Supplementary materials for

Graph theory approaches to functional network organization in brain disorders: A critique for a brave new small-world

Michael N. Hallquist

and

Frank G. Hillary

Table S1. Parameters used in network simulations

Simulation	Parameter	Description	Value
Whack-a-node *hyper*-connectivity	σ_b	Between-person variation in mean FC	.2
	σ_w	Within-person variation in FC	.2
	σ_e	Edge noise	.2
	$\mu_{a_i}, i \in P$	Mean shift in Positive node targets in patient group	.14
	$\sigma_{a_i}, i \in P$	Between-person variation in FC shifts for Positive targets	.07
	$\sigma_{v_i}, i \in P$	Within-person variation in FC variation of Positive node *i* across its neighbors, *j*	.07
	$\mu_{a_i}, i \in N$	Mean shift in Negative node targets in patient group	-.04
	$\sigma_{a_i}, i \in N$	Between-person variation in FC shifts for Negative targets	.02
	$\sigma_{v_i}, i \in N$	Within-person variation in FC variation of Positive node *i* across its neighbors, *j*	.02
Whack-a-node *hypo*-connectivity	σ_b	Between-person variation in mean FC	.2
	σ_w	Within-person variation in FC	.2
	σ_e	Edge noise	.2
	$\mu_{a_i}, i \in P$	Mean shift in Positive node targets in patient group	.04
	$\sigma_{a_i}, i \in P$	Between-person variation in FC shifts for Positive targets	.02
	$\sigma_{v_i}, i \in P$	Within-person variation in FC variation of Positive node *i* across its neighbors, *j*	.02
	$\mu_{a_i}, i \in N$	Mean shift in Negative node targets in patient group	-.14
	$\sigma_{a_i}, i \in N$	Between-person variation in FC shifts for Negative targets	.07
	$\sigma_{v_i}, i \in N$	Within-person variation in FC variation of Positive node *i* across its neighbors, *j*	.07
Global insensitivity	σ_b	Between-person variation in mean FC	.2
	σ_w	Within-person variation in FC	.2
	σ_e	Edge noise	.2
	$\mu_{a_i}, i \in$ FP, DAN	Mean shift in between-module connectivity of F-P and DAN nodes in control group	.1
	$\sigma_{a_i}, i \in$ FP, DAN	Between-person variation in between-module connectivity of FP and DAN nodes in control group	.05
	$\sigma_{v_i}, i \in$ FP, DAN	Within-person variation in between-module connectivity of FP and DAN nodes in control group	.05
	$\mu_{a_i}, i \in$ FP, DAN	Mean shift in within-module connectivity of F-P and DAN nodes in control group	.2
	$\sigma_{a_i}, i \in$ FP, DAN	Between-person variation in within-module connectivity of FP and DAN nodes in control group	.1
	$\sigma_{v_i}, i \in$ FP, DAN	Within-person variation in within-module connectivity of FP and DAN nodes in control group	.1
	$\mu_{a_i}, i \in$ DMN	Mean shift in between-module connectivity of DMN nodes in patient group	.1
	$\sigma_{a_i}, i \in$ DMN	Between-person variation in between-module connectivity of DMN nodes in patient group	.05
	$\sigma_{v_i}, i \in$ DMN	Within-person variation in between-module connectivity of DMN nodes in patient group	.05
	$\mu_{a_i}, i \in$ DMN	Mean shift in within-module connectivity of DMN nodes in patient group	.2
	$\sigma_{a_i}, i \in$ DMN	Between-person variation in within-module connectivity of DMN nodes in patient group	.1

σ_{v_i} , $i \in$ DMN	Within-person variation in within-module connectivity of DMN nodes in patient group	.1

Note. P = Positive targets (3 per simulation); *N* = Negative targets (3 per simulation); FP = frontoparietal network; DAN = dorsal attention network; DMN = default mode network.

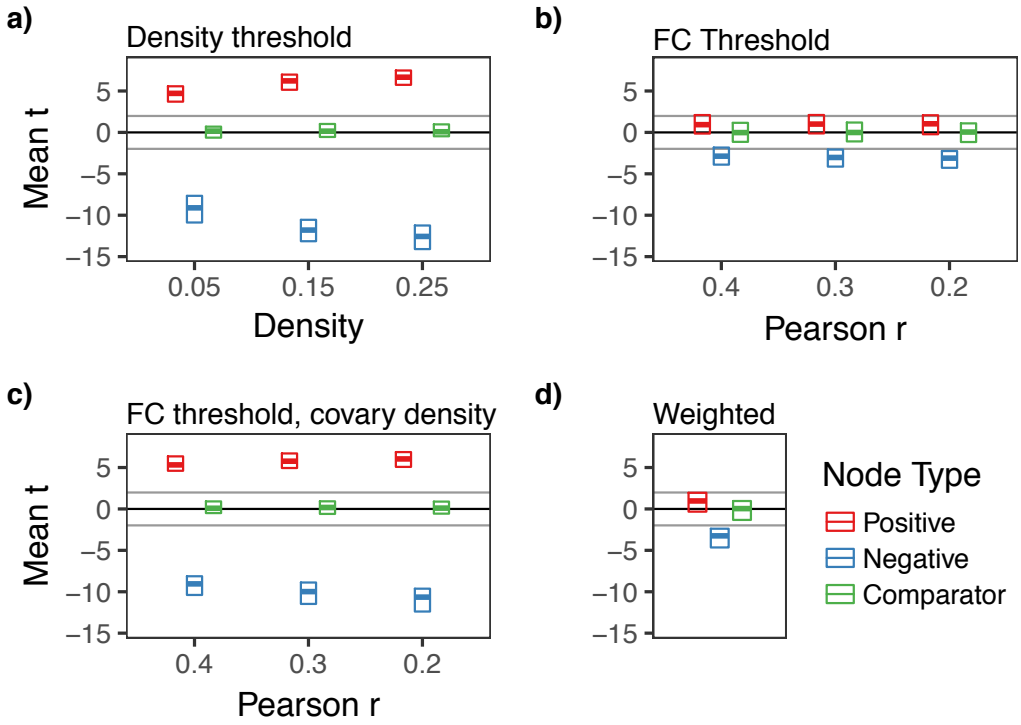

Figure S1. The effect of thresholding method on group differences in degree centrality when there is strong hypoconnectivity in three randomly selected nodes (Negative) and weak hyperconnectivity in three nodes (Positive). For simulation details, see Table S1, Whack-a-node hypoconnectivity. The central bar of each rectangle denotes the median *t* statistic (patient – control) across 100 replication datasets (patient $n = 50$, control $n = 50$), whereas the upper and lower boundaries denote the 90th and 10th percentiles, respectively. The dark line at $t = 0$ reflects no mean difference between groups, whereas the light gray lines at $t = -1.99$ and 1.99 reflect group differences that would be significant at $p = .05$. a) Graphs binarized at 5%, 15%, and 25% density. b) Graphs binarized at $r = \{.2, .3, .4\}$. c) Graphs binarized at $r = \{.2, .3, .4\}$, with density included as a between-subjects covariate. d) Strength centrality (weighted graphs).

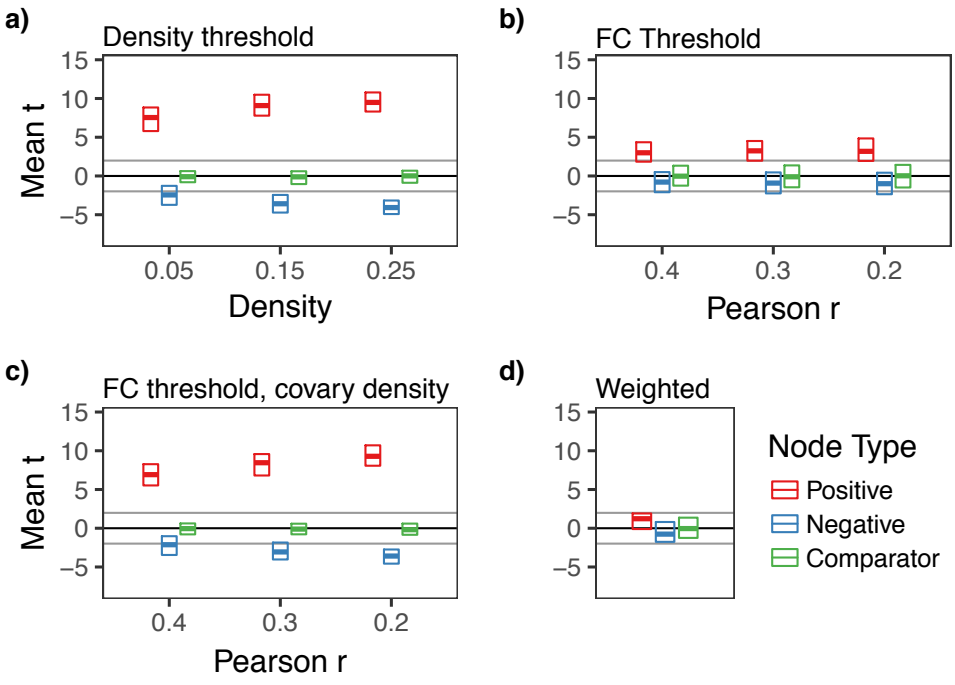

Figure S2. The effect of thresholding method on group differences in degree centrality when there is strong hyperconnectivity in three randomly selected nodes (Positive) and weak hypoconnectivity in three nodes (Negative). Relative to Figure 1, this simulation applied *proportional* changes to FC such that edges were shifted as a fraction of their original strength, rather than shifting edges by an absolute amount (i.e., in correlational units). Thus, FC for positive nodes was increased by 14%, on average, whereas negative nodes were decreased by 4%. All simulation parameters are identical to Table S1, Whack-a-node hyperconnectivity, but with changes applied *proportionately.*

The central bar of each rectangle denotes the median *t* statistic (patient – control) across 100 replication datasets (patient n = 50, control n = 50), whereas the upper and lower boundaries denote the 90th and 10th percentiles, respectively. The dark line at t = 0 reflects no mean difference between groups, whereas the light gray lines at t = -1.99 and 1.99 reflect group differences that would be significant at p = .05. a) Graphs binarized at 5%, 15%, and 25% density. b) Graphs binarized at r = {.2, .3, .4}. c) Graphs binarized at r = {.2, .3, .4}, with density included as a between-subjects covariate. d) Strength centrality (weighted graphs).