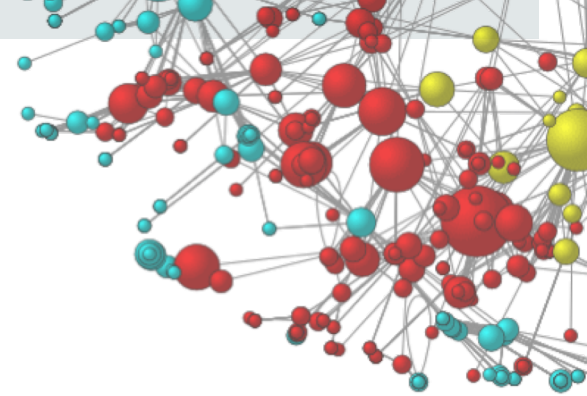




Towards a Dynamical Systems Approach to Mental Disorders

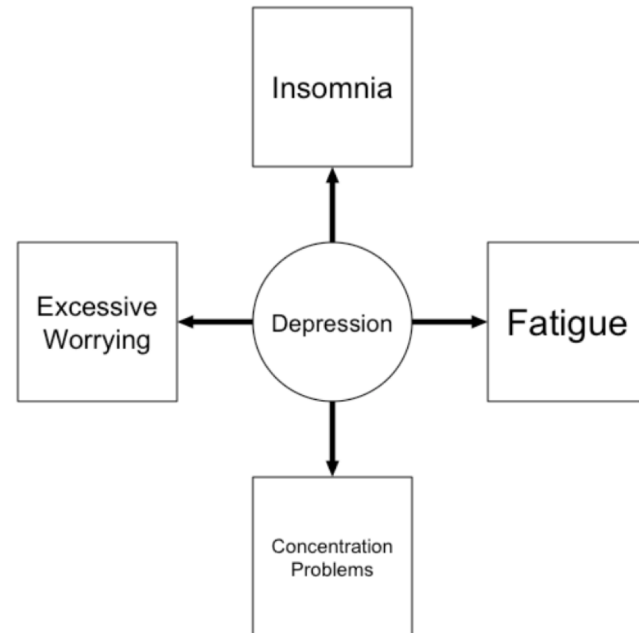
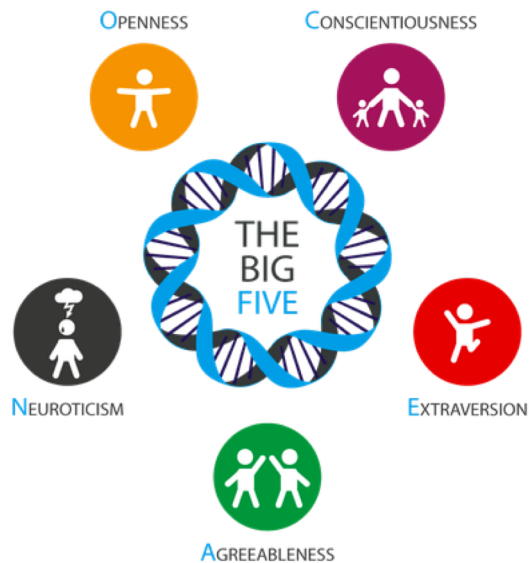
Adela Isvoranu

Department of Psychological Research Methods

University of Amsterdam

Part 1. Story of Origins

Psychology as a Complex System



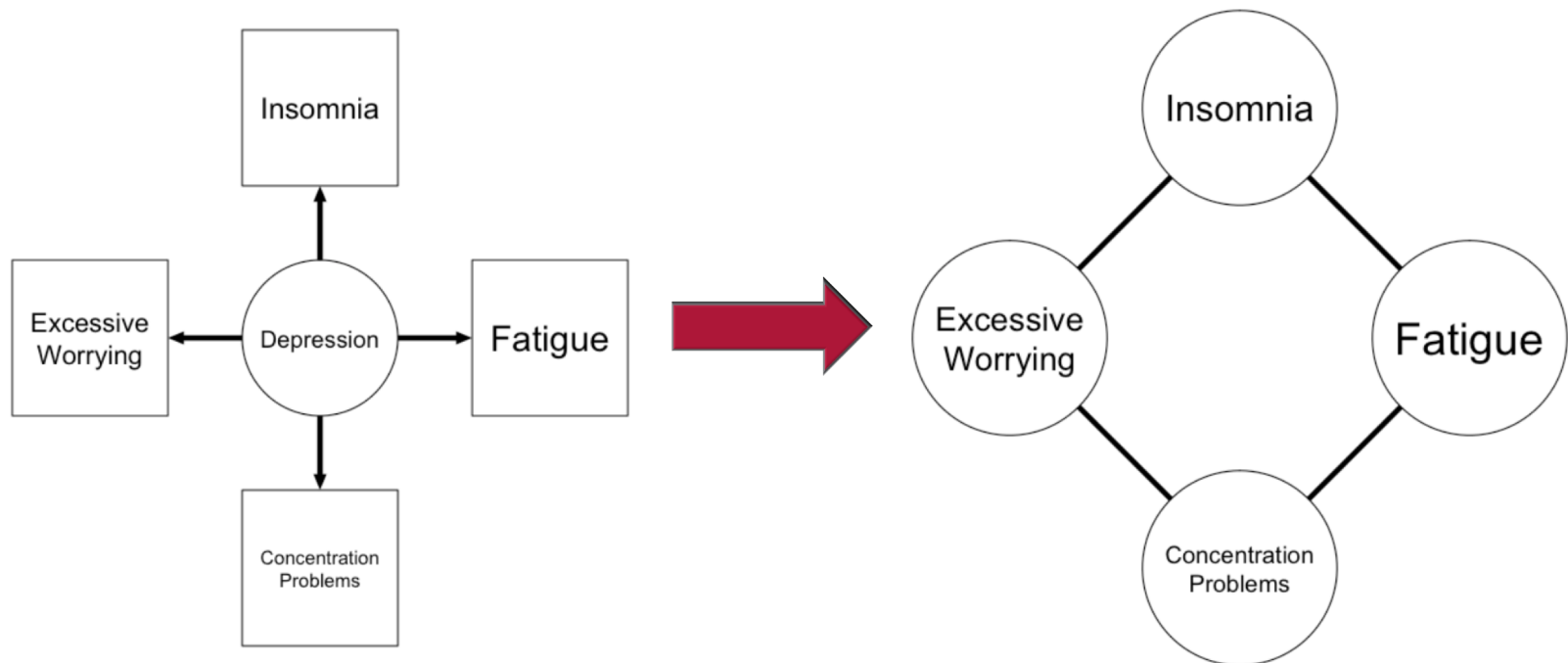
Cramer, A. O. J., Waldorp, L., van der Maas, H., & Borsboom, D. (2010). Comorbidity: A Network Perspective. *Behavioral and Brain Sciences*, 33(2-3), 137– 150. doi: 10.1017/S0140525X09991567

Borsboom, D. (2017). A network theory of mental disorders. *World Psychiatry*, 16(1):5–13.

Psychology as a Complex System

- Psychological processes are increasingly understood as **complex dynamical systems** of interacting components
 - ✓ Psychological
 - ✓ Biological
 - ✓ Sociological
 - ✓ ...
- Recent literature (~10 years) in the field of mental disorders started embracing this complexity

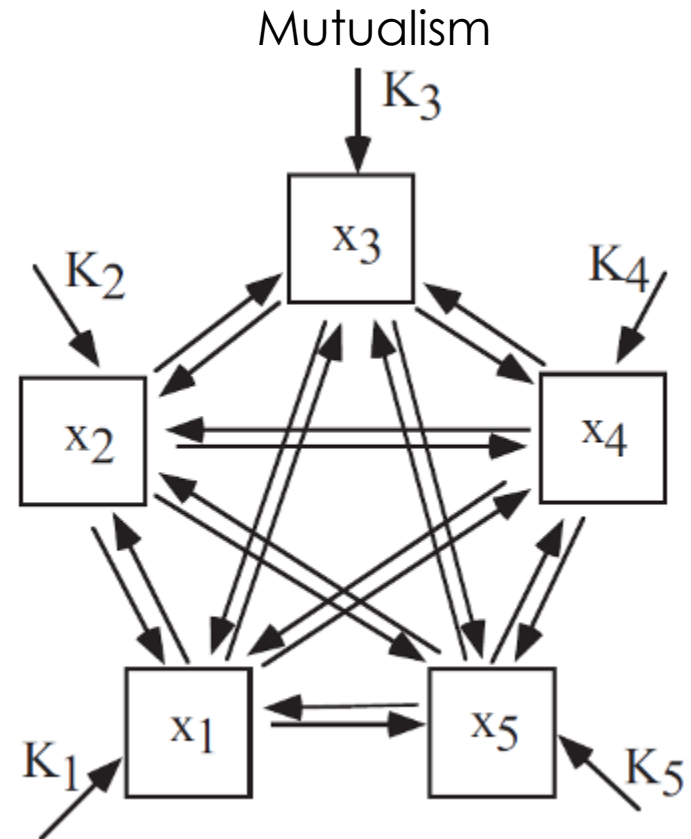
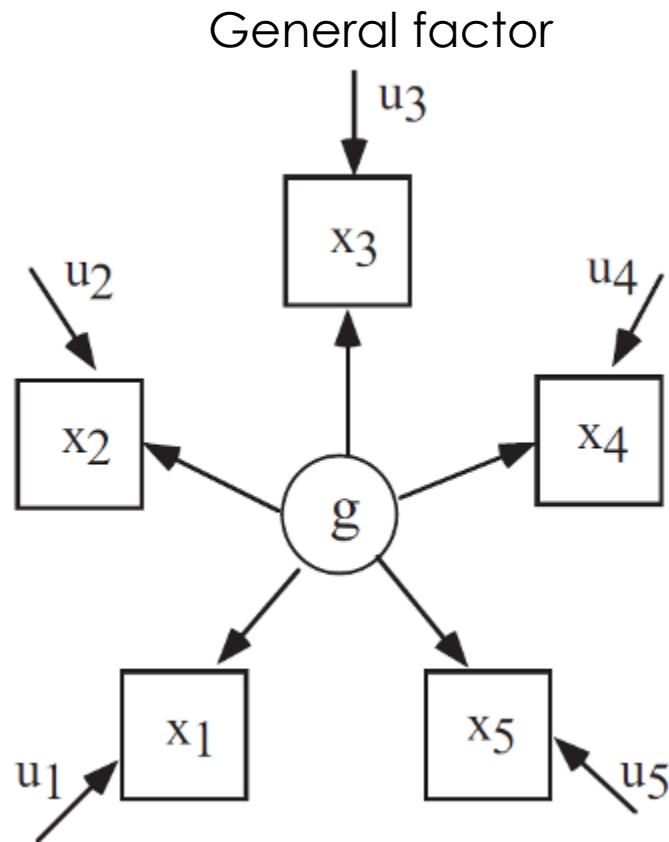
Psychology as a Complex System



Cramer, A. O. J., Waldorp, L., van der Maas, H., & Borsboom, D. (2010). Comorbidity: A Network Perspective. *Behavioral and Brain Sciences*, 33(2-3), 137– 150. doi: 10.1017/S0140525X09991567

Borsboom, D. (2017). A network theory of mental disorders. *World Psychiatry*, 16(1):5–13.

Analogy from Ecology

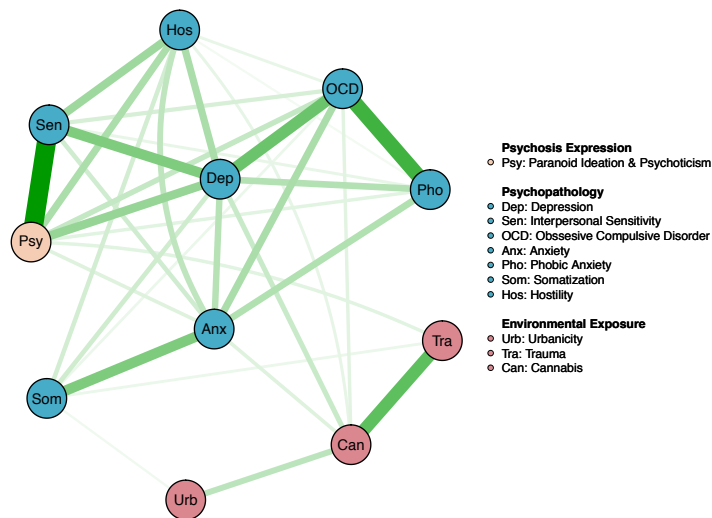


van der Maas, H. L., Dolan, C. V., Grasman, R. P., Wicherts, J. M., Huizenga, H. M., & Raijmakers, M. E. (2006). A dynamical model of general intelligence: The positive manifold of intelligence by mutualism. *Psychological Review*, 113(4), 842–861. doi: 10.1037/ 0033-295X.113.4.842

Network Psychometrics

Psychological networks differ from networks of many other disciplines in one very fundamental aspect

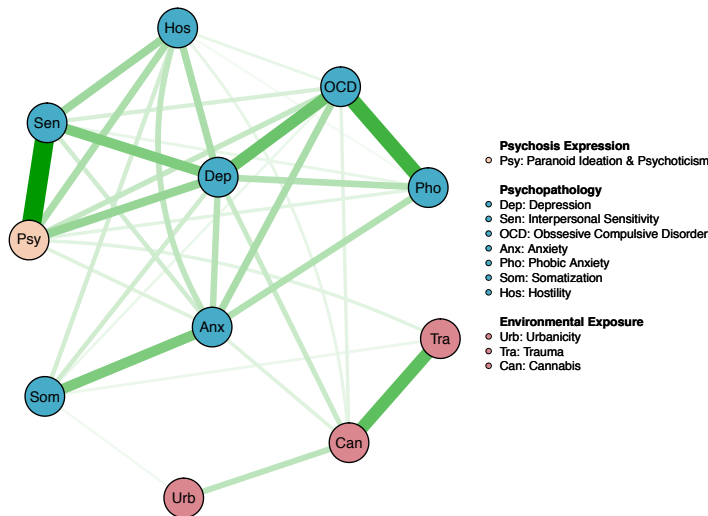
- Edges are *not observed* and need to be *estimated*



Network Psychometrics

Psychological networks differ from networks of many other disciplines in one very fundamental aspect

- Edges are *not observed* and need to be *estimated*

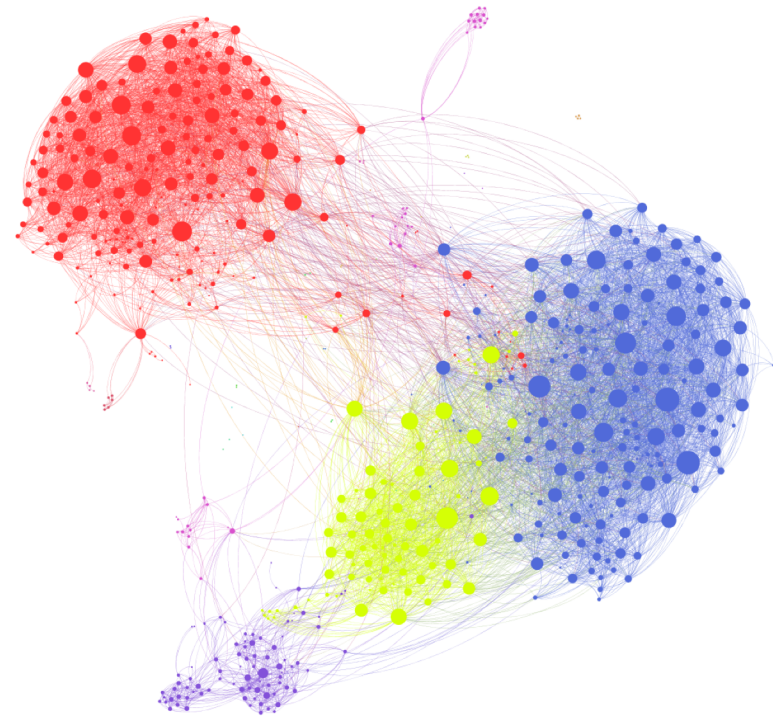


Typically two steps:

- (1) Estimate a statistical model on data, from which some parameters can be represented as a weighted network between observed variables
- (2) Analyze the weighted network structure using measures taken from graph theory to infer, for instance, the most central nodes.

Network Psychometrics

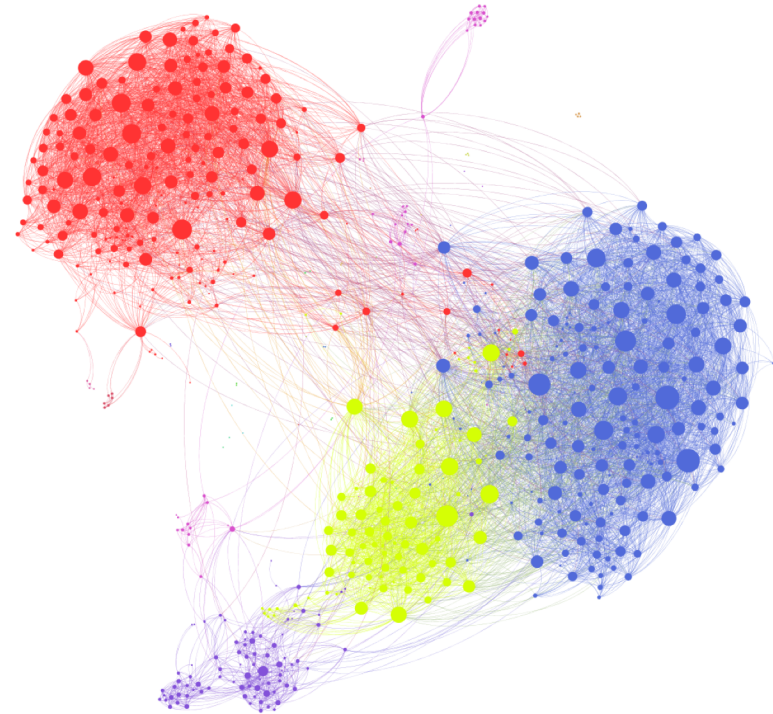
- A node represents an entity
 - People
 - Cities
 - **Symptoms**
 - **Psychological constructs**



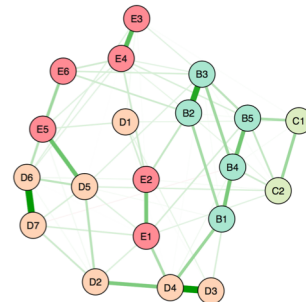
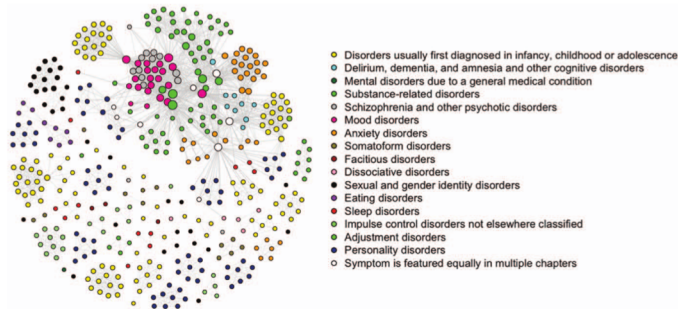
Network Psychometrics

An edge represents some connection between two nodes

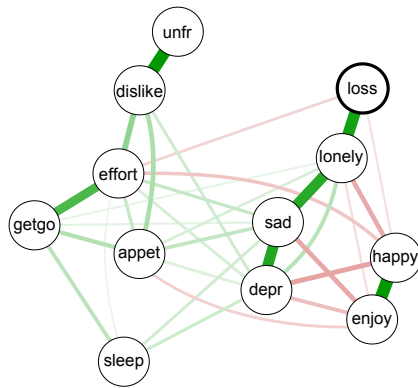
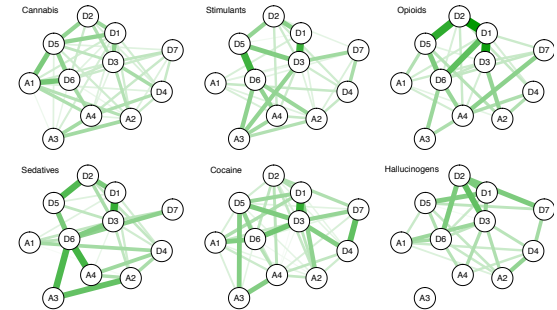
- ▣ Friendship / contact
- ▣ Distance
- ▣ **Comorbidity**
- ▣ **Causality**
- ▣ **Interaction**



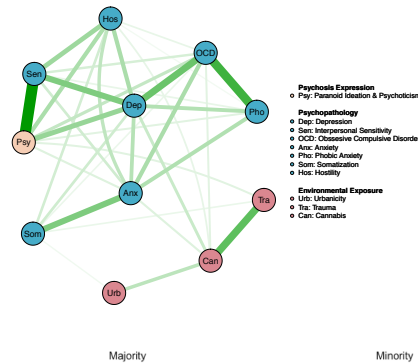
Network Psychometrics: Psycho(patho)logy



- B1 - Intrusive thoughts
- B2 - Nightmares
- B3 - Flashbacks
- B4 - Emotional cue reactivity
- B5 - Physiological cue reactivity
- C1 - Avoidance of thoughts
- C2 - Avoidance of reminders
- D1 - Trauma-related amnesia
- D2 - Negative beliefs
- D3 - Blame of self or others
- D4 - Negative trauma-related emotions
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- E1 - Irritability/anger
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- E6 - Sleep disturbance

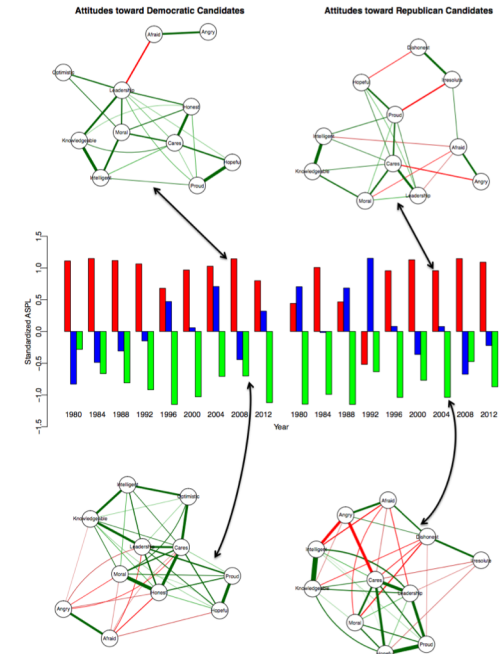
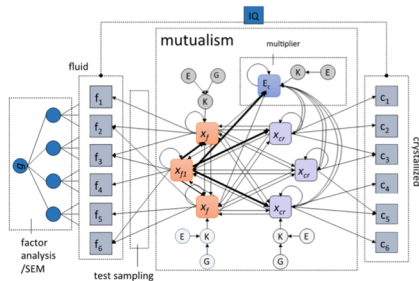
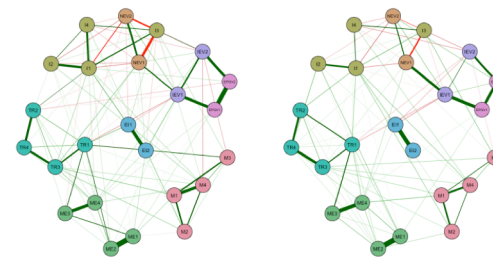


(a) Interrelations Environmental Exposure & Symptomatology



Majority

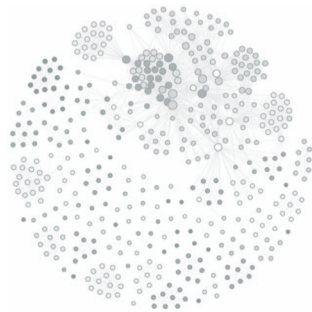
Minority



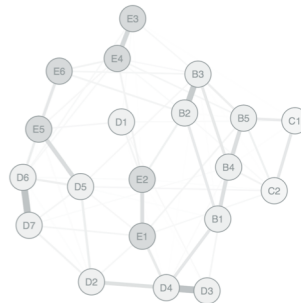
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Network Psychometrics: Psycho(patho)logy



- Disorders usually first diagnosed in infancy, childhood or adolescence
- Delirium, dementia, and amnesia and other cognitive disorders
- Mental disorders due to a general medical condition
- Substance-related disorders
- Schizophrenia and other psychotic disorders
- Mood disorders
- Anxiety disorders
- Somatiform disorders
- Factitious disorders
- Dissociative disorders
- Sexual and gender identity disorders
- Eating disorders
- Sleep disorders
- Impulse control disorders not elsewhere classified
- Adjustment disorders
- Personality disorders
- Symptom is featured equally in multiple chapters



- B1 - Intrusive thoughts
- B2 - Nightmares
- B3 - Flashbacks
- B4 - Emotional cue reactivity
- B5 - Physiological cue reactivity
- C1 - Avoidance of thoughts
- C2 - Avoidance of reminders
- D1 - Trauma-related amnesia
- D2 - Negative beliefs
- D3 - Blame of self or others
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- E2 - Self-destructive/reckless behavior
- E3 - Hypervigilance
- E4 - Exaggerated startle response
- E5 - Difficulty concentrating
- E6 - Sleep disturbance



Part 2. Examples in Psycho(patho)logy



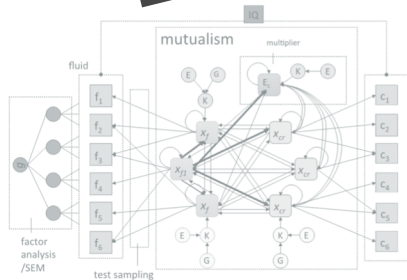
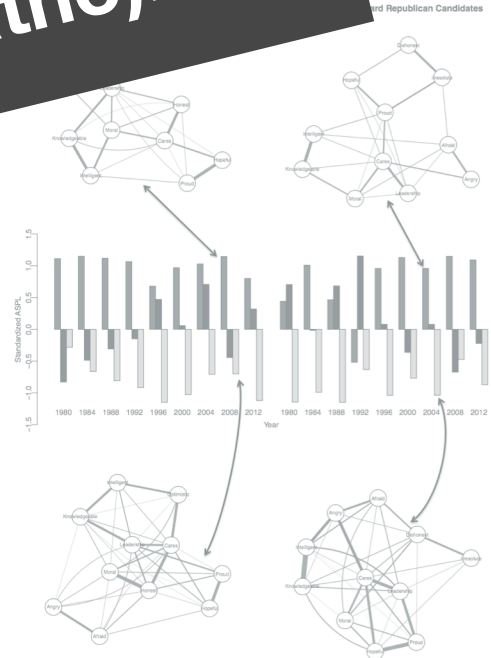
(a) Interrelations Environmental Exposure & Symptomatology



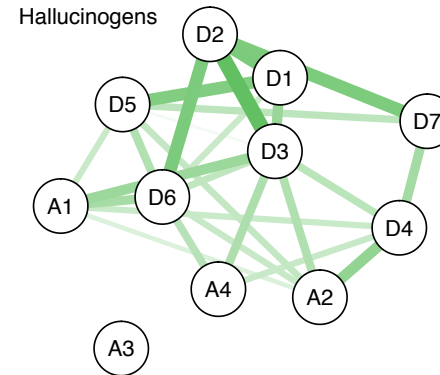
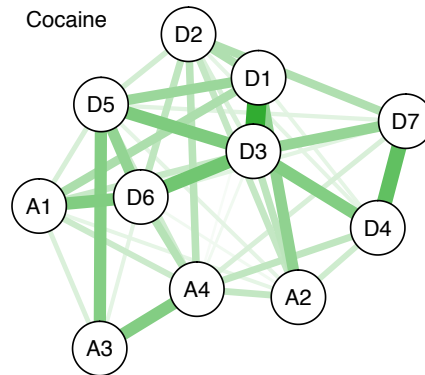
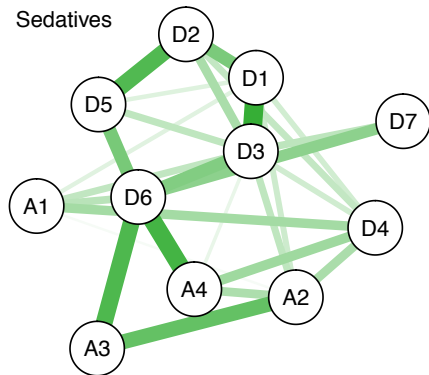
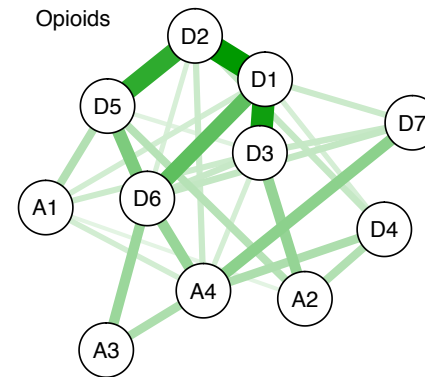
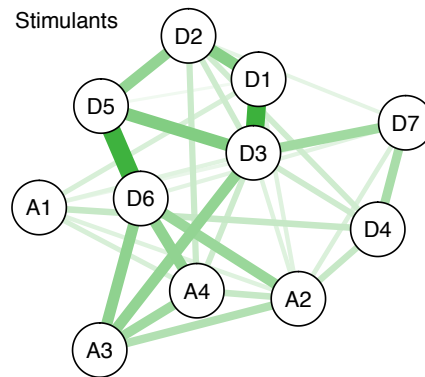
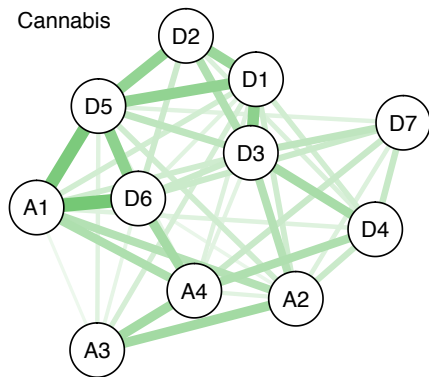
Majority



Minority



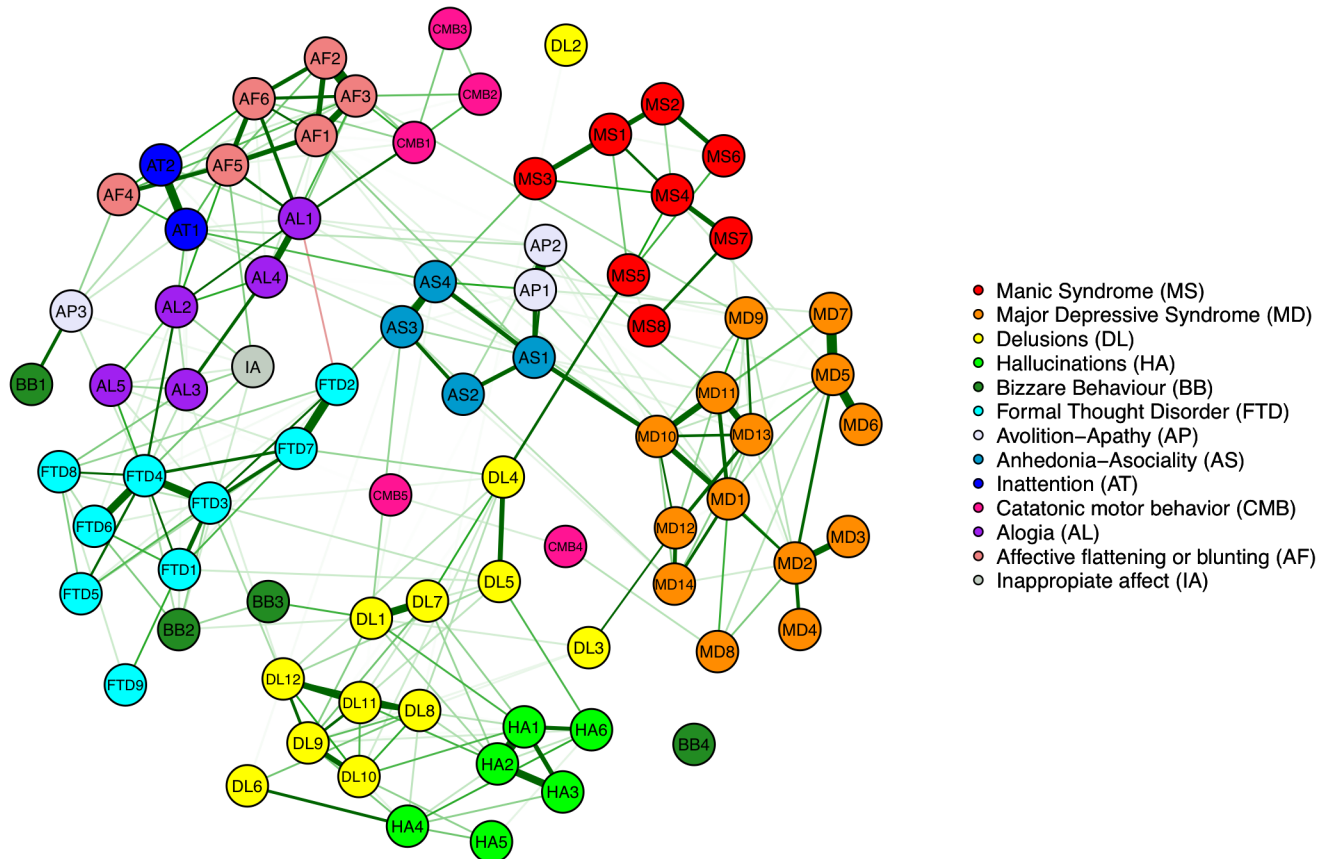
Substance Use



A1: Inopportune timing
 A2: Hazardous use
 A3: Legal Consequences
 A4: Social Problems
 D1: Tolerance
 D2: Withdrawal
 D3: Use longer than planned
 D4: Unable to stop
 D5: Monopolizes time
 D6: Interferes with work/life
 D7: Physical/mental problems

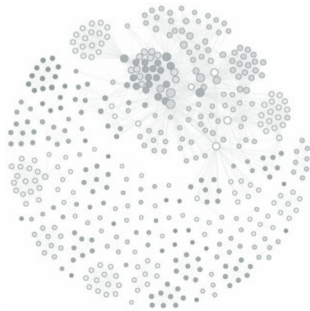
Rhemtulla, M., Fried, E. I., Aggen, S. H., Tuerlinckx, F., Kendler, K. S., & Borsboom, D. (2016). Network analysis of substance abuse and dependence symptoms. *Drug and alcohol dependence*, 161, 230-237.

Psychosis

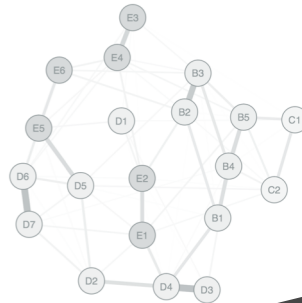


van Rooijen, G., **Isvoranu, A. M.**, Meijer, C. J., van Borkulo, C.D., , Ruhé H. G., de Haan, L., GROUP (in press). A Symptom Network Structure of the Psychosis Spectrum. *Schizophrenia Research*.

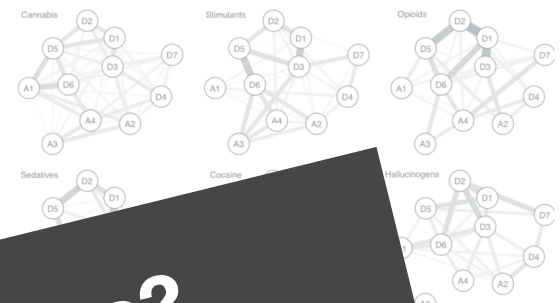
Network Psychometrics: Psychopathology



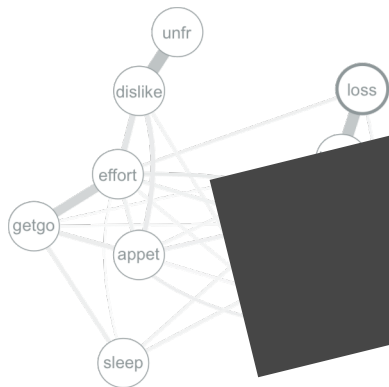
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- Delirium, dementia, and amnesia and other cognitive disorders
- Mental disorders due to a general medical condition
- Substance-related disorders
- Schizophrenia and other psychotic disorders
- Mood disorders
- Anxiety disorders
- Somatoform disorders
- Factitious disorders
- Dissociative disorders
- Sexual and gender identity disorders
- Eating disorders
- Sleep disorders
- Impulse control disorders not elsewhere classified
- Adjustment disorders
- Personality disorders
- Symptom is featured equally in multiple chapters



- B1 - Intrusive thoughts
- B2 - Nightmares
- B3 - Flashbacks
- B4 - Emotional cue reactivity
- B5 - Physiological cue reactivity
- C1 - Avoidance of thoughts
- C2 - Avoidance of reminders
- D1 - Trauma-related amnesia
- D2 - Negative beliefs
- D3 - Blame of self or others
- D4 - Negative trauma-related emotions
- D5 - Loss of interest
- D6 - Detachment
- D7 - Restricted affect
- E1 - Irritability/anger
- E2 - Self-destructive/reckless behavior
- E3 - Hypervigilance
- E4 - Exaggerated startle response
- E5 - Diffusivity of attention
- E6 - ...



More than just symptoms?

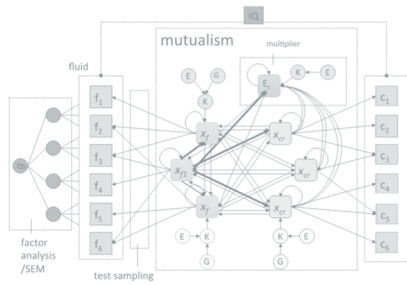
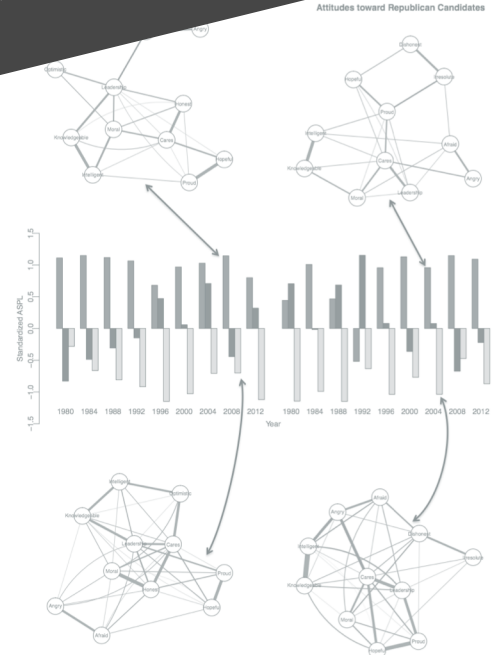


(a) Interrelations Environmental Exposure & ...

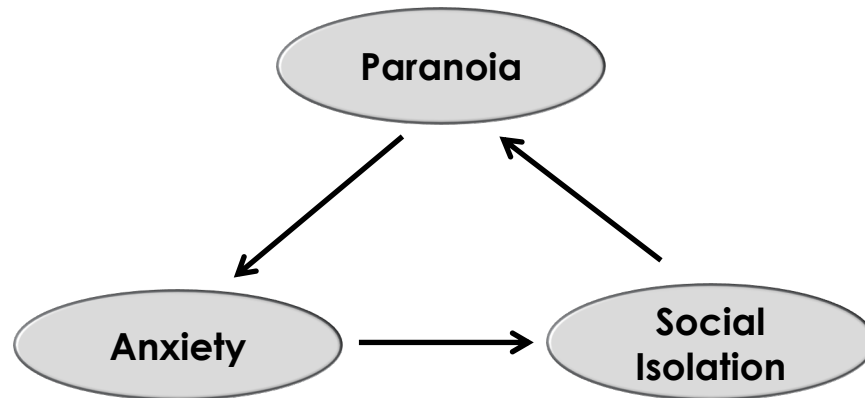


Majority

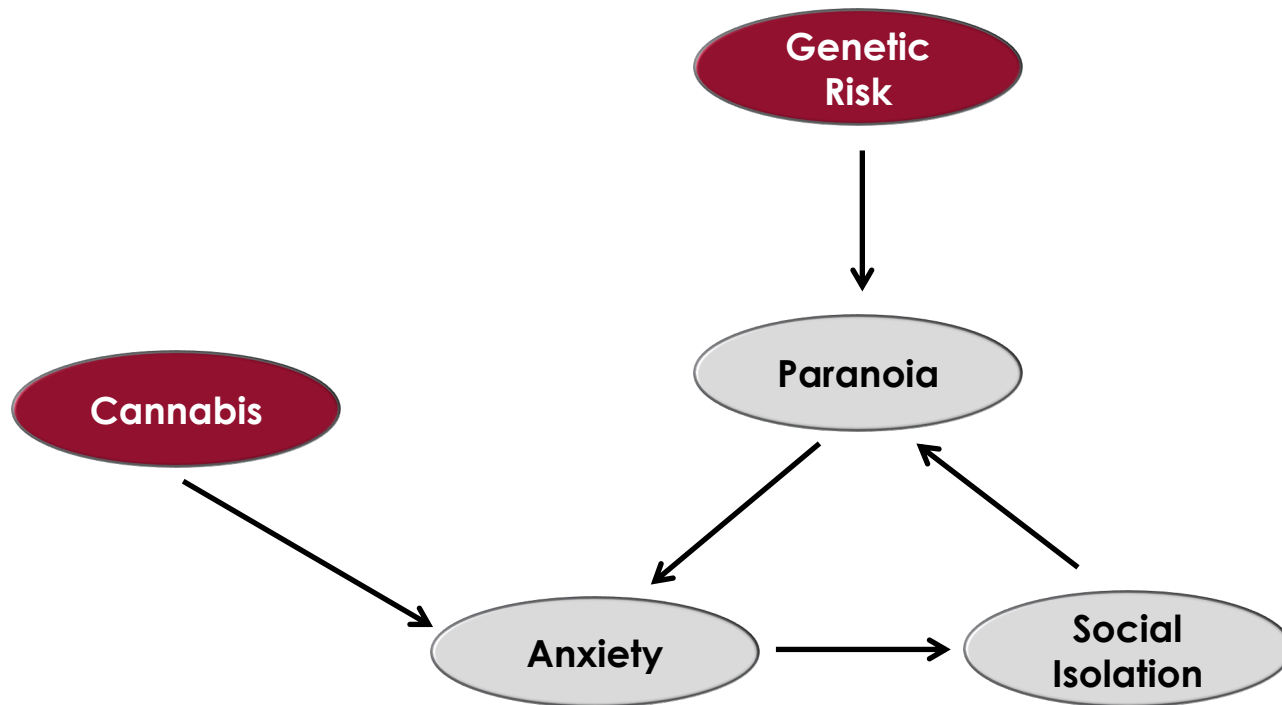
Minority



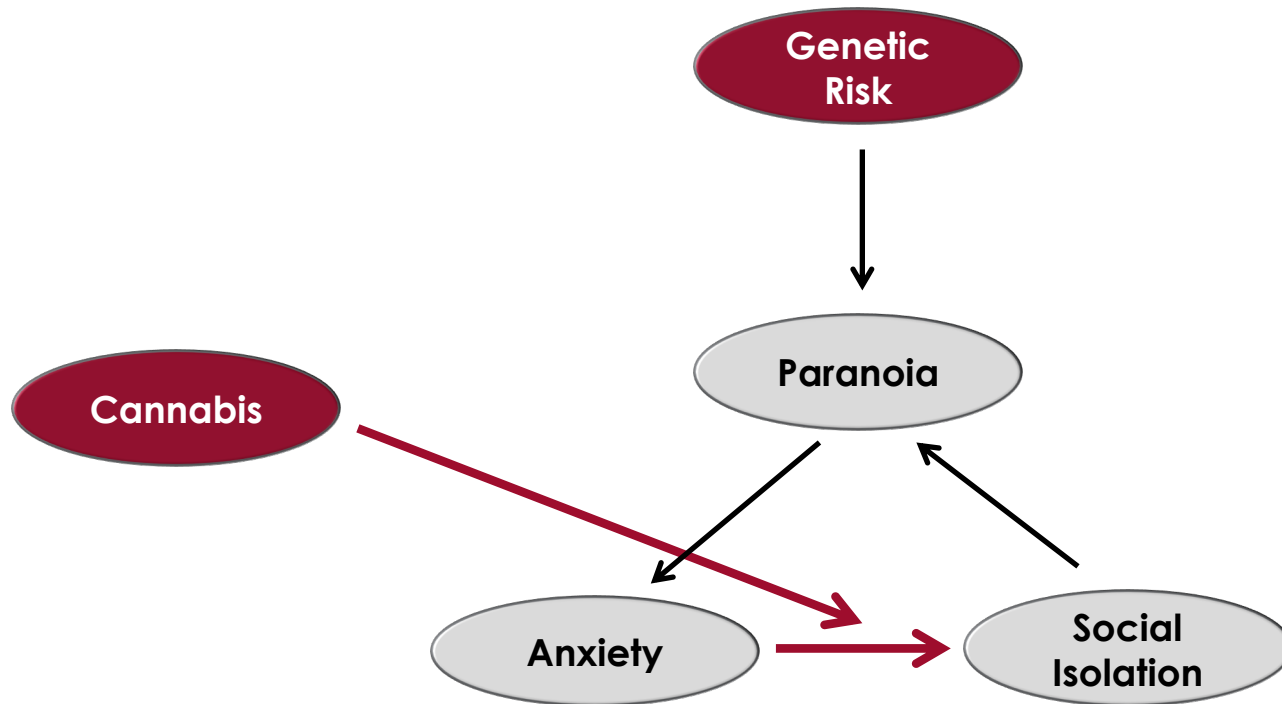
External Influence on a Network Model



External Influence on a Network Model

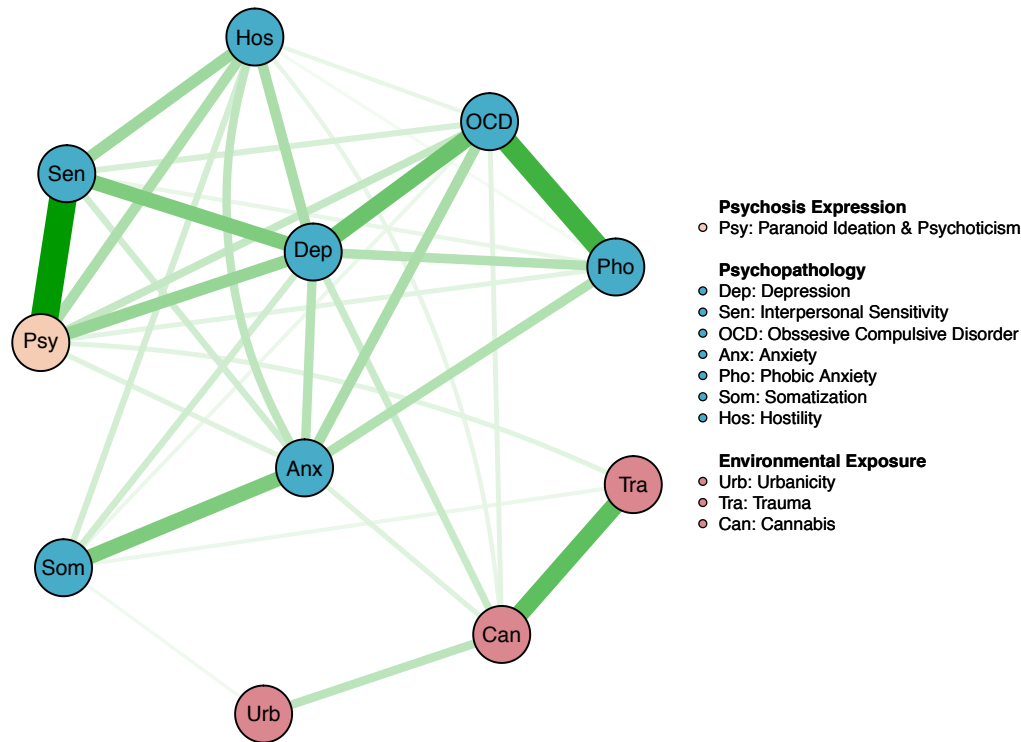


External Influence on a Network Model



Environmental Impact in Psychotic Disorders

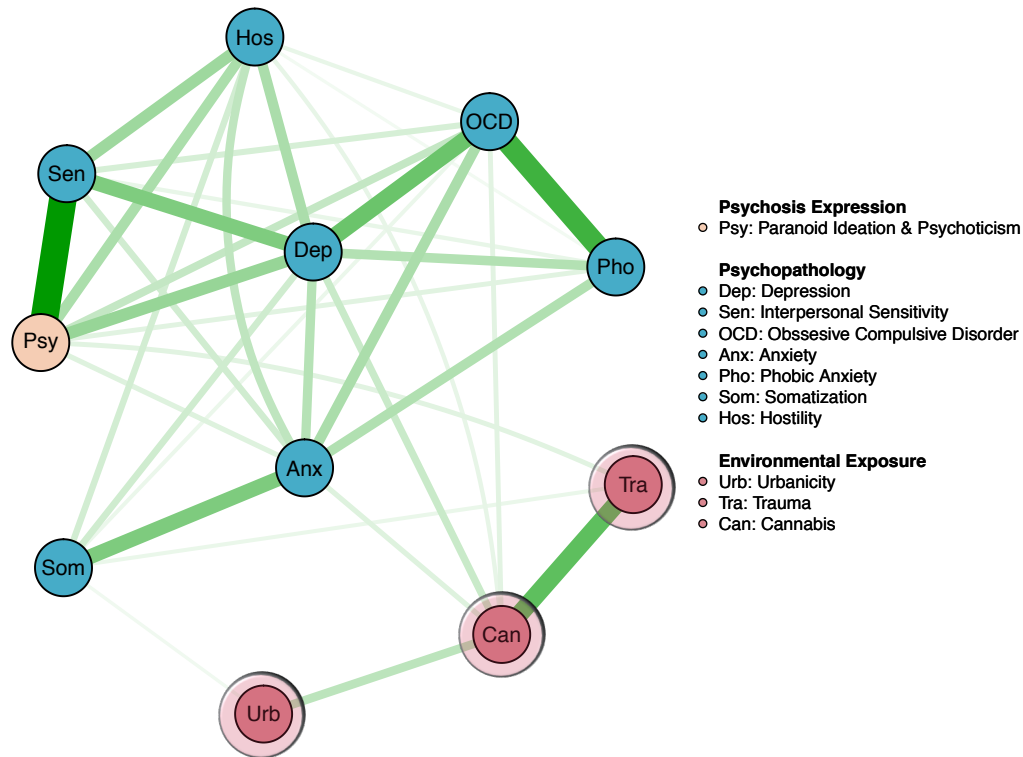
(a) Interrelations Environmental Exposure & Symptomatology



Isvoranu, A. M., Borsboom, D., van Os, J. & Guloksuz, S. (2016). A Network Approach to Environmental Impact in Psychotic Disorder: Brief Theoretical Framework. *Schizophrenia Bulletin*, 42(4), 870-873.

Environmental Impact in Psychotic Disorders

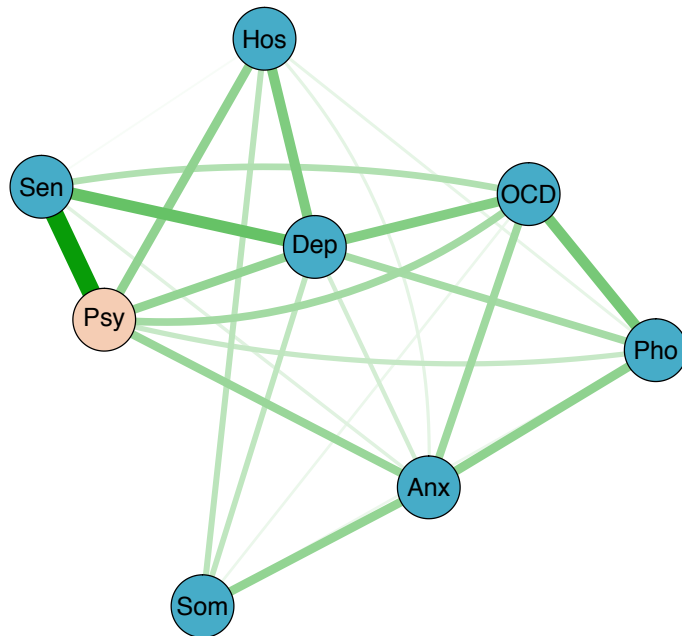
(a) Interrelations Environmental Exposure & Symptomatology



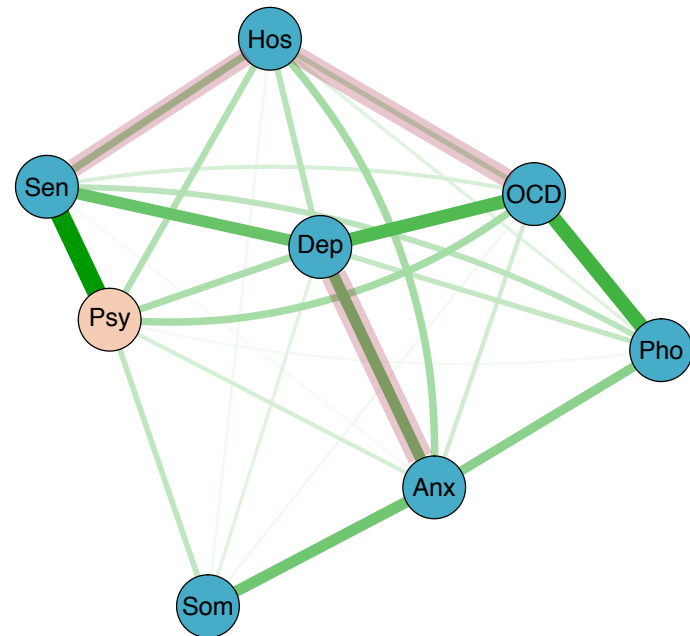
Isvoranu, A. M., Borsboom, D., van Os, J. & Guloksuz, S. (2016). A Network Approach to Environmental Impact in Psychotic Disorder: Brief Theoretical Framework. *Schizophrenia Bulletin*, 42(4), 870-873.

Environmental Impact in Psychotic Disorders

(b) No Environmental Exposure

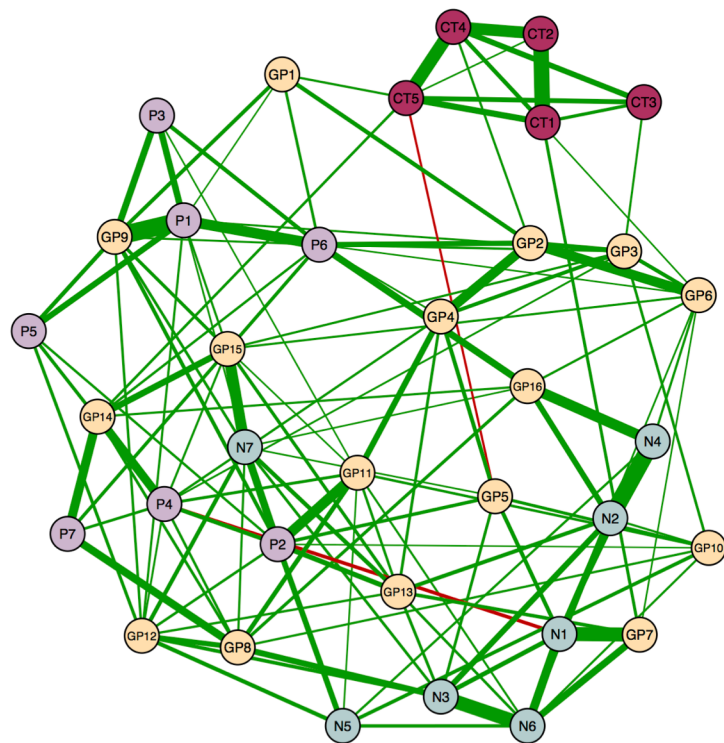


(c) Environmental Exposure Cannabis



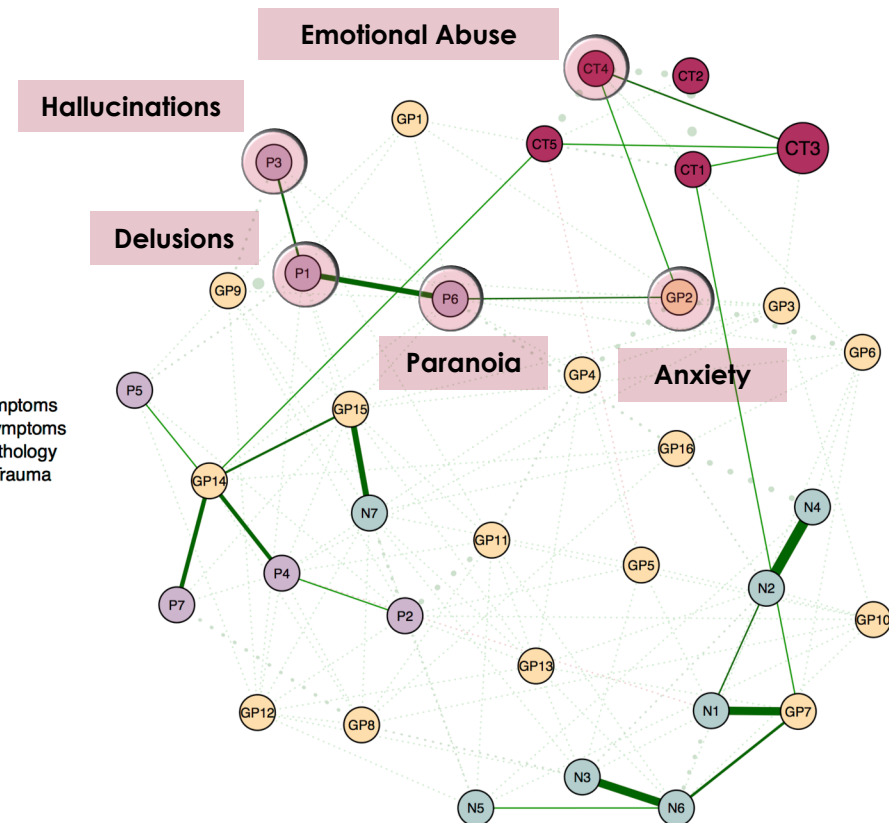
Isvoranu, A. M., Borsboom, D., van Os, J. & Guloksuz, S. (2016). A Network Approach to Environmental Impact in Psychotic Disorder: Brief Theoretical Framework. *Schizophrenia Bulletin*, 42(4), 870-873.

Pathways Between Childhood Trauma and Psychotic Symptoms



- Positive Symptoms
- Negative Symptoms
- GPsycho pathology
- Childhood Trauma

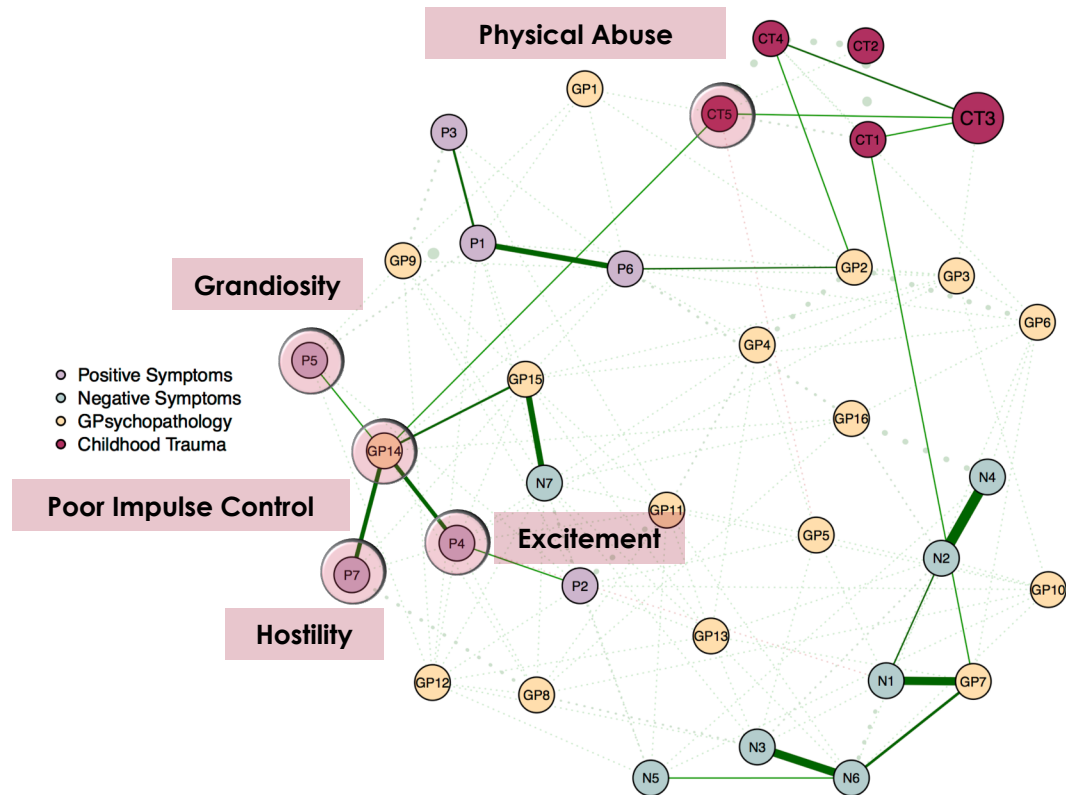
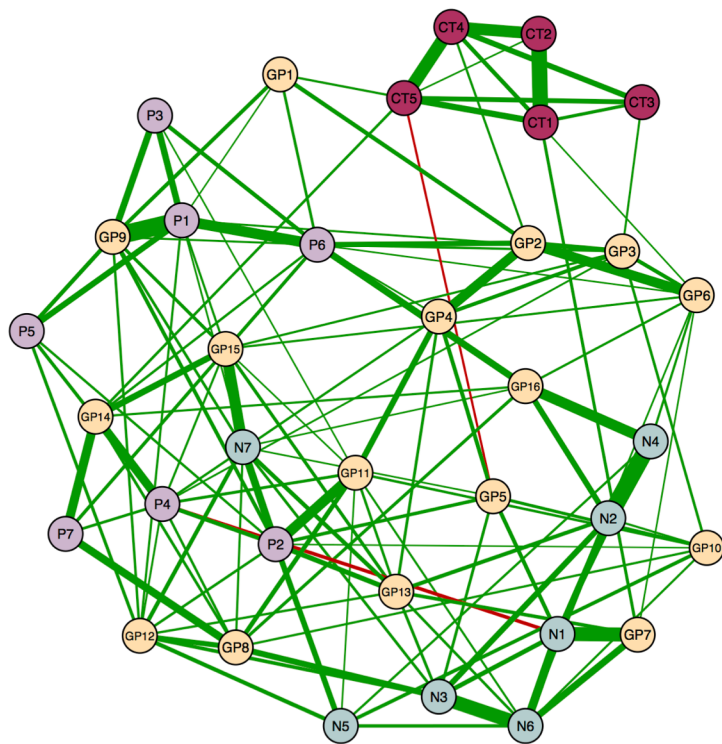
a. Shortest Paths: Sexual Abuse – Positive and Negative Symptoms



Isvoranu, A. M., van Borkulo, C. D., Boyette, L. L., Wigman, J. T. W., Vinkers, C. H., Borsboom, D. (2017). A Network Approach to Psychosis: Pathways Between Childhood Trauma and Psychotic Symptoms. *Schizophrenia Bulletin*, 43(1), 187-196.

Pathways Between Childhood Trauma and Psychotic Symptoms

a. Shortest Paths: Sexual Abuse – Positive and Negative Symptoms



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Part 3. Implications & Conclusions

Consequences & Conclusions

- ❑ Co-occurrence of symptoms, moods, personality aspects understood as emergent behavior
 - ❑ Implication: symptom-based interventions possible
- ❑ Every person is a different system
 - ❑ Implication: personalized modeling and treatment
- ❑ Possible to think in terms of attractor states with smooth or critical transitions
 - ❑ Implication: dynamical models may lead to insight in optimal intervention
- ❑ Possible to think about theory formation

Facebook Community



facebook.com/groups/PsychologicalDynamics

Thank you for your attention!



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www.adelaisvoranu.com/presentations

