

# **Mental health, deprivation, and the neighbourhood environment: a network analysis**

## **Supplementary materials**

## **S1. Description of bootstrapped difference tests of network accuracy and stability.**

Edge weight accuracy refers to the degree of confidence with which we can interpret the ranking of the edge weights (strongest to weakest). To assess the accuracy of the networks, bootstrapped difference testing was performed (Epskamp, Borsboom, & Fried, 2017). This procedure takes the observed difference in edge values and constructs bootstrapped 95% confidence intervals (CIs) around these values. If the 95% CI crosses zero, this suggests the edges are not statistically different (Epskamp et al., 2017). Centrality reliability refers to the reliability of the rank ordering of the centrality indices. This was examined using the case-dropping subset bootstrap method (Epskamp et al., 2017); networks were re-estimated using increasingly smaller subsets of the original sample, and correlations between the original centrality indices and the subset centrality indices were calculated. A small-to-moderate decrease in correlation as participants are removed suggests that the order of centrality is relatively stable/reliable. This can be quantified in the form of the correlation stability coefficient, with values above 0.7 deemed to reflect high centrality reliability, and values between 0.25 and 0.7 denoting moderate reliability (Epskamp et al., 2017). Accuracy and reliability analyses were conducted using the R package ‘bootnet’, based on 1,000 bootstrapped samples (Epskamp et al., 2017).

## **S2. Description of network comparison tests.**

NCT allows for the comparison of specific edges across networks, and tests invariance in overall connectivity (i.e. global strength). This procedure is carried out in three phases. First, the two networks in question are estimated and the relevant test statistics are calculated (van Borkulo et al., 2016). For individual edges, the test statistic is the observed difference in edge weight. For invariance in overall connectivity, the test statistic is the difference in global-strength (i.e., difference in sum of edge weights of two networks). For structural invariance, the statistic is the largest individual difference in edge strength observed between the two networks. Second, cases are repeatedly and randomly swapped between networks, and the test statistics re-estimated. Third, a reference distribution is created from these test statistics and statistical significance is determined, with the  $p$ -value equal to the proportion of test statistics that have an equal or higher value than the observed test statistic (van Borkulo et al., 2016). Networks were compared using 1,000 random permutations.

**Table S1. Labels scoring and frequencies of items**

Label	Question	Scoring*	Frequency (N = 3,670)
<i>Depression</i>			
Intr	Q64/1. Little interest or pleasure in doing things?	1 = Not at all 2 = Several days 3 = More than half the days 4 = Nearly every day	0 = 3018 (82%) 1 = 652 (18%)
Dep	Q64/2. Feeling down, depressed, or hopeless?	“	0 = 3227 (88%) 1 = 443 (12%)
Slp	Q64/3. Trouble falling or staying asleep, or sleeping too much?	“	0 = 2895 (79%) 1 = 775 (21%)
Tired	Q64/4. Feeling tired or having little energy?	“	0 = 2817 (78%) 1 = 853 (22%)
Appt	Q64/5. Poor appetite or overeating?	“	0 = 3176 (87%) 1 = 494 (13%)
Glt	Q64/6. Feeling bad about yourself - or that you are a failure or have let yourself or your family down	“	0 = 3286 (90%) 1 = 384 (10%)
Con	Q64/7. Trouble concentrating on things, such as reading the newspaper or watching television?	“	0 = 3263 (89%) 1 = 407 (11%)
Mov	Q64/8. Moving or speaking so slowly that other people could have noticed? Or the opposite - being so fidgety or restless that you have been moving around a lot more than usual?	“	0 = 3368 (92%) 1 = 302 (8%)
Sui	Q64/9. Thoughts that you would be better off dead, or of hurting yourself in some way?	“	0 = 3488 (95%) 1 = 182 (5%)
<i>Paranoia</i>			
Decv	Q67/1. My friends often tell me to relax and stop worrying about being deceived or harmed.	1 = Strongly disagree 2 = Disagree 3 = Neither agree or disagree 4 = Agree 5 = Strongly agree	0 = 3080 (84%) 1 = 587 (16%)
Susp	Q67/2. I'm often suspicious of other people's intentions towards me	“	0 = 3130 (85%) 1 = 540 (15%)
Lied	Q67/3. People will almost certainly lie to me.	“	0 = 3169 (86%) 1 = 501 (14%)
Hurt	Q67/4. I believe that some people want to hurt me deliberately.	“	0 = 3500 (95%) 1 = 170 (5%)
Self	Q67/5. You should only trust yourself.	“	0 = 3001 (82%) 1 = 669 (18%)

Auditory hallucinations

Voi	Q66/1. I have been troubled by hearing voices in my head	“	0 = 3577 (97%) 1 = 93 (3%)
Tht	Q66/2. I often hear a voice speaking my thoughts aloud	“	0 = 3558 (97%) 1 = 112 (3%)

Social connectivity

Liv	Q1A. How many people live here including you?	Range = 1 – 10**	0 = 2584 (70%) 1 = 1086 (30%)
Help	Q21/1. How much do you agree or disagree with the following statements? : If I needed help, there are people who would be there for me	1 = Definitely disagree  2 = Tend to disagree 3 = Tend to agree 4 = Definitely agree	0 = 174 (5%) 1 = 3496 (95%)
Comp	Q21/2. How much do you agree or disagree with the following statements? : If I wanted company or to socialise, there are people I can call on	“	0 = 183 (5%) 1 = 3487 (95%)

Generalized Anxiety

Nerv	Q65/1. Feeling nervous, anxious or on edge?	1 = Not at all  2 = Several days 3 = More than half the days 4 = Nearly every day	0 = 3302 (90%) 1 = 368 (10%)
Worry 1	Q65/2. Not being able to stop or control worrying?	“	0 = 3212 (88%) 1 = 458 (12%)
Worry 2	Q65/3. Worrying too much about different things?	“	0 = 3103 (85%) 1 = 567 (15%)
Rel	Q65/4. Trouble relaxing?	“	0 = 3178 (87%) 1 = 492 (13%)
Rst	Q65/5. Being so restless that it is hard to sit still?	“	0 = 3281 (89%) 1 = 389 (11%)
Irr	Q65/6. Becoming easily annoyed or irritable?	“	0 = 3215 (88%) 1 = 455 (12%)
Fear	Q65/7. Feeling afraid as if something awful might happen?	“	0 = 3382 (92%) 1 = 288 (8%)

Neighbourhood cohesion

Blng	Q24. Using the answers on this card, please tell me how strongly you feel you belong to your immediate neighbourhood?	1 = Not at all strongly 2 = Not very strongly 3 = Fairly strongly 4 = Very strongly	0 = 587 (16%) 1 = 3083 (84%)
Trust	Q25/1. How comfortable would you be with the following? : Asking a neighbour to keep a set of keys to your home for emergencies, for example if you were locked out	1 = Very uncomfortable 2 = Fairly uncomfortable 3 = Fairly comfortable 4 = Fairly comfortable	0 = 954 (26%) 1 = 2716 (74%)
Look	Q27. Would you say this neighbourhood is a place where neighbours look out for each other?	1 = No 2 = Yes to some extent 3 = Yes definitely	0 = 512 (14%) 1 = 3158 (86%)
Infl	Q34. Do you agree or disagree that you can influence decisions affecting your local area?	1 = Definitely disagree 2 = Tend to disagree 3 = Tend to agree 4 = Definitely agree	0 = 1985 (54%) 1 = 1712 (46%)

Neighbourhood disorder

Drnk	Q28/1. People being drunk or rowdy in public places	1 = not a problem at all 2 = Not a very big problem 3 = Fairly big problem 4 = Very big problem	0 = 566 (15%) 1 = 3104 (85%)
Rub	Q28/2. Rubbish or litter lying around	“	0 = 2529 (69%) 1 = 1141 (31%)
Vand	Q28/3. Vandalism, graffiti and other deliberate damage to property or vehicles	“	0 = 384 (10%) 1 = 3286 (90%)
Min	Q28/4. People being attacked or harassed because of their skin colour, ethnic origin or religion	“	0 = 3479 (95%) 1 = 191 (5%)
Tngr	Q28/5. Teenagers hanging around on the street	“	0 = 2928 (80%) 1 = 742 (20%)
Trb	Q28/6. Troublesome neighbours	“	0 = 3435 (94%) 1 = 235 (6%)

\*Broken lines indicate placement of binary split; above line = 0; below line = 1. \*\* dichotomised as 0 = lives with someone; 1 = lives alone. “ = same as above.

Table S2. Mean scores and standard deviations for mental health measures and IMD based on level of deprivation

	Full Sample (N=3670)		Low deprivation (n=1310)		Moderate deprivation (n=1192)		High deprivation (n=1168)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
PHQ-9	4.44	5.59	3.25	4.39	4.81	5.85	5.40	6.25
GAD-7	3.32	4.82	2.40	3.81	3.49	4.99	4.18	5.45
PaDS	4.46	4.28	3.81	3.86	4.97	4.32	5.21	4.55
Launay-Slade Hallucination Scale	0.54	1.27	0.40	1.06	0.68	1.38	0.57	1.35
Index of Multiple Deprivation	39.65	21.06	17.31	9.84	40.40	5.54	63.95	10.29

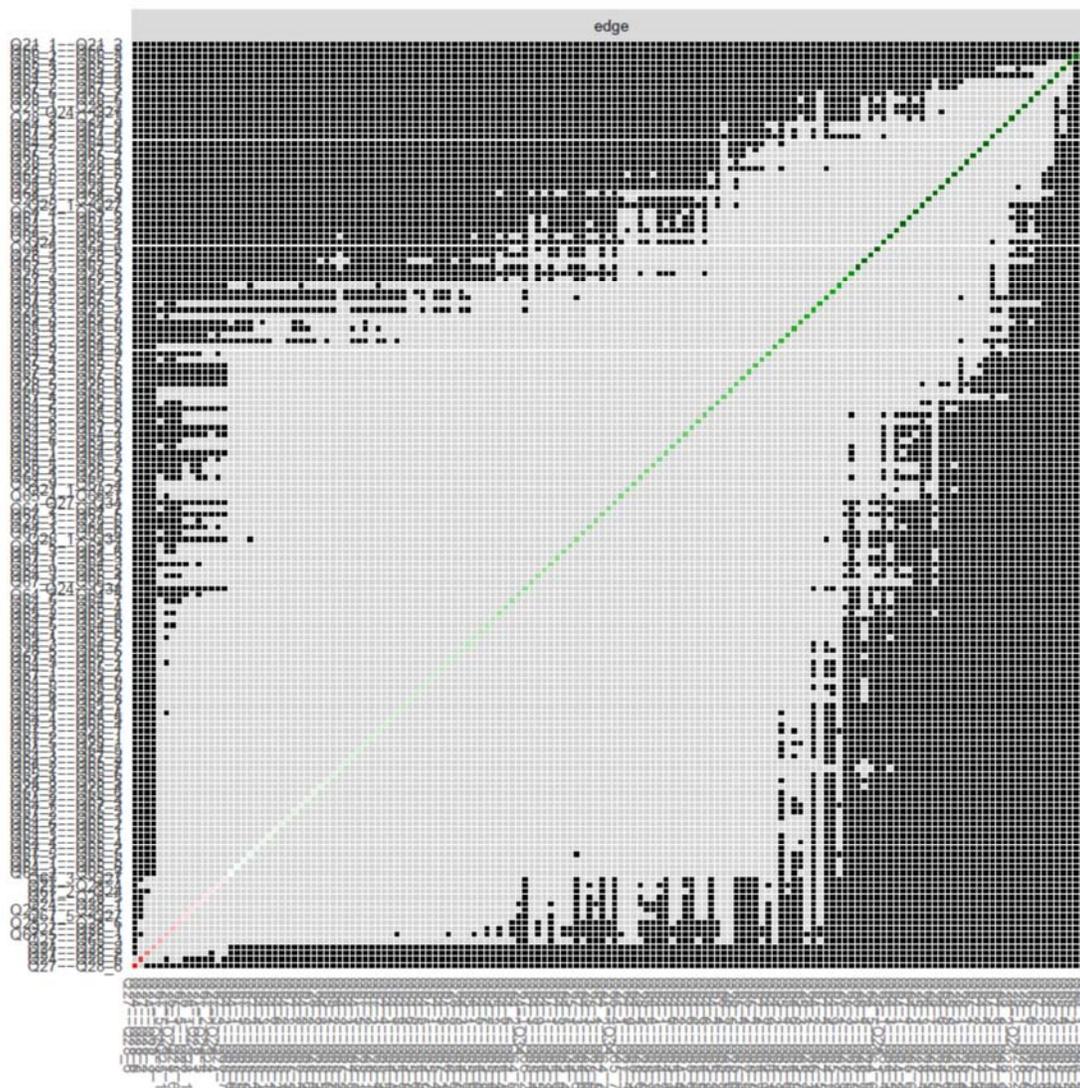


Fig S1. Bootstrapped difference tests between non-zero edges. Black squares indicate significant differences between edges ( $\alpha = 0.05$ ), whereas grey boxes indicate no significant difference.

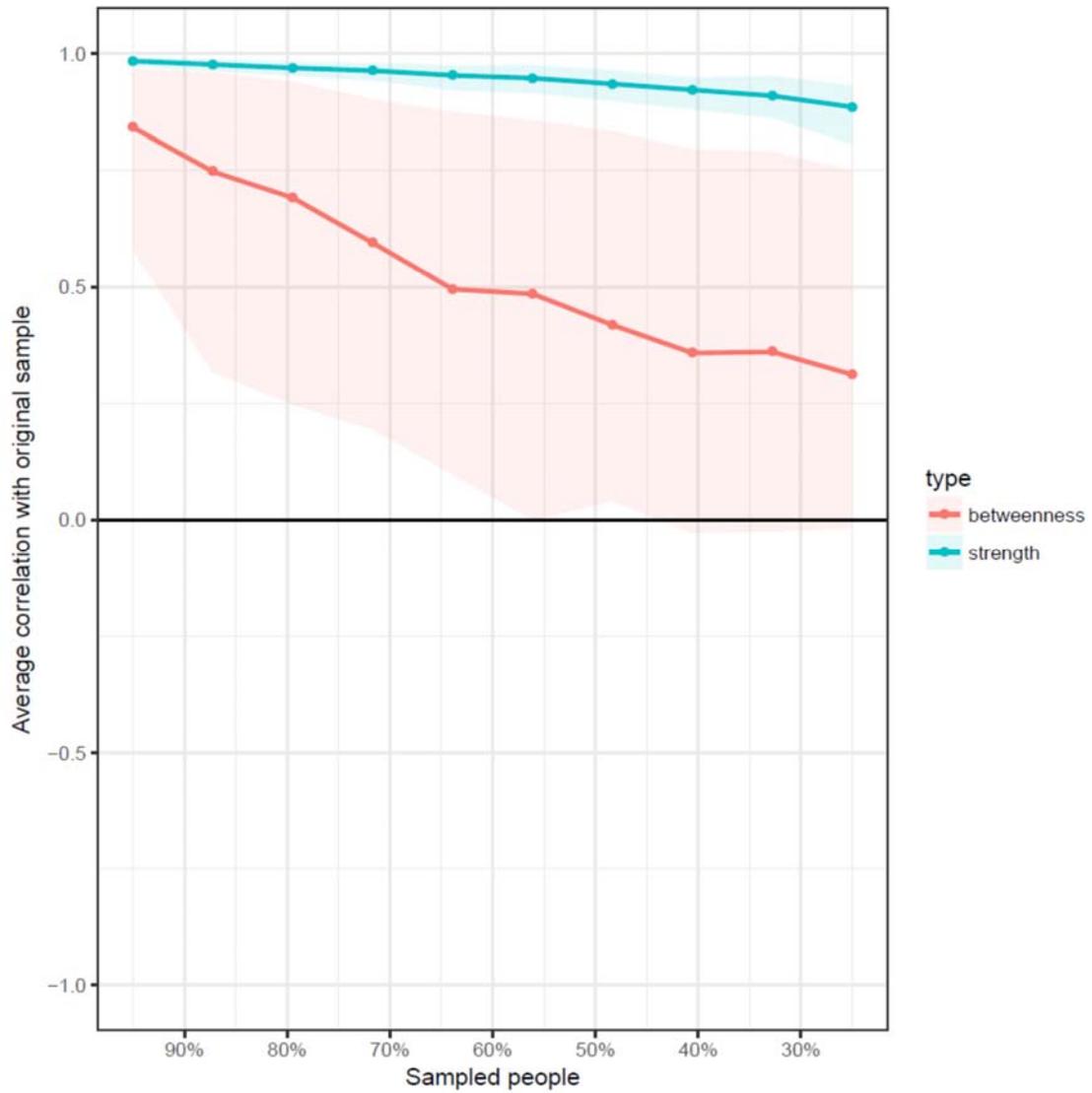


Fig S2. Mean correlations between centrality values of original sample and sub samples with different percentages of persons dropped. Lines reflect means and areas around the lines reflect 95% CIs.

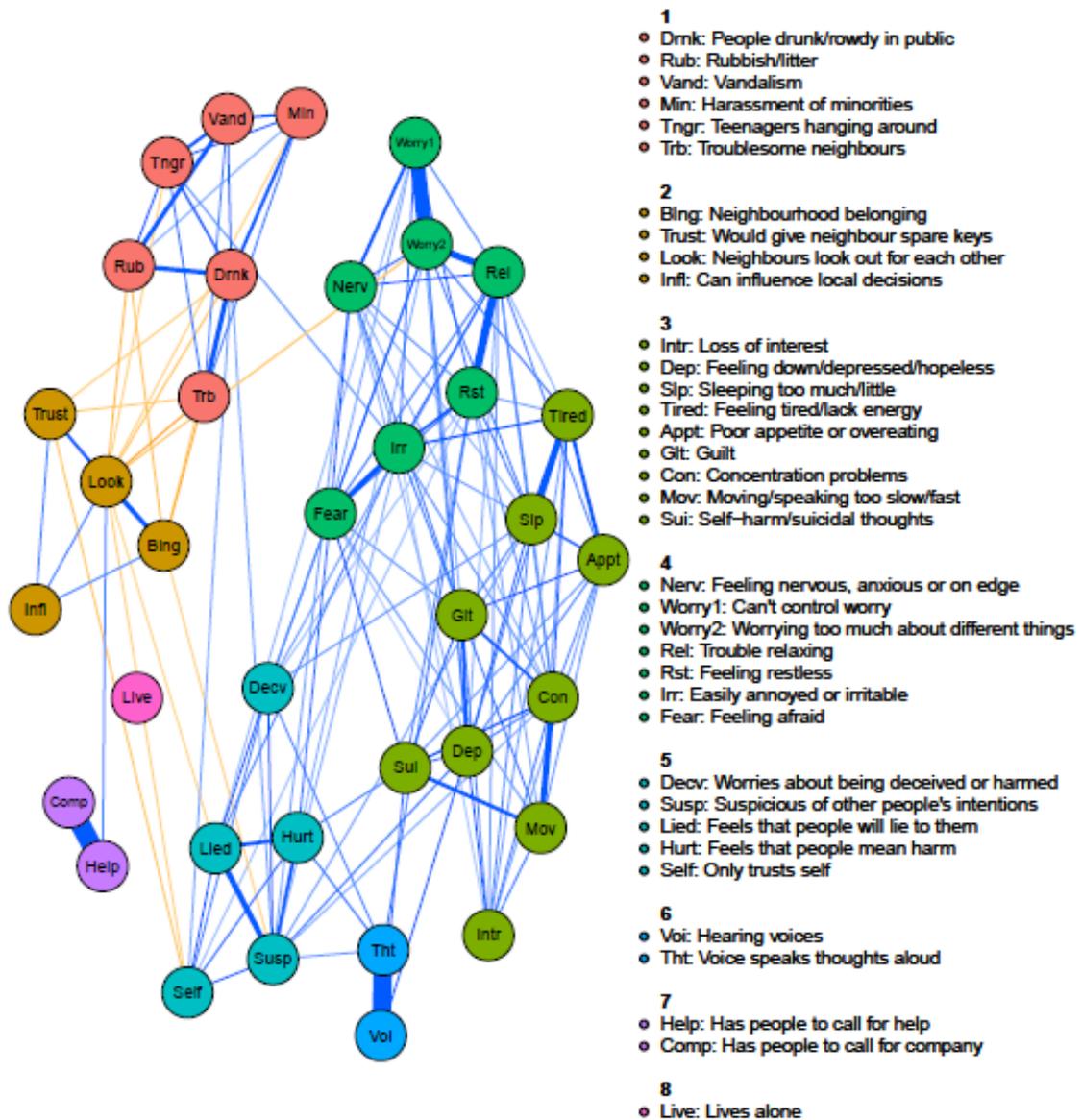


Fig S3. Clustering structure identified using walktrap algorithm.

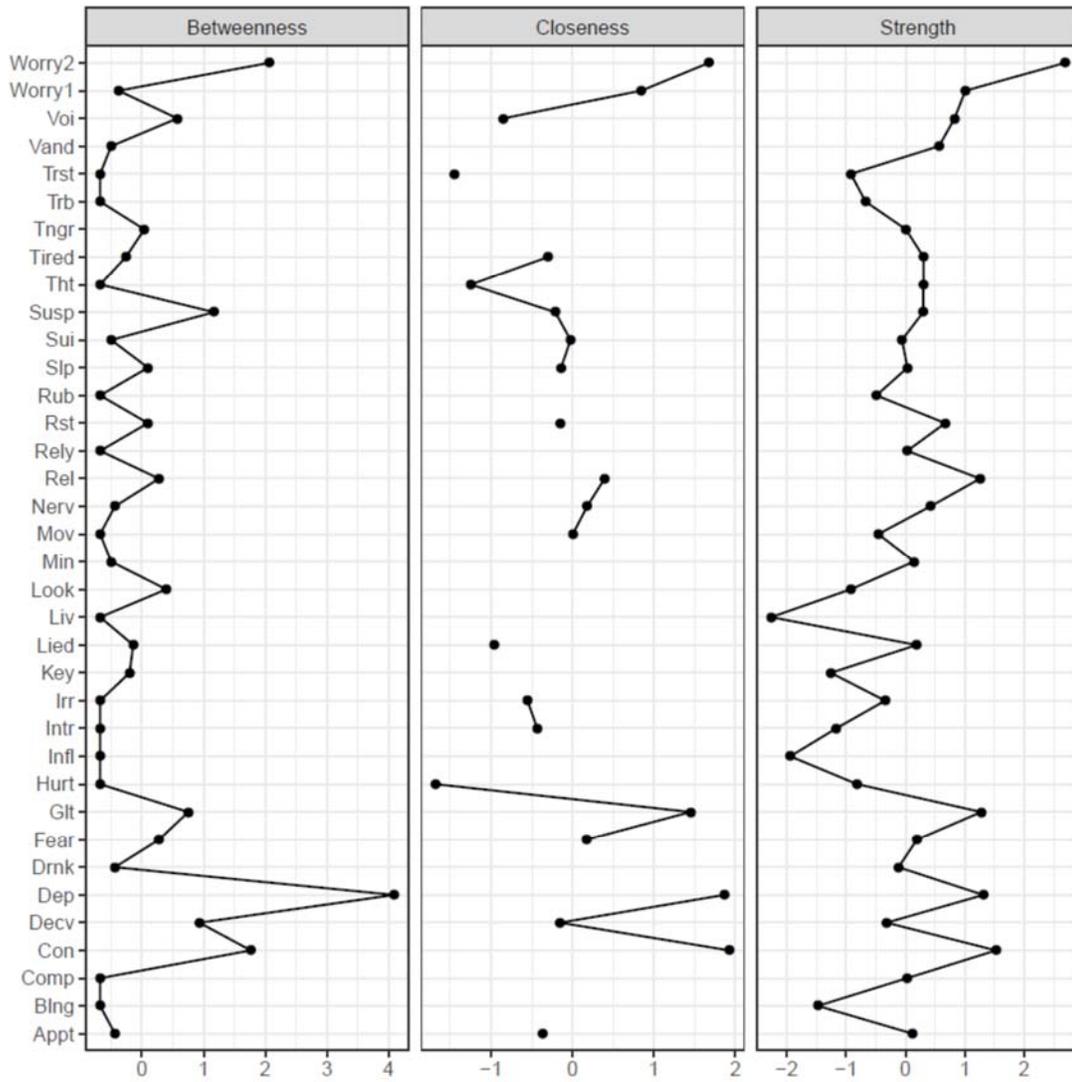


Fig S4. Centrality values for low deprivation subsample (n=1,310). Values presented as Z-scores.

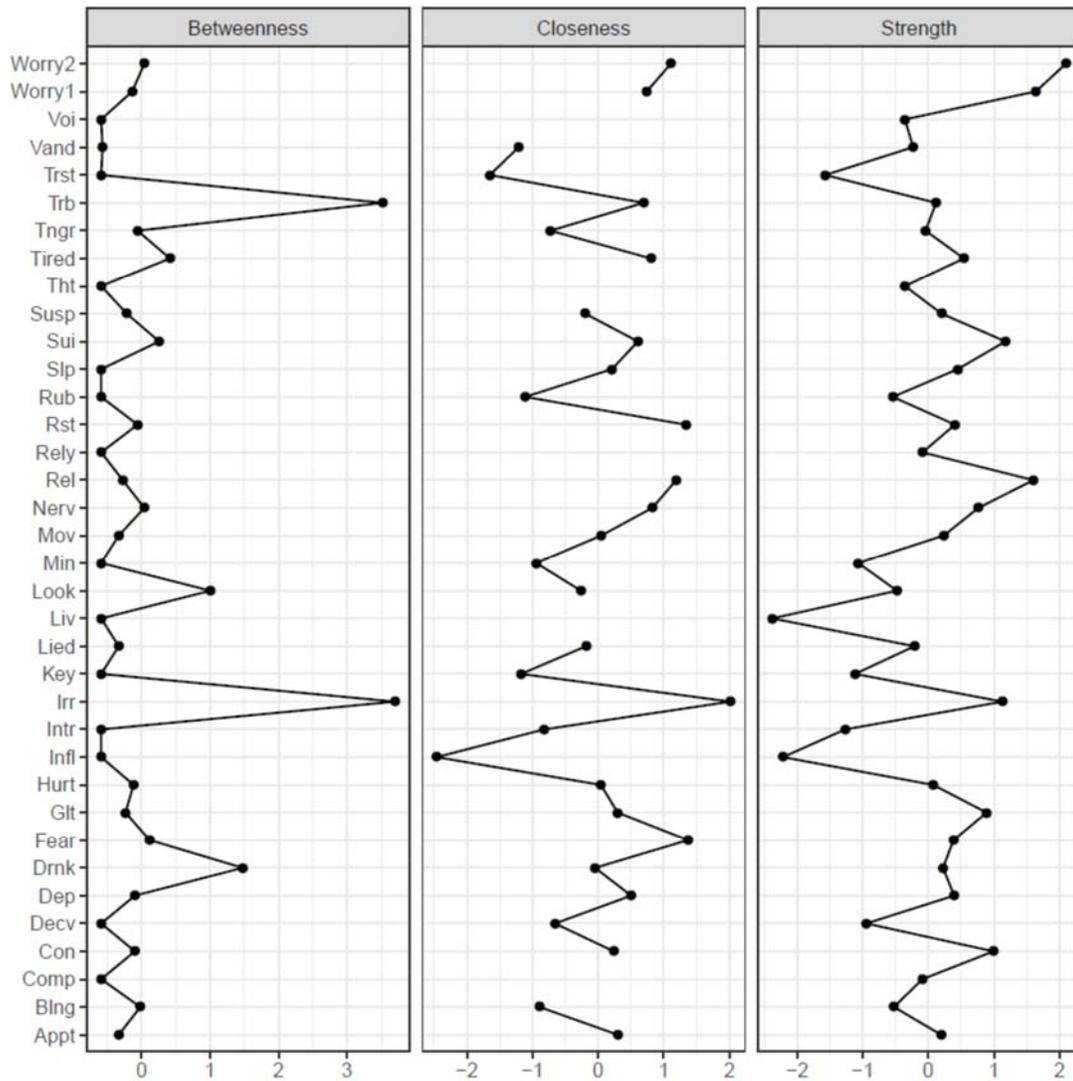


Fig S5. Centrality values for mid deprivation subsample (n=1,192). Values presented as Z-scores.

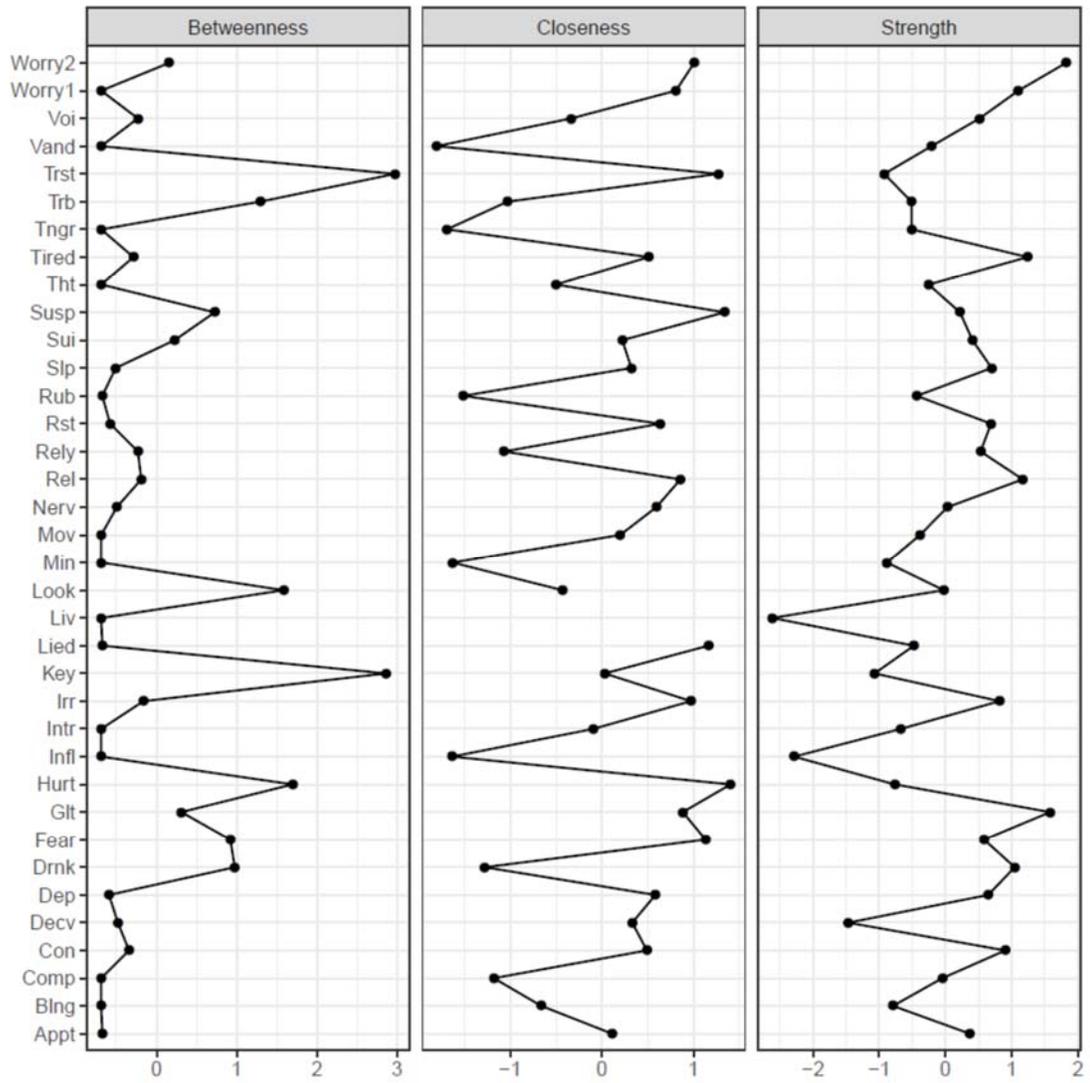


Fig S6. Centrality values for high deprivation subsample (n=1,168). Values presented as Z-scores.

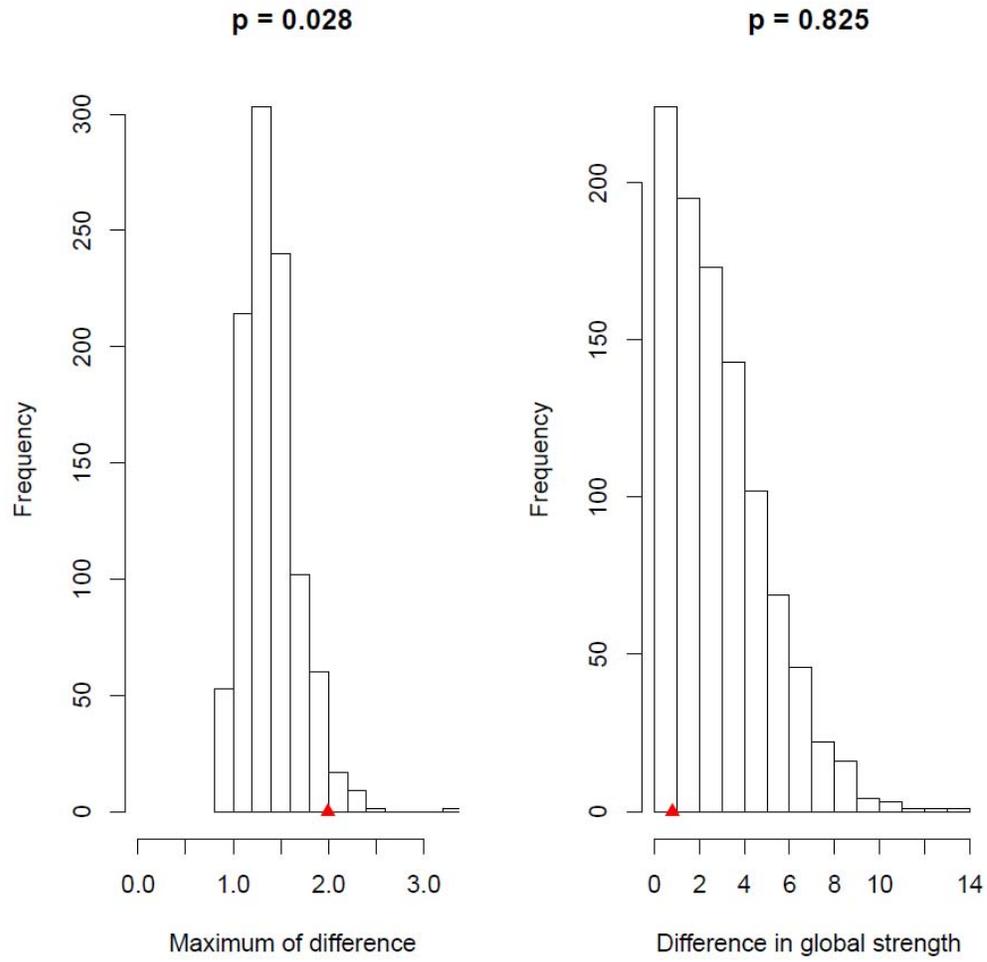


Figure S7. Reference distributions created by non-parametric permutation tests. Red marker indicates observed difference.