



Leiden University
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Dynamic time warp analysis of individual symptom trajectories in patients with bipolar disorder

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Bipolar disorder (BD)

- heterogeneity in symptom presentation
- Symptomatology, severity, polarity, and cycling patterns of episodes differed strongly between patients with BD
- recurrent episodes within a patient often seemed to present a similar pattern of symptomatology



Treatment in BD

PERSONAL CRISIS PLAN

SOME GOOD WAYS TO DISTRACT MYSELF ARE:

I KNOW I'M TRIGGERED WHEN I NOTICE _____

SAFE PEOPLE I CAN REACH OUT TO:

1. _____

2. _____

3. _____

COPING SKILLS I CAN USE:

WAYS TO KEEP MYSELF & MY SPACE SAFE:

OTHER RESOURCES I CAN USE TO GET MYSELF CARE

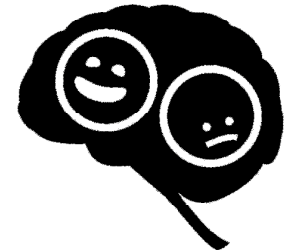
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article text line:
text HOME to 741741

DTW and BD

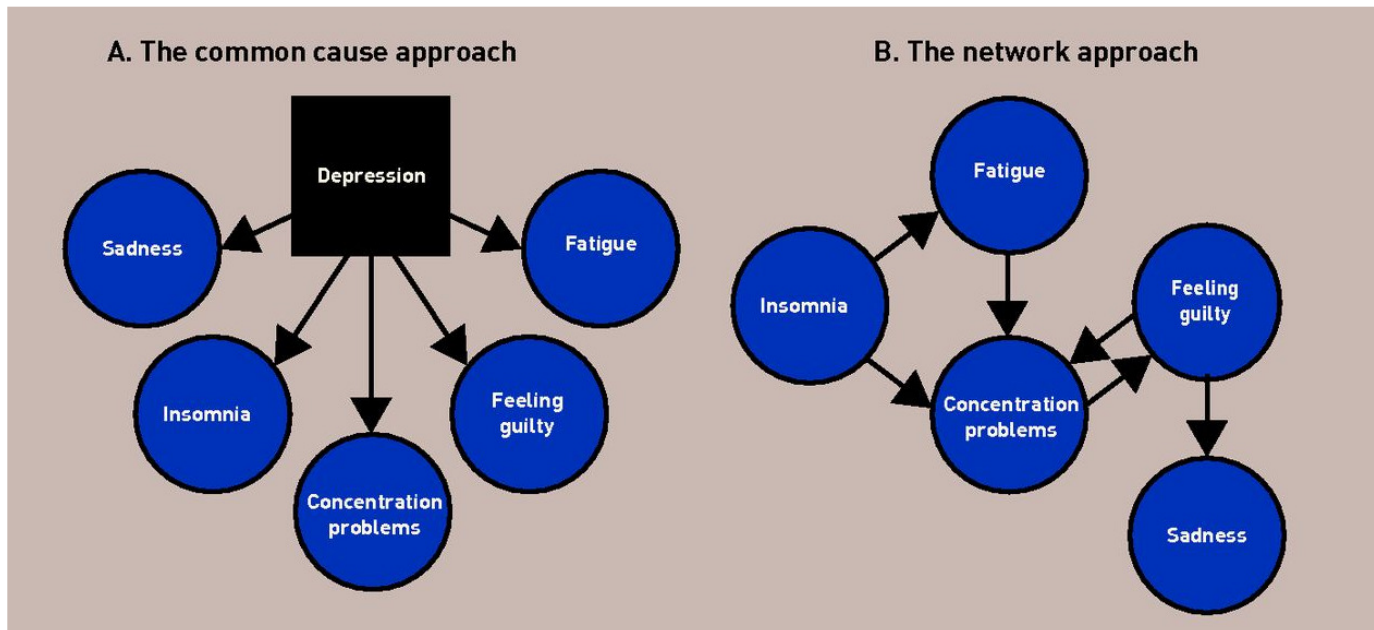
Only two cross-sectional studies have used network analysis to examine symptoms of BD.

1. Sum scores of manic and depressive symptoms
2. life charts -> register the flux of mood states over time



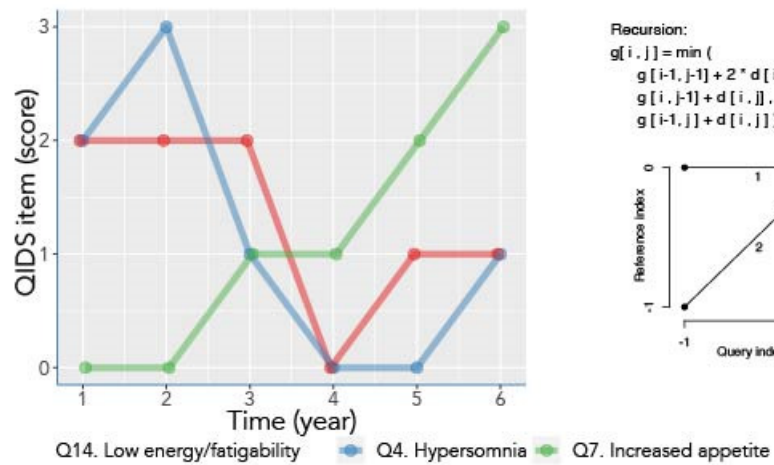
Weintraub, Marc J., Christopher D. Schneck, and David J. Miklowitz. 2020. "Network Analysis of Mood Symptoms in Adolescents with or at High Risk for Bipolar Disorder." *Bipolar Disorders* 22 (2): 128–38.
Koenders, M. A., R. de Kleijn, E. J. Giltay, B. M. Elzinga, P. Spinhoven, and A. T. Spijker. 2015. "A Network Approach to Bipolar Symptomatology in Patients with Different Course Types." *PloS One* 10 (10): e0141420.

Latent model VS network model



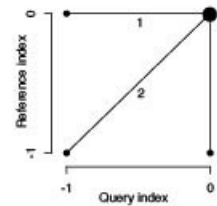
Dynamic time warp analysis (DTW)

A. Scores of items Q4, Q7, and Q14 over time



Step pattern: "symmetric2"

Recursion:
 $g[i, j] = \min ($
 $g[i-1, j-1] + 2 * d[i, j],$
 $g[i, j-1] + d[i, j],$
 $g[i-1, j] + d[i, j])$

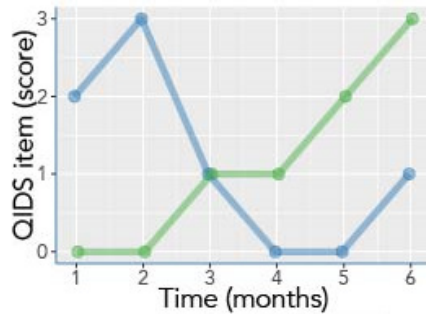


B. Distance matrix

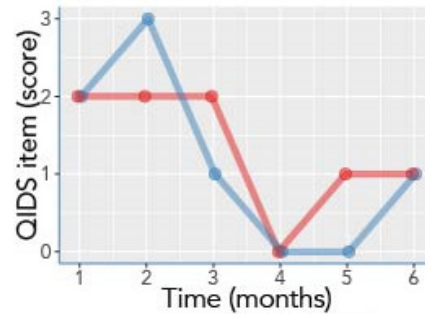
Q14	3	12	0
Q7	13	0	12
Q4	0	13	3
	Q4	Q7	Q14
	Item		

Dynamic time warp analysis (DTW)

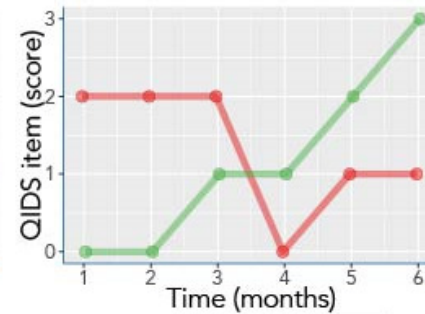
C. Scores of Items Q4 and Q7 over time



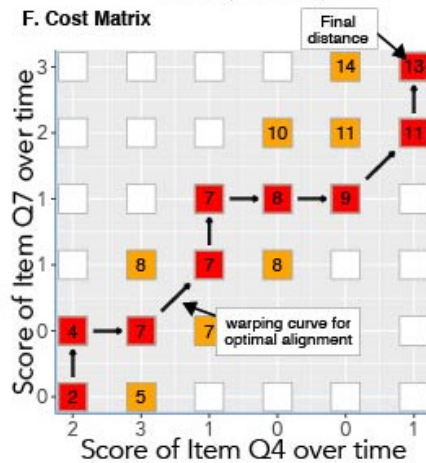
D. Scores of Items Q4 and Q14 over time



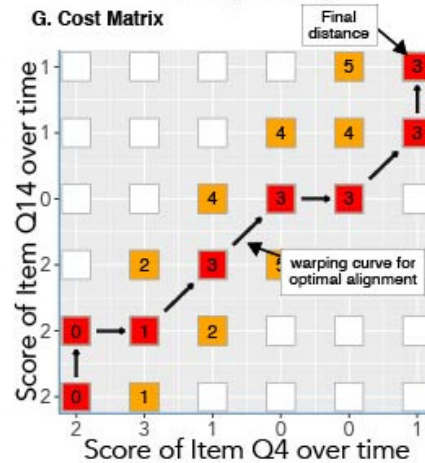
E. Scores of Items Q7 and Q14 over time



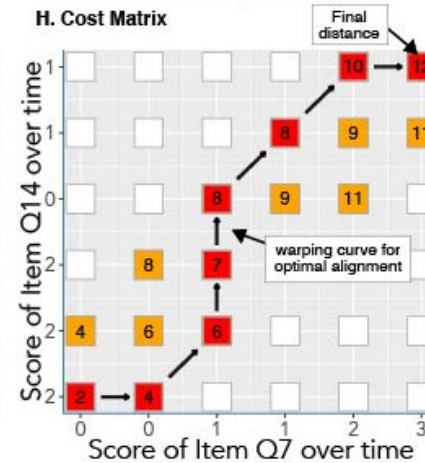
F. Cost Matrix



G. Cost Matrix



H. Cost Matrix



Dynamic time warp analysis (DTW)

- Network approach in time series
- Sparse dataset
- Individual network



Aim of the study

To investigate the symptom of bipolar disorder (BD) interconnection in panel data with novel technique Dynamic Time Warp (DTW) time-series analysis



Slide 9

MR(7

Mesbah, R. (PSY); 15-10-2019

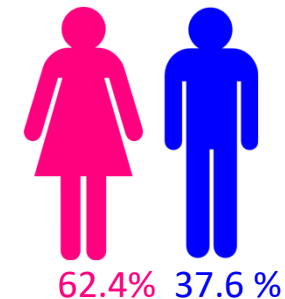
Method

- 2-year longitudinal study among 181 adult bipolar outpatients, with a diagnosis of BD I or BD II in naturalistic cohort study
- the Outpatients Clinic for Mood Disorders in the Hague (the Netherlands)

Method

Current study

- only data of mood assessments of depressive and manic symptoms
- baseline and subsequently every 3 to 6 months yielding up to 6 measurement points (at baseline, 6, 12, 18, 21, and 24 months) per participant.



n = 141 , mean age = 49,1 years

Measurements

Depressive symptoms

Quick Inventory of Depressive Symptomatology (QIDS-SR) : 16 items

Feeling Sad:

- 0: I do not feel sad.
- 1: I feel sad less than half the time.
- 2: I feel sad more than half the time.
- 3: I feel sad nearly all of the time.

Manic symptoms

Young Mania Rating Scale (YMRS): 11 items

Elevated Mood

- 0: Absent
- 1: Mildly or possibly increased
- 2: Definite subjective elevation; optimistic, self-confident; cheerful; appropriate to content
- 3: Elevated, inappropriate to content; humorous
- 4: Euphoric, inappropriate laughter, singing

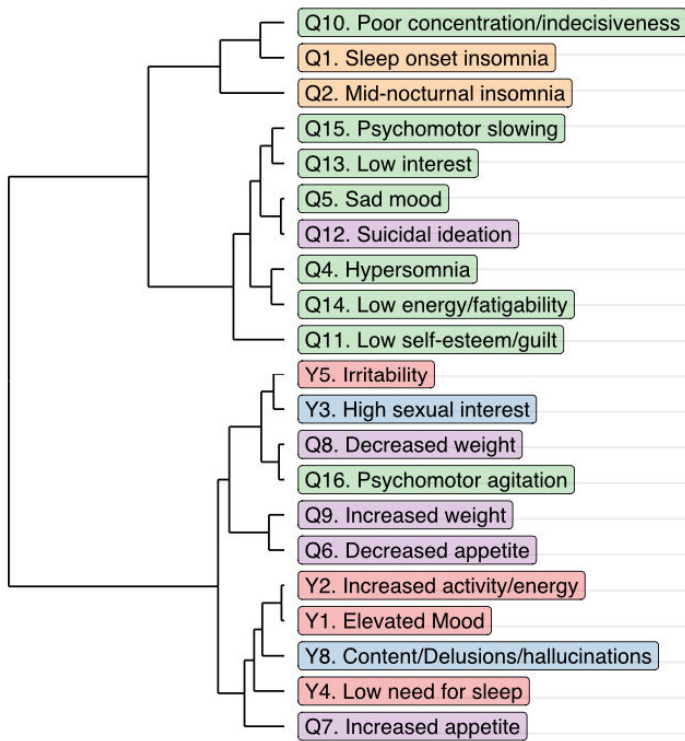
Rush, A. John, Madhukar H. Trivedi, Hicham M. Ibrahim, Thomas J. Carmody, Bruce Arnow, Daniel N. Klein, John C. Markowitz, et al. 2003. "The 16-Item Quick Inventory of Depressive
Young, R. C., J. T. Biggs, V. E. Ziegler, and D. A. Meyer. 1978. "A Rating Scale for Mania: Reliability, Validity and Sensitivity." The British Journal of Psychiatry: The Journal of Mental Science 133 (November): 429–35.

DTW

Dynamic Time Warp (DTW) is an algorithm that may capture symptom interactions from panel data with sparse observations over time.

Individual patient analyses

A. Dendrogram

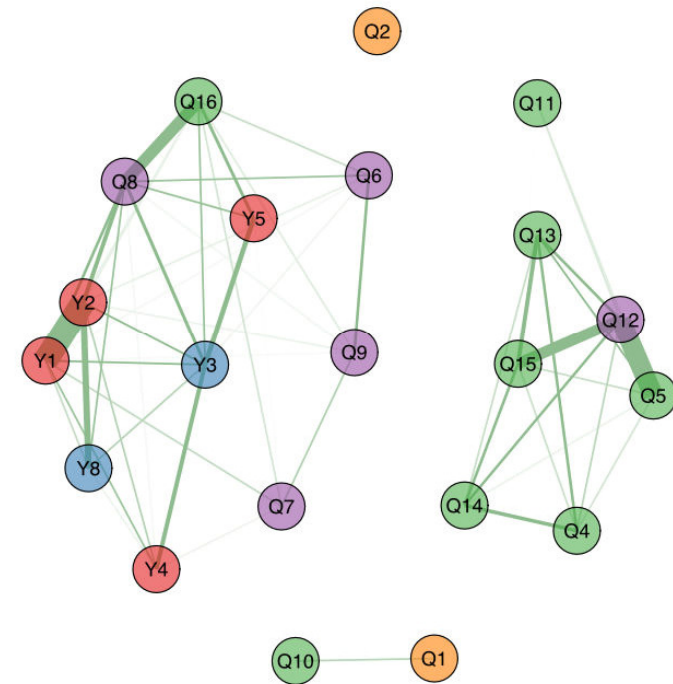


B. Item scores over time

Q10. Poor concentration/indecisiveness	2	1	1	1	1	1
Q1. Sleep onset insomnia	1	1	1	1	1	0
Q2. Mid-nocturnal insomnia	1	2	0	2	1	2
Q15. Psychomotor slowing	2	1	0	0	0	0
Q13. Low interest	1	2	0	0	0	0
Q5. Sad mood	2	2	2	0	0	0
Q12. Suicidal ideation	2	2	1	0	0	0
Q4. Hypersomnia	1	2	1	0	0	1
Q14. Low energy/fatigability	2	1	1	0	0	1
Q11. Low self-esteem/guilt	3	3	1	0	0	0
Y5. Irritability	0	0	0	2	0	0
Y3. High sexual interest	0	0	0	0	2	0
Q8. Decreased weight	0	0	0	0	1	0
Q16. Psychomotor agitation	0	0	0	1	0	0
Q9. Increased weight	0	1	0	1	0	1
Q6. Decreased appetite	0	1	0	0	1	0
Y2. Increased activity/energy	0	0	0	0	1	1
Y1. Elevated Mood	0	0	0	1	1	1
Y8. Content/Delusions/hallucinations	0	0	0	0	0	2
Y4. Low need for sleep	0	0	0	1	2	1
Q7. Increased appetite	0	0	1	1	0	2
	1	2	3	4	5	6

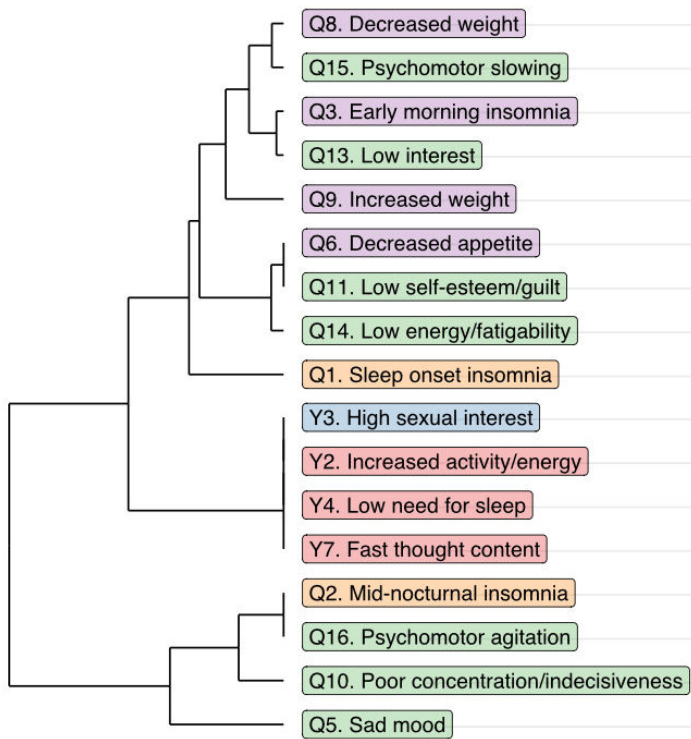
Assessment

C. Individual symptom network

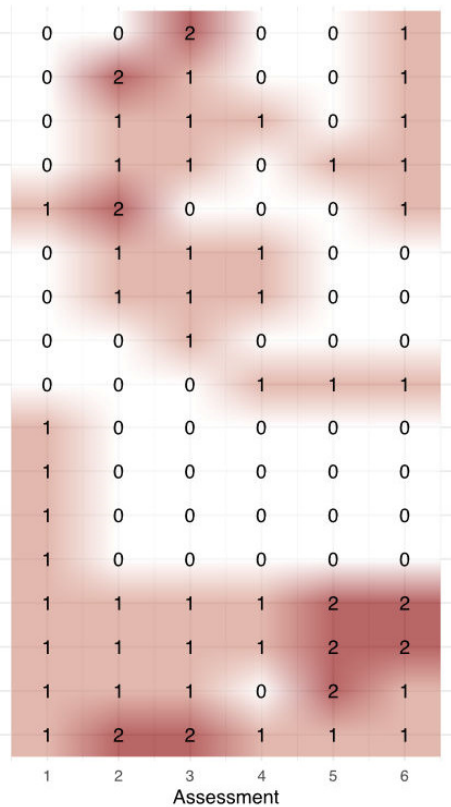


Individual patient analyses

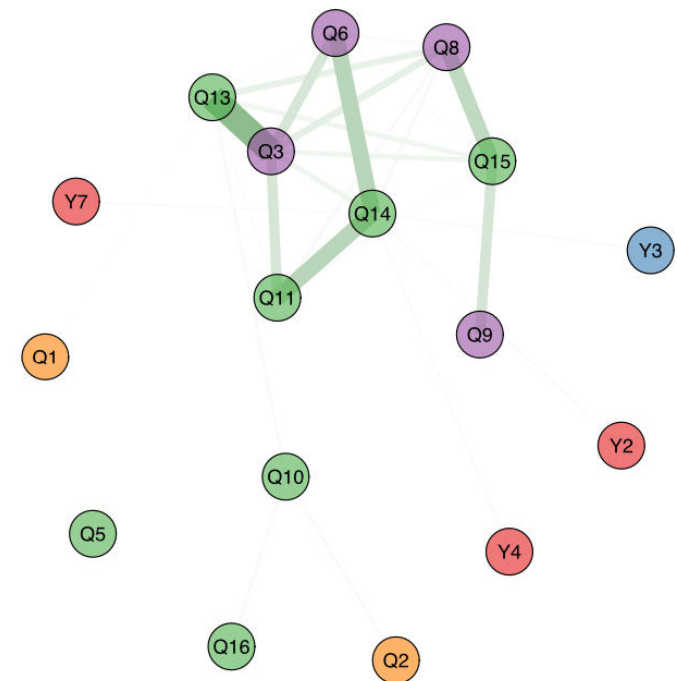
A. Dendrogram



B. Item scores over time

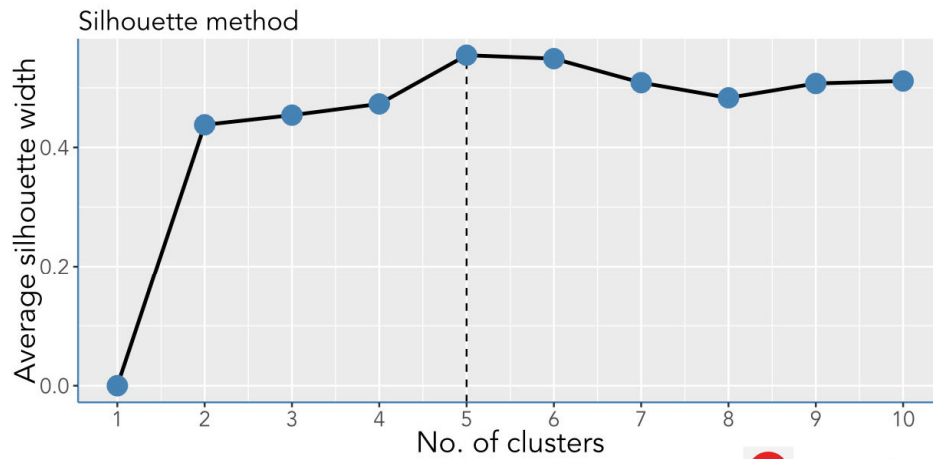
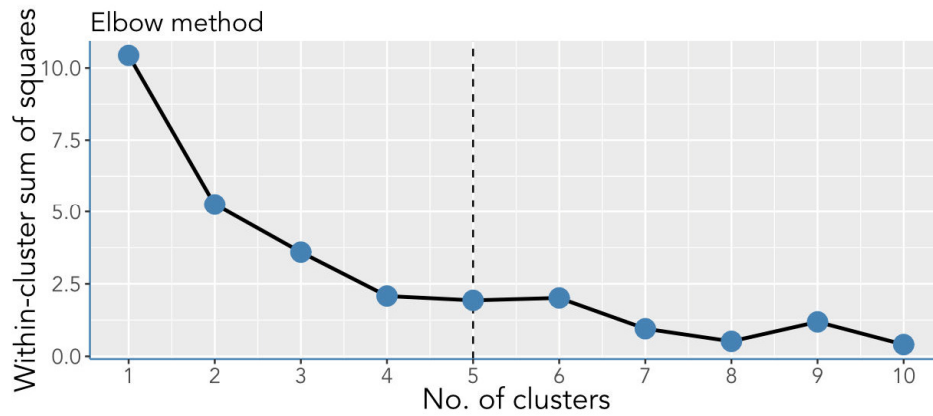


C. Individual symptom network

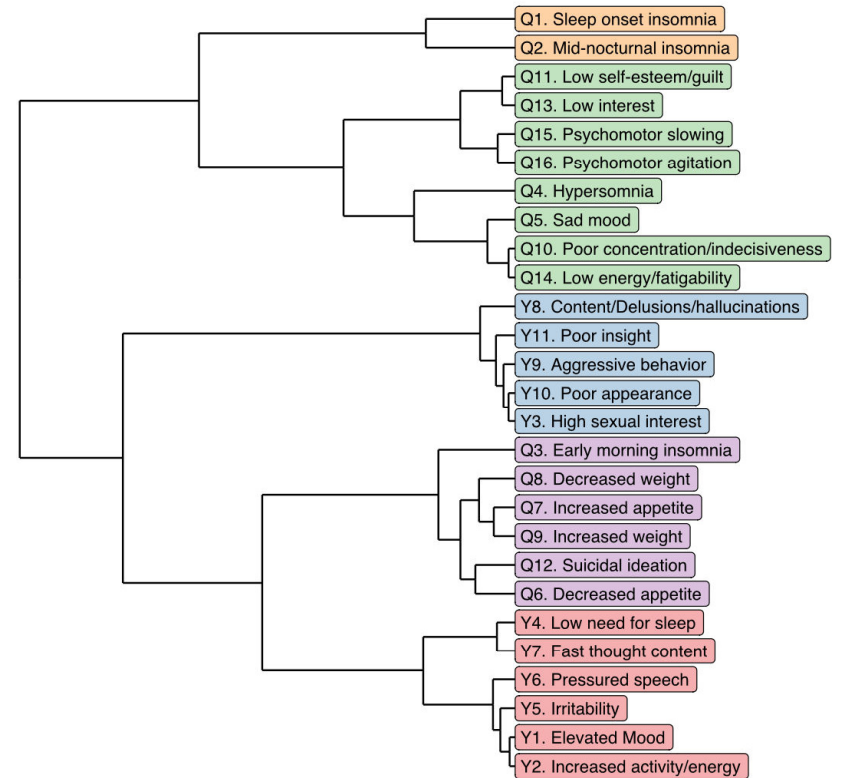


Group-level analysis

A. Elbow and Silhouette plots



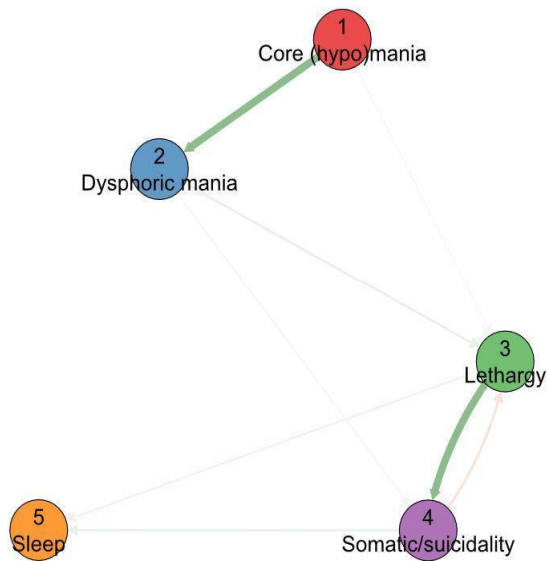
B. Dendrogram



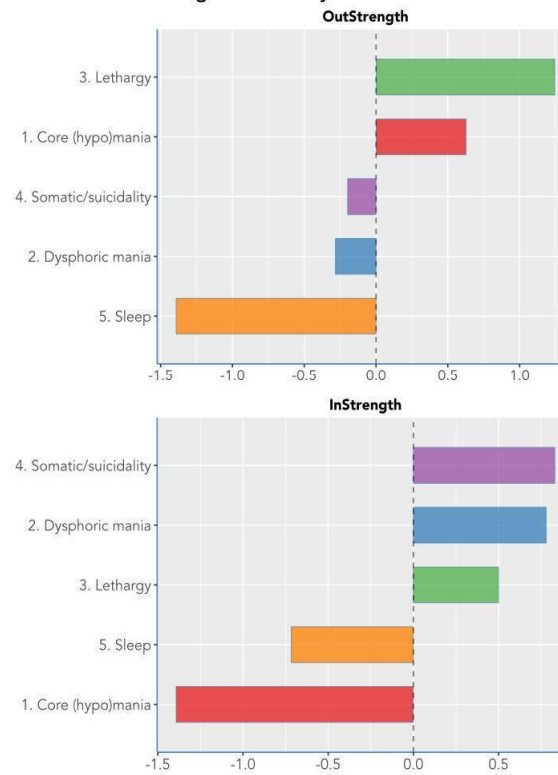
- 1. Core (hypo)mania
- 2. Dysphoric mania
- 3. Lethargy
- 4. Somatic/suicidality
- 5. Sleep

Group-level analysis

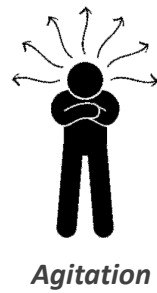
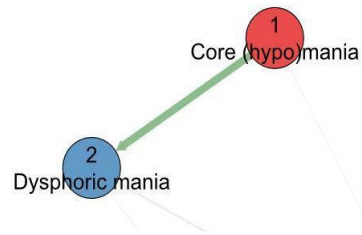
A. Directed symptom network



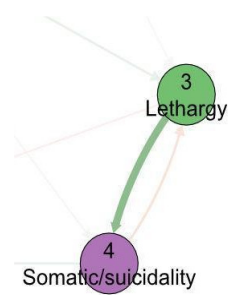
B. In- and out-strength centrality



Group-level analysis



Group-level analysis



Conclusion

- Our individual patient -> variability between patients
- Our group-level analyses -> 5 symptom dimensions
core (hypo)mania, dysphoric mania, lethargy, somatic/suicidality, and sleep
- meaningful BD symptom interactions from panel data with sparse observations in both individual patients as well as in groups of patients.