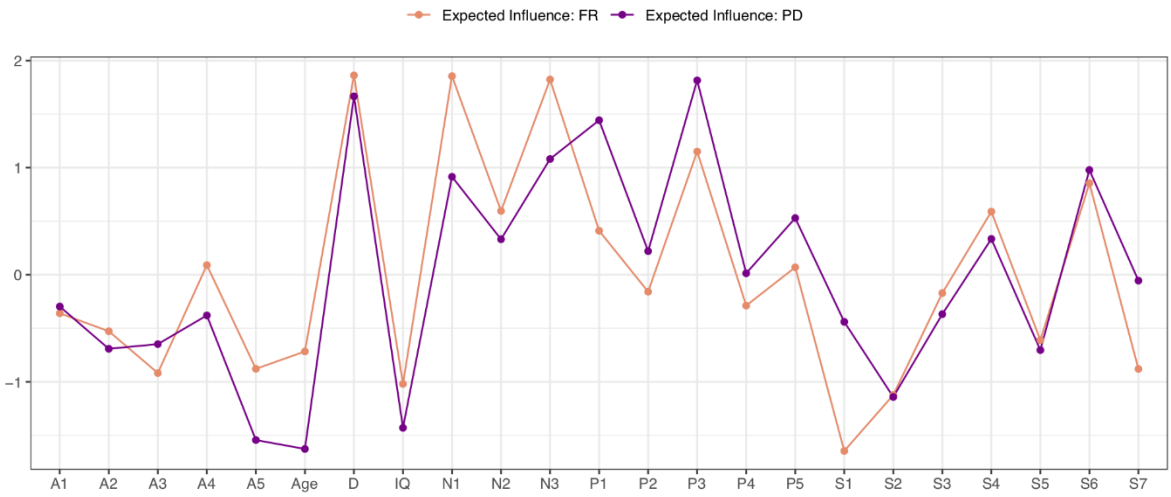
Supplementary Online Content

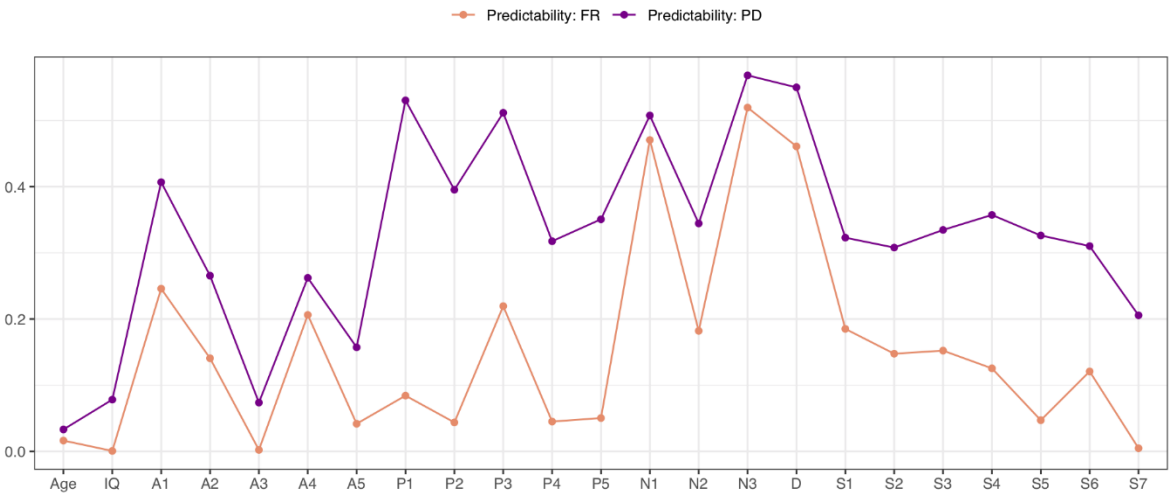
Isvoranu, A.M., Ziermans, T., Schirmbeck, S., Borsboom, D., Geurts, H.M., de Haan, L., GROUP Investigators. Autistic Symptoms and Social Functioning in Psychosis: A Network Approach

This supplementary material has been provided by the authors to give readers additional information about their work.

Appendix 1. Additional centrality results



sFigure 1. Expected influence centrality for each node included in the network. The orange line indicates expected influence centrality for the familiar risk (FR) sample, while the purple line indicates strength centrality for the psychotic disorder (PD) sample.



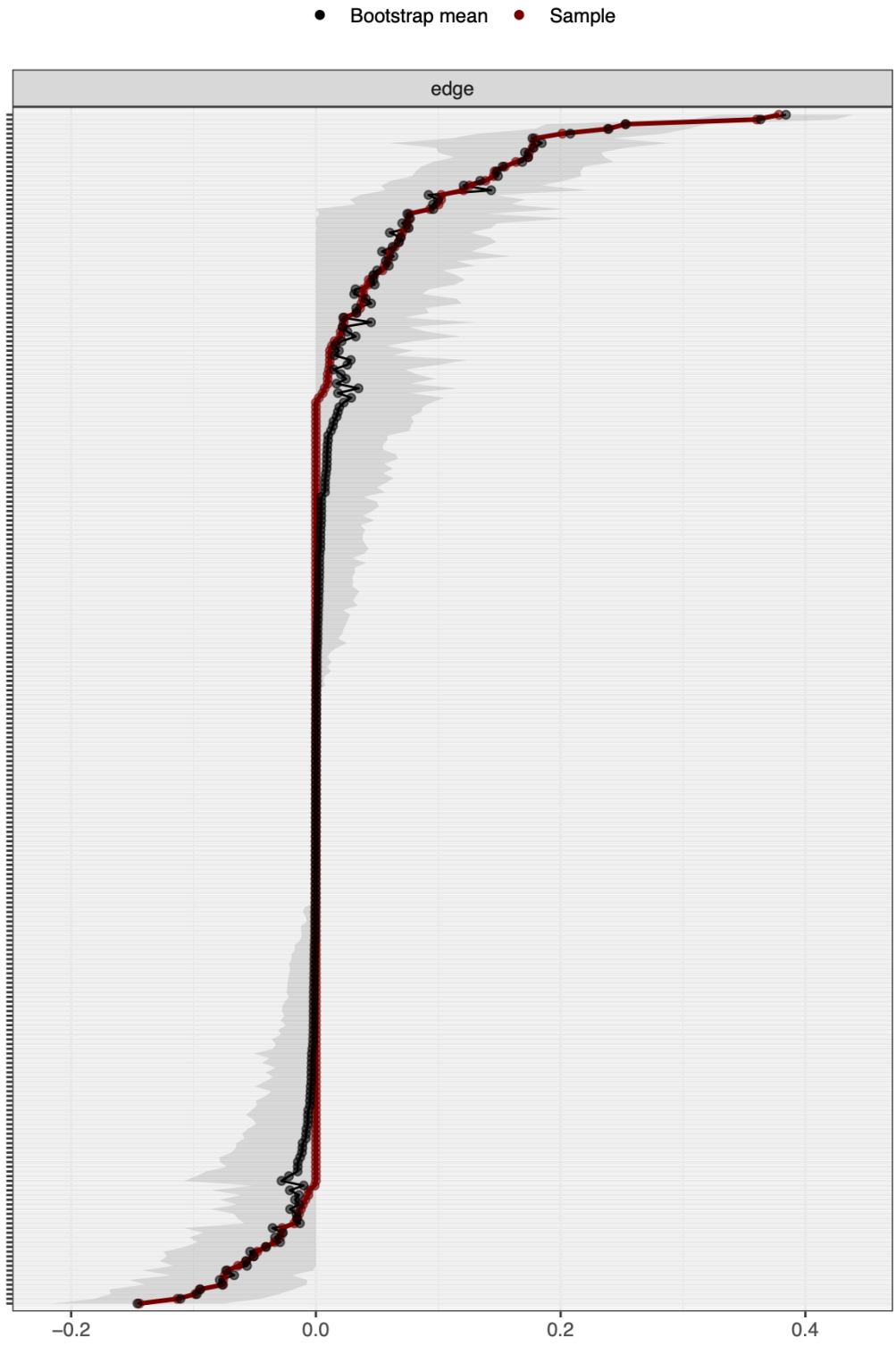
sFigure 2. Predictability measures for each node included in the network. The orange line indicates predictability for the familiar risk (FR) sample, while the purple line indicates predictability for the psychotic disorder (PD) sample.

Appendix 2. Accuracy and stability checks

We used the R-package *bootnet* version 1.4.3[†], following the procedure described by Epskamp et al. (2018)[1]. Specifically, we investigated the accuracy of the edge weights using non-parametric bootstrapping (i.e., re-estimating the network after resampling) and centrality measures using case-drop bootstrapping (i.e., re-estimating the network with fewer cases). To quantify the stability of strength and bridge strength centrality indices, we used a correlation stability coefficient (CS-coefficient). The CS-coefficient represents the maximum proportion of cases that can be dropped, such that with 95% probability the correlation between the original centrality indices and centrality of networks based on subsets is 0.7 or higher. *sFigures 3-10* below present the results of the bootstrap analyses. All results are based on 1000 iterations.

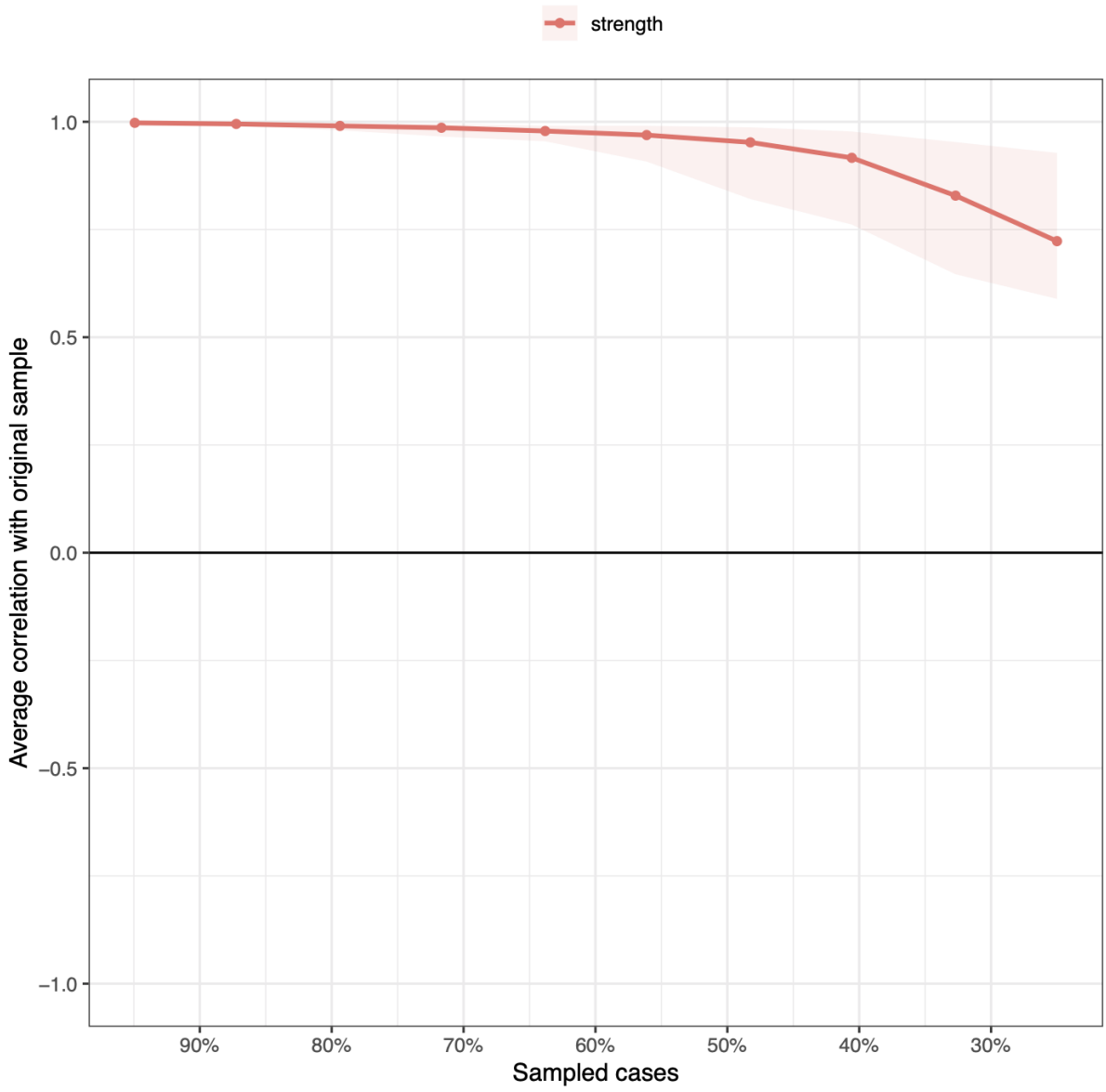
Generally, the results show high stability both for the FR and the PD network structures. The sample values lie within the bootstrapped confidence intervals and the bootstrap mean values are generally well-aligned with the sample values. The bootstrapped confidence intervals are slightly wider for the FR network than for the PD network, but overall, the results indicate accurate estimations. The CS-coefficients obtained for strength were CS = .59 for the FR sample and CS = .67 for the PD sample. The CS-coefficients obtained for bridge strength were CS = .59 for the FR sample and CS = .36 for the PD sample. Most of these are above the preferred .5 cut-off, and above recommended .25 cut-off, generally indicating stable results. The nodes with the highest centrality were in general significantly more central than most other nodes in the network, but not more central than each other (see *sFigure 7 – sFigure 10*).

[1]Epskamp, S., Borsboom, D., & Fried, E. I. (2018). Estimating psychological networks and their accuracy: A tutorial paper. *Behavior Research Methods, 50*(1), 195-212.

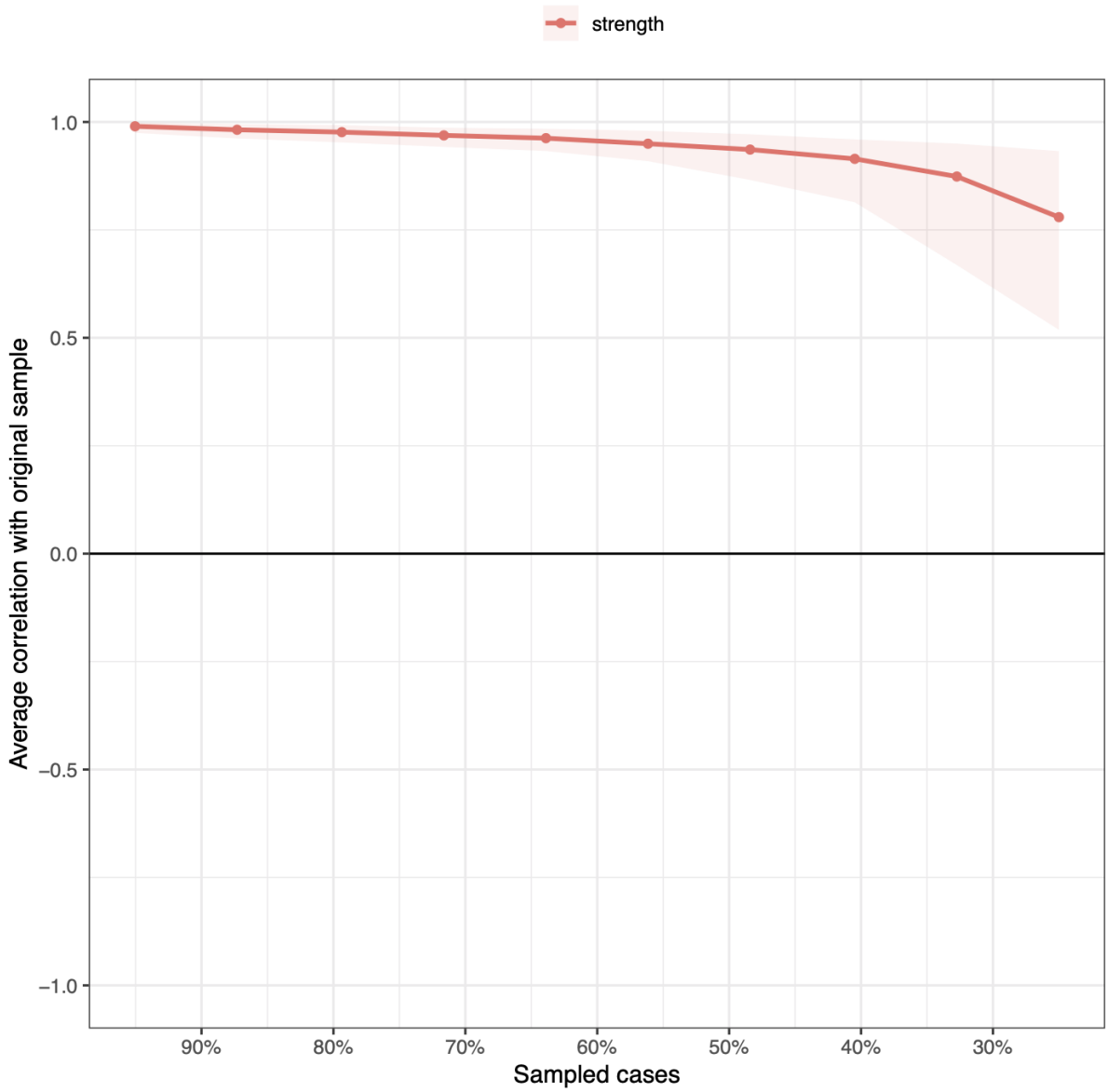


sFigure 3. Accuracy of the edge-weights for the familial risk (FR) network. The horizonal area within the plot represents the 95% quantile range of the parameter values across 1000 bootstraps. The red dots indicate the sample values, while the black dots indicate the bootstrap mean values.

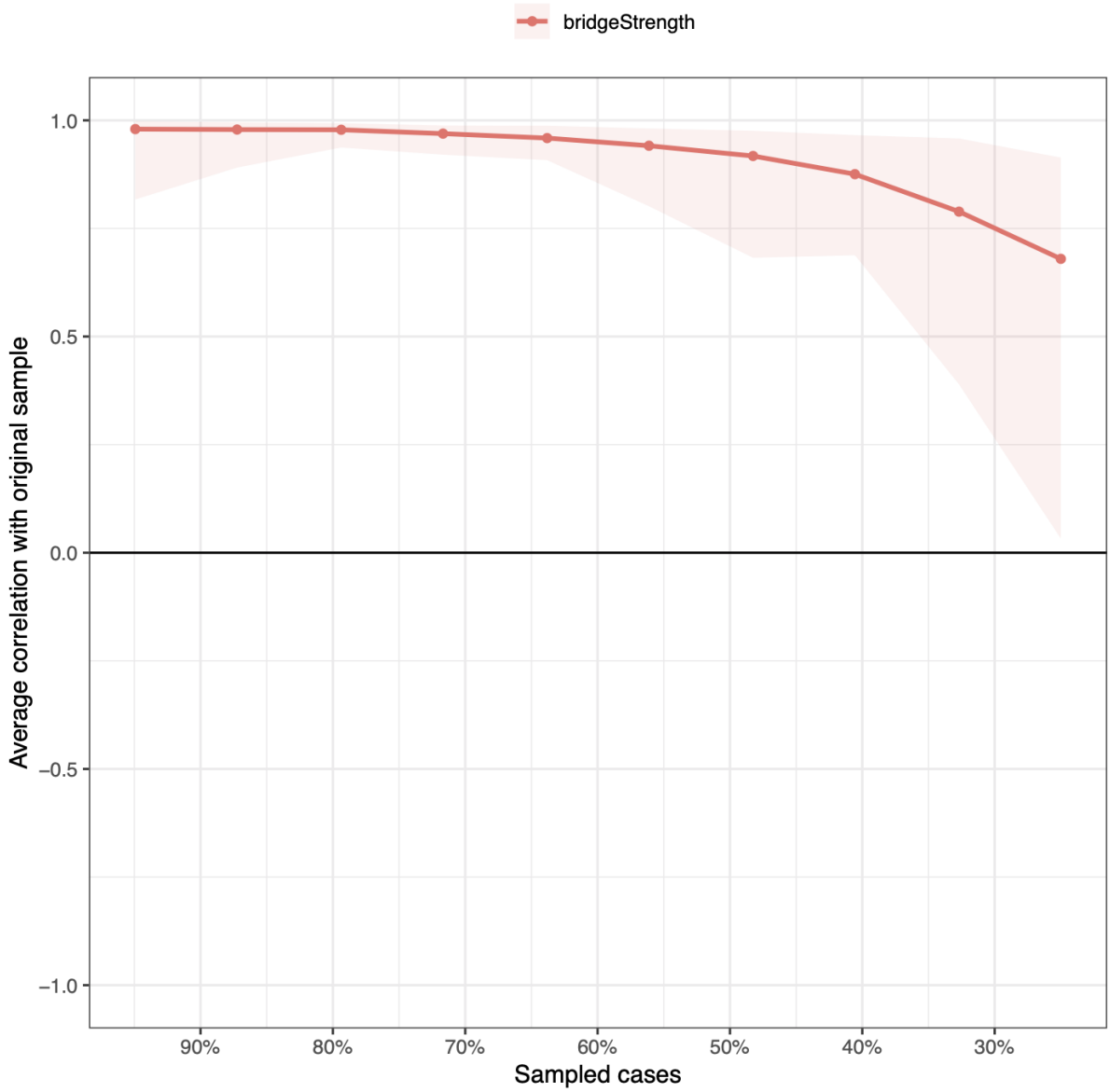
sFigure 4. Accuracy of the edge-weights for the psychotic disorders (PD) network. The horizonal area within the plot represents the 95% quantile range of the parameter values across 1000 bootstraps. The red dots indicate the sample values, while the black dots indicate the bootstrap mean values.



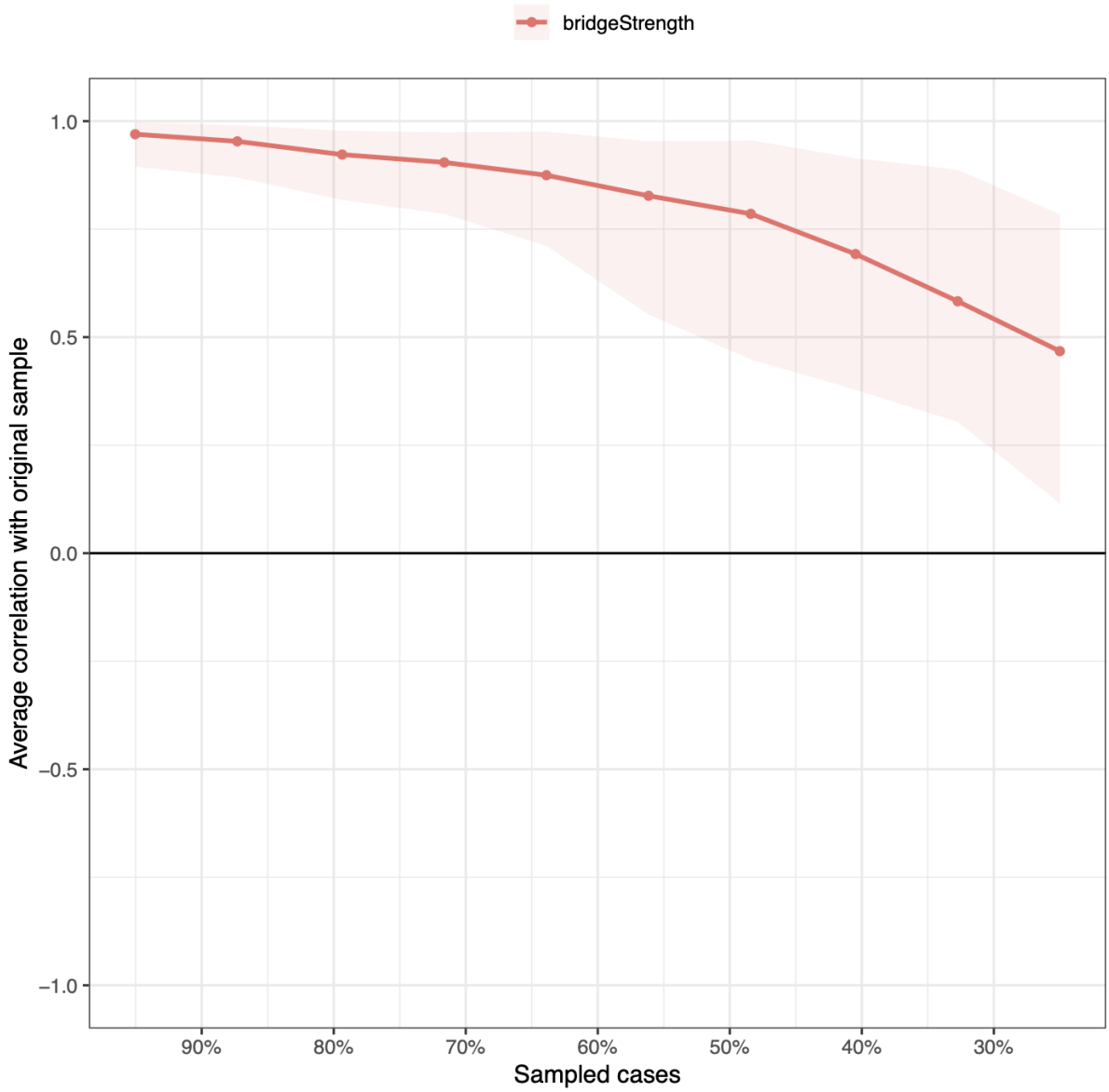
sFigure 5. Accuracy of *strength* centrality for the familial risk (FR) network.



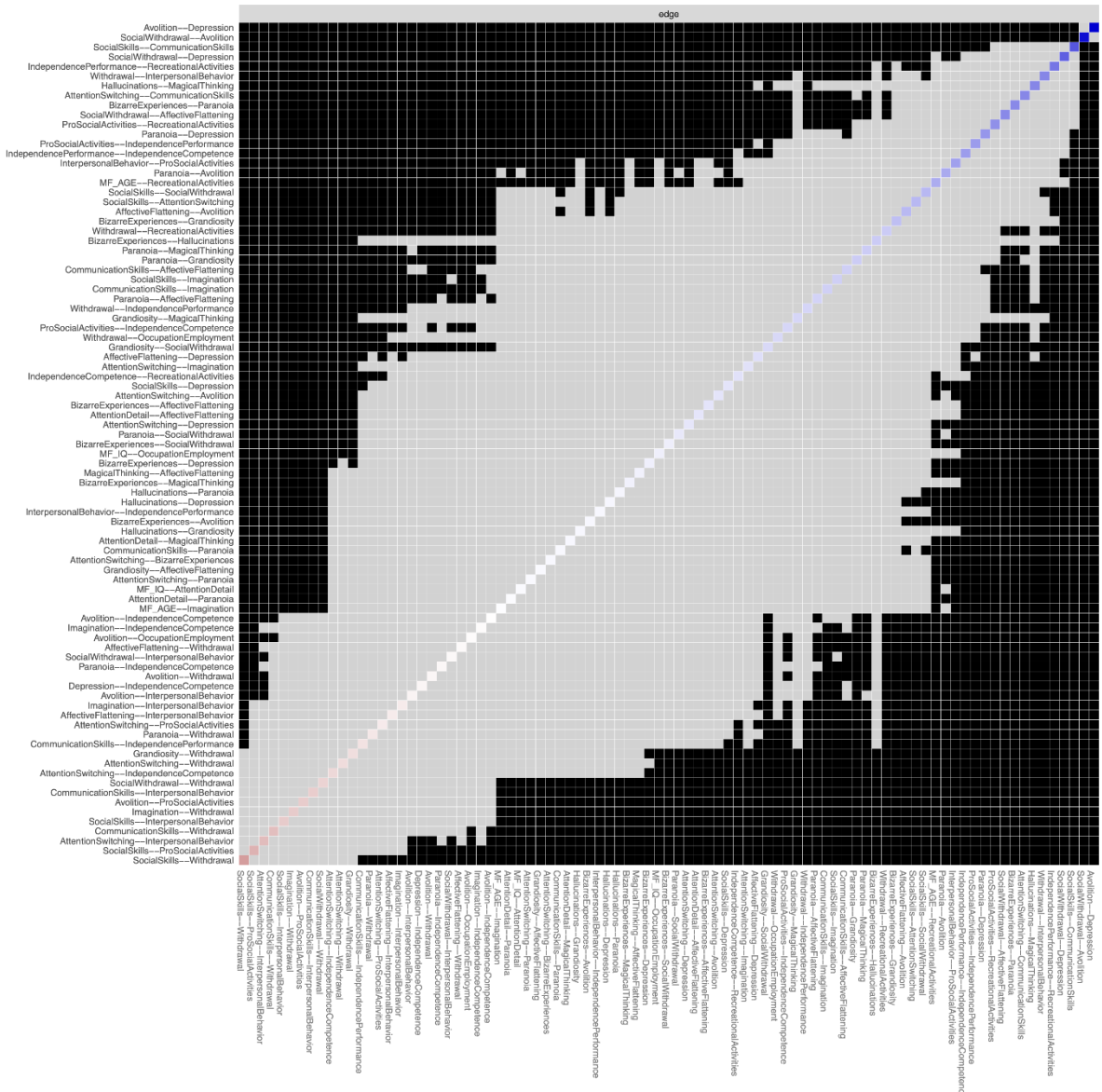
sFigure 6. Accuracy of *strength* centrality for the psychotic disorders (PD) network.



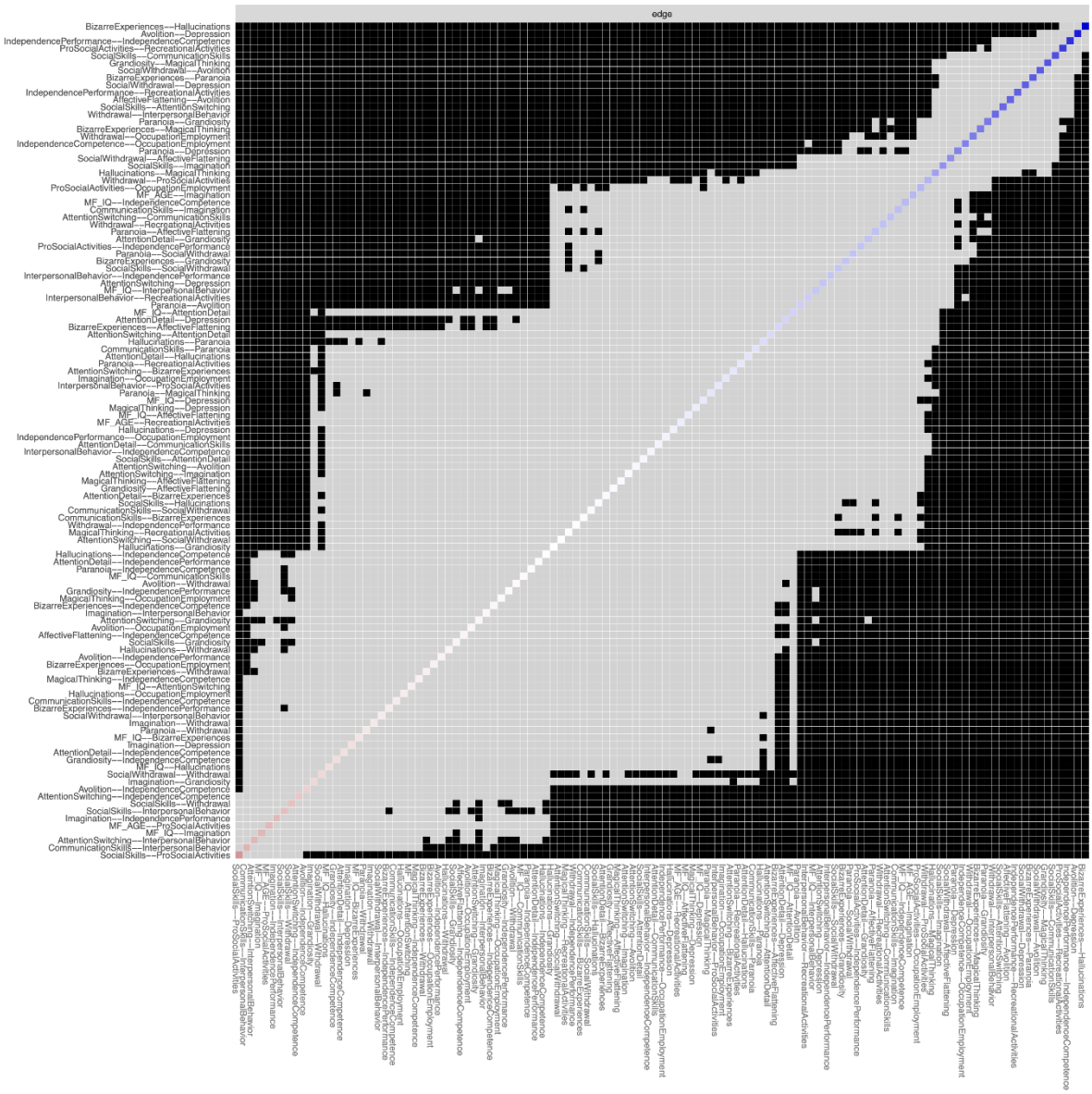
sFigure 7. Accuracy of *bridge strength* centrality for the familial risk (FR) network.



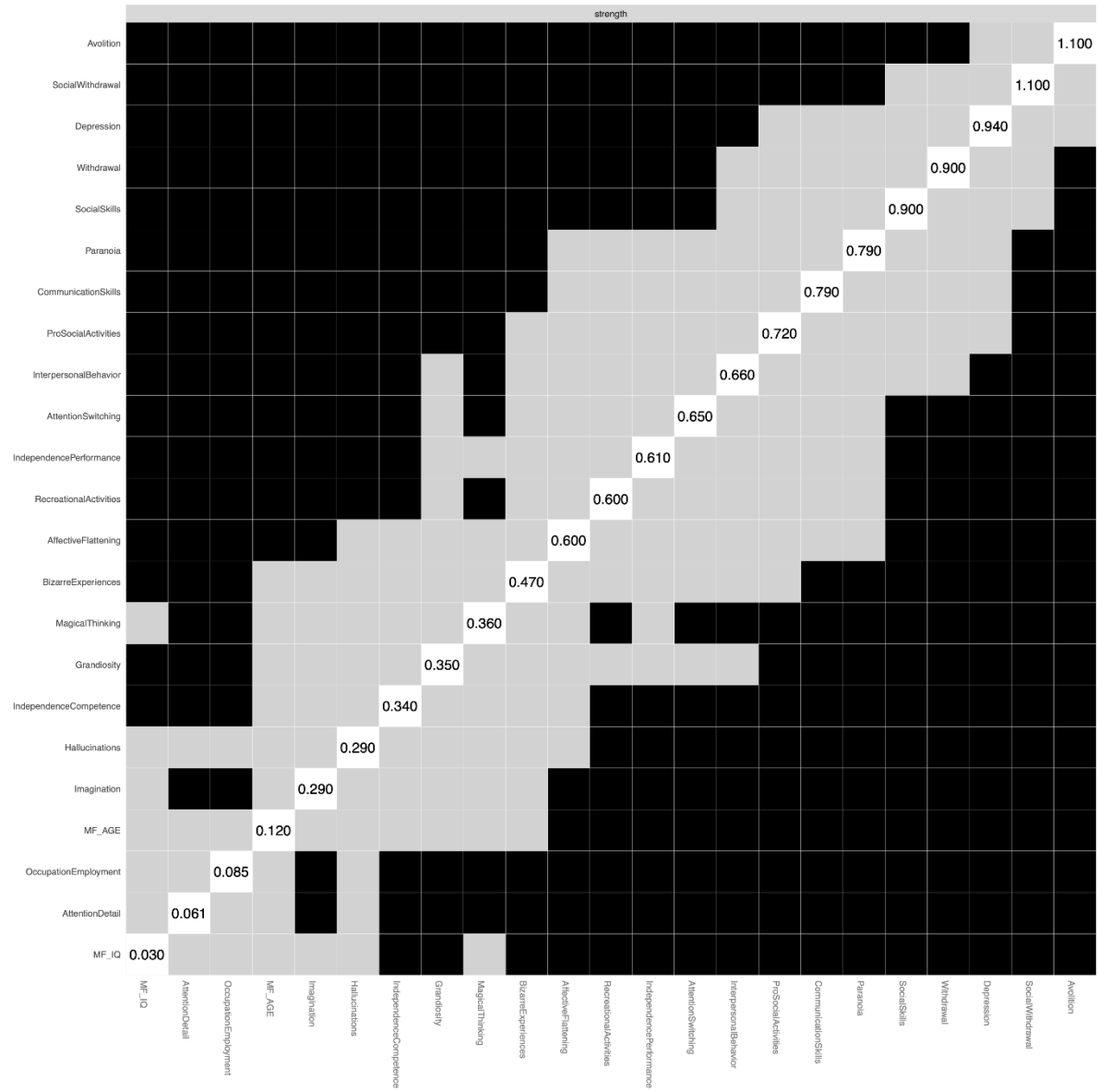
sFigure 8. Accuracy of *bridge strength* centrality for the psychotic disorders (PD) network.



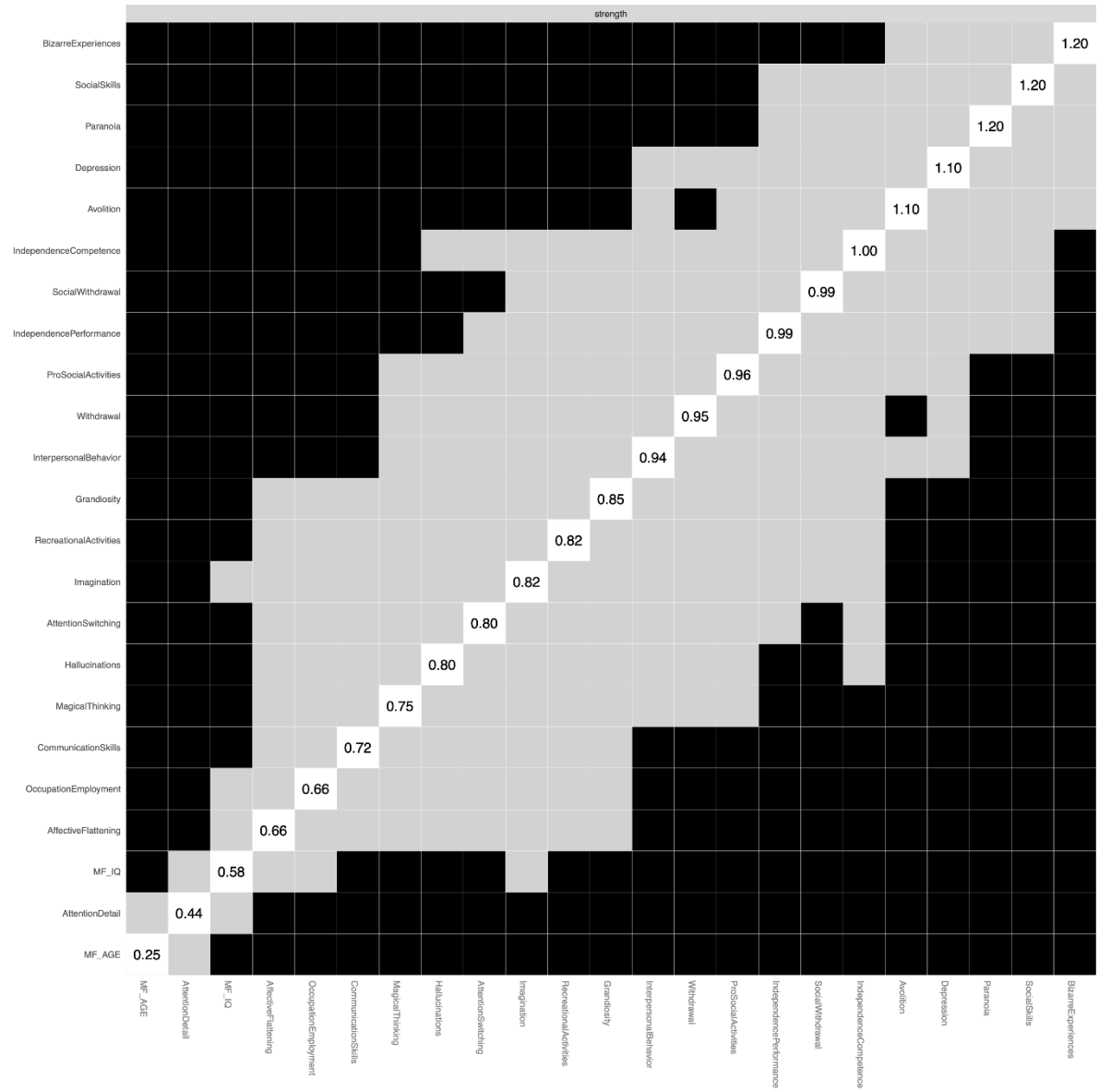
sFigure 9. Bootstrapped difference test for edge weights for the familial risk (FR) network. The significance difference testing (α=0.05) examines whether edges significantly differ from each other in strength. The color of the boxes indicates whether there is a significant difference (i.e., grey boxes reflect no significant differences and black boxes reflect significant differences).



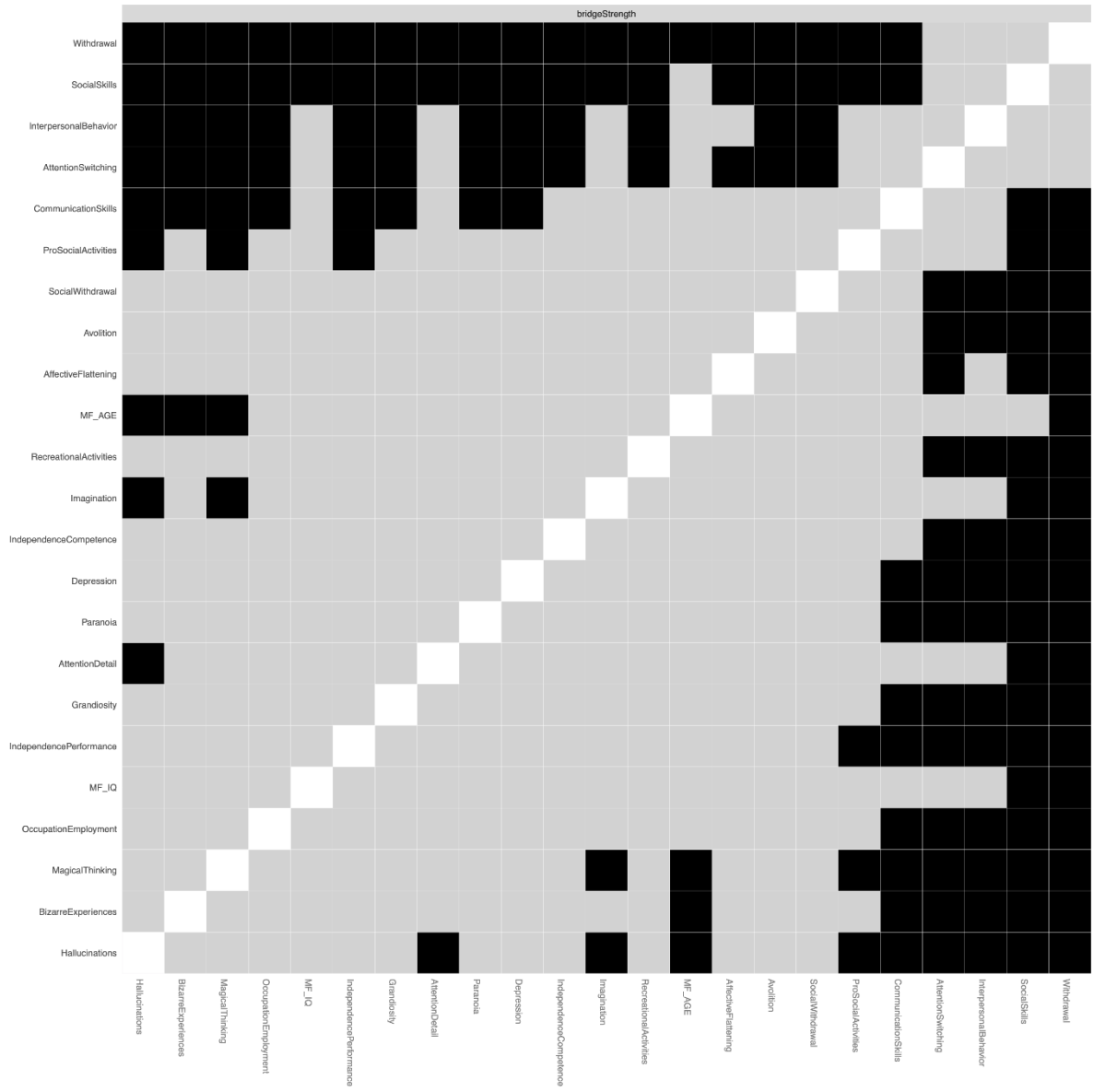
sFigure 10. Bootstrapped difference test for edge weights for the psychotic disorders (PD) network. The significance difference testing (α=0.05) examines whether edges significantly differ from each other in strength. The color of the boxes indicates whether there is a significant difference (i.e., grey boxes reflect no significant differences and black boxes reflect significant differences).



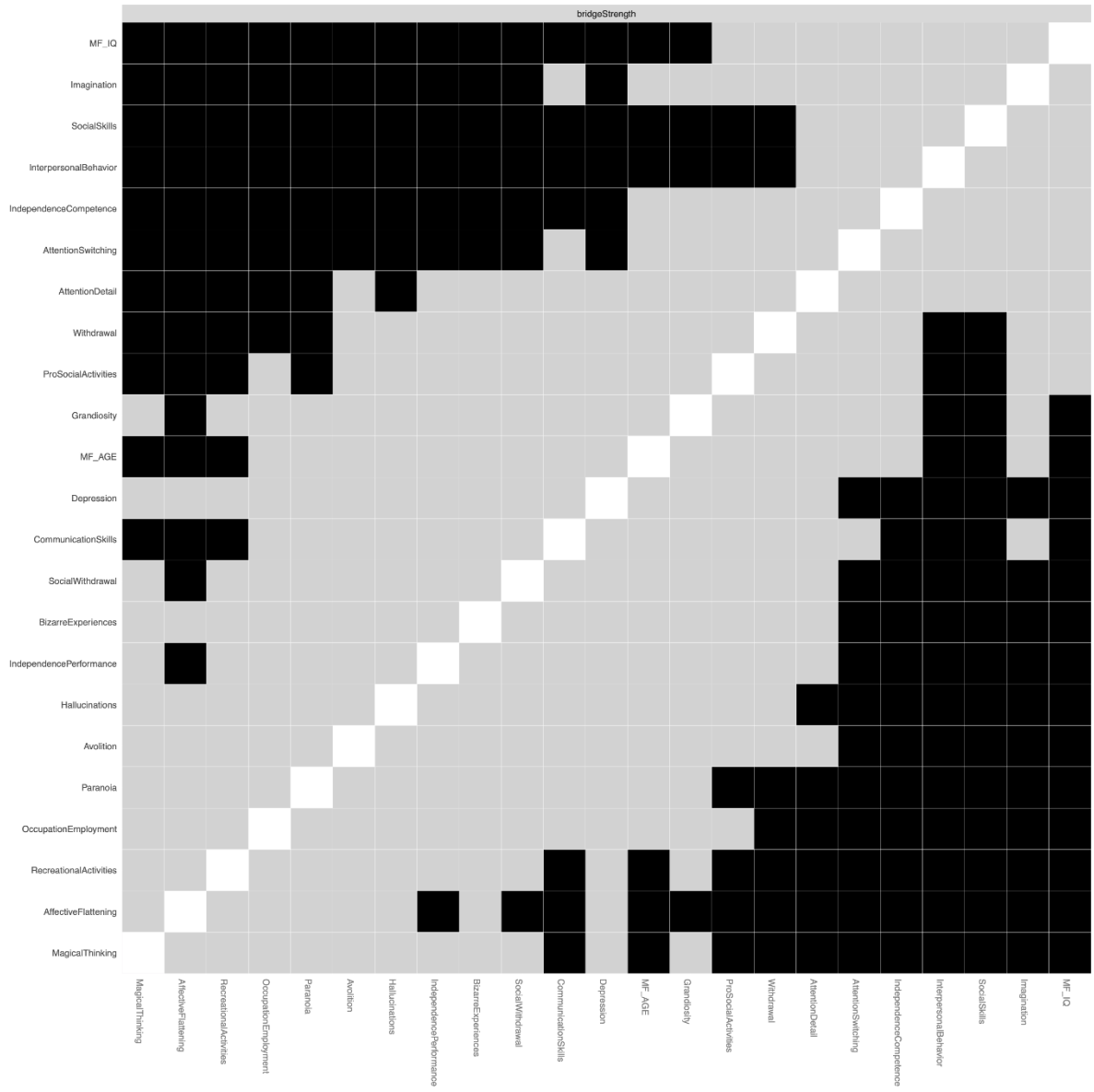
sFigure 11. Bootstrapped difference test for strength centrality for the familial risk (FR) network. The significance difference testing (α=0.05) examines whether nodes significantly differ from each other in strength centrality. The color of the boxes indicates whether there is a significant difference (i.e., grey boxes reflect no significant differences and black boxes reflect significant differences).



sFigure 12. Bootstrapped difference test for strength centrality for the psychotic disorders (PD) network. The significance difference testing (α=0.05) examines whether nodes significantly differ from each other in strength centrality. The color of the boxes indicates whether there is a significant difference (i.e., grey boxes reflect no significant differences and black boxes reflect significant differences).



sFigure 13. Bootstrapped difference test for bridge strength centrality for the familial risk (FR) network. The significance difference testing (α=0.05) examines whether nodes significantly differ from each other in bridge strength centrality. The color of the boxes indicates whether there is a significant difference (i.e., grey boxes reflect no significant differences and black boxes reflect significant differences).



sFigure 14. Bootstrapped difference test for bridge strength centrality for the psychotic disorders (PD) network. The significance difference testing (α=0.05) examines whether nodes significantly differ from each other in bridge strength centrality. The color of the boxes indicates whether there is a significant difference (i.e., grey boxes reflect no significant differences and black boxes reflect significant differences)**.**

sTable 1. Mean and standard deviation of scores for typical comparisons (TC), familial risk (FR), and psychotic disorders (PD) samples

Variable	Mean (SD) TC Sample	Mean (SD) FR Sample	Mean (SD) PD Sample
Age	38.51 (10.64)	34 (7.89)	33.38 (7.19)
IQ	115.31 (17.12)	111.61 (17.70)	100.79 (17.90)
Social Skills	1.75 (1.82)	1.97 (1.95)	3.56 (2.34)
Attention Switching	2.79 (2.01)	3.08 (1.97)	4.97 (2.21)
Attention to Detail	3.15 (1.93)	3.33 (1.87)	4.02 (2.20)
Communication Skills	1.82 (1.64)	1.97 (1.68)	3.27 (1.96)
Imagination	2.93 (1.77)	3.11 (1.80)	4.17 (1.99)
Bizarre Experiences	0.15 (0.74)	0.17 (0.66)	2.67 (3.80)
Hallucinations	0.06 (0.46)	0.04 (0.26)	1.34 (2.20)
Paranoia	0.85 (1.29)	1.00 (1.34)	3.04 (2.77)
Grandiosity	0.21 (0.68)	0.24 (0.67)	1.05 (1.48)
Magical Thinking	0.25 (0.70)	0.28 (0.78)	1.22 (1.57)
Social Withdrawal	2.02 (1.79)	2.27 (2.02)	3.90 (2.59)
Affective Flattening	0.71 (1.21)	0.93 (1.42)	2.32 (2.16)
Avolition	3.02 (2.56)	3.51 (3.06)	6.01 (4.14)
Depression	3.83 (3.29)	4.06 (3.33)	7.07 (4.75)
Withdrawal	13.27 (1.83)	12.99 (1.92)	10.73 (2.60)
Interpersonal Behavior	8.83 (0.59)	8.66 (0.85)	7.58 (1.69)
Prosocial Activities	27.04 (8.86)	26.22 (9.72)	20.32 (10.01)
Independence Performance	34.75 (3.90)	34.03 (4.32)	30.92 (5.83)
Independence Competence	38.62 (1.48)	38.70 (1.13)	36.40 (3.93)
Recreational Activities	27.25 (5.63)	25.86 (5.92)	22.61 (6.33)
Occupation Employment	9.58 (1.38)	9.46 (1.47)	6.64 (3.07)

sTable 2. Node names

Variable	**Node name**
Age	Age
IQ	IQ
Social Skills	A1
Attention Switching	A2
Attention to Detail	A3
Communication Skills	A4
Imagination	A5
Bizarre Experiences	P1
Hallucinations	P2
Paranoia	P3
Grandiosity	P4
Magical Thinking	P5
Social Withdrawal	N1
Affective Flattening	N2
Avolition	N3
Depression	D
Withdrawal	S1
Interpersonal Behavior	S2
Prosocial Activities	S3
Independence Performance	S4
Independence Competence	S5
Recreational Activities	S6
Occupation Employment	S7

sTable 3. Additional demographic and clinical data

	PD (504)	FR (572)	TC (337)	Statistic	P-value	Post-hoc[1]
Sex (% male)	365 (72.4)	254 (44.4)	153 (42.4)	$\chi^2 = 108.17$	<.001	PD > FR & TC
Age in years (sd)	33.4 (7.2)	34.0 (7.9)	38.5 (10.6)	$F = 30.89$	<.001	PD & FR < TC
Estimated IQ	100.7 (17.9)	111.5 (17.7)	115.4 (17.1)	$F = 83.15$	<.001	PD < FR < TC
DSM-IV Diagnosis[3]						
Schizophrenia	310 (61.5)	-	-			
Schizophreniform d.	36 (7.1)	-	-			
Schizoaffective d.	67 (13.3)	-	-			
Psychotic d.	79 (15.7)	-	-			
Delusional d.	12 (2.4)	-	-			
In remission > 6 month[4]						
yes / no / unknown	198 / 274 / 29					
Antipsychotic medication						
yes / no / unknown	345 / 4 / 155	-	-			

PD = psychotic disorder group; FR = familial risk group; TC = typical comparison group; [1]Games-Howell, $p < .05$; [2] Missing data: Age of onset – 1 PD; [3]Based on the Comprehensive Assessment of Symptoms and History (CASH) and the Schedules for Clinical Assessment for Neuropsychiatry (SCAN 2.1) at baseline, reported for schizophrenia spectrum only; [4]Based on PANSS remission tool.

Participant inclusion

Participant groups for this study consisted of patients diagnosed with schizophrenia or related PD, unaffected siblings with FR and TC individuals from the general population. Participants were recruited in 36 mental health care institutes in the Netherlands and Belgium. PD were identified through clinicians in the participating institutes by applying the following inclusion criteria: (1) age between 16 to 50 years, (2) meet DSM-IV-TR (American Psychiatric Association 2000) criteria for a non-affective psychotic disorder, (3) good command of the Dutch language, and (4) able and willing to provide informed consent. Siblings were not allowed to meet criteria for a lifetime diagnosis of any psychotic disorder at baseline. Healthy control participants had no lifetime diagnosis of a psychotic disorder at baseline and no first-degree relative with a lifetime psychotic disorder. For the purpose of the present study, we only included participants from the database (Data release 6.0) with available data on the Autism Spectrum Quotient (AQ) measured at the 6-year follow-up assessment (T3).