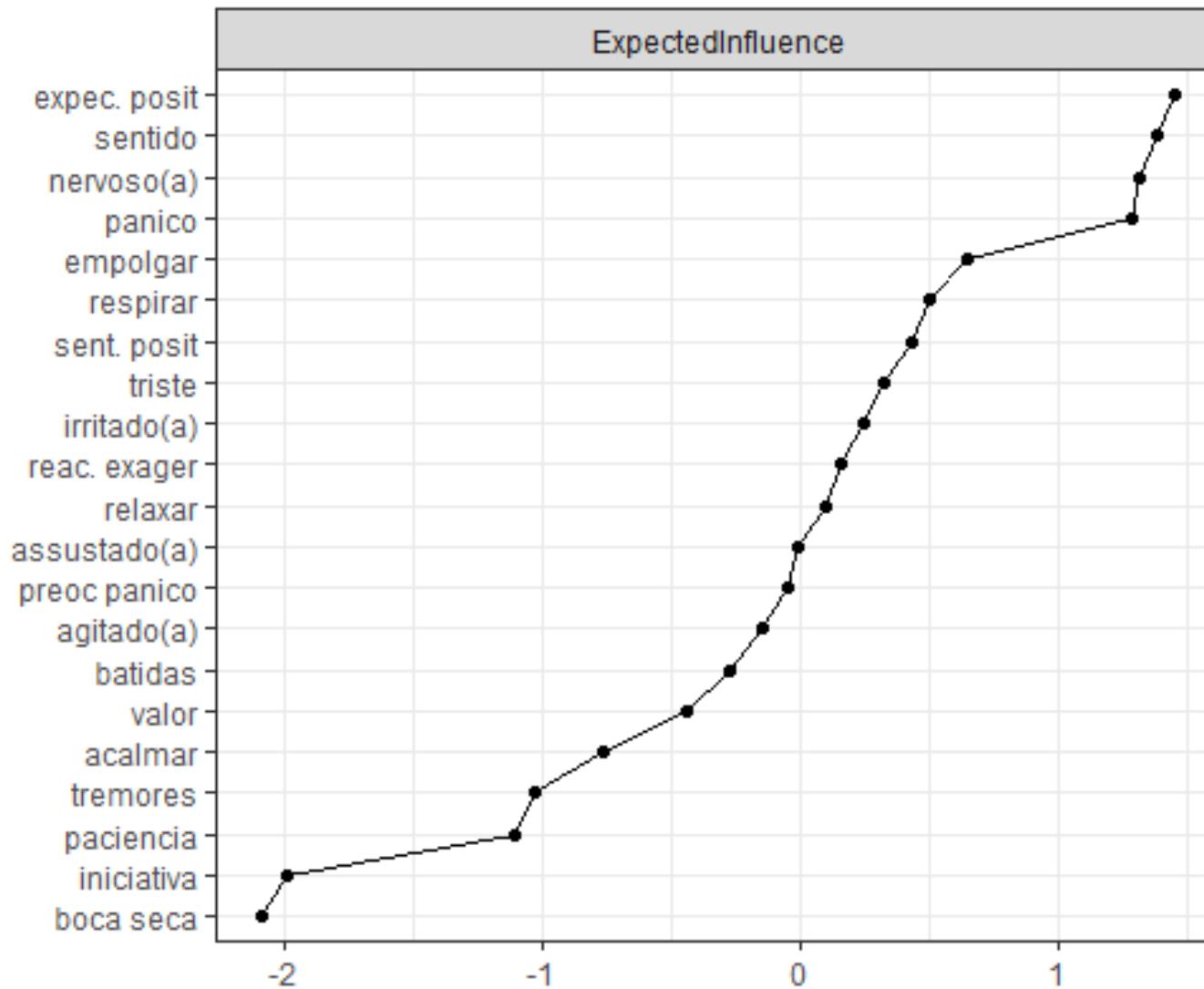
## Identifying Highly Influential Nodes in the Complicated Grief Network

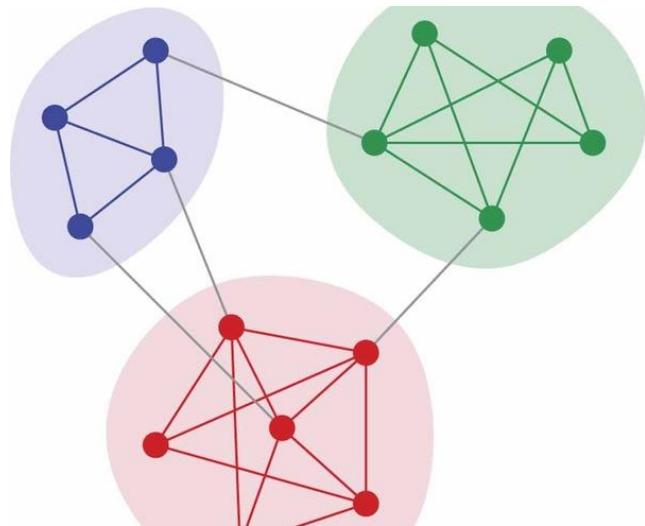
Donald J. Robinaugh<sup>1,2</sup>, Alexander J. Millner<sup>3</sup>, and Richard J. McNally<sup>3</sup>

<sup>1</sup>Massachusetts General Hospital, Department of Psychiatry

<sup>2</sup>Harvard Medical School

<sup>3</sup>Department of Psychology, Harvard University





A Comparative Analysis of Community Detection Algorithms on Artificial Networks

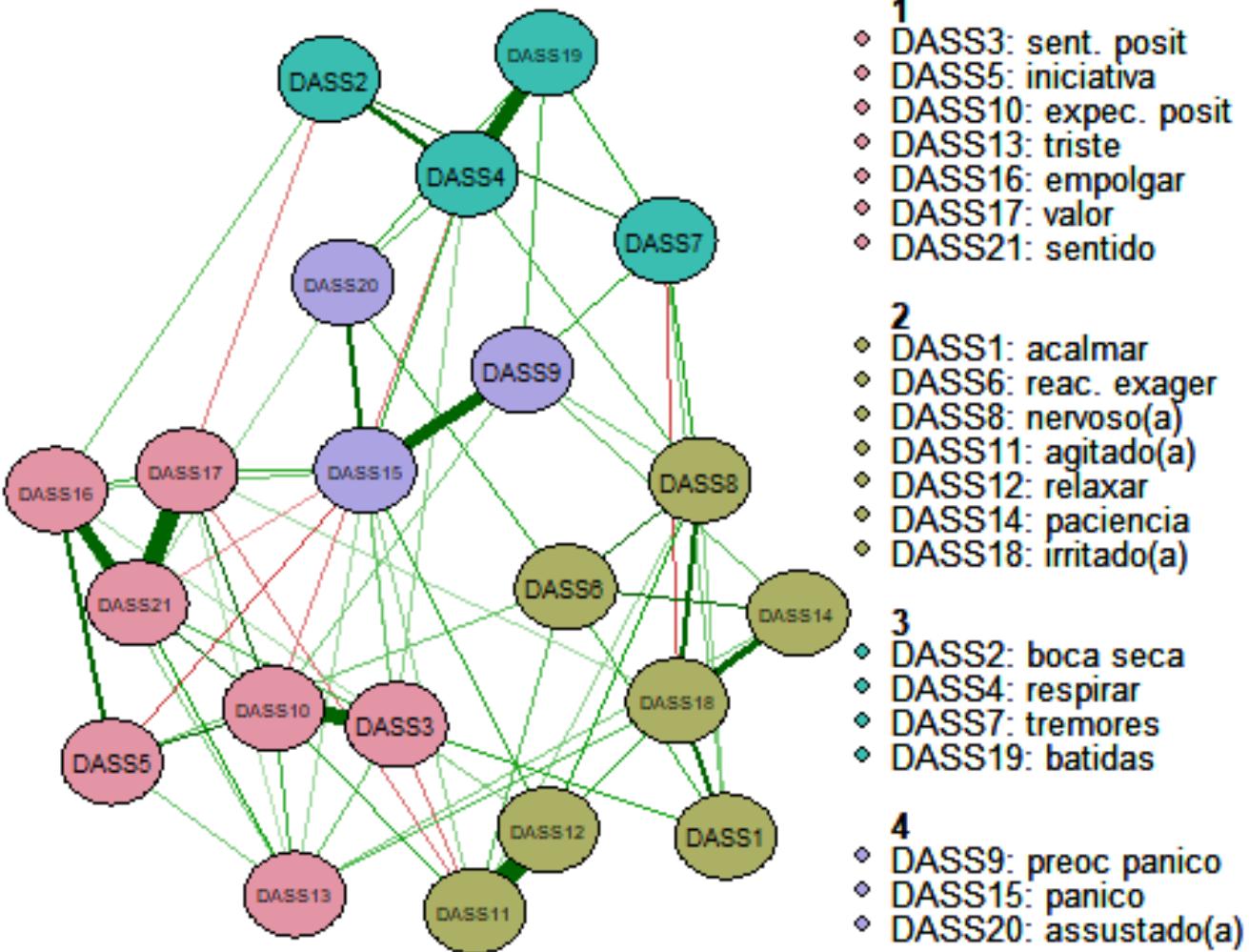
Zhao Yang , René Algesheimer & Claudio J. Tessone

*Scientific Reports* 6, Article number: 30750  
(2016)  
doi:10.1038/srep30750

Received: 31 March 2016  
Accepted: 07 July 2016  
Published online: 01 August 2016

# Análise de comunidades

- Existem subgrupos de variáveis ou observações na rede?
- Três métodos mais populares:
- Waltrap – parte de passos aleatórios e vai decompondo o conjunto em  $N-1$  comunidades, calculando a distância das arestas entre e dentre comunidades
- Spinglass – baseado também em um modelo do ferromagnetismo (Potts), baseado na ideia de “spin state” e fluxo de energia
- **Multinível** – decomposição e permutação dos vértices até encontrar a solução que otimiza a modularidade (divisão em módulos ou grupos)



**1**  
• DASS3: sent. posit  
• DASS5: iniciativa  
• DASS10: expec. posit  
• DASS13: triste  
• DASS16: empolar  
• DASS17: valor  
• DASS21: sentido

**2**  
• DASS1: acalmar  
• DASS6: reac. exager  
• DASS8: nervoso(a)  
• DASS11: agitado(a)  
• DASS12: relaxar  
• DASS14: paciencia  
• DASS18: irritado(a)

**3**  
• DASS2: boca seca  
• DASS4: respirar  
• DASS7: tremores  
• DASS19: batidas

**4**  
• DASS9: preoc panico  
• DASS15: panico  
• DASS20: assustado(a)

# Predição exemplo com pacientes do espectro autista

Original Article

## Multicausal systems ask for multicausal approaches: A network perspective on subjective well-being in individuals with autism spectrum disorder

Marie K Deserno<sup>1,2</sup>, Denny Borsboom<sup>2</sup>, Sander Begeer<sup>3</sup>  
and Hilde M Geurts<sup>1,2</sup>



Autism

1–12

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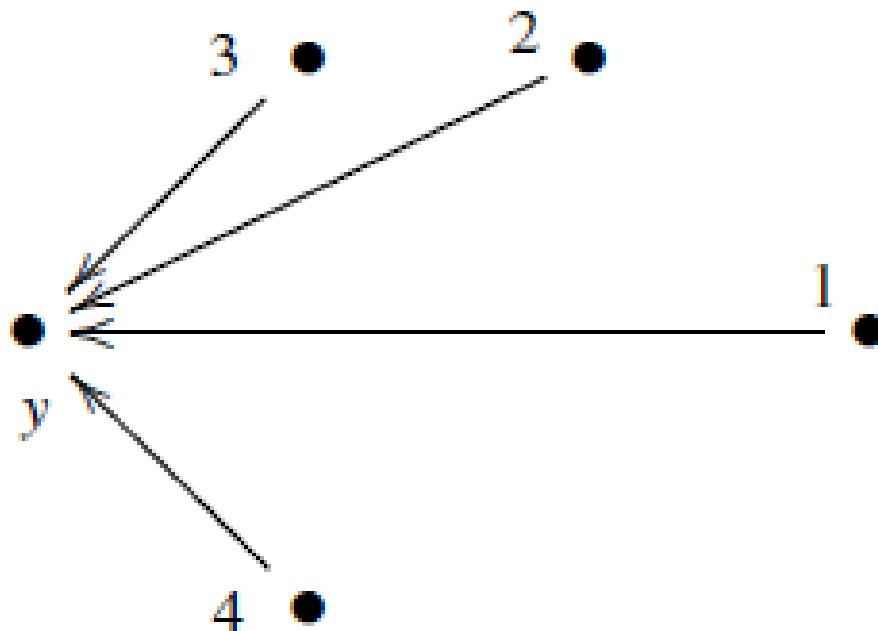
DOI: 10.1177/1362361316660309

aut.sagepub.com

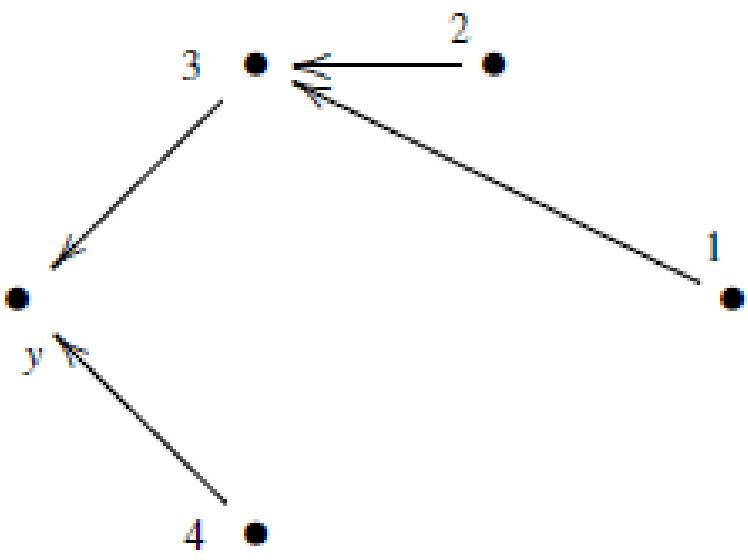


# Modelos preditivos

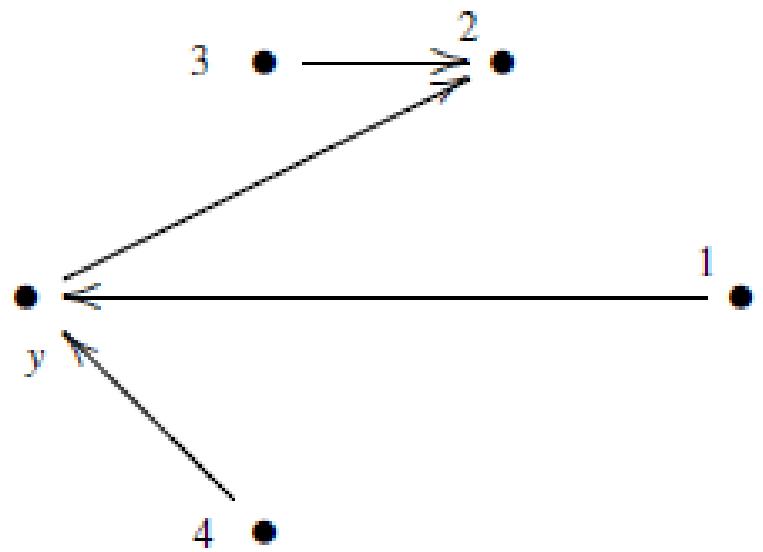
- Modelo de regressão comum

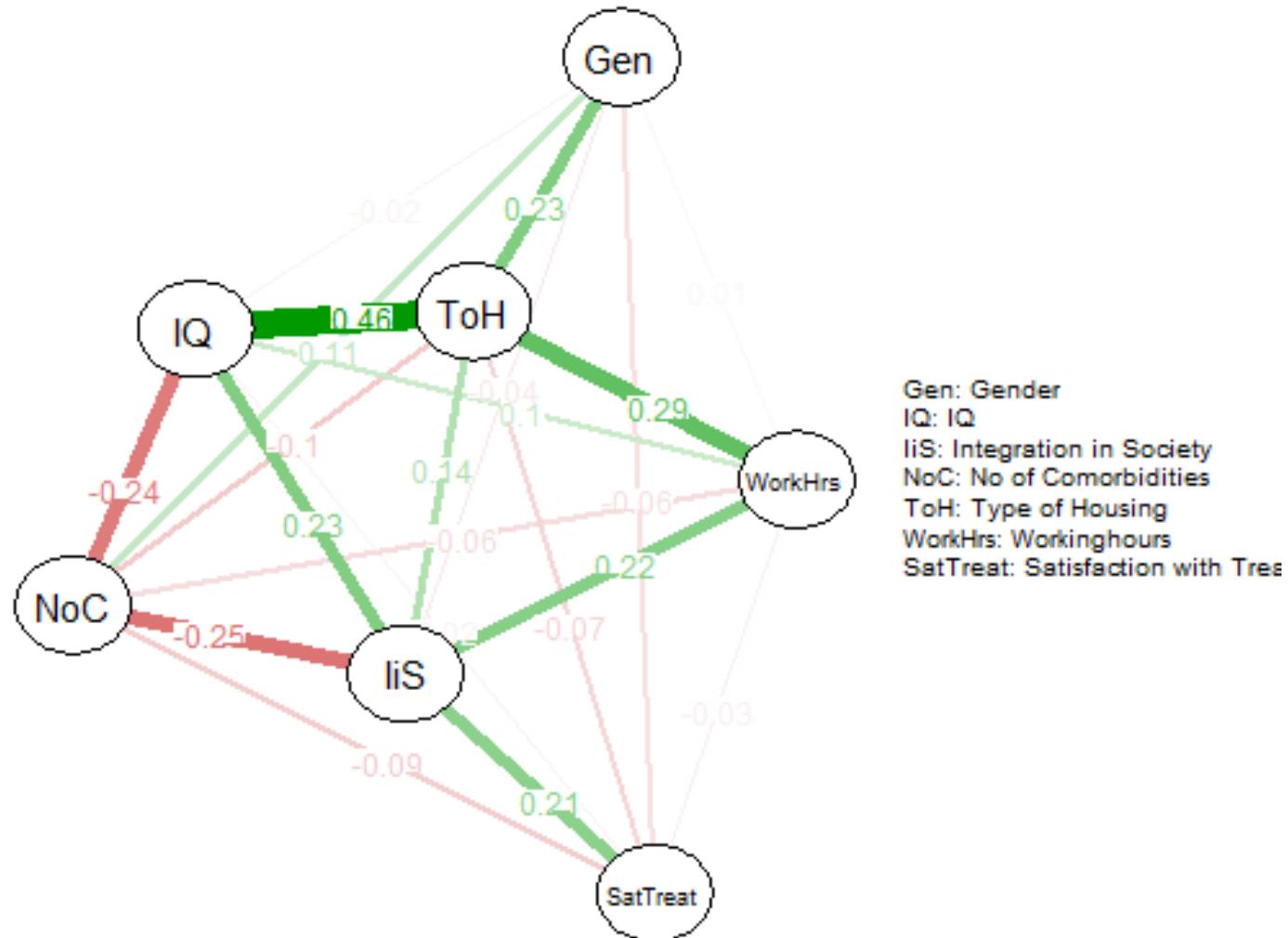


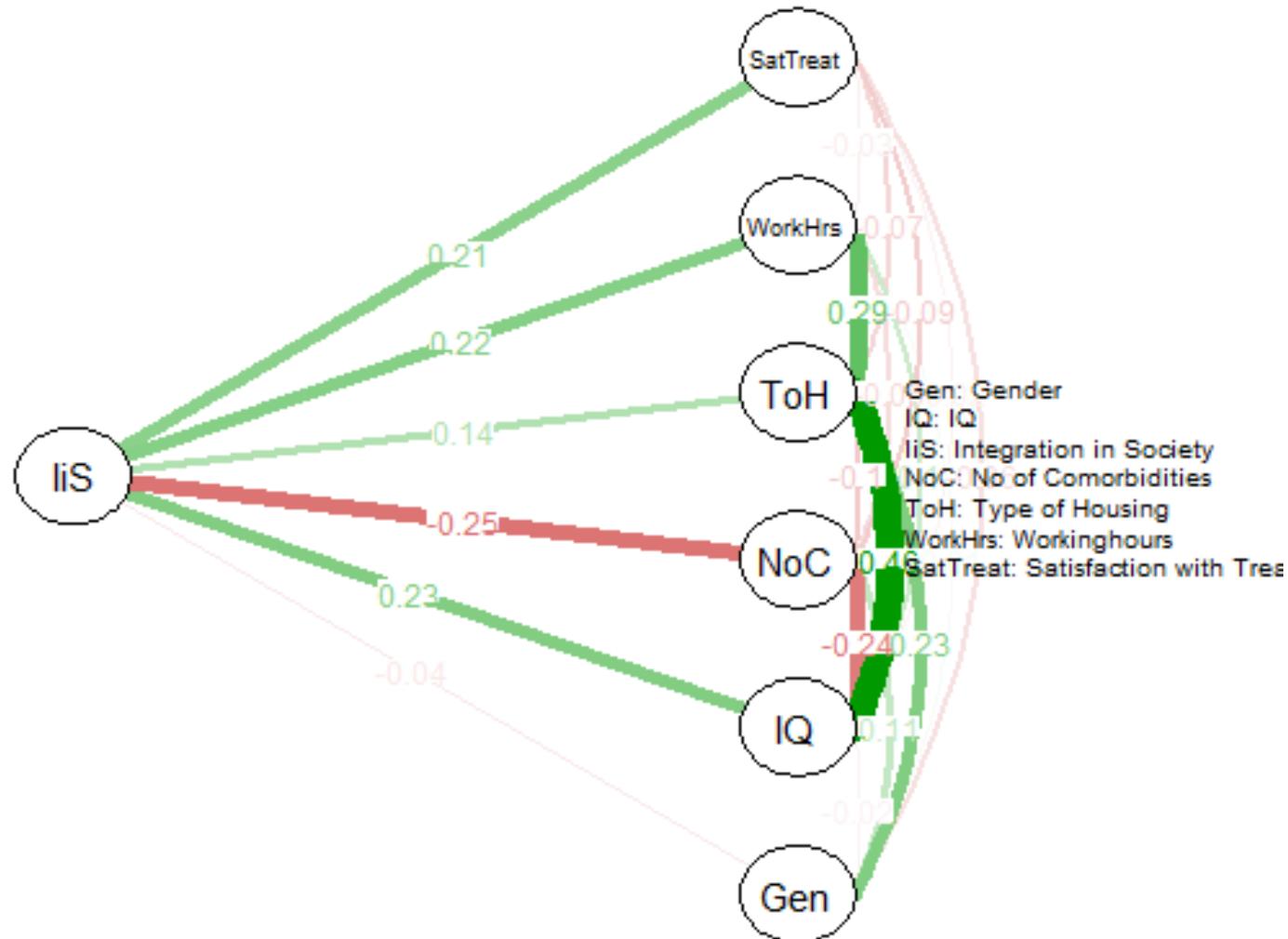
(Epskamp, 2013)



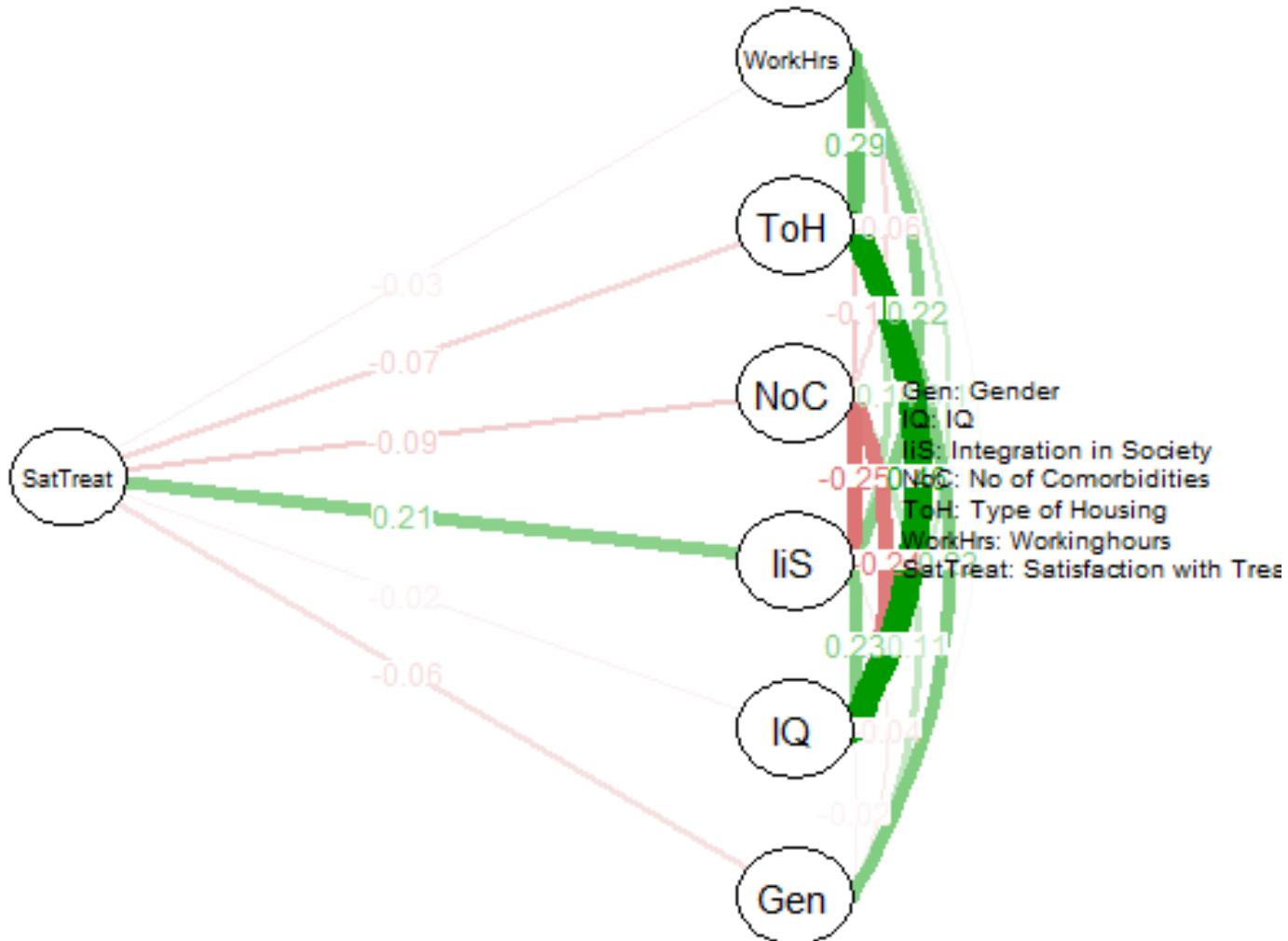
?







Gen: Gender  
IQ: IQ  
IIS: Integration in Society  
NoC: No of Comorbidities  
ToH: Type of Housing  
WorkHrs: Workinghours  
SatTreat: Satisfaction with Trees



# Outros tópicos em análise de rede

- Modelos de dados dicotômicos (0,1)
- Modelos de moderação
- Séries temporais
- $N = 1$  networks
- Modelos multiníveis



Muito obrigado!!!

# Redes frequentistas

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