Supplementary material

Methods

Network topological analysis

'Strength', which reflected, on average, the sum of all neighboring link weights of individual nodes. Strength of a node *i* can be computed as the sum of the connectivity weights of the edges attached to each node *i* [1, 2],

$$s_i = \sum_{j \in N, i \neq j} w_{ij} \quad \textbf{[S1]}$$

Where *k* is a proportion, it varies between zero and one, where k=0 indicates that no connections are present, k=1 indicates that the network is fully connected, and $0<k<1$ represents the fraction of all possible connections that are present in the network.

Global brain network segregation was assessed via the calculation of clustering coefficient. 'Clustering coefficient', a measure of the propensity of the network, formed clusters that was computed as the average fraction of triangles out of all connected triples [3]. The clustering coefficient of a node $0<C_i<1$ is a ratio that defines the proportion of possible connections that actually exist between the nearest neighbors of a node, reflecting the large-scale network segregation [3, 4]

$$C_i = \sum_{i \in G} \frac{\sum_{i,h \in G} (W_{ij} W_{ih} W_{jh})^{1/3}}{k_i (k_i - 1)/2} \quad \textbf{[S2]}$$

Where k_i is the degree of node *i*, and the W_{ij} is the weight between node *i*, and node *j* in the network. The mean clustering coefficient of network *C* is the average over each node's clustering coefficient, reflecting the level of local connectedness of a node.

$$C = \frac{1}{N} C_i \quad \textbf{[S3]}$$

Brain network integration was assessed using characteristic path length. Characteristic path length represented the average of shortest paths between brain regions in the network. The increase in average path length represented loss of network integration. The characteristic path length (L_p) is the mean minimal travel distance between nodes in the network, reflecting the large-scale integration[4, 5]

$$L_p = \frac{1}{N(N-1)} \sum_{i \neq j} \min\{L_{i,j}\} \quad \textbf{[S4]}$$

Where $\min\{L_{i,j}\}$ is the shortest path length between the *i*th node and the *j*th node.

'Nodal efficiency' reflected the extent of fault tolerant and the robustness of the network after deletion of individual nodes. The local efficiency reflects how much the network is fault tolerant and show how efficient the communication is among the first neighbors of the node I when it is removed [5], which is computed as follows:

$$E_i = \frac{1}{(N-1)} \sum_{G(i)} \frac{1}{\min\{L_{i,j}\}} \quad \textbf{[S5]}$$

$$E = \frac{1}{N} \sum_{i \neq j} E_i \quad \textbf{[S6]}$$

Where E_i is the local efficiency of node *i*; Where G_i denotes the subgraph composed of the nearest neighbors of node *i*.

Rich club coefficient

For all individual structural networks the weighted-rich club coefficient $\emptyset^w(k)$ was computed as follows [6].

(1) All non-zero connections of the examined FABIRC -weighted network were ranked in respect to their weight, resulting in a vector W^{ranked}.

(2) Within the connectivity matrix *M*, for each value of degree *k*, the sub-graph of nodes with a degree larger than *k* was selected (with *k* defined as the number of each node's binary connections).

(3) The number of links $E_{>k}$ present between the members of the subset was determined and the sum of their collective weight $W_{>k}$ was computed.

(4) The maximal level of connectivity between the top number $E_{>k}$of connections in the network was determined, again computed as the sum of the weights.

(5) The weighted rich club parameter $\emptyset^w(k)$ was computed as the ratio between $W_{>k}$ and this sum of the strongest number of links $E_{>k}$ in the total network. Formally, $\emptyset^w(k)$ is given by [7].

$$\emptyset^w(k) = \frac{W_{>k}}{\sum_{l=1}^{E_{>k}} w_l^{ranked}} \quad \textbf{[S7]}$$

$\emptyset^w(k)$ is typically normalized relative to a set of comparable random networks, to determine the extent to which empirically observed connection density between rich club nodes exceeds that predicted by the random null model, driven by node degree alone. Comparison of $\emptyset^w(k)$ to $\emptyset_{random}(k)$ obtained from a population of random networks, resulted in a normalized rich club coefficient $\emptyset_{norm}$. Formally, A normalized coefficient $\emptyset_{norm}$ greater than 1 over a range of *k* suggests the existence of rich club organization in a network[8]. To this end, for each network, a population of *m*=1,000 random networks[9] were computed by shuffling the links in *M,* preserving the weights of the connections as well as the (binary) degree sequence and thus all node degrees (including the hubs) in the network[9]. This algorithm does not preserve the weight distribution of the nodes [10]. For each random network the rich club coefficient $\emptyset^w_{random}$ was computed over all levels of *k* and $\emptyset^w_{random}(k)$ was computed as the average rich club coefficient over the 1,000 random networks. Note that the normalized rich club coefficient is invariant for an overall connectivity of the network, enabling the possibility of comparing $\emptyset^w(k)$ between groups.

Results

Individual rich club selection

Group differences (ANCOVA; age and gender covariates) were observed in rich club connectivity strength (F(3,220)= 16.323, *P*<0.001, η^2= 0.182). Significant reductions were in rich club connectivity strength in aMCI versus NC (*P*<0.001), d-AD versus NC (*P*<0.001), aMCI versus SCD (*P*<0.001), d-AD versus SCD ((*P*<0.001, **Figure S1A**).

Group differences in feeder connectivity strength (F(3,220)= 37.259, *P*<0.001, partial η^2= 0.506. Feeder connectivity strength significantly decreased in SCD versus NC (*P*<0.001), aMCI versus NC (*P*<0.001), and d-AD versus aMCI (*P*<0.001), no significant difference in SCD versus aMCI (**Figure S1B**).

Similar group differences were in local connectivity strength (F(3,220)= 83.919, *P*<0.001, partial η^2= 0.534). Local connectivity strength significantly decreased in SCD versus NC (*P*<0.001), d-AD versus SCD (*P*=0.045), and d-AD versus aMCI (*P*<0.001), no significant difference in SCD versus aMCI (*P*>0.05, **Figure S1C**).

Effects of fiber length

Across all the groups of subjects, rich club connections showed the longest fibers (rich club | feeder | local, mean/std 83.175/7.86682 | 70.697/4.62046 | 62.674/4.39247; **Figure S2A**) than feeder (*P*<0.001) and local connections (*P*<0.001), supporting previous findings that rich club connections mostly spanned long distances and constituted a high-cost feature of brain architecture [11]. Feeder connections were

significantly longer than local connections ($P < 0.001$). Across all the groups of subjects, the set of rich club connections (mean/std 0.427/0.02531) displayed a significantly higher level of FABIRC as compared to feeder (mean/std 0.398/ 0.02159) and local connections (mean/std 0.387/0.02285) ($P<0.001$ | $P<0.001$), suggesting a higher level of microstructural organization of rich club connections in the brain network (**Figure S2B**). Furthermore, feeder connections also showed a higher level of FABIRC than local connections ($P<0.001$).

To examine whether the observed relatively stable rich club was not just an effect of the relatively stable longer distances in SCD, an additional analysis was performed [11-13]. FABIRC measurements was corrected for influences of physical length by regressing out average fiber length across each category of connections.

The results still revealed group differences (ANCOVA; age, gender, and average fiber length across each category of connections as covariates) in rich club connectivity strength ($F(3,220)= 13.326$, $P<0.001$, $\eta^2= 0.154$). Significantly lower FABIRC of rich club connectivity strength was in aMCI ($P<0.001$) and d-AD ($P<0.001$) compared to NC. In addition, significant lower FABIRC rich club connectivity strength in aMCI ($P=0.001$) and d-AD ($P=0.003$) compared to SCD was observed, and no significant group differences was observed neither between SCD with NC nor between aMCI with d-AD (**Figure S3A**)

Group differences in feeder connectivity strength ($F(3,220)= 34.143$, $P<0.001$, partial $\eta^2= 0.318$). Feeder connectivity strength significantly decreased in SCD versus NC ($P=0.005$), aMCI versus SCD ($P=0.001$), d-AD versus SCD($P<0.001$), and no significant difference in d-AD versus aMCI (**Figure S3B**)

Similar group differences in local connectivity strength ($F(3,220)= 53.406$, $P<0.001$, partial $\eta^2= 0.421$). Local connectivity strength significantly decreased in SCD versus NC ($P<0.001$), aMCI versus SCD ($P<0.001$), d-AD versus SCD($P<0.001$), and no significant difference in d-AD versus aMCI (**Figure S3C**)

Age-matched replication dataset

Rich club disturbances with disease progression

The rich club coefficient ($\emptyset$) was significantly lower in all patient groups relative to controls, but especially at low-degree k-levels: k=3-7 in SCD patients, k=4-13 in aMCI patients, and k=2-16 in d-AD patients (Bonferroni-corrected, **Table S15-16**).

Normalized rich club coefficients ($\emptyset_{norm}$) were significantly higher in all patient groups relative to controls, but especially at low-degree k-levels: k=7-13 in SCD patients, k=5-12 in aMCI patients, and k=4-13,16 in d-AD patients (Bonferroni-

corrected, **Table S17-18**).

Significant group differences (ANOVA) were observed in rich club connectivity strength (F(3,220)=10.848, *P*<0.001, partial η^2=0.153), feeder connectivity strength (F(3,220)=55.035, *P*<0.001, partial η^2=0.478), and local connectivity strength (F(3,220)=96.976, *P*<0.001, partial η^2=0.618; **Table S19**). Post hoc comparisons revealed decreased local and feeder connectivity strength in the SCD group versus NC (*P*<0.001), and the d-AD group versus the aMCI group (*P*<0.001). There was no significant difference between aMCI group and the SCD group. Significant rich club connectivity strength reductions were seen in the d-AD patients versus NC: *P*<0.001). There were no other significant differences between groups (*P*>0.05; **Table S20**).

Network topological metrics

Group differences (ANOVA) were observed for the strength metric (F(3,220)=88.561, *P*<0.001, partial η^2=0.596, **Table S21**). Post hoc comparisons revealed decreased strength in the SCD group versus NC (*P*<0.001), and the d-AD group versus the aMCI group (*P*<0.001). There was no significant difference between aMCI group and the SCD group (**Table S22**).

Group differences (ANOVA) were observed for the clustering coefficient (F(3,220)=11.586, *P*<0.001, partial η^2=0.116). Significant reductions were seen in the d-AD patients versus NC: *P*<0.001). There were no other significant differences between groups (*P*>0.05). In addition, there were significant group differences in normalized clustering coefficient (F(3,220)= 34.436, *P*<0.001, partial η^2=0.365. Post hoc comparisons revealed decreased normalized clustering coefficient in the SCD group versus NC (*P*<0.001), and the d-AD group versus the aMCI group (*P*<0.001). There was no significant difference between aMCI group and the SCD group (**Table S21-22**).

There were significant group differences in characteristic path length (F(3,220)=39.791, *P*<0.001, partial η^2=0.399). Post hoc comparisons revealed decreased characteristic path length in the SCD group versus NC (*P*<0.001), and the d-AD group versus the aMCI group (*P*<0.001). There was no significant difference between aMCI group and the SCD group. Group differences were also observed for the normalized characteristic path length (F(3,220)= 4.365, *P*= 0.003, partial η^2= 0.068). There was no significant difference between groups (**Table S21-22**).

Behavioral correlation analysis

In NC patients, the normalized rich club coefficient was significantly negative correlated with AVLT-D performance, after Bonferroni corrections (k=3). In addition, in d-AD patients, normalized rich club coefficient showed a significantly negative

association with AVLT-D (k=2) and AVLT-R (k=6). These relationships were not observed in SCD and aMCI patients (**Table S23**). For rich club coefficient, in SCD patients, this metric was significantly positive correlated with AVLT-D performance, after Bonferroni corrections (k=5). aMCI group showed a similar positive relationship between rich club coefficient and AVLT-D (k=12-16), AVLT-I (k=3), and MoCA (k=3). In addition, in d-AD patients, rich club coefficient showed a significantly positive association with AVLT-I (k=2), MMSE (k=2,8) and MoCA (k=2). These relationships were not observed in NC (**Table S24**).

In SCD patients, the AVLT-D performance was significantly positively correlated with feeder connectivity strength after Bonferroni corrections: those people who showed poorer memory performance tended to suffer from a greater disruption of feeder connections involving peripheral regions (r=0.426). Similar results were also found in aMCI patients (r=0.486). This relationship seen in SCD and aMCI patients was not displayed by NC or d-AD patients (**Table S25**).

After Bonferroni corrections, in SCD patients, the AVLT-D performance was significantly negatively correlated with strength (r= 0.398). Similar association was also between AVLT-d and characteristic path length (r= -0.390). In aMCI patients, the AVLT-D performance was significantly negatively correlated with normalized clustering coefficient (r= -0.423). Similar association was also between AVLT-R and clustering coefficient (r= 0.361). These relationships were not displayed by NC and d-AD patients (**Table S26**).

After Bonferroni corrections, network topological metrics was significantly correlated with rich club/feeder/local connectivity strength (**Table S27**). Previous studies have extensively used these network topological metrics in AD studies to reveal the differences between AD patients and normal subjects. Our results showed that there is a significant correlation between white matter lesion load and network results, indicating that rich club organization analysis is reliable.

References

1. Bullmore ET, Sporns O. Complex brain networks: graph theoretical analysis of structural and functional systems. Nat Rev Neurosci. 2009; 10: 186-98.

2. Rubinov M, Sporns O. Complex network measures of brain connectivity: Uses and interpretations. Neuroimage. 2010; 52: 1059-69.

3. Onnela JP, Saramaki J, Kertesz J, Kaski K. Intensity and coherence of motifs in weighted complex networks. Phys Rev E Stat Nonlin Soft Matter Phys. 2005; 71(2): 065103.

4. Watts DJ, Strogatz SH. Collective dynamics of 'small-world' networks. Nature. 1998; 393: 440-2.

5. Latora V, Marchiori M. Efficient behavior of small-world networks. Phys Rev Lett. 2001; 5; 87(19): 198701.

6. van den Heuvel MP, Sporns O, Collin G, Scheewe T, Mandl RCW, Cahn W, et al. Abnormal Rich Club Organization and Functional Brain Dynamics in Schizophrenia. JAMA Psychiatry. 2013; 70: 783-92.

7. Opsahl T, Colizza V, Panzarasa P, Ramasco JJ. Prominence and control: the weighted rich-club effect. Phys Rev Lett. 2008; 101: 168702.

8. Jessen F, Amariglio RE, van Boxtel M, Breteler M, Ceccaldi M, Chetelat G, et al. A conceptual framework for research on subjective cognitive decline in preclinical Alzheimer's disease. Alzheimers Dement. 2014; 10: 844-52.

9. Lu J, Li D, Li F, Zhou A, Wang F, Zuo X, et al. Montreal cognitive assessment in detecting cognitive impairment in Chinese elderly individuals: a population-based study. J Geriatr Psychiatry Neurol. 2011; 24: 184-90.

10. Maslov S, Sneppen K. Specificity and stability in topology of protein networks. Science. 2002; 296: 910-3.

11. van den Heuvel MP, Kahn RS, Goni J, Sporns O. High-cost, high-capacity backbone for global brain communication. Proc Natl Acad Sci U S A. 2012; 109: 11372-7.

12. Collin G, Sporns O, Mandl RCW, van den Heuvel MP. Structural and Functional Aspects Relating to Cost and Benefit of Rich Club Organization in the Human Cerebral Cortex. Cereb Cortex. 2014; 24: 2258-67.

13. Tuladhar AM, Lawrence A, Norris DG, Barrick TR, Markus HS, de Leeuw FE. Disruption of Rich Club Organisation in Cerebral Small Vessel Disease. Hum Brain Mapp. 2017; 38: 1751-66.

Tables

Table S1. Post hoc testing on age and education from ANOVA.

Demographics	(I) Group	(J) Group	Mean Difference (I-J)	SE	P	95% Confidence Interval for Difference	
						Lower Bound	Upper Bound
Age	NC	SCD	-2.059	1.728	0.235	-5.465	1.347
		aMCI	-3.996	1.618	**0.014**	-7.185	-0.807
		d-AD	-7.654	1.671	**<0.001**	-10.948	-4.359
	SCD	NC	2.059	1.728	0.235	-1.347	5.465
		aMCI	-1.937	1.740	0.267	-5.367	1.493
		d-AD	-5.594	1.790	**0.002**	-9.123	-2.066
	aMCI	NC	3.996	1.618	**0.014**	0.807	7.185
		SCD	1.937	1.740	0.267	-1.493	5.367
		d-AD	-3.657	1.684	**0.031**	-6.977	-0.338
	d-AD	NC	7.654	1.671	**<0.001**	4.359	10.948
		SCD	5.594	1.790	**0.002**	2.066	9.123
		aMCI	3.657	1.684	**0.031**	0.338	6.977
Education	NC	SCD	-0.751	0.973	0.441	-2.667	1.166
		aMCI	1.202	0.911	0.188	-0.593	2.996
		d-AD	2.103	0.941	**0.026**	0.248	3.957
	SCD	NC	0.751	0.973	0.441	-1.166	2.667
		aMCI	1.952	0.980	**0.048**	0.022	3.883
		d-AD	2.853	1.008	**0.005**	0.867	4.839
	aMCI	NC	-1.202	0.911	0.188	-2.996	0.593
		SCD	-1.952	0.980	**0.048**	-3.883	-0.022
		d-AD	0.901	0.948	0.343	-0.967	2.769
	d-AD	NC	-2.103	0.941	**0.026**	-3.957	-0.248
		SCD	-2.853	1.008	**0.005**	-4.839	-0.867
		aMCI	-0.901	0.948	0.343	-2.769	0.967

Table S2. Post hoc testing on cognitive variables from ANCOVA with age, gender and education as covariates.

COV: Age & Gender & Education	(I) Group	(J) Group	Mean Difference (I-J)	SE	P	95% Confidence Interval for Difference	
						Lower Bound	Upper Bound
AVLT-Immediate Recall Scores	NC	SCD	0.738	0.344	**0.033**	0.060	1.416
		aMCI	2.687	0.325	**<0.001**	2.046	3.328
		d-AD	5.126	0.352	**<0.001**	4.432	5.819
	SCD	NC	-0.738	0.344	**0.033**	-1.416	-0.060
		aMCI	1.949	0.340	**<0.001**	1.279	2.620
		d-AD	4.388	0.363	**<0.001**	3.671	5.104
	aMCI	NC	-2.687	0.325	**<0.001**	-3.328	-2.046
		SCD	-1.949	0.340	**<0.001**	-2.620	-1.279
		d-AD	2.438	0.331	**<0.001**	1.786	3.090
	d-AD	NC	-5.126	0.352	**<0.001**	-5.819	-4.432
		SCD	-4.388	0.363	**<0.001**	-5.104	-3.671
		aMCI	-2.438	0.331	**<0.001**	-3.090	-1.786
AVLT-Delayed Recall Scores	NC	SCD	1.285	0.527	**0.016**	0.246	2.324
		aMCI	5.589	0.498	**<0.001**	4.606	6.571
		d-AD	8.208	0.539	**<0.001**	7.144	9.271
	SCD	NC	-1.285	0.527	**0.016**	-2.324	-0.246
		aMCI	4.303	0.521	**<0.001**	3.276	5.331
		d-AD	6.923	0.557	**<0.001**	5.824	8.021
	aMCI	NC	-5.589	0.498	**<0.001**	-6.571	-4.606
		SCD	-4.303	0.521	**<0.001**	-5.331	-3.276
		d-AD	2.619	0.507	**<0.001**	1.620	3.619
	d-AD	NC	-8.208	0.539	**<0.001**	-9.271	-7.144
		SCD	-6.923	0.557	**<0.001**	-8.021	-5.824
		aMCI	-2.619	0.507	**<0.001**	-3.619	-1.620
AVLT-Recognition Scores	NC	SCD	0.738	0.630	0.243	-0.504	1.980
		aMCI	3.785	0.596	**<0.001**	2.611	4.960
		d-AD	7.622	0.645	**<0.001**	6.351	8.894
	SCD	NC	-0.738	0.630	0.243	-1.980	0.504
		aMCI	3.047	0.623	**<0.001**	1.819	4.276
		d-AD	6.884	0.666	**<0.001**	5.571	8.198
	aMCI	NC	-3.785	0.596	**<0.001**	-4.960	-2.611
		SCD	-3.047	0.623	**<0.001**	-4.276	-1.819
		d-AD	3.837	0.606	**<0.001**	2.642	5.032
	d-AD	NC	-7.622	0.645	**<0.001**	-8.894	-6.351
		SCD	-6.884	0.666	**<0.001**	-8.198	-5.571
		aMCI	-3.837	0.606	**<0.001**	-5.032	-2.642
MMSE	NC	SCD	0.238	0.758	0.754	-1.257	1.733
		aMCI	2.751	0.717	**<0.001**	1.337	4.166
		d-AD	10.110	0.776	**<0.001**	8.579	11.640

	SCD	NC	-0.238	0.758	0.754	-1.733	1.257
		aMCI	2.513	0.750	**0.001**	1.034	3.992
		d-AD	9.872	0.802	**<0.001**	8.291	11.453
	aMCI	NC	-2.751	0.717	**<0.001**	-4.166	-1.337
		SCD	-2.513	0.750	**0.001**	-3.992	-1.034
		d-AD	7.358	0.730	**<0.001**	5.920	8.797
	d-AD	NC	-10.110	0.776	**<0.001**	-11.640	-8.579
		SCD	-9.872	0.802	**<0.001**	-11.453	-8.291
		aMCI	-7.358	0.730	**<0.001**	-8.797	-5.920
MoCA	NC	SCD	1.422	0.698	**0.043**	0.046	2.798
		aMCI	5.981	0.660	**<0.001**	4.679	7.282
		d-AD	12.466	0.714	**<0.001**	11.057	13.874
	SCD	NC	-1.422	0.698	**0.043**	-2.798	-0.046
		aMCI	4.558	0.690	**<0.001**	3.197	5.919
		d-AD	11.043	0.738	**<0.001**	9.588	12.499
	aMCI	NC	-5.981	0.660	**<0.001**	-7.282	-4.679
		SCD	-4.558	0.690	**<0.001**	-5.919	-3.197
		d-AD	6.485	0.671	**<0.001**	5.161	7.809
	d-AD	NC	-12.466	0.714	**<0.001**	-13.874	-11.057
		SCD	-11.043	0.738	**<0.001**	-12.499	-9.588
		aMCI	-6.485	0.671	**<0.001**	-7.809	-5.161

Table S3. Rich club coefficient.

k (degree)	NC		SCD		aMCI		d-AD		F	p[a]	Es[b]	Post hocs[c]
	Mean	SD	Mean	SD	Mean	SD	Mean	SD				
1	0.999	0.000	0.999	0.001	0.999	0.001	0.999	0.001	6.048	<0.001	0.077	NC>d-AD
2	0.998	0.001	0.997	0.002	0.997	0.002	0.996	0.003	14.656	<0.001	0.168	NC, SCD, aMCI>d-AD
3	0.996	0.003	0.993	0.004	0.993	0.004	0.989	0.005	26.453	<0.001	0.267	NC>SCD, aMCI>d-AD
4	0.992	0.004	0.986	0.006	0.984	0.006	0.978	0.007	45.085	<0.001	0.383	NC>SCD, aMCI>d-AD
5	0.985	0.006	0.975	0.008	0.973	0.008	0.963	0.010	66.922	<0.001	0.479	NC>SCD, aMCI>d-AD
6	0.974	0.008	0.962	0.011	0.959	0.009	0.945	0.013	68.930	<0.001	0.487	NC>SCD, aMCI>d-AD
7	0.961	0.009	0.948	0.012	0.943	0.012	0.925	0.017	67.637	<0.001	0.482	NC>SCD, aMCI>d-AD
8	0.945	0.011	0.933	0.014	0.925	0.013	0.906	0.022	53.441	<0.001	0.424	NC>SCD, aMCI>d-AD
9	0.929	0.011	0.918	0.015	0.909	0.017	0.886	0.027	45.661	<0.001	0.386	NC>aMCI>d-AD; SCD>d-AD
10	0.914	0.012	0.902	0.015	0.893	0.019	0.868	0.028	47.527	<0.001	0.395	NC>aMCI>d-AD; SCD>d-AD
11	0.898	0.014	0.886	0.018	0.877	0.022	0.849	0.034	38.875	<0.001	0.349	NC>aMCI>d-AD; SCD>d-AD
12	0.883	0.016	0.870	0.025	0.859	0.025	0.827	0.043	32.090	<0.001	0.306	NC>aMCI>d-AD; SCD>d-AD
13	0.867	0.020	0.851	0.033	0.841	0.031	0.810	0.048	22.093	<0.001	0.233	NC>aMCI>d-AD; SCD>d-AD
14	0.854	0.024	0.835	0.039	0.820	0.040	0.785	0.065	19.727	<0.001	0.214	NC>aMCI>d-AD; SCD>d-AD
15	0.838	0.025	0.817	0.045	0.803	0.043	0.766	0.068	18.648	<0.001	0.204	NC>aMCI>d-AD; SCD>d-AD
16	0.823	0.029	0.801	0.054	0.787	0.046	0.756	0.062	13.803	<0.001	0.160	NC，SCD>d-AD

[a] Values from ANCOVA with age and gender as covariates.

[b] Effect size; partial η^2 for rich club coefficient.

[c] Least significant difference; post hoc testing on rich club coefficient based on means adjusted for age, gender.

aMCI: amnestic mild cognitive impairment; d-AD: dementia of Alzheimer's disease; NC: normal control; SCD: subjective cognitive decline.

Table S4. Post hoc testing on rich club coefficient from ANCOVA with age and gender as covariates (Bonferroni-corrected for groups).

k (degree)	(I) Group	(J) Group	Mean Difference (I-J)	SE	P	95% Confidence Interval for Difference	
						Lower Bound	Upper Bound
1	NC	SCD	0.000	0.000	1.000	0.000	0.001
		aMCI	0.000	0.000	1.000	0.000	0.001
		d-AD	0.001	0.000	**<0.001**	0.000	0.001
	SCD	NC	0.000	0.000	1.000	-0.001	0.000
		aMCI	0.000	0.000	1.000	0.000	0.000
		d-AD	0.000	0.000	**0.024**	0.000	0.001
	aMCI	NC	0.000	0.000	1.000	-0.001	0.000
		SCD	0.000	0.000	1.000	0.000	0.000
		d-AD	0.000	0.000	**0.016**	0.000	0.001
	d-AD	NC	-0.001	0.000	**<0.001**	-0.001	0.000
		SCD	0.000	0.000	**0.024**	-0.001	0.000
		aMCI	0.000	0.000	**0.016**	-0.001	0.000
2	NC	SCD	0.001	0.000	**0.042**	0.000	0.002
		aMCI	0.001	0.000	**0.017**	0.000	0.002
		d-AD	0.003	0.000	**<0.001**	0.002	0.004
	SCD	NC	-0.001	0.000	**0.042**	-0.002	0.000
		aMCI	0.000	0.000	1.000	-0.001	0.001
		d-AD	0.001	0.000	**0.002**	0.000	0.003
	aMCI	NC	-0.001	0.000	**0.017**	-0.002	0.000
		SCD	0.000	0.000	1.000	-0.001	0.001
		d-AD	0.001	0.000	**0.001**	0.000	0.002
	d-AD	NC	-0.003	0.000	**<0.001**	-0.004	-0.002
		SCD	-0.001	0.000	**0.002**	-0.003	0.000
		aMCI	-0.001	0.000	**0.001**	-0.002	0.000
3	NC	SCD	0.003	0.001	**0.002**	0.001	0.005
		aMCI	0.003	0.001	**0.001**	0.001	0.005
		d-AD	0.007	0.001	**<0.001**	0.005	0.009
	SCD	NC	-0.003	0.001	**0.002**	-0.005	-0.001
		aMCI	0.000	0.001	1.000	-0.002	0.002
		d-AD	0.004	0.001	**<0.001**	0.002	0.006
	aMCI	NC	-0.003	0.001	**0.001**	-0.005	-0.001
		SCD	0.000	0.001	1.000	-0.002	0.002
		d-AD	0.004	0.001	**<0.001**	0.002	0.006
	d-AD	NC	-0.007	0.001	**<0.001**	-0.009	-0.005
		SCD	-0.004	0.001	**<0.001**	-0.006	-0.002
		aMCI	-0.004	0.001	**<0.001**	-0.006	-0.002
4	NC	SCD	0.006	0.001	**<0.001**	0.003	0.009
		aMCI	0.007	0.001	**<0.001**	0.004	0.010
		d-AD	0.013	0.001	**<0.001**	0.010	0.016

	SCD	NC	-0.006	0.001	<**0.001**	-0.009	-0.003
		aMCI	0.001	0.001	1.000	-0.002	0.004
		d-AD	0.007	0.001	<**0.001**	0.004	0.010
	aMCI	NC	-0.007	0.001	<**0.001**	-0.010	-0.004
		SCD	-0.001	0.001	1.000	-0.004	0.002
		d-AD	0.006	0.001	<**0.001**	0.003	0.009
	d-AD	NC	-0.013	0.001	<**0.001**	-0.016	-0.010
		SCD	-0.007	0.001	<**0.001**	-0.010	-0.004
		aMCI	-0.006	0.001	<**0.001**	-0.009	-0.003
5	NC	SCD	0.009	0.001	<**0.001**	0.005	0.013
		aMCI	0.011	0.001	<**0.001**	0.008	0.015
		d-AD	0.021	0.001	<**0.001**	0.017	0.025
	SCD	NC	-0.009	0.001	<**0.001**	-0.013	-0.005
		aMCI	0.002	0.001	1.000	-0.002	0.006
		d-AD	0.011	0.002	<**0.001**	0.007	0.016
	aMCI	NC	-0.011	0.001	<**0.001**	-0.015	-0.008
		SCD	-0.002	0.001	1.000	-0.006	0.002
		d-AD	0.009	0.001	<**0.001**	0.006	0.013
	d-AD	NC	-0.021	0.001	<**0.001**	-0.025	-0.017
		SCD	-0.011	0.002	<**0.001**	-0.016	-0.007
		aMCI	-0.009	0.001	<**0.001**	-0.013	-0.006
6	NC	SCD	0.012	0.002	<**0.001**	0.007	0.017
		aMCI	0.015	0.002	<**0.001**	0.010	0.020
		d-AD	0.028	0.002	<**0.001**	0.023	0.033
	SCD	NC	-0.012	0.002	<**0.001**	-0.017	-0.007
		aMCI	0.003	0.002	0.720	-0.002	0.008
		d-AD	0.016	0.002	0.000	0.011	0.022
	aMCI	NC	-0.015	0.002	<**0.001**	-0.020	-0.010
		SCD	-0.003	0.002	0.720	-0.008	0.002
		d-AD	0.013	0.002	<**0.001**	0.008	0.018
	d-AD	NC	-0.028	0.002	<**0.001**	-0.033	-0.023
		SCD	-0.016	0.002	<**0.001**	-0.022	-0.011
		aMCI	-0.013	0.002	<**0.001**	-0.018	-0.008
7	NC	SCD	0.013	0.002	<**0.001**	0.006	0.019
		aMCI	0.017	0.002	<**0.001**	0.011	0.023
		d-AD	0.034	0.002	<**0.001**	0.028	0.041
	SCD	NC	-0.013	0.002	<**0.001**	-0.019	-0.006
		aMCI	0.005	0.002	0.352	-0.002	0.011
		d-AD	0.022	0.003	<**0.001**	0.015	0.029
	aMCI	NC	-0.017	0.002	<**0.001**	-0.023	-0.011
		SCD	-0.005	0.002	0.352	-0.011	0.002
		d-AD	0.017	0.002	<**0.001**	0.011	0.024
	d-AD	NC	-0.034	0.002	<**0.001**	-0.041	-0.028
		SCD	-0.022	0.003	<**0.001**	-0.029	-0.015
		aMCI	-0.017	0.002	<**0.001**	-0.024	-0.011
8	NC	SCD	0.011	0.003	**0.002**	0.003	0.019
		aMCI	0.019	0.003	<**0.001**	0.011	0.026

		d-AD	0.037	0.003	<**0.001**	0.029	0.045
	SCD	NC	-0.011	0.003	**0.002**	-0.019	-0.003
		aMCI	0.008	0.003	0.078	0.000	0.016
		d-AD	0.026	0.003	<**0.001**	0.018	0.035
	aMCI	NC	-0.019	0.003	<**0.001**	-0.026	-0.011
		SCD	-0.008	0.003	0.078	-0.016	0.000
		d-AD	0.019	0.003	<**0.001**	0.011	0.027
	d-AD	NC	-0.037	0.003	<**0.001**	-0.045	-0.029
		SCD	-0.026	0.003	<**0.001**	-0.035	-0.018
		aMCI	-0.019	0.003	<**0.001**	-0.027	-0.011
9	NC	SCD	0.011	0.004	**0.019**	0.001	0.020
		aMCI	0.019	0.003	<**0.001**	0.010	0.028
		d-AD	0.040	0.004	<**0.001**	0.031	0.050
	SCD	NC	-0.011	0.004	**0.019**	-0.020	-0.001
		aMCI	0.008	0.004	0.134	-0.001	0.018
		d-AD	0.030	0.004	<**0.001**	0.020	0.040
	aMCI	NC	-0.019	0.003	<**0.001**	-0.028	-0.010
		SCD	-0.008	0.004	0.134	-0.018	0.001
		d-AD	0.021	0.003	<**0.001**	0.012	0.031
	d-AD	NC	-0.040	0.004	<**0.001**	-0.050	-0.031
		SCD	-0.030	0.004	<**0.001**	-0.040	-0.020
		aMCI	-0.021	0.003	<**0.001**	-0.031	-0.012
10	NC	SCD	0.011	0.004	**0.028**	0.001	0.021
		aMCI	0.020	0.004	<**0.001**	0.010	0.029
		d-AD	0.044	0.004	<**0.001**	0.034	0.054
	SCD	NC	-0.011	0.004	**0.028**	-0.021	-0.001
		aMCI	0.009	0.004	0.098	-0.001	0.019
		d-AD	0.033	0.004	<**0.001**	0.022	0.043
	aMCI	NC	-0.020	0.004	<**0.001**	-0.029	-0.010
		SCD	-0.009	0.004	0.098	-0.019	0.001
		d-AD	0.024	0.004	<**0.001**	0.014	0.033
	d-AD	NC	-0.044	0.004	<**0.001**	-0.054	-0.034
		SCD	-0.033	0.004	<**0.001**	-0.043	-0.022
		aMCI	-0.024	0.004	<**0.001**	-0.033	-0.014
11	NC	SCD	0.012	0.005	**0.043**	0.000	0.024
		aMCI	0.020	0.004	<**0.001**	0.009	0.032
		d-AD	0.047	0.004	<**0.001**	0.035	0.059
	SCD	NC	-0.012	0.005	**0.043**	-0.024	0.000
		aMCI	0.008	0.005	0.447	-0.004	0.020
		d-AD	0.035	0.005	<**0.001**	0.023	0.048
	aMCI	NC	-0.020	0.004	<**0.001**	-0.032	-0.009
		SCD	-0.008	0.005	0.447	-0.020	0.004
		d-AD	0.027	0.004	<**0.001**	0.015	0.039
	d-AD	NC	-0.047	0.004	<**0.001**	-0.059	-0.035
		SCD	-0.035	0.005	<**0.001**	-0.048	-0.023
		aMCI	-0.027	0.004	<**0.001**	-0.039	-0.015
		SCD	0.013	0.006	0.145	-0.002	0.028

12	NC	aMCI	0.023	0.005	<**0.001**	0.008	0.037
		d-AD	0.053	0.006	<**0.001**	0.038	0.068
	SCD	NC	-0.013	0.006	0.145	-0.028	0.002
		aMCI	0.010	0.006	0.506	-0.005	0.025
		d-AD	0.041	0.006	<**0.001**	0.025	0.056
	aMCI	NC	-0.023	0.005	<**0.001**	-0.037	-0.008
		SCD	-0.010	0.006	0.506	-0.025	0.005
		d-AD	0.031	0.005	<**0.001**	0.016	0.045
	d-AD	NC	-0.053	0.006	<**0.001**	-0.068	-0.038
		SCD	-0.041	0.006	<**0.001**	-0.056	-0.025
		aMCI	-0.031	0.005	<**0.001**	-0.045	-0.016
13	NC	SCD	0.015	0.007	0.162	-0.003	0.032
		aMCI	0.023	0.006	<**0.001**	0.006	0.040
		d-AD	0.052	0.007	<**0.001**	0.035	0.070
	SCD	NC	-0.015	0.007	0.162	-0.032	0.003
		aMCI	0.008	0.007	1.000	-0.009	0.026
		d-AD	0.038	0.007	<**0.001**	0.019	0.056
	aMCI	NC	-0.023	0.006	<**0.001**	-0.040	-0.006
		SCD	-0.008	0.007	1.000	-0.026	0.009
		d-AD	0.029	0.006	<**0.001**	0.012	0.046
	d-AD	NC	-0.052	0.007	<**0.001**	-0.070	-0.035
		SCD	-0.038	0.007	<**0.001**	-0.056	-0.019
		aMCI	-0.029	0.006	<**0.001**	-0.046	-0.012
14	NC	SCD	0.018	0.009	0.240	-0.005	0.040
		aMCI	0.031	0.008	**0.001**	0.009	0.052
		d-AD	0.064	0.008	<**0.001**	0.041	0.086
	SCD	NC	-0.018	0.009	0.240	-0.040	0.005
		aMCI	0.013	0.009	0.749	-0.010	0.036
		d-AD	0.046	0.009	<**0.001**	0.022	0.070
	aMCI	NC	-0.031	0.008	**0.001**	-0.052	-0.009
		SCD	-0.013	0.009	0.749	-0.036	0.010
		d-AD	0.033	0.008	**0.001**	0.011	0.055
	d-AD	NC	-0.064	0.008	<**0.001**	-0.086	-0.041
		SCD	-0.046	0.009	<**0.001**	-0.070	-0.022
		aMCI	-0.033	0.008	**0.001**	-0.055	-0.011
15	NC	SCD	0.019	0.009	0.234	-0.005	0.043
		aMCI	0.031	0.009	**0.002**	0.008	0.054
		d-AD	0.066	0.009	<**0.001**	0.042	0.090
	SCD	NC	-0.019	0.009	0.234	-0.043	0.005
		aMCI	0.013	0.009	1.000	-0.012	0.037
		d-AD	0.047	0.009	<**0.001**	0.022	0.073
	aMCI	NC	-0.031	0.009	**0.002**	-0.054	-0.008
		SCD	-0.013	0.009	1.000	-0.037	0.012
		d-AD	0.035	0.009	**0.001**	0.011	0.058
	d-AD	NC	-0.066	0.009	<**0.001**	-0.090	-0.042
		SCD	-0.047	0.009	<**0.001**	-0.073	-0.022
		aMCI	-0.035	0.009	**0.001**	-0.058	-0.011

16	NC	SCD	0.020	0.009	0.207	-0.005	0.044
		aMCI	0.031	0.009	**0.003**	0.007	0.054
		d-AD	0.059	0.009	**<0.001**	0.034	0.083
	SCD	NC	-0.020	0.009	0.207	-0.044	0.005
		aMCI	0.011	0.009	1.000	-0.014	0.036
		d-AD	0.039	0.010	**0.001**	0.013	0.065
	aMCI	NC	-0.031	0.009	**0.003**	-0.054	-0.007
		SCD	-0.011	0.009	1.000	-0.036	0.014
		d-AD	0.028	0.009	**0.015**	0.004	0.052
	d-AD	NC	-0.059	0.009	**<0.001**	-0.083	-0.034
		SCD	-0.039	0.010	**0.001**	-0.065	-0.013
		aMCI	-0.028	0.009	**0.015**	-0.052	-0.004

Table S5. Normalized rich club coefficient.

k (degree)	NC		SCD		aMCI		d-AD		F	p[a]	Es[b]	Post hocs[c]
	Mean	SD	Mean	SD	Mean	SD	Mean	SD				
1	1.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000	0.843	0.472	0.013	-
2	1.001	0.001	1.001	0.001	1.001	0.001	1.001	0.001	3.464	0.017	0.051	-
3	1.001	0.001	1.002	0.002	1.002	0.001	1.003	0.002	6.095	<0.001	0.086	NC<d-AD
4	1.002	0.002	1.003	0.003	1.004	0.003	1.006	0.004	14.162	<0.001	0.180	NC, SCD<d-AD
5	1.003	0.002	1.005	0.004	1.007	0.003	1.009	0.005	20.561	<0.001	0.241	NC<aMCI, d-AD; SCD<d-AD
6	1.004	0.003	1.007	0.005	1.010	0.005	1.015	0.008	33.989	<0.001	0.345	NC<aMCI<d-AD; SCD<d-AD
7	1.006	0.004	1.010	0.007	1.015	0.006	1.021	0.011	32.910	<0.001	0.337	NC<aMCI, d-AD; SCD<d-AD
8	1.008	0.004	1.016	0.007	1.021	0.008	1.027	0.013	37.332	<0.001	0.366	NC<aMCI; NC<SCD<d-AD
9	1.011	0.006	1.022	0.009	1.025	0.011	1.032	0.015	32.025	<0.001	0.331	NC<aMCI; NC<SCD<d-AD
10	1.015	0.007	1.027	0.010	1.031	0.013	1.037	0.016	28.020	<0.001	0.302	NC<aMCI; NC<SCD<d-AD
11	1.018	0.008	1.032	0.013	1.034	0.015	1.040	0.019	20.707	<0.001	0.243	NC<SCD, aMCI, d-AD
12	1.022	0.011	1.036	0.016	1.039	0.020	1.042	0.027	9.440	<0.001	0.127	NC<aMCI, d-AD
13	1.024	0.011	1.041	0.023	1.041	0.024	1.047	0.035	7.343	<0.001	0.102	NC<d-AD
14	1.028	0.014	1.046	0.027	1.041	0.029	1.011	0.201	1.001	0.394	0.015	-
15	1.030	0.015	1.051	0.033	1.050	0.029	1.191	1.925	0.199	0.897	0.003	-
16	1.034	0.021	1.035	0.172	0.994	0.259	0.818	0.460	5.046	0.002	0.072	-

[a] Values from ANCOVA with age and gender as covariates.

[b] Effect size; partial η^2 for normalized rich club coefficient.

[c] Least significant difference; post hoc testing on normalized rich club coefficient based on means adjusted for age, gender.

aMCI: amnestic mild cognitive impairment; d-AD: dementia of Alzheimer's disease; NC: normal control; SCD: subjective cognitive decline.

Table S6. Post hoc testing on normalized rich club coefficient from ANCOVA with age and gender as covariates (Bonferroni-corrected for groups).

k (degree)	(I) Group	(J) Group	Mean Difference (I-J)	SE	P	95% Confidence Interval for Difference	
						Lower Bound	Upper Bound
1	NC	SCD	0.000	0.000	1.000	0.000	0.000
		aMCI	0.000	0.000	1.000	0.000	0.000
		d-AD	0.000	0.000	1.000	0.000	0.000
	SCD	NC	0.000	0.000	1.000	0.000	0.000
		aMCI	0.000	0.000	0.767	0.000	0.000
		d-AD	0.000	0.000	1.000	0.000	0.000
	aMCI	NC	0.000	0.000	1.000	0.000	0.000
		SCD	0.000	0.000	0.767	0.000	0.000
		d-AD	0.000	0.000	1.000	0.000	0.000
	d-AD	NC	0.000	0.000	1.000	0.000	0.000
		SCD	0.000	0.000	1.000	0.000	0.000
		aMCI	0.000	0.000	1.000	0.000	0.000
2	NC	SCD	0.000	0.000	0.420	-0.001	0.000
		aMCI	0.000	0.000	0.543	-0.001	0.000
		d-AD	-0.001	0.000	**0.010**	-0.001	0.000
	SCD	NC	0.000	0.000	0.420	0.000	0.001
		aMCI	0.000	0.000	1.000	0.000	0.001
		d-AD	0.000	0.000	1.000	-0.001	0.000
	aMCI	NC	0.000	0.000	0.543	0.000	0.001
		SCD	0.000	0.000	1.000	-0.001	0.000
		d-AD	0.000	0.000	0.833	-0.001	0.000
	d-AD	NC	0.001	0.000	**0.010**	0.000	0.001
		SCD	0.000	0.000	1.000	0.000	0.001
		aMCI	0.000	0.000	0.833	0.000	0.001
3	NC	SCD	-0.001	0.000	0.094	-0.002	0.000
		aMCI	-0.001	0.000	0.474	-0.002	0.000
		d-AD	-0.001	0.000	<**0.001**	-0.002	-0.001
	SCD	NC	0.001	0.000	0.094	0.000	0.002
		aMCI	0.000	0.000	1.000	-0.001	0.001
		d-AD	-0.001	0.000	0.760	-0.002	0.000
	aMCI	NC	0.001	0.000	0.474	0.000	0.002
		SCD	0.000	0.000	1.000	-0.001	0.001
		d-AD	-0.001	0.000	0.099	-0.002	0.000
	d-AD	NC	0.001	0.000	<**0.001**	0.001	0.002
		SCD	0.001	0.000	0.760	0.000	0.002
		aMCI	0.001	0.000	0.099	0.000	0.002
4	NC	SCD	-0.001	0.001	0.259	-0.003	0.000
		aMCI	-0.002	0.001	**0.007**	-0.003	0.000
		d-AD	-0.004	0.001	<**0.001**	-0.005	-0.002

	SCD	NC	0.001	0.001	0.259	0.000	0.003
		aMCI	-0.001	0.001	1.000	-0.002	0.001
		d-AD	-0.002	0.001	**0.001**	-0.004	-0.001
	aMCI	NC	0.002	0.001	**0.007**	0.000	0.003
		SCD	0.001	0.001	1.000	-0.001	0.002
		d-AD	-0.002	0.001	**0.013**	-0.003	0.000
	d-AD	NC	0.004	0.001	<**0.001**	0.002	0.005
		SCD	0.002	0.001	**0.001**	0.001	0.004
		aMCI	0.002	0.001	**0.013**	0.000	0.003
5	NC	SCD	-0.002	0.001	0.096	-0.004	0.000
		aMCI	-0.003	0.001	<**0.001**	-0.005	-0.001
		d-AD	-0.006	0.001	<**0.001**	-0.008	-0.004
	SCD	NC	0.002	0.001	0.096	0.000	0.004
		aMCI	-0.002	0.001	0.277	-0.004	0.001
		d-AD	-0.004	0.001	<**0.001**	-0.006	-0.002
	aMCI	NC	0.003	0.001	<**0.001**	0.001	0.005
		SCD	0.002	0.001	0.277	-0.001	0.004
		d-AD	-0.002	0.001	**0.023**	-0.004	0.000
	d-AD	NC	0.006	0.001	<**0.001**	0.004	0.008
		SCD	0.004	0.001	<**0.001**	0.002	0.006
		aMCI	0.002	0.001	**0.023**	0.000	0.004
6	NC	SCD	-0.003	0.001	0.062	-0.006	0.000
		aMCI	-0.006	0.001	<**0.001**	-0.009	-0.003
		d-AD	-0.010	0.001	<**0.001**	-0.013	-0.008
	SCD	NC	0.003	0.001	0.062	0.000	0.006
		aMCI	-0.003	0.001	0.051	-0.006	0.000
		d-AD	-0.007	0.001	<**0.001**	-0.011	-0.004
	aMCI	NC	0.006	0.001	<**0.001**	0.003	0.009
		SCD	0.003	0.001	0.051	0.000	0.006
		d-AD	-0.004	0.001	<**0.001**	-0.007	-0.002
	d-AD	NC	0.010	0.001	<**0.001**	0.008	0.013
		SCD	0.007	0.001	<**0.001**	0.004	0.011
		aMCI	0.004	0.001	<**0.001**	0.002	0.007
7	NC	SCD	-0.004	0.001	**0.022**	-0.008	0.000
		aMCI	-0.009	0.001	<**0.001**	-0.013	-0.005
		d-AD	-0.014	0.001	<**0.001**	-0.017	-0.010
	SCD	NC	0.004	0.001	**0.022**	0.000	0.008
		aMCI	-0.004	0.002	**0.024**	-0.009	0.000
		d-AD	-0.009	0.002	<**0.001**	-0.013	-0.005
	aMCI	NC	0.009	0.001	<**0.001**	0.005	0.013
		SCD	0.004	0.002	**0.024**	0.000	0.009
		d-AD	-0.005	0.001	**0.006**	-0.009	-0.001
	d-AD	NC	0.014	0.001	<**0.001**	0.010	0.017
		SCD	0.009	0.002	<**0.001**	0.005	0.013
		aMCI	0.005	0.001	**0.006**	0.001	0.009
8	NC	SCD	-0.007	0.002	<**0.001**	-0.012	-0.002
		aMCI	-0.012	0.002	<**0.001**	-0.017	-0.007

		d-AD	-0.018	0.002	<**0.001**	-0.022	-0.013
	SCD	NC	0.007	0.002	<**0.001**	0.002	0.012
		aMCI	-0.005	0.002	0.075	-0.010	0.000
		d-AD	-0.011	0.002	<**0.001**	-0.015	-0.006
	aMCI	NC	0.012	0.002	<**0.001**	0.007	0.017
		SCD	0.005	0.002	0.075	0.000	0.010
		d-AD	-0.006	0.002	**0.006**	-0.010	-0.001
	d-AD	NC	0.018	0.002	<**0.001**	0.013	0.022
		SCD	0.011	0.002	<**0.001**	0.006	0.015
		aMCI	0.006	0.002	**0.006**	0.001	0.010
9	NC	SCD	-0.011	0.002	<**0.001**	-0.017	-0.005
		aMCI	-0.014	0.002	<**0.001**	-0.020	-0.009
		d-AD	-0.020	0.002	<**0.001**	-0.026	-0.015
	SCD	NC	0.011	0.002	<**0.001**	0.005	0.017
		aMCI	-0.003	0.002	0.837	-0.010	0.003
		d-AD	-0.009	0.002	<**0.001**	-0.016	-0.003
	aMCI	NC	0.014	0.002	<**0.001**	0.009	0.020
		SCD	0.003	0.002	0.837	-0.003	0.010
		d-AD	-0.006	0.002	0.031	-0.012	0.000
	d-AD	NC	0.020	0.002	<**0.001**	0.015	0.026
		SCD	0.009	0.002	<**0.001**	0.003	0.016
		aMCI	0.006	0.002	0.031	0.000	0.012
10	NC	SCD	-0.012	0.003	<**0.001**	-0.019	-0.005
		aMCI	-0.016	0.002	<**0.001**	-0.022	-0.009
		d-AD	-0.021	0.002	<**0.001**	-0.028	-0.015
	SCD	NC	0.012	0.003	<**0.001**	0.005	0.019
		aMCI	-0.004	0.003	0.786	-0.011	0.003
		d-AD	-0.009	0.003	0.002	-0.016	-0.002
	aMCI	NC	0.016	0.002	<**0.001**	0.009	0.022
		SCD	0.004	0.003	0.786	-0.003	0.011
		d-AD	-0.005	0.002	0.160	-0.012	0.001
	d-AD	NC	0.021	0.002	<**0.001**	0.015	0.028
		SCD	0.009	0.003	**0.002**	0.002	0.016
		aMCI	0.005	0.002	0.160	-0.001	0.012
11	NC	SCD	-0.014	0.003	<**0.001**	-0.021	-0.006
		aMCI	-0.016	0.003	<**0.001**	-0.024	-0.009
		d-AD	-0.021	0.003	<**0.001**	-0.028	-0.013
	SCD	NC	0.014	0.003	<**0.001**	0.006	0.021
		aMCI	-0.003	0.003	1.000	-0.011	0.005
		d-AD	-0.007	0.003	0.096	-0.015	0.001
	aMCI	NC	0.016	0.003	<**0.001**	0.009	0.024
		SCD	0.003	0.003	1.000	-0.005	0.011
		d-AD	-0.005	0.003	0.591	-0.012	0.003
	d-AD	NC	0.021	0.003	<**0.001**	0.013	0.028
		SCD	0.007	0.003	0.096	-0.001	0.015
		aMCI	0.005	0.003	0.591	-0.003	0.012
		SCD	-0.014	0.004	**0.005**	-0.024	-0.003

12	NC	aMCI	-0.016	0.004	<**0.001**	-0.027	-0.006
		d-AD	-0.018	0.004	<**0.001**	-0.029	-0.008
	SCD	NC	0.014	0.004	**0.005**	0.003	0.024
		aMCI	-0.003	0.004	1.000	-0.014	0.008
		d-AD	-0.005	0.004	1.000	-0.016	0.006
	aMCI	NC	0.016	0.004	<**0.001**	0.006	0.027
		SCD	0.003	0.004	1.000	-0.008	0.014
		d-AD	-0.002	0.004	1.000	-0.012	0.008
	d-AD	NC	0.018	0.004	<**0.001**	0.008	0.029
		SCD	0.005	0.004	1.000	-0.006	0.016
		aMCI	0.002	0.004	1.000	-0.008	0.012
13	NC	SCD	-0.017	0.005	**0.006**	-0.031	-0.004
		aMCI	-0.017	0.005	**0.005**	-0.030	-0.004
		d-AD	-0.021	0.005	<**0.001**	-0.034	-0.008
	SCD	NC	0.017	0.005	0.006	0.004	0.031
		aMCI	0.001	0.005	1.000	-0.014	0.015
		d-AD	-0.004	0.005	1.000	-0.018	0.010
	aMCI	NC	0.017	0.005	**0.005**	0.004	0.030
		SCD	-0.001	0.005	1.000	-0.015	0.014
		d-AD	-0.004	0.005	1.000	-0.018	0.009
	d-AD	NC	0.021	0.005	<**0.001**	0.008	0.034
		SCD	0.004	0.005	1.000	-0.010	0.018
		aMCI	0.004	0.005	1.000	-0.009	0.018
14	NC	SCD	-0.020	0.022	1.000	-0.079	0.040
		aMCI	-0.017	0.021	1.000	-0.074	0.040
		d-AD	0.013	0.021	1.000	-0.044	0.071
	SCD	NC	0.020	0.022	1.000	-0.040	0.079
		aMCI	0.003	0.023	1.000	-0.059	0.064
		d-AD	0.033	0.023	0.895	-0.028	0.094
	aMCI	NC	0.017	0.021	1.000	-0.040	0.074
		SCD	-0.003	0.023	1.000	-0.064	0.059
		d-AD	0.031	0.021	0.934	-0.027	0.088
	d-AD	NC	-0.013	0.021	1.000	-0.071	0.044
		SCD	-0.033	0.023	0.895	-0.094	0.028
		aMCI	-0.031	0.021	0.934	-0.088	0.027
15	NC	SCD	0.007	0.210	1.000	-0.553	0.566
		aMCI	0.036	0.201	1.000	-0.500	0.572
		d-AD	-0.109	0.200	1.000	-0.643	0.425
	SCD	NC	-0.007	0.210	1.000	-0.566	0.553
		aMCI	0.029	0.216	1.000	-0.546	0.605
		d-AD	-0.116	0.214	1.000	-0.687	0.455
	aMCI	NC	-0.036	0.201	1.000	-0.572	0.500
		SCD	-0.029	0.216	1.000	-0.605	0.546
		d-AD	-0.145	0.201	1.000	-0.680	0.390
	d-AD	NC	0.109	0.200	1.000	-0.425	0.643
		SCD	0.116	0.214	1.000	-0.455	0.687
		aMCI	0.145	0.201	1.000	-0.390	0.680

16	NC	SCD	-0.011	0.059	1.000	-0.167	0.146
		aMCI	0.020	0.056	1.000	-0.131	0.170
		d-AD	0.183	0.056	**0.008**	0.034	0.333
	SCD	NC	0.011	0.059	1.000	-0.146	0.167
		aMCI	0.030	0.060	1.000	-0.131	0.192
		d-AD	0.194	0.060	**0.009**	0.034	0.354
	aMCI	NC	-0.020	0.056	1.000	-0.170	0.131
		SCD	-0.030	0.060	1.000	-0.192	0.131
		d-AD	0.164	0.056	**0.024**	0.014	0.313
	d-AD	NC	-0.183	0.056	**0.008**	-0.333	-0.034
		SCD	-0.194	0.060	**0.009**	-0.354	-0.034
		aMCI	-0.164	0.056	**0.024**	-0.313	-0.014

Table S7. Post hoc testing on rich club, feeder, local connectivity strength from ANCOVA with age and gender as covariates (Bonferroni-corrected for groups).

ANCOVA COV: Age & Gender	(I) Group	(J) Group	Mean Difference (I-J)	SE	P	95% Confidence Interval for Difference[b]	
						Lower Bound	Upper Bound
Rich Club Connectivity Strength	NC	SCD	0.660	0.375	0.481	-0.339	1.659
		aMCI	1.570	0.355	**<0.001**	0.628	2.521
		AD	2.215	0.373	**<0.001**	1.221	3.209
	SCD	NC	-0.660	0.375	0.481	-1.659	0.339
		aMCI	0.914	0.377	0.097	-0.091	1.919
		AD	1.555	0.392	**0.001**	0.511	2.600
	aMCI	NC	-1.574	0.355	**<0.001**	-2.521	-0.628
		SCD	-0.914	0.377	0.097	-1.919	0.091
		AD	0.641	0.366	0.487	-0.333	1.614
	d-AD	NC	-2.215	0.373	**<0.001**	-3.209	-1.221
		SCD	-1.555	0.392	**0.001**	-2.600	-0.511
		aMCI	-0.641	0.366	0.487	-1.614	0.333
Feeder Connectivity Strength	NC	SCD	9.500	1.415	**<0.001**	5.733	13.267
		aMCI	12.889	1.340	**<0.001**	9.320	16.457
		AD	19.608	1.408	**<0.001**	15.859	23.357
	SCD	NC	-9.500	1.415	**<0.001**	-13.267	-5.733
		aMCI	3.389	1.423	0.109	-0.400	7.178
		AD	10.108	1.479	**<0.001**	6.169	14.046
	aMCI	NC	-12.889	1.340	**<0.001**	-16.457	-9.320
		SCD	-3.389	1.423	0.109	-7.178	0.400
		AD	6.719	1.379	**<0.001**	3.049	10.390
	d-AD	NC	-19.608	1.408	**<0.001**	-23.357	-15.859
		SCD	-10.108	1.479	**<0.001**	-14.046	-6.169
		aMCI	-6.719	1.379	**<0.001**	-10.390	-3.049
Local Connectivity Strength	NC	SCD	21.542	2.232	**<0.001**	15.600	27.485
		aMCI	27.603	2.114	**<0.001**	21.974	33.232
		AD	40.150	2.221	**<0.001**	34.236	46.063
	SCD	NC	-21.542	2.232	**<0.001**	-27.485	-15.600
		aMCI	6.061	2.245	**0.045**	0.084	12.038
		AD	18.607	2.333	**<0.001**	12.394	24.820
	aMCI	NC	-27.603	2.114	**<0.001**	-33.232	-21.974
		SCD	-6.061	2.245	**0.045**	-12.038	-0.084
		AD	12.546	2.175	**<0.001**	6.756	18.337
	d-AD	NC	-40.150	2.221	**<0.001**	-46.063	-34.236
		SCD	-18.607	2.333	**<0.001**	-24.820	-12.394
		aMCI	-12.546	2.175	**<0.001**	-18.337	-6.756

Table S8. Post hoc testing on network topological metrics from ANCOVA with age and gender as covariates (Bonferroni-corrected for groups).

Network Topological Metrics	(I) Group	(J) Group	Mean Difference (I-J)	SE	P	95% Confidence Interval for Difference	
						Lower Bound	Upper Bound
Strength	NC	SCD	0.704	0.079	<**0.001**	0.494	0.915
		aMCI	0.935	0.075	<**0.001**	0.736	1.134
		d-AD	1.377	0.079	<**0.001**	1.168	1.586
	SCD	NC	-0.704	0.079	<**0.001**	-0.915	-0.494
		aMCI	0.230	0.079	**0.024**	0.019	0.442
		d-AD	0.673	0.082	<**0.001**	0.453	0.892
	aMCI	NC	-0.935	0.075	<**0.001**	-1.134	-0.736
		SCD	-0.230	0.079	**0.024**	-0.442	-0.019
		d-AD	0.442	0.077	<**0.001**	0.238	0.647
	d-AD	NC	-1.377	0.079	<**0.001**	-1.586	-1.168
		SCD	-0.673	0.082	<**0.001**	-0.892	-0.453
		aMCI	-0.442	0.077	<**0.001**	-0.647	-0.238
Clustering Coefficient	NC	SCD	0.015	0.004	0.003	0.004	0.026
		aMCI	0.019	0.004	<**0.001**	0.008	0.029
		d-AD	0.026	0.004	<**0.001**	0.015	0.037
	SCD	NC	-0.015	0.004	**0.003**	-0.026	-0.004
		aMCI	0.003	0.004	1.000	-0.008	0.015
		d-AD	0.011	0.004	0.101	-0.001	0.022
	aMCI	NC	-0.019	0.004	<**0.001**	-0.029	-0.008
		SCD	-0.003	0.004	1.000	-0.015	0.008
		d-AD	0.007	0.004	0.486	-0.004	0.018
	d-AD	NC	-0.026	0.004	<**0.001**	-0.037	-0.015
		SCD	-0.011	0.004	0.101	-0.022	0.001
		aMCI	-0.007	0.004	0.486	-0.018	0.004
Normalized Clustering Coefficient	NC	SCD	-0.158	0.031	<**0.001**	-0.240	-0.076
		aMCI	-0.145	0.029	<**0.001**	-0.223	-0.068
		d-AD	-0.340	0.031	<**0.001**	-0.422	-0.259
	SCD	NC	0.158	0.031	<**0.001**	0.076	0.240
		aMCI	0.013	0.031	1.000	-0.070	0.095
		d-AD	-0.182	0.032	<**0.001**	-0.268	-0.097
	aMCI	NC	0.145	0.029	<**0.001**	0.068	0.223
		SCD	-0.013	0.031	1.000	-0.095	0.070
		d-AD	-0.195	0.030	<**0.001**	-0.275	-0.115
	d-AD	NC	0.340	0.031	<**0.001**	0.259	0.422
		SCD	0.182	0.032	<**0.001**	0.097	0.268
		aMCI	0.195	0.030	<**0.001**	0.115	0.275
Characteristic Path Length	NC	SCD	-0.348	0.065	<**0.001**	-0.521	-0.176
		aMCI	-0.468	0.061	<**0.001**	-0.631	-0.305
		d-AD	-0.760	0.064	<**0.001**	-0.931	-0.588

	SCD	NC	0.348	0.065	<**0.001**	0.176	0.521
		aMCI	-0.119	0.065	0.408	-0.293	0.054
		d-AD	-0.411	0.068	<**0.001**	-0.591	-0.231
	aMCI	NC	0.468	0.061	<**0.001**	0.305	0.631
		SCD	0.119	0.065	0.408	-0.054	0.293
		d-AD	-0.292	0.063	<**0.001**	-0.460	-0.124
	d-AD	NC	0.760	0.064	<**0.001**	0.588	0.931
		SCD	0.411	0.068	<**0.001**	0.231	0.591
		aMCI	0.292	0.063	<**0.001**	0.124	0.460
Normalized Characteristic Path length	NC	SCD	-0.005	0.002	0.135	-0.011	0.001
		aMCI	0.000	0.002	1.000	-0.006	0.005
		d-AD	-0.007	0.002	**0.015**	-0.013	-0.001
	SCD	NC	0.005	0.002	0.135	-0.001	0.011
		aMCI	0.005	0.002	0.212	-0.001	0.011
		d-AD	-0.002	0.002	1.000	-0.008	0.004
	aMCI	NC	0.000	0.002	1.000	-0.005	0.006
		SCD	-0.005	0.002	0.212	-0.011	0.001
		d-AD	-0.006	0.002	**0.021**	-0.012	-0.001
	d-AD	NC	0.007	0.002	**0.015**	0.001	0.013
		SCD	0.002	0.002	1.000	-0.004	0.008
		aMCI	0.006	0.002	**0.021**	0.001	0.012

Table S9. Whole-brain structural connectivity of nodes with the highest number of aberrant connections in patient groups compared with NC. Nodes with the highest number of aberrant connections in each patient groups (range = 11 to 27 aberrant connections), based on two-sample t-test (NC versus each patient groups) with FDR corrected to the P values to correct for multiple comparisons across all edges. Significance was set at $P<0.05$. The bold nodes represent the rich club nodes in all groups.

Region	MNI			Number of Connections		
	x	y	z	SCD vs. NC	aMCI vs. NC	d-AD vs. NC
CAU.L	-11.46	11	9.24	15	15	22
CAU.R	14.84	12.07	9.42	12	14	20
ORBmid.L	-30.65	50.43	-9.62	11	9	7
PCUN.L	-7.24	-56.07	48.01		19	27
SFGdor.R	21.9	31.12	43.82		17	17
MOG.L	-32.39	-80.73	16.11		16	18
PCUN.R	9.98	-56.05	43.77		15	26
THA.L	-10.85	-17.56	7.98		15	20
SPG.R	26.11	-59.18	62.06		15	17
HIP.L	-25.03	-20.74	-10.13		15	16
HIP.R	29.23	-19.78	-10.33		15	13
SPG.L	-23.45	-59.56	58.96		14	22
DCG.L	-5.48	-14.92	41.57		14	17
ORBsup.L	-16.56	47.32	-13.31		14	15
OLF.L	-8.06	15.05	-11.46		13	13
CAL.L	-7.14	-78.67	6.44		13	13
ACG.R	8.46	37.01	15.84		13	12
PUT.R	27.78	4.91	2.46		12	17
ACG.L	-4.04	35.4	13.95		12	15
PUT.L	-23.91	3.86	2.4		12	15
SOG.L	-16.54	-84.26	28.17		12	14
ORBmid.R	33.18	52.59	-10.73		12	12
CUN.L	-5.93	-80.13	27.22		12	
PHG.R	25.38	-15.15	-20.47		11	17
IFGtriang.R	50.33	30.16	14.17		11	16
INS.L	-35.13	6.65	3.44		11	14
PCG.L	-4.85	-42.92	24.67		11	14
SMA.R	8.62	0.17	61.85		11	13
TPOsup.R	48.25	14.75	-16.86		11	13
LING.R	16.29	-66.93	-3.87		11	12
THA.R	13	-17.55	8.09			20
IFGtriang.L	-45.58	29.91	13.99			17
MFG.R	37.59	33.06	34.04			14
DCG.R	8.02	-8.83	39.79			14

ORBinf.R	41.22	32.23	-11.91	13
SMA.L	-5.32	4.85	61.38	13
SFGmed.R	9.1	50.84	30.22	13
INS.R	39.02	6.25	2.08	13
CUN.R	13.51	-79.36	28.23	13
ITG.L	-49.77	-28.05	-23.17	13
ITG.R	53.69	-31.07	-22.32	13
MFG.L	-33.43	32.73	35.46	12
ORBinf.L	-35.98	30.71	-12.11	12
SFGmed.L	-4.8	49.17	30.89	12
LING.L	-14.62	-67.56	-4.63	12
SOG.R	24.29	-80.85	30.59	12
SFGdor.L	-18.45	34.81	42.2	11
PoCG.R	41.43	-25.49	52.55	11
PCL.L	-7.63	-25.36	70.07	11

Table S10. Post hoc testing on nodal efficiency from ANCOVA with age and gender as covariates (Bonferroni-corrected for groups).

COV: Age & Gender	(I) Group	(J) Group	Mean Difference (I-J)	SE	P	95% Confidence Interval for Difference	
						Lower Bound	Upper Bound
CAU.L Efficiency	NC	SCD	0.021	0.006	**0.005**	0.005	0.037
		aMCI	0.016	0.006	**0.031**	0.001	0.032
		AD	0.021	0.006	**0.004**	0.005	0.038
	SCD	NC	-0.021	0.006	**0.005**	-0.037	-0.005
		aMCI	-0.005	0.006	1.000	-0.021	0.012
		AD	0.000	0.006	1.000	-0.017	0.017
	aMCI	NC	-0.016	0.006	**0.031**	-0.032	-0.001
		SCD	0.005	0.006	1.000	-0.012	0.021
		AD	0.005	0.006	1.000	-0.011	0.021
	d-AD	NC	-0.021	0.006	**0.004**	-0.038	-0.005
		SCD	0.000	0.006	1.000	-0.017	0.017
		aMCI	-0.005	0.006	1.000	-0.021	0.011
CAU.R Efficiency	NC	SCD	0.014	0.006	0.071	-0.001	0.029
		aMCI	0.014	0.005	**0.044**	0.000	0.028
		AD	0.023	0.006	**<0.001**	0.008	0.038
	SCD	NC	-0.014	0.006	0.071	-0.029	0.001
		aMCI	0.000	0.006	1.000	-0.015	0.015
		AD	0.009	0.006	0.788	-0.007	0.024
	aMCI	NC	-0.014	0.005	**0.044**	-0.028	0.000
		SCD	0.000	0.006	1.000	-0.015	0.015
		AD	0.009	0.005	0.662	-0.006	0.023
	d-AD	NC	-0.023	0.006	**<0.001**	-0.038	-0.008
		SCD	-0.009	0.006	0.788	-0.024	0.007
		aMCI	-0.009	0.005	0.662	-0.023	0.006
ORBmid.L Efficiency	NC	SCD	0.092	0.020	**<0.001**	0.040	0.145
		aMCI	0.095	0.019	**<0.001**	0.045	0.145
		AD	0.097	0.020	**<0.001**	0.045	0.149
	SCD	NC	-0.092	0.020	**<0.001**	-0.145	-0.040
		aMCI	0.003	0.020	1.000	-0.050	0.055
		AD	0.005	0.021	1.000	-0.050	0.059
	aMCI	NC	-0.095	0.019	**<0.001**	-0.145	-0.045
		SCD	-0.003	0.020	1.000	-0.055	0.050
		AD	0.002	0.019	1.000	-0.049	0.053
	d-AD	NC	-0.097	0.020	**<0.001**	-0.149	-0.045
		SCD	-0.005	0.021	1.000	-0.059	0.050
		aMCI	-0.002	0.019	1.000	-0.053	0.049

Table S11. Partial Pearson's correlations between rich club, feeder and local connectivity strength and clinical performance. Partial Pearson's correlations controlled for age, gender, and education were used to assess how rich club, feeder and local connectivity related to clinical performance in each group. The bold numbers represent significant correlations at $P<0.05$ without Bonferroni corrections. The star-labeled numbers represent significant correlations at $P<0.05$ after Bonferroni corrections for the number of cognitive test variables (AVLT-immediate recall, AVLT-delayed recall, AVLT-recognition, MMSE and MoCA).

COV: Age & Gender & Education			Rich Club Connectivity Strength	Feeder Connectivity Strength	Local Connectivity Strength
NC DF=49	AVLT-Immediate Recall Scores	r	0.119	0.192	0.001
		p	0.202	0.089	0.496
	AVLT-Delayed Recall Scores	r	-0.150	0.099	-0.012
		p	0.146	0.245	0.467
	AVLT-Recognition Scores	r	-0.153	0.209	0.112
		p	0.141	0.070	0.218
	MMSE	r	0.085	0.157	0.120
		p	0.278	0.135	0.201
	MoCA	r	-0.095	0.231	0.181
		p	0.253	0.051	0.102
SCD DF=39	AVLT-Immediate Recall Scores	r	0.047	0.234	0.087
		p	0.386	0.070	0.294
	AVLT-Delayed Recall Scores	r	0.223	0.362	0.214
		p	0.080	**0.010***	0.090
	AVLT-Recognition Scores	r	-0.027	0.162	-0.068
		p	0.433	0.156	0.336
	MMSE	r	-0.018	0.064	-0.039
		p	0.456	0.346	0.405
	MoCA	r	0.152	0.061	0.006
		p	0.171	0.353	0.486
aMCI DF=53	AVLT-Immediate Recall Scores	r	0.118	0.226	0.019
		p	0.195	**0.049**	0.446
	AVLT-Delayed Recall Scores	r	0.231	0.442	0.149
		p	**0.045**	**<0.001***	0.138
	AVLT-Recognition Scores	r	0.164	0.227	0.007
		p	0.116	**0.048**	0.480
	MMSE	r	0.177	0.110	0.023
		p	0.098	0.213	0.433
	MoCA	r	0.241	0.294	0.086
		p	**0.038**	**0.015**	0.266
d-AD DF=43	AVLT-Immediate Recall Scores	r	0.021	0.038	0.071
		p	0.446	0.403	0.321
	AVLT-Delayed Recall Scores	r	0.033	0.030	0.074
		p	0.415	0.422	0.315
		r	0.207	0.205	0.197

AVLT-Recognition Scores	p	0.086	0.089	0.097
MMSE	r	0.063	0.264	0.274
	p	0.340	**0.040**	**0.034**
MoCA	r	0.011	0.205	0.151
	p	0.472	0.088	0.161

Table S12. Partial Pearson's correlations between nodal efficiency and clinical performance. Partial Pearson's correlations controlled for age, gender and education were used to assess how the nodal efficiency of the CAU.L and ORBmid.L related to clinical performance in each group. The bold numbers represent significant correlations at $P<0.05$ without Bonferroni corrections. The star-labeled numbers represent significant correlations at $P<0.05$ after Bonferroni corrections for the number of cognitive test variables (AVLT-immediate recall, AVLT-delayed recall, AVLT-recognition, MMSE and MoCA).

COV: Gender & Age & Education			CAU.L Efficiency	ORBmid.L Efficiency
NC DF=49	AVLT-Immediate Recall Scores	r	-0.178	0.208
		p	0.105	0.071
	AVLT-Delayed Recall Scores	r	-0.126	0.098
		p	0.190	0.247
	AVLT-Recognition Scores	r	-0.035	0.111
		p	0.402	0.218
	MMSE	r	-0.006	0.190
		p	0.484	0.091
	MoCA	r	0.054	-0.113
		p	0.354	0.216
SCD DF=39	AVLT-Immediate Recall Scores	r	-0.021	-0.023
		p	0.447	0.443
	AVLT-Delayed Recall Scores	r	0.210	-0.042
		p	0.093	0.396
	AVLT-Recognition Scores	r	0.021	0.141
		p	0.449	0.189
	MMSE	r	0.138	0.097
		p	0.194	0.274
	MoCA	r	-0.125	-0.014
		p	0.219	0.466
aMCI DF=53	AVLT-Immediate Recall Scores	r	-0.193	0.098
		p	0.079	0.239
	AVLT-Delayed Recall Scores	r	-0.078	0.119
		p	0.286	0.193
	AVLT-Recognition Scores	r	-0.054	0.163
		p	0.348	0.117
	MMSE	r	-0.244	0.268
		p	**0.036**	**0.024**
	MoCA	r	0.013	0.290
		p	0.463	**0.016**
d-AD DF=43	AVLT-Immediate Recall Scores	r	0.253	-0.045
		p	**0.047**	0.383
	AVLT-Delayed Recall Scores	r	0.339	0.317
		p	**0.011**	**0.017**
		r	0.385	0.167

AVLT-Recognition Scores	p	**0.004***	0.136
MMSE	r	0.290	-0.024
	p	**0.026**	0.437
MoCA	r	0.235	0.001
	p	0.060	0.497

Table S13. Demographic, clinical and cognitive test variables for age-matched dataset.

Demographics and Neuropsychological Tests	NC	SCD	aMCI	d-AD	F	p[a]	Es[b]
	59	42	47	35			
Age (years)	62.54 (7.60)	63.85 (7.54)	64.01 (7.81)	65.96 (8.09)	1.442	0.232	0.024
Education (years)	10.76 (4.80)	11.21 (4.61)	10.77 (4.30)	8.94 (4.55)	1.802	0.148	0.029
Gender (F/M)	38/21	25/17	25/22	23/13	1.612	0.657	-
AVLT-Immediate Recall Scores	8.98 (1.90)	8.28 (1.82)	6.54 (1.55)	3.56 (1.85)	67.452	<0.001	0.555
AVLT-Delayed Recall Scores	9.77 (3.04)	8.74 (2.76)	4.44 (2.78)	1.29 (1.81)	83.524	<0.001	0.607
AVLT-Recognition Scores	11.69 (2.62)	11.07 (2.46)	8.42 (3.51)	3.61 (3.16)	55.252	<0.001	0.506
MMSE	27.75 (2.26)	27.92 (1.78)	25.47 (3.45)	16.97 (7.12)	62.692	<0.001	0.537
MoCA	25.76 (3.37)	25.00 (2.94)	20.64 (3.78)	13.13 (5.57)	96.615	<0.001	0.641

[a] Values for age and education derived from ANOVA; gender from chi-square test; all clinical/cognitive variables from ANCOVA with education as covariates.

[b] Effect size; η^2 for demographic and clinical variables and partial η2 for cognitive variables.

[c] Least significant difference; post hoc testing on cognitive variables based on means adjusted for education.

aMCI: amnestic mild cognitive impairment; AVLT: auditory verbal learning test; d-AD: dementia of Alzheimer's disease; MMSE: mini-mental state examination; MoCA: Montreal cognitive assessment; NC: normal control; SCD: subjective cognitive decline.

Table S14. Post hoc testing on cognitive variables from ANCOVA with education as covariates for age-matched dataset.

COV: Education	(I) Group	(J) Group	Mean Difference (I-J)	SE	P	95% Confidence Interval for Difference	
						Lower Bound	Upper Bound
AVLT-Immediate Recall Scores	NC	SCD	0.783	0.372	**0.037**	0.048	1.518
		aMCI	2.480	0.357	**<0.001**	1.775	3.184
		d-AD	5.366	0.398	**<0.001**	4.580	6.152
	SCD	NC	-0.783	0.372	**0.037**	-1.518	-0.048
		aMCI	1.697	0.383	**<0.001**	0.940	2.454
		d-AD	4.583	0.424	**<0.001**	3.745	5.421
	aMCI	NC	-2.480	0.357	**<0.001**	-3.184	-1.775
		SCD	-1.697	0.383	**<0.001**	-2.454	-0.940
		d-AD	2.886	0.410	**<0.001**	2.077	3.696
	d-AD	NC	-5.366	0.398	**<0.001**	-6.152	-4.580
		SCD	-4.583	0.424	**<0.001**	-5.421	-3.745
		aMCI	-2.886	0.410	**<0.001**	-3.696	-2.077
AVLT-Delayed Recall Scores	NC	SCD	1.181	0.559	**0.036**	0.078	2.285
		aMCI	5.398	0.536	**<0.001**	4.340	6.456
		d-AD	8.376	0.597	**<0.001**	7.196	9.555
	SCD	NC	-1.181	0.559	**0.036**	-2.285	-0.078
		aMCI	4.217	0.576	**<0.001**	3.080	5.354
		d-AD	7.195	0.637	**<0.001**	5.936	8.453
	aMCI	NC	-5.398	0.536	**<0.001**	-6.456	-4.340
		SCD	-4.217	0.576	**<0.001**	-5.354	-3.080
		d-AD	2.978	0.616	**<0.001**	1.762	4.194
	d-AD	NC	-8.376	0.597	**<0.001**	-9.555	-7.196
		SCD	-7.195	0.637	**<0.001**	-8.453	-5.936
		aMCI	-2.978	0.616	**<0.001**	-4.194	-1.762
AVLT-Recognition Scores	NC	SCD	0.743	0.618	0.231	-0.478	1.965
		aMCI	3.330	0.593	**<0.001**	2.159	4.501
		d-AD	7.995	0.661	**<0.001**	6.689	9.300
	SCD	NC	-0.743	0.618	0.231	-1.965	0.478
		aMCI	2.587	0.637	**<0.001**	1.329	3.845
		d-AD	7.251	0.705	**<0.001**	5.859	8.644
	aMCI	NC	-3.330	0.593	**<0.001**	-4.501	-2.159
		SCD	-2.587	0.637	**<0.001**	-3.845	-1.329
		d-AD	4.664	0.682	**<0.001**	3.318	6.010
	d-AD	NC	-7.995	0.661	**<0.001**	-9.300	-6.689
		SCD	-7.251	0.705	**<0.001**	-8.644	-5.859
		aMCI	-4.664	0.682	**<0.001**	-6.010	-3.318
MMSE	NC	SCD	0.081	0.786	0.918	-1.470	1.633
		aMCI	2.403	0.753	**0.002**	0.916	3.890
		d-AD	10.614	0.840	**<0.001**	8.955	12.272

	SCD	NC	-0.081	0.786	0.918	-1.633	1.470
		aMCI	2.322	0.809	**0.005**	0.723	3.920
		d-AD	10.532	0.896	**<0.001**	8.763	12.301
	aMCI	NC	-2.403	0.753	**0.002**	-3.890	-0.916
		SCD	-2.322	0.809	**0.005**	-3.920	-0.723
		d-AD	8.211	0.866	**<0.001**	6.501	9.920
	d-AD	NC	-10.614	0.840	**<0.001**	-12.272	-8.955
		SCD	-10.532	0.896	**<0.001**	-12.301	-8.763
		aMCI	-8.211	0.866	**<0.001**	-9.920	-6.501
MoCA	NC	SCD	1.189	0.724	0.103	-0.242	2.620
		aMCI	5.322	0.695	**<0.001**	3.951	6.694
		d-AD	12.362	0.774	**<0.001**	10.833	13.891
	SCD	NC	-1.189	0.724	0.103	-2.620	0.242
		aMCI	4.133	0.746	**<0.001**	2.659	5.607
		d-AD	11.173	0.826	**<0.001**	9.542	12.804
	aMCI	NC	-5.322	0.695	**<0.001**	-6.694	-3.951
		SCD	-4.133	0.746	**<0.001**	-5.607	-2.659
		d-AD	7.040	0.798	**<0.001**	5.463	8.617
	d-AD	NC	-12.362	0.774	**<0.001**	-13.891	-10.833
		SCD	-11.173	0.826	**<0.001**	-12.804	-9.542
		aMCI	-7.040	0.798	**<0.001**	-8.617	-5.463

Table S15. Rich club coefficient for age-matched dataset.

k	NC		SCD		aMCI		d-AD		F	p[a]	Es[b]
(degree)	Mean	SD	Mean	SD	Mean	SD	Mean	SD			
1	0.999	0.000	0.999	0.001	0.999	0.001	0.999	0.001	2.867	0.038	0.046
2	0.998	0.001	0.997	0.002	0.997	0.002	0.996	0.003	10.853	<0.001	0.153
3	0.996	0.003	0.993	0.004	0.994	0.003	0.989	0.005	27.048	<0.001	0.311
4	0.992	0.004	0.985	0.006	0.985	0.006	0.979	0.006	48.027	<0.001	0.445
5	0.985	0.006	0.975	0.008	0.974	0.008	0.963	0.009	64.814	<0.001	0.519
6	0.974	0.008	0.962	0.011	0.959	0.009	0.946	0.013	59.969	<0.001	0.500
7	0.961	0.009	0.949	0.012	0.944	0.012	0.925	0.018	58.885	<0.001	0.495
8	0.945	0.011	0.934	0.014	0.927	0.013	0.907	0.022	47.588	<0.001	0.442
9	0.929	0.011	0.918	0.015	0.911	0.017	0.888	0.026	41.479	<0.001	0.409
10	0.913	0.013	0.903	0.016	0.895	0.018	0.868	0.027	47.160	<0.001	0.440
11	0.898	0.014	0.886	0.019	0.879	0.022	0.851	0.031	37.201	<0.001	0.383
12	0.884	0.017	0.870	0.027	0.860	0.027	0.829	0.036	33.605	<0.001	0.359
13	0.867	0.020	0.851	0.035	0.842	0.032	0.812	0.038	24.729	<0.001	0.292
14	0.854	0.024	0.835	0.041	0.824	0.041	0.789	0.055	20.525	<0.001	0.255
15	0.838	0.026	0.818	0.047	0.809	0.041	0.772	0.058	18.634	<0.001	0.237
16	0.823	0.030	0.802	0.056	0.795	0.044	0.764	0.052	13.127	<0.001	0.180

[a] Values from ANOVA.

[b] Effect size; η^2 for rich club coefficient.

Table S16. Post hoc testing on rich club coefficient from ANOVA for age-matched dataset (Bonferroni-corrected for groups).

k (degree)	(I) Group	(J) Group	Mean Difference (I-J)	SE	P	95% Confidence Interval for Difference	
						Lower Bound	Upper Bound
1	NC	SCD	0.000	0.000	0.387	0.000	0.001
		aMCI	0.000	0.000	0.329	0.000	0.001
		d-AD	0.000	0.000	**0.042**	0.000	0.001
	SCD	NC	0.000	0.000	0.387	-0.001	0.000
		aMCI	0.000	0.000	1.000	0.000	0.000
		d-AD	0.000	0.000	1.000	0.000	0.001
	aMCI	NC	0.000	0.000	0.329	-0.001	0.000
		SCD	0.000	0.000	1.000	0.000	0.000
		d-AD	0.000	0.000	1.000	0.000	0.000
	d-AD	NC	0.000	0.000	**0.042**	-0.001	0.000
		SCD	0.000	0.000	1.000	-0.001	0.000
		aMCI	0.000	0.000	1.000	0.000	0.000
2	NC	SCD	0.001	0.000	**0.007**	0.000	0.002
		aMCI	0.001	0.000	0.068	0.000	0.002
		d-AD	0.002	0.000	**<0.001***	0.001	0.003
	SCD	NC	-0.001	0.000	**0.007**	-0.002	0.000
		aMCI	0.000	0.000	1.000	-0.001	0.001
		d-AD	0.001	0.000	0.142	0.000	0.002
	aMCI	NC	-0.001	0.000	0.068	-0.002	0.000
		SCD	0.000	0.000	1.000	-0.001	0.001
		d-AD	0.001	0.000	**0.015**	0.000	0.003
	d-AD	NC	-0.002	0.000	**<0.001***	-0.003	-0.001
		SCD	-0.001	0.000	0.142	-0.002	0.000
		aMCI	-0.001	0.000	**0.015**	-0.003	0.000
3	NC	SCD	0.003	0.001	**<0.001***	0.001	0.005
		aMCI	0.003	0.001	**0.003**	0.001	0.004
		d-AD	0.007	0.001	**<0.001***	0.005	0.009
	SCD	NC	-0.003	0.001	**<0.001***	-0.005	-0.001
		aMCI	-0.001	0.001	1.000	-0.003	0.001
		d-AD	0.004	0.001	**<0.001***	0.001	0.006
	aMCI	NC	-0.003	0.001	**0.003**	-0.004	-0.001
		SCD	0.001	0.001	1.000	-0.001	0.003
		d-AD	0.004	0.001	**<0.001***	0.002	0.006
	d-AD	NC	-0.007	0.001	**<0.001***	-0.009	-0.005
		SCD	-0.004	0.001	**<0.001***	-0.006	-0.001
		aMCI	-0.004	0.001	**<0.001***	-0.006	-0.002
4	NC	SCD	0.007	0.001	**<0.001***	0.004	0.010
		aMCI	0.007	0.001	**<0.001***	0.004	0.010
		d-AD	0.013	0.001	**<0.001***	0.010	0.016

	SCD	NC	-0.007	0.001	<**0.001***	-0.010	-0.004
		aMCI	0.000	0.001	1.000	-0.003	0.003
		d-AD	0.007	0.001	<**0.001***	0.003	0.010
	aMCI	NC	-0.007	0.001	<**0.001***	-0.010	-0.004
		SCD	0.000	0.001	1.000	-0.003	0.003
		d-AD	0.006	0.001	<**0.001***	0.003	0.009
	d-AD	NC	-0.013	0.001	<**0.001***	-0.016	-0.010
		SCD	-0.007	0.001	<**0.001***	-0.010	-0.003
		aMCI	-0.006	0.001	<**0.001***	-0.009	-0.003
5	NC	SCD	0.010	0.002	<**0.001***	0.006	0.014
		aMCI	0.011	0.001	<**0.001***	0.007	0.015
		d-AD	0.022	0.002	<**0.001***	0.018	0.026
	SCD	NC	-0.010	0.002	<**0.001***	-0.014	-0.006
		aMCI	0.002	0.002	1.000	-0.003	0.006
		d-AD	0.012	0.002	<**0.001***	0.008	0.017
	aMCI	NC	-0.011	0.001	<**0.001***	-0.015	-0.007
		SCD	-0.002	0.002	1.000	-0.006	0.003
		d-AD	0.011	0.002	<**0.001***	0.006	0.015
	d-AD	NC	-0.022	0.002	<**0.001***	-0.026	-0.018
		SCD	-0.012	0.002	<**0.001***	-0.017	-0.008
		aMCI	-0.011	0.002	<**0.001***	-0.015	-0.006
6	NC	SCD	0.012	0.002	<**0.001***	0.006	0.017
		aMCI	0.015	0.002	<**0.001***	0.010	0.020
		d-AD	0.028	0.002	<**0.001***	0.022	0.034
	SCD	NC	-0.012	0.002	<**0.001***	-0.017	-0.006
		aMCI	0.003	0.002	0.766	-0.002	0.009
		d-AD	0.017	0.002	<**0.001***	0.010	0.023
	aMCI	NC	-0.015	0.002	<**0.001***	-0.020	-0.010
		SCD	-0.003	0.002	0.766	-0.009	0.002
		d-AD	0.013	0.002	<**0.001***	0.007	0.019
	d-AD	NC	-0.028	0.002	<**0.001***	-0.034	-0.022
		SCD	-0.017	0.002	<**0.001***	-0.023	-0.010
		aMCI	-0.013	0.002	<**0.001***	-0.019	-0.007
7	NC	SCD	0.012	0.003	<**0.001***	0.005	0.019
		aMCI	0.017	0.002	<**0.001***	0.010	0.024
		d-AD	0.035	0.003	<**0.001***	0.028	0.043
	SCD	NC	-0.012	0.003	<**0.001***	-0.019	-0.005
		aMCI	0.005	0.003	0.374	-0.002	0.012
		d-AD	0.023	0.003	<**0.001***	0.016	0.031
	aMCI	NC	-0.017	0.002	<**0.001***	-0.024	-0.010
		SCD	-0.005	0.003	0.374	-0.012	0.002
		d-AD	0.018	0.003	<**0.001***	0.011	0.026
	d-AD	NC	-0.035	0.003	<**0.001***	-0.043	-0.028
		SCD	-0.023	0.003	<**0.001***	-0.031	-0.016
		aMCI	-0.018	0.003	<**0.001***	-0.026	-0.011
8	NC	SCD	0.011	0.003	**0.004**	0.002	0.019
		aMCI	0.018	0.003	<**0.001***	0.010	0.026

		d-AD	0.037	0.003	<**0.001***	0.029	0.046
	SCD	NC	-0.011	0.003	**0.004**	-0.019	-0.002
		aMCI	0.007	0.003	0.165	-0.001	0.016
		d-AD	0.027	0.003	<**0.001***	0.018	0.036
	aMCI	NC	-0.018	0.003	<**0.001***	-0.026	-0.010
		SCD	-0.007	0.003	0.165	-0.016	0.001
		d-AD	0.020	0.003	<**0.001***	0.011	0.029
	d-AD	NC	-0.037	0.003	<**0.001***	-0.046	-0.029
		SCD	-0.027	0.003	<**0.001***	-0.036	-0.018
		aMCI	-0.020	0.003	<**0.001***	-0.029	-0.011
9	NC	SCD	0.011	0.004	**0.018**	0.001	0.020
		aMCI	0.017	0.003	<**0.001***	0.008	0.026
		d-AD	0.040	0.004	<**0.001***	0.031	0.050
	SCD	NC	-0.011	0.004	**0.018**	-0.020	-0.001
		aMCI	0.007	0.004	0.429	-0.003	0.017
		d-AD	0.030	0.004	<**0.001***	0.019	0.040
	aMCI	NC	-0.017	0.003	<**0.001***	-0.026	-0.008
		SCD	-0.007	0.004	0.429	-0.017	0.003
		d-AD	0.023	0.004	<**0.001***	0.013	0.033
	d-AD	NC	-0.040	0.004	<**0.001***	-0.050	-0.031
		SCD	-0.030	0.004	<**0.001***	-0.040	-0.019
		aMCI	-0.023	0.004	<**0.001***	-0.033	-0.013
10	NC	SCD	0.011	0.004	**0.026**	0.001	0.020
		aMCI	0.018	0.004	<**0.001***	0.009	0.028
		d-AD	0.045	0.004	<**0.001***	0.035	0.055
	SCD	NC	-0.011	0.004	**0.026**	-0.020	-0.001
		aMCI	0.007	0.004	0.326	-0.003	0.018
		d-AD	0.034	0.004	<**0.001***	0.023	0.045
	aMCI	NC	-0.018	0.004	<**0.001***	-0.028	-0.009
		SCD	-0.007	0.004	0.326	-0.018	0.003
		d-AD	0.027	0.004	<**0.001***	0.016	0.038
	d-AD	NC	-0.045	0.004	<**0.001***	-0.055	-0.035
		SCD	-0.034	0.004	<**0.001***	-0.045	-0.023
		aMCI	-0.027	0.004	<**0.001***	-0.038	-0.016
11	NC	SCD	0.012	0.004	**0.032**	0.001	0.024
		aMCI	0.019	0.004	<**0.001***	0.008	0.030
		d-AD	0.048	0.005	<**0.001***	0.035	0.060
	SCD	NC	-0.012	0.004	**0.032**	-0.024	-0.001
		aMCI	0.007	0.005	0.828	-0.005	0.019
		d-AD	0.035	0.005	<**0.001***	0.022	0.048
	aMCI	NC	-0.019	0.004	<**0.001***	-0.030	-0.008
		SCD	-0.007	0.005	0.828	-0.019	0.005
		d-AD	0.029	0.005	<**0.001***	0.016	0.041
	d-AD	NC	-0.048	0.005	<**0.001***	-0.060	-0.035
		SCD	-0.035	0.005	<**0.001***	-0.048	-0.022
		aMCI	-0.029	0.005	<**0.001***	-0.041	-0.016
		SCD	0.014	0.005	0.069	-0.001	0.028

12	NC	aMCI	0.023	0.005	**<0.001***	0.010	0.037
		d-AD	0.055	0.006	**<0.001***	0.040	0.070
	SCD	NC	-0.014	0.005	0.069	-0.028	0.001
		aMCI	0.010	0.006	0.507	-0.005	0.025
		d-AD	0.041	0.006	**<0.001***	0.025	0.057
	aMCI	NC	-0.023	0.005	**<0.001***	-0.037	-0.010
		SCD	-0.010	0.006	0.507	-0.025	0.005
		d-AD	0.032	0.006	**<0.001***	0.016	0.047
	d-AD	NC	-0.055	0.006	**<0.001***	-0.070	-0.040
		SCD	-0.041	0.006	**<0.001***	-0.057	-0.025
		aMCI	-0.032	0.006	**<0.001***	-0.047	-0.016
13	NC	SCD	0.016	0.006	0.067	-0.001	0.032
		aMCI	0.025	0.006	**<0.001***	0.009	0.041
		d-AD	0.055	0.006	**<0.001***	0.038	0.072
	SCD	NC	-0.016	0.006	0.067	-0.032	0.001
		aMCI	0.009	0.007	1.000	-0.009	0.026
		d-AD	0.039	0.007	**<0.001***	0.021	0.058
	aMCI	NC	-0.025	0.006	**<0.001***	-0.041	-0.009
		SCD	-0.009	0.007	1.000	-0.026	0.009
		d-AD	0.030	0.007	**<0.001***	0.012	0.049
	d-AD	NC	-0.055	0.006	**<0.001***	-0.072	-0.038
		SCD	-0.039	0.007	**<0.001***	-0.058	-0.021
		aMCI	-0.030	0.007	**<0.001***	-0.049	-0.012
14	NC	SCD	0.019	0.008	0.102	-0.002	0.041
		aMCI	0.030	0.008	**0.001**	0.009	0.051
		d-AD	0.065	0.008	**<0.001***	0.043	0.088
	SCD	NC	-0.019	0.008	0.102	-0.041	0.002
		aMCI	0.011	0.008	1.000	-0.012	0.034
		d-AD	0.046	0.009	**<0.001***	0.022	0.070
	aMCI	NC	-0.030	0.008	**0.001**	-0.051	-0.009
		SCD	-0.011	0.008	1.000	-0.034	0.012
		d-AD	0.035	0.009	**0.001**	0.012	0.059
	d-AD	NC	-0.065	0.008	**<0.001***	-0.088	-0.043
		SCD	-0.046	0.009	**<0.001***	-0.070	-0.022
		aMCI	-0.035	0.009	**0.001**	-0.059	-0.012
15	NC	SCD	0.020	0.009	0.137	-0.003	0.043
		aMCI	0.029	0.008	**0.003**	0.007	0.052
		d-AD	0.067	0.009	**<0.001***	0.043	0.090
	SCD	NC	-0.020	0.009	0.137	-0.043	0.003
		aMCI	0.010	0.009	1.000	-0.014	0.034
		d-AD	0.047	0.010	**<0.001***	0.021	0.073
	aMCI	NC	-0.029	0.008	**0.003**	-0.052	-0.007
		SCD	-0.010	0.009	1.000	-0.034	0.014
		d-AD	0.037	0.009	**0.001**	0.012	0.062
	d-AD	NC	-0.067	0.009	**<0.001***	-0.090	-0.043
		SCD	-0.047	0.010	**<0.001***	-0.073	-0.021
		aMCI	-0.037	0.009	**0.001**	-0.062	-0.012

16	NC	SCD	0.022	0.009	0.113	-0.003	0.046
		aMCI	0.029	0.009	**0.008**	0.005	0.052
		d-AD	0.059	0.010	**<0.001***	0.034	0.085
	SCD	NC	-0.022	0.009	0.113	-0.046	0.003
		aMCI	0.007	0.010	1.000	-0.018	0.033
		d-AD	0.038	0.010	**0.002**	0.010	0.065
	aMCI	NC	-0.029	0.009	**0.008**	-0.052	-0.005
		SCD	-0.007	0.010	1.000	-0.033	0.018
		d-AD	0.031	0.010	**0.015**	0.004	0.057
	d-AD	NC	-0.059	0.010	**<0.001***	-0.085	-0.034
		SCD	-0.038	0.010	**0.002**	-0.065	-0.010
		aMCI	-0.031	0.010	**0.015**	-0.057	-0.004

Table S17. Normalized rich club coefficient for age-matched dataset.

k	NC		SCD		aMCI		d-AD		F	p[a]	Es[b]
(degree)	Mean	SD	Mean	SD	Mean	SD	Mean	SD			
1	1.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000	1.497	0.217	0.024
2	1.001	0.001	1.001	0.001	1.001	0.001	1.001	0.001	3.774	0.012	0.059
3	1.001	0.001	1.002	0.002	1.002	0.001	1.003	0.002	5.062	0.002	0.078
4	1.002	0.002	1.003	0.003	1.004	0.003	1.005	0.004	13.030	<0.001	0.178
5	1.003	0.002	1.004	0.004	1.006	0.003	1.009	0.005	24.371	<0.001	0.289
6	1.004	0.003	1.007	0.005	1.009	0.005	1.014	0.007	36.300	<0.001	0.377
7	1.006	0.004	1.010	0.007	1.014	0.006	1.019	0.011	33.950	<0.001	0.361
8	1.008	0.004	1.015	0.008	1.019	0.008	1.027	0.013	39.639	<0.001	0.398
9	1.011	0.006	1.022	0.009	1.023	0.010	1.032	0.015	35.980	<0.001	0.375
10	1.015	0.008	1.027	0.010	1.029	0.011	1.037	0.016	31.503	<0.001	0.344
11	1.018	0.009	1.032	0.013	1.032	0.011	1.040	0.017	28.453	<0.001	0.322
12	1.022	0.011	1.036	0.016	1.034	0.014	1.043	0.020	15.944	<0.001	0.210
13	1.024	0.012	1.041	0.023	1.036	0.017	1.048	0.023	14.381	<0.001	0.193
14	1.028	0.015	1.044	0.025	1.039	0.023	1.017	0.178	0.916	0.434	0.015
15	1.030	0.016	1.050	0.033	1.051	0.028	0.935	0.338	5.128	0.002	0.079
16	1.033	0.021	1.036	0.168	1.038	0.159	0.835	0.454	7.350	<0.001	0.109

[a] Values from ANOVA.

[b] Effect size; η^2 for normalized rich club coefficient.

Table S18. Post hoc testing on normalized rich club coefficient from ANOVA for age-matched dataset (Bonferroni-corrected for groups).

k (degree)	(I) Group	(J) Group	Mean Difference (I-J)	SE	P	95% Confidence Interval for Difference	
						Lower Bound	Upper Bound
1	NC	SCD	0.000	0.000	1.000	0.000	0.000
		aMCI	0.000	0.000	1.000	0.000	0.000
		d-AD	0.000	0.000	1.000	0.000	0.000
	SCD	NC	0.000	0.000	1.000	0.000	0.000
		aMCI	0.000	0.000	0.498	0.000	0.000
		d-AD	0.000	0.000	1.000	0.000	0.000
	aMCI	NC	0.000	0.000	1.000	0.000	0.000
		SCD	0.000	0.000	0.498	0.000	0.000
		d-AD	0.000	0.000	0.384	0.000	0.000
	d-AD	NC	0.000	0.000	1.000	0.000	0.000
		SCD	0.000	0.000	1.000	0.000	0.000
		aMCI	0.000	0.000	0.384	0.000	0.000
2	NC	SCD	0.000	0.000	**0.049**	-0.001	0.000
		aMCI	0.000	0.000	0.312	-0.001	0.000
		d-AD	-0.001	0.000	**0.024**	-0.001	0.000
	SCD	NC	0.000	0.000	**0.049**	0.000	0.001
		aMCI	0.000	0.000	1.000	0.000	0.001
		d-AD	0.000	0.000	1.000	-0.001	0.000
	aMCI	NC	0.000	0.000	0.312	0.000	0.001
		SCD	0.000	0.000	1.000	-0.001	0.000
		d-AD	0.000	0.000	1.000	-0.001	0.000
	d-AD	NC	0.001	0.000	**0.024**	0.000	0.001
		SCD	0.000	0.000	1.000	0.000	0.001
		aMCI	0.000	0.000	1.000	0.000	0.001
3	NC	SCD	-0.001	0.000	0.079	-0.002	0.000
		aMCI	-0.001	0.000	0.191	-0.002	0.000
		d-AD	-0.001	0.000	**0.002**	-0.002	0.000
	SCD	NC	0.001	0.000	0.079	0.000	0.002
		aMCI	0.000	0.000	1.000	-0.001	0.001
		d-AD	0.000	0.000	1.000	-0.002	0.001
	aMCI	NC	0.001	0.000	0.191	0.000	0.002
		SCD	0.000	0.000	1.000	-0.001	0.001
		d-AD	-0.001	0.000	0.620	-0.002	0.000
	d-AD	NC	0.001	0.000	**0.002**	0.000	0.002
		SCD	0.000	0.000	1.000	-0.001	0.002
		aMCI	0.001	0.000	0.620	0.000	0.002
4	NC	SCD	-0.001	0.001	0.178	-0.003	0.000
		aMCI	-0.002	0.001	**0.003**	-0.003	0.000
		d-AD	-0.004	0.001	**<0.001***	-0.005	-0.002

	SCD	NC	0.001	0.001	0.178	0.000	0.003
		aMCI	-0.001	0.001	1.000	-0.002	0.001
		d-AD	-0.002	0.001	**0.001**	-0.004	-0.001
	aMCI	NC	0.002	0.001	**0.003**	0.000	0.003
		SCD	0.001	0.001	1.000	-0.001	0.002
		d-AD	-0.002	0.001	**0.042**	-0.003	0.000
	d-AD	NC	0.004	0.001	**<0.001***	0.002	0.005
		SCD	0.002	0.001	**0.001**	0.001	0.004
		aMCI	0.002	0.001	**0.042**	0.000	0.003
5	NC	SCD	-0.002	0.001	0.129	-0.003	0.000
		aMCI	-0.004	0.001	**<0.001***	-0.005	-0.002
		d-AD	-0.006	0.001	**<0.001***	-0.008	-0.004
	SCD	NC	0.002	0.001	0.129	0.000	0.003
		aMCI	-0.002	0.001	0.053	-0.004	0.000
		d-AD	-0.004	0.001	**<0.001***	-0.006	-0.002
	aMCI	NC	0.004	0.001	**<0.001***	0.002	0.005
		SCD	0.002	0.001	0.053	0.000	0.004
		d-AD	-0.002	0.001	**0.015**	-0.004	0.000
	d-AD	NC	0.006	0.001	**<0.001***	0.004	0.008
		SCD	0.004	0.001	**<0.001***	0.002	0.006
		aMCI	0.002	0.001	**0.015**	0.000	0.004
6	NC	SCD	-0.003	0.001	**0.009**	-0.006	-0.001
		aMCI	-0.006	0.001	**<0.001***	-0.008	-0.003
		d-AD	-0.010	0.001	**<0.001***	-0.013	-0.008
	SCD	NC	0.003	0.001	**0.009**	0.001	0.006
		aMCI	-0.003	0.001	0.075	-0.005	0.000
		d-AD	-0.007	0.001	**<0.001***	-0.010	-0.004
	aMCI	NC	0.006	0.001	**<0.001***	0.003	0.008
		SCD	0.003	0.001	0.075	0.000	0.005
		d-AD	-0.005	0.001	**<0.001***	-0.007	-0.002
	d-AD	NC	0.010	0.001	**<0.001***	0.008	0.013
		SCD	0.007	0.001	**<0.001***	0.004	0.010
		aMCI	0.005	0.001	**<0.001***	0.002	0.007
7	NC	SCD	-0.005	0.001	**0.005**	-0.008	-0.001
		aMCI	-0.008	0.001	**<0.001***	-0.012	-0.005
		d-AD	-0.014	0.001	**<0.001***	-0.018	-0.010
	SCD	NC	0.005	0.001	**0.005**	0.001	0.008
		aMCI	-0.004	0.001	0.055	-0.008	0.000
		d-AD	-0.009	0.002	**<0.001***	-0.013	-0.005
	aMCI	NC	0.008	0.001	**<0.001***	0.005	0.012
		SCD	0.004	0.001	0.055	0.000	0.008
		d-AD	-0.005	0.002	**0.002**	-0.009	-0.001
	d-AD	NC	0.014	0.001	**<0.001***	0.010	0.018
		SCD	0.009	0.002	**<0.001***	0.005	0.013
		aMCI	0.005	0.002	**0.002**	0.001	0.009
8	NC	SCD	-0.007	0.002	**<0.001***	-0.012	-0.003
		aMCI	-0.011	0.002	**<0.001***	-0.015	-0.007

		d-AD	-0.018	0.002	<**0.001***	-0.023	-0.014
	SCD	NC	0.007	0.002	<**0.001***	0.003	0.012
		aMCI	-0.004	0.002	0.213	-0.008	0.001
		d-AD	-0.011	0.002	<**0.001***	-0.016	-0.006
	aMCI	NC	0.011	0.002	<**0.001***	0.007	0.015
		SCD	0.004	0.002	0.213	-0.001	0.008
		d-AD	-0.008	0.002	<**0.001***	-0.012	-0.003
	d-AD	NC	0.018	0.002	<**0.001***	0.014	0.023
		SCD	0.011	0.002	<**0.001***	0.006	0.016
		aMCI	0.008	0.002	<**0.001***	0.003	0.012
9	NC	SCD	-0.011	0.002	<**0.001***	-0.016	-0.006
		aMCI	-0.012	0.002	<**0.001***	-0.017	-0.007
		d-AD	-0.021	0.002	<**0.001***	-0.027	-0.016
	SCD	NC	0.011	0.002	<**0.001***	0.006	0.016
		aMCI	-0.001	0.002	1.000	-0.007	0.004
		d-AD	-0.010	0.002	<**0.001***	-0.016	-0.004
	aMCI	NC	0.012	0.002	<**0.001***	0.007	0.017
		SCD	0.001	0.002	1.000	-0.004	0.007
		d-AD	-0.009	0.002	<**0.001***	-0.015	-0.003
	d-AD	NC	0.021	0.002	<**0.001***	0.016	0.027
		SCD	0.010	0.002	<**0.001***	0.004	0.016
		aMCI	0.009	0.002	<**0.001***	0.003	0.015
10	NC	SCD	-0.012	0.002	<**0.001***	-0.018	-0.006
		aMCI	-0.014	0.002	<**0.001***	-0.020	-0.008
		d-AD	-0.022	0.002	<**0.001***	-0.028	-0.016
	SCD	NC	0.012	0.002	<**0.001***	0.006	0.018
		aMCI	-0.002	0.002	1.000	-0.008	0.004
		d-AD	-0.010	0.003	<**0.001***	-0.017	-0.003
	aMCI	NC	0.014	0.002	<**0.001***	0.008	0.020
		SCD	0.002	0.002	1.000	-0.004	0.008
		d-AD	-0.008	0.002	**0.008**	-0.015	-0.001
	d-AD	NC	0.022	0.002	<**0.001***	0.016	0.028
		SCD	0.010	0.003	<**0.001***	0.003	0.017
		aMCI	0.008	0.002	**0.008**	0.001	0.015
11	NC	SCD	-0.014	0.002	<**0.001***	-0.020	-0.007
		aMCI	-0.014	0.002	<**0.001***	-0.020	-0.007
		d-AD	-0.023	0.003	<**0.001***	-0.029	-0.016
	SCD	NC	0.014	0.002	<**0.001***	0.007	0.020
		aMCI	0.000	0.003	1.000	-0.007	0.007
		d-AD	-0.009	0.003	**0.010**	-0.016	-0.001
	aMCI	NC	0.014	0.002	<**0.001***	0.007	0.020
		SCD	0.000	0.003	1.000	-0.007	0.007
		d-AD	-0.009	0.003	**0.007**	-0.016	-0.002
	d-AD	NC	0.023	0.003	<**0.001***	0.016	0.029
		SCD	0.009	0.003	**0.010**	0.001	0.016
		aMCI	0.009	0.003	**0.007**	0.002	0.016
		SCD	-0.014	0.003	<**0.001***	-0.022	-0.006

12	NC	aMCI	-0.012	0.003	**<0.001***	-0.020	-0.004
		d-AD	-0.021	0.003	**<0.001***	-0.029	-0.012
	SCD	NC	0.014	0.003	**<0.001***	0.006	0.022
		aMCI	0.002	0.003	1.000	-0.007	0.010
		d-AD	-0.007	0.003	0.257	-0.016	0.002
	aMCI	NC	0.012	0.003	**<0.001***	0.004	0.020
		SCD	-0.002	0.003	1.000	-0.010	0.007
		d-AD	-0.009	0.003	0.066	-0.018	0.000
	d-AD	NC	0.021	0.003	**<0.001***	0.012	0.029
		SCD	0.007	0.003	0.257	-0.002	0.016
		aMCI	0.009	0.003	0.066	0.000	0.018
13	NC	SCD	-0.017	0.004	**<0.001***	-0.027	-0.007
		aMCI	-0.012	0.004	**0.005**	-0.022	-0.003
		d-AD	-0.024	0.004	**<0.001***	-0.034	-0.013
	SCD	NC	0.017	0.004	**<0.001***	0.007	0.027
		aMCI	0.005	0.004	1.000	-0.006	0.015
		d-AD	-0.007	0.004	0.607	-0.018	0.004
	aMCI	NC	0.012	0.004	**0.005**	0.003	0.022
		SCD	-0.005	0.004	1.000	-0.015	0.006
		d-AD	-0.012	0.004	**0.030**	-0.022	-0.001
	d-AD	NC	0.024	0.004	**<0.001***	0.013	0.034
		SCD	0.007	0.004	0.607	-0.004	0.018
		aMCI	0.012	0.004	**0.030**	0.001	0.022
14	NC	SCD	-0.017	0.016	1.000	-0.060	0.027
		aMCI	-0.012	0.016	1.000	-0.054	0.030
		d-AD	0.010	0.017	1.000	-0.035	0.056
	SCD	NC	0.017	0.016	1.000	-0.027	0.060
		aMCI	0.005	0.017	1.000	-0.041	0.051
		d-AD	0.027	0.018	0.856	-0.022	0.076
	aMCI	NC	0.012	0.016	1.000	-0.030	0.054
		SCD	-0.005	0.017	1.000	-0.051	0.041
		d-AD	0.022	0.018	1.000	-0.026	0.070
	d-AD	NC	-0.010	0.017	1.000	-0.056	0.035
		SCD	-0.027	0.018	0.856	-0.076	0.022
		aMCI	-0.022	0.018	1.000	-0.070	0.026
15	NC	SCD	-0.020	0.030	1.000	-0.101	0.061
		aMCI	-0.021	0.029	1.000	-0.099	0.058
		d-AD	0.095	0.032	**0.019**	0.010	0.180
	SCD	NC	0.020	0.030	1.000	-0.061	0.101
		aMCI	-0.001	0.032	1.000	-0.086	0.085
		d-AD	0.115	0.034	**0.006**	0.024	0.206
	aMCI	NC	0.021	0.029	1.000	-0.058	0.099
		SCD	0.001	0.032	1.000	-0.085	0.086
		d-AD	0.116	0.033	**0.004**	0.027	0.205
	d-AD	NC	-0.095	0.032	**0.019**	-0.180	-0.010
		SCD	-0.115	0.034	**0.006**	-0.206	-0.024
		aMCI	-0.116	0.033	**0.004**	-0.205	-0.027

16	NC	SCD	-0.003	0.046	1.000	-0.127	0.121
		aMCI	-0.004	0.045	1.000	-0.124	0.116
		d-AD	0.199	0.049	**<0.001***	0.069	0.328
	SCD	NC	0.003	0.046	1.000	-0.121	0.127
		aMCI	-0.001	0.049	1.000	-0.132	0.129
		d-AD	0.202	0.052	**0.001**	0.062	0.341
	aMCI	NC	0.004	0.045	1.000	-0.116	0.124
		SCD	0.001	0.049	1.000	-0.129	0.132
		d-AD	0.203	0.051	**0.001**	0.067	0.339
	d-AD	NC	-0.199	0.049	**<0.001***	-0.328	-0.069
		SCD	-0.202	0.052	**0.001**	-0.341	-0.062
		aMCI	-0.203	0.051	**0.001**	-0.339	-0.067

Table S19. Rich club, feeder and local connectivity strength for age-matched dataset.

ANOVA	F	p[a]	Es[b]
Rich Club Connectivity Strength	10.848	<0.001	0.153
Feeder Connectivity Strength	55.035	<0.001	0.478
Local Connectivity Strength	96.976	<0.001	0.618

[a] Values from ANOVA.

[b] Effect size; η^2 for rich club, feeder and local connectivity strength.

Table S20. Post hoc testing on rich club, feeder and local connectivity strength from ANOVA for age-matched dataset (Bonferroni-corrected for groups).

ANOVA	(I) Group	(J) Group	Mean Difference (I-J)	SE	P	95% Confidence Interval for Difference	
						Lower Bound	Upper Bound
Rich Club Connectivity Strength	NC	SCD	0.777	0.393	0.296	-0.271	1.825
		aMCI	1.506	0.380	**0.001**	0.491	2.521
		d-AD	2.180	0.412	**<0.001***	1.082	3.278
	SCD	NC	-0.777	0.393	0.296	-1.825	0.271
		aMCI	0.729	0.413	0.476	-0.373	1.831
		d-AD	1.403	0.442	**0.011**	0.224	2.582
	aMCI	NC	-1.506	0.380	**0.001**	-2.521	-0.491
		SCD	-0.729	0.413	0.476	-1.831	0.373
		d-AD	0.674	0.431	0.719	-0.476	1.823
	d-AD	NC	-2.180	0.412	**<0.001***	-3.278	-1.082
		SCD	-1.403	0.442	**0.011**	-2.582	-0.224
		aMCI	-0.674	0.431	0.719	-1.823	0.476
Feeder Connectivity Strength	NC	SCD	10.164	1.569	**<0.001***	5.978	14.350
		aMCI	12.632	1.520	**<0.001***	8.578	16.686
		d-d-AD	20.263	1.644	**<0.001***	15.877	24.648
	SCD	NC	-10.164	1.569	**<0.001***	-14.350	-5.978
		aMCI	2.468	1.650	0.819	-1.935	6.871
		d-d-AD	10.099	1.765	**<0.001***	5.389	14.808
	aMCI	NC	-12.632	1.520	**<0.001***	-16.686	-8.578
		SCD	-2.468	1.650	0.819	-6.871	1.935
		d-AD	7.631	1.721	**<0.001***	3.038	12.223
	d-AD	NC	-20.263	1.644	**<0.001***	-24.648	-15.877
		SCD	-10.099	1.765	**<0.001***	-14.808	-5.389
		aMCI	-7.631	1.721	**<0.001***	-12.223	-3.038
Local Connectivity Strength	NC	SCD	22.202	2.461	**<0.001***	15.637	28.767
		aMCI	27.368	2.383	**<0.001***	21.010	33.726
		d-AD	41.655	2.578	**<0.001***	34.777	48.532
	SCD	NC	-22.202	2.461	**<0.001***	-28.767	-15.637
		aMCI	5.165	2.588	0.285	-1.739	12.070
		d-AD	19.452	2.769	**<0.001***	12.067	26.838
	aMCI	NC	-27.368	2.383	**<0.001***	-33.726	-21.010
		SCD	-5.165	2.588	0.285	-12.070	1.739
		d-AD	14.287	2.700	**<0.001***	7.085	21.489
	d-AD	NC	-41.655	2.578	**<0.001***	-48.532	-34.777
		SCD	-19.452	2.769	**<0.001***	-26.838	-12.067
		aMCI	-14.287	2.700	**<0.001***	-21.489	-7.085

Table S21. Network topological metrics for age-matched dataset.

ANOVA	F	p[a]	Es[b]
Strength	88.561	<0.001	0.596
Clustering Coefficient	11.586	<0.001	0.162
Normalized Clustering Coefficient	34.436	<0.001	0.365
Characteristic Path Length	39.791	<0.001	0.399
Normalized Characteristic Path Length	4.365	0.005	0.068

[a] Values from ANOVA.

[b] Effect size; η^2 for network topological metrics.

Table S22. Post hoc testing on network topological metrics from ANOVA for age-matched dataset (Bonferroni-corrected for groups).

ANOVA	(I) Group	(J) Group	Mean Difference (I-J)	SE	P	95% Confidence Interval for Difference	
						Lower Bound	Upper Bound
Strength	NC	SCD	0.737	0.088	**<0.001***	0.503	0.970
		aMCI	0.922	0.085	**<0.001***	0.696	1.149
		d-AD	1.424	0.092	**<0.001***	1.179	1.669
	SCD	NC	-0.737	0.088	**<0.001***	-0.970	-0.503
		aMCI	0.186	0.092	0.272	-0.060	0.432
		d-AD	0.688	0.099	**<0.001***	0.425	0.951
	aMCI	NC	-0.922	0.085	**<0.001***	-1.149	-0.696
		SCD	-0.186	0.092	0.272	-0.432	0.060
		d-AD	0.502	0.096	**<0.001***	0.245	0.759
	d-AD	NC	-1.424	0.092	**<0.001***	-1.669	-1.179
		SCD	-0.688	0.099	**<0.001***	-0.951	-0.425
		aMCI	-0.502	0.096	**<0.001***	-0.759	-0.245
Clustering Coefficient	NC	SCD	0.015	0.005	**0.014**	0.002	0.027
		aMCI	0.016	0.005	**0.005**	0.003	0.028
		d-AD	0.028	0.005	**<0.001***	0.015	0.042
	SCD	NC	-0.015	0.005	**0.014**	-0.027	-0.002
		aMCI	0.001	0.005	1.000	-0.012	0.014
		d-AD	0.014	0.005	0.057	0.000	0.028
	aMCI	NC	-0.016	0.005	**0.005**	-0.028	-0.003
		SCD	-0.001	0.005	1.000	-0.014	0.012
		d-AD	0.013	0.005	0.086	-0.001	0.027
	d-AD	NC	-0.028	0.005	**<0.001***	-0.042	-0.015
		SCD	-0.014	0.005	0.057	-0.028	0.000
		aMCI	-0.013	0.005	0.086	-0.027	0.001
Normalized Clustering Coefficient	NC	SCD	-0.181	0.033	**<0.001***	-0.270	-0.092
		aMCI	-0.148	0.032	**<0.001***	-0.234	-0.062
		d-AD	-0.352	0.035	**<0.001***	-0.446	-0.259
	SCD	NC	0.181	0.033	**<0.001***	0.092	0.270
		aMCI	0.033	0.035	1.000	-0.061	0.127
		d-AD	-0.171	0.038	**<0.001***	-0.272	-0.071
	aMCI	NC	0.148	0.032	**<0.001***	0.062	0.234
		SCD	-0.033	0.035	1.000	-0.127	0.061
		d-AD	-0.204	0.037	**<0.001***	-0.302	-0.106
	d-AD	NC	0.352	0.035	**<0.001***	0.259	0.446
		SCD	0.171	0.038	**<0.001***	0.071	0.272
		aMCI	0.204	0.037	**<0.001***	0.106	0.302
Characteristic Path Length	NC	SCD	-0.380	0.072	**<0.001***	-0.572	-0.187
		aMCI	-0.465	0.070	**<0.001***	-0.652	-0.279
		d-AD	-0.803	0.076	**<0.001***	-1.005	-0.601

	SCD	NC	0.380	0.072	**<0.001***	0.187	0.572
		aMCI	-0.085	0.076	1.000	-0.288	0.117
		d-AD	-0.423	0.081	**<0.001***	-0.640	-0.207
	aMCI	NC	0.465	0.070	**<0.001***	0.279	0.652
		SCD	0.085	0.076	1.000	-0.117	0.288
		d-AD	-0.338	0.079	**<0.001***	-0.549	-0.127
	d-AD	NC	0.803	0.076	**<0.001***	0.601	1.005
		SCD	0.423	0.081	**<0.001***	0.207	0.640
		aMCI	0.338	0.079	**<0.001***	0.127	0.549
Normalized Characteristic Path Length	NC	SCD	-0.007	0.003	**0.042**	-0.014	0.000
		aMCI	-0.001	0.002	1.000	-0.008	0.005
		d-AD	-0.008	0.003	**0.024**	-0.015	-0.001
	SCD	NC	0.007	0.003	**0.042**	0.000	0.014
		aMCI	0.005	0.003	0.238	-0.002	0.013
		d-AD	-0.001	0.003	1.000	-0.008	0.007
	aMCI	NC	0.001	0.002	1.000	-0.005	0.008
		SCD	-0.005	0.003	0.238	-0.013	0.002
		d-AD	-0.006	0.003	0.143	-0.014	0.001
	d-AD	NC	0.008	0.003	**0.024**	0.001	0.015
		SCD	0.001	0.003	1.000	-0.007	0.008
		aMCI	0.006	0.003	0.143	-0.001	0.014

Table S23. Partial Pearson's correlations between normalized rich club coefficients and clinical performance for age-matched dataset. Partial Pearson's correlations controlled for education were used to assess how normalized rich club coefficients related to clinical performance in each group. The bold numbers represent significant correlations at $P<0.05$. The star-labeled numbers represent significant correlations at $P<0.05$ after Bonferroni corrections for the number of cognitive test variables (AVLT-immediate recall, AVLT-delayed recall, AVLT-recognition, MMSE and MoCA).

COV: Education		k	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	AVLT-	r	-0.172	-0.242	-0.140	0.039	0.075	0.190	0.141	0.085	0.020	0.091	0.069	0.102	0.014	-0.001	0.038
	Immediate	p	0.114	**0.043**	0.163	0.392	0.299	0.091	0.162	0.277	0.444	0.263	0.315	0.238	0.462	0.498	0.396
	AVLT-	r	-0.011	-0.342	-0.319	0.002	-0.061	0.107	0.017	-0.044	-0.061	-0.014	0.014	0.004	-0.107	-0.097	-0.116
	Delayed	p	0.469	**0.007***	**0.011**	0.494	0.334	0.228	0.453	0.381	0.334	0.461	0.461	0.489	0.227	0.249	0.210
NC	AVLT-	r	0.111	-0.054	-0.100	0.150	0.129	0.242	0.174	0.103	0.059	0.019	-0.009	-0.150	-0.231	-0.131	-0.161
DF=49	Recognition	p	0.219	0.354	0.242	0.146	0.184	**0.043**	0.111	0.236	0.339	0.448	0.476	0.147	0.051	0.180	0.129
	MMSE	r	0.110	-0.034	0.038	0.033	0.107	0.152	0.018	-0.097	-0.105	-0.068	-0.078	0.072	-0.005	-0.019	-0.112
		p	0.221	0.406	0.395	0.409	0.227	0.143	0.451	0.249	0.231	0.317	0.292	0.307	0.486	0.446	0.216
	MoCA	r	0.026	-0.178	-0.055	-0.015	-0.090	-0.042	-0.090	-0.066	-0.073	-0.025	-0.117	0.006	-0.066	-0.053	-0.143
		p	0.427	0.106	0.352	0.457	0.265	0.384	0.265	0.322	0.305	0.432	0.207	0.482	0.322	0.356	0.158
	AVLT-	r	-0.133	0.027	0.061	0.026	-0.086	-0.022	-0.080	-0.073	-0.134	-0.125	0.019	0.016	-0.034	-0.055	0.101
	Immediate	p	0.213	0.436	0.358	0.439	0.303	0.448	0.316	0.331	0.211	0.228	0.456	0.463	0.421	0.371	0.272
	AVLT-	r	0.013	-0.119	-0.181	-0.172	-0.298	-0.305	-0.296	-0.164	-0.294	-0.284	-0.072	-0.057	0.030	-0.049	0.122
	Delayed	p	0.469	0.239	0.138	0.152	**0.035**	**0.031**	**0.036**	0.163	**0.037**	**0.042**	0.334	0.367	0.430	0.384	0.233
SCD	AVLT-	r	0.073	0.163	-0.007	-0.117	-0.112	-0.139	-0.162	-0.171	-0.222	-0.184	-0.200	-0.313	-0.297	-0.298	-0.186
DF=36	Recognition	p	0.332	0.164	0.482	0.242	0.251	0.203	0.165	0.152	0.091	0.134	0.114	**0.028**	**0.035**	**0.034**	0.132
	MMSE	r	-0.057	-0.089	-0.161	-0.135	-0.191	-0.245	-0.186	-0.156	-0.312	-0.349	-0.190	-0.217	-0.254	-0.372	0.008
		p	0.366	0.298	0.167	0.210	0.126	0.069	0.132	0.175	**0.028**	**0.016**	0.127	0.095	0.062	**0.011**	0.480
	MoCA	r	0.051	0.134	0.034	0.045	0.070	-0.036	-0.058	-0.045	0.010	-0.143	-0.058	-0.141	-0.175	-0.227	0.082
		p	0.380	0.212	0.419	0.393	0.338	0.415	0.364	0.395	0.476	0.196	0.365	0.200	0.147	0.085	0.312
	AVLT-	r	-0.032	0.022	-0.223	-0.240	-0.193	-0.061	-0.072	-0.185	-0.181	-0.266	-0.203	-0.118	-0.091	-0.144	0.021
	Immediate	p	0.419	0.443	0.073	0.058	0.105	0.348	0.320	0.115	0.119	**0.040**	0.093	0.223	0.279	0.175	0.446
	AVLT-	r	-0.001	-0.029	-0.191	-0.286	-0.216	-0.247	-0.124	-0.113	-0.144	-0.228	-0.111	0.096	0.084	-0.076	0.219
	Delayed	p	0.497	0.427	0.107	**0.030**	0.080	0.053	0.211	0.232	0.176	0.068	0.236	0.268	0.293	0.311	0.076
aMCI	AVLT-	r	-0.072	-0.220	-0.063	-0.159	-0.194	-0.254	-0.025	0.011	0.015	-0.089	0.105	0.137	0.127	-0.148	0.033
DF=42	Recognition	p	0.321	0.076	0.343	0.151	0.104	0.048	0.435	0.471	0.461	0.283	0.249	0.187	0.206	0.168	0.416
	MMSE	r	0.048	-0.209	-0.151	-0.238	-0.286	-0.243	-0.193	-0.086	-0.153	-0.215	-0.038	-0.029	-0.173	-0.192	0.007
		p	0.379	0.087	0.164	0.060	**0.030**	0.056	0.105	0.290	0.160	0.081	0.404	0.426	0.130	0.106	0.482
	MoCA	r	0.042	-0.259	-0.215	-0.289	-0.277	-0.250	-0.174	-0.121	-0.248	-0.264	-0.039	0.090	-0.021	-0.011	0.140
		p	0.393	**0.045**	0.080	**0.029**	**0.034**	0.051	0.130	0.217	0.052	**0.042**	0.400	0.281	0.447	0.473	0.183
	AVLT-	r	-0.041	0.170	-0.126	-0.036	-0.191	-0.184	-0.123	0.056	0.064	0.131	-0.032	-0.171	-0.054	-0.077	0.097
	Immediate	p	0.415	0.185	0.254	0.425	0.156	0.165	0.259	0.385	0.369	0.245	0.434	0.182	0.389	0.343	0.305
d-AD	AVLT-	r	-0.422	-0.222	-0.223	-0.052	-0.136	-0.169	-0.152	-0.126	-0.069	0.083	-0.071	-0.034	0.134	-0.013	0.140
DF=28	Delayed	p	**0.010***	0.119	0.119	0.392	0.237	0.187	0.211	0.254	0.358	0.331	0.354	0.430	0.239	0.474	0.230
	AVLT-	r	-0.447	-0.169	-0.266	-0.407	-0.429	-0.389	-0.304	-0.209	-0.178	-0.244	-0.260	-0.288	-0.100	0.041	0.201
	Recognition	p	**0.007**	0.186	0.078	**0.013**	**0.008***	**0.017**	0.051	0.133	0.173	0.097	0.083	0.062	0.300	0.415	0.144

MMSE	r	-0.043	0.086	-0.114	-0.095	-0.214	-0.247	-0.258	-0.079	-0.149	-0.241	-0.240	-0.409	-0.055	-0.041	0.024
	p	0.411	0.325	0.274	0.309	0.128	0.094	0.084	0.339	0.216	0.100	0.101	0.012	0.387	0.415	0.450
MoCA	r	-0.116	0.041	-0.064	-0.073	-0.187	-0.219	-0.224	-0.060	-0.128	-0.245	-0.234	-0.337	-0.071	-0.033	-0.012
	p	0.271	0.415	0.368	0.351	0.161	0.122	0.117	0.376	0.250	0.096	0.106	0.034	0.356	0.431	0.475

Table S24. Partial Pearson's correlations between rich club coefficients and clinical performance for age-matched dataset. Partial Pearson's correlations controlled for education were used to assess how rich club coefficients related to clinical performance in each group. The bold numbers represent significant correlations at $P<0.05$. The star-labeled numbers represent significant correlations at $P<0.05$ after Bonferroni corrections for the number of cognitive test variables (AVLT-immediate recall, AVLT-delayed recall, AVLT-recognition, MMSE and MoCA).

COV: Education		k	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
NC DF=49	AVLT-Immediate Recall Scores	r	0.131	0.126	0.120	-0.088	0.086	-0.055	-0.005	0.040	-0.046	-0.031	0.054	0.066	0.047	0.104	0.170
		p	0.179	0.189	0.201	0.269	0.274	0.352	0.487	0.391	0.374	0.415	0.354	0.323	0.373	0.234	0.117
	AVLT-Delayed Recall Scores	r	0.246	0.053	0.027	-0.031	-0.057	-0.147	-0.086	0.058	-0.037	0.059	0.065	0.054	0.028	0.089	0.128
		p	**0.041**	0.356	0.427	0.414	0.345	0.151	0.275	0.343	0.398	0.341	0.325	0.353	0.422	0.267	0.185
	AVLT-Recognition Scores	r	0.301	0.095	0.051	0.014	0.022	-0.061	0.018	0.222	0.197	0.173	0.123	0.069	0.045	0.132	0.112
		p	**0.016**	0.254	0.361	0.462	0.438	0.334	0.449	0.059	0.083	0.112	0.195	0.316	0.376	0.178	0.217
	MMSE	r	0.078	0.074	0.145	0.179	0.121	0.029	0.017	0.093	0.183	0.117	0.047	0.176	0.194	0.218	0.140
		p	0.293	0.304	0.155	0.105	0.200	0.420	0.454	0.259	0.099	0.207	0.371	0.108	0.087	0.062	0.164
	MoCA	r	-0.025	0.053	0.176	0.219	0.322	0.297	0.230	0.259	0.275	0.172	0.098	0.191	0.215	0.175	0.102
		p	0.432	0.356	0.108	0.062	**0.011**	**0.017**	0.052	**0.033**	**0.025**	0.114	0.247	0.090	0.065	0.109	0.237
SCD DF=36	AVLT-Immediate Recall Scores	r	0.203	0.156	0.217	0.237	0.176	0.166	0.036	0.064	-0.019	-0.145	0.000	0.097	0.056	0.112	0.086
		p	0.111	0.175	0.095	0.076	0.145	0.160	0.415	0.351	0.454	0.193	0.499	0.281	0.368	0.251	0.305
	AVLT-Delayed Recall Scores	r	0.247	0.225	0.233	0.375	0.334	0.347	0.238	0.274	0.183	0.164	0.299	0.284	0.306	0.296	0.365
		p	0.067	0.087	0.080	**0.010***	**0.020**	**0.016**	0.075	**0.048**	0.135	0.163	**0.034**	**0.042**	**0.031**	**0.036**	**0.012**
	AVLT-Recognition Scores	r	0.081	0.098	-0.049	-0.067	-0.108	-0.117	-0.277	-0.132	-0.043	-0.095	-0.052	-0.108	-0.105	-0.033	0.031
		p	0.315	0.279	0.385	0.345	0.260	0.241	0.046	0.215	0.398	0.286	0.379	0.259	0.266	0.423	0.427
	MMSE	r	0.097	-0.001	-0.009	0.108	0.069	0.094	0.063	0.021	0.041	0.008	0.093	0.136	0.072	0.029	0.173
		p	0.281	0.498	0.479	0.259	0.339	0.288	0.354	0.450	0.403	0.481	0.289	0.208	0.335	0.432	0.149
	MoCA	r	-0.045	0.104	0.079	-0.050	-0.130	-0.071	0.011	0.082	0.193	0.085	0.118	0.077	0.080	0.086	0.269
		p	0.395	0.268	0.319	0.382	0.218	0.336	0.474	0.312	0.122	0.307	0.239	0.322	0.316	0.304	0.051
aMCI DF=42	AVLT-Immediate Recall Scores	r	0.222	0.363	0.044	0.002	-0.145	-0.217	-0.152	-0.078	0.066	0.063	0.118	0.121	0.128	0.114	0.135
		p	0.074	**0.007***	0.389	0.495	0.175	0.078	0.162	0.307	0.335	0.343	0.222	0.216	0.203	0.231	0.191
	AVLT-Delayed Recall Scores	r	0.157	0.332	0.225	0.154	0.185	0.008	0.002	0.065	0.198	0.251	0.390	0.436	0.387	0.386	0.422
		p	0.155	**0.014**	0.071	0.159	0.114	0.480	0.494	0.337	0.099	0.050	**0.004***	**0.002***	**0.004***	**0.004***	**0.002***
	AVLT-Recognition Scores	r	-0.029	-0.002	0.103	-0.034	0.077	-0.031	-0.054	-0.042	0.152	0.130	0.282	0.227	0.213	0.128	0.106
		p	0.427	0.495	0.254	0.414	0.309	0.422	0.363	0.393	0.162	0.199	**0.032**	0.069	0.083	0.203	0.247
	MMSE	r	0.042	0.190	0.191	-0.041	-0.024	-0.098	-0.093	-0.021	0.052	0.062	0.160	0.177	0.077	0.058	0.048
		p	0.393	0.108	0.107	0.396	0.438	0.264	0.274	0.446	0.368	0.345	0.149	0.126	0.309	0.354	0.377
	MoCA	r	0.181	0.371	0.204	0.002	0.059	-0.042	0.084	0.024	0.046	0.152	0.242	0.245	0.193	0.169	0.208
		p	0.120	**0.006***	0.092	0.495	0.352	0.393	0.295	0.439	0.385	0.162	0.057	0.054	0.104	0.136	0.087
d-AD DF=28	AVLT-Immediate Recall Scores	r	0.533	0.230	0.090	0.115	0.064	0.108	0.269	0.314	0.246	0.119	0.078	0.032	-0.001	0.062	0.062
		p	**0.001***	0.111	0.318	0.273	0.369	0.286	0.075	0.046	0.095	0.265	0.340	0.433	0.499	0.372	0.373
	AVLT-Delayed Recall Scores	r	0.374	0.302	0.153	0.122	0.043	0.217	0.285	0.362	0.256	0.167	0.058	-0.005	-0.034	-0.059	0.071
		p	**0.021**	0.052	0.209	0.261	0.411	0.125	0.064	**0.025**	0.086	0.189	0.379	0.489	0.430	0.379	0.355
	AVLT-Recognition Scores	r	0.140	0.183	0.316	0.237	0.143	0.255	0.243	0.340	0.297	0.148	0.112	0.094	0.126	0.089	0.133
		p	0.230	0.167	**0.044**	0.104	0.226	0.087	0.098	**0.033**	0.056	0.217	0.278	0.311	0.253	0.321	0.243

MMSE	r	0.583	0.204	0.172	0.253	0.203	0.216	0.426	0.397	0.301	0.149	0.184	0.106	0.033	0.111	0.126
	p	**<0.001**	0.140	0.182	0.089	0.141	0.125	**0.009**	**0.015**	0.053	0.217	0.165	0.289	0.431	0.280	0.253
MoCA	r	0.616	0.176	0.161	0.154	0.096	0.147	0.360	0.380	0.226	0.043	0.053	-0.031	-0.078	-0.035	0.025
	p	**<0.001**	0.175	0.198	0.209	0.306	0.219	**0.025**	**0.019**	0.115	0.412	0.391	0.436	0.340	0.427	0.447

Table S25. Partial Pearson's correlations between rich club, feeder and local connectivity strength and clinical performance for age-matched dataset. Partial Pearson's correlations controlled for education were used to assess how rich club, feeder and local connectivity strength related to clinical performance in each group. The bold numbers represent significant correlations at $P<0.05$. The star-labeled numbers represent significant correlations at $P<0.05$ after Bonferroni corrections for the number of cognitive test variables (AVLT-immediate recall, AVLT-delayed recall, AVLT-recognition, MMSE and MoCA).

	COV: Education		Rich Club Connectivity Strength	Feeder Connectivity Strength	Local Connectivity Strength
NC (DF=49)	AVLT-Immediate Recall Scores	r	0.105	0.194	-0.040
		p	0.232	0.086	0.391
	AVLT-Delayed Recall Scores	r	-0.148	0.120	-0.045
		p	0.150	0.201	0.377
	AVLT-Recognition Scores	r	-0.171	0.217	0.067
		p	0.115	0.063	0.321
	MMSE	r	0.060	0.168	0.103
		p	0.338	0.119	0.235
	MoCA	r	-0.078	0.231	0.234
		p	0.293	0.051	**0.049**
SCD (DF=36)	AVLT-Immediate Recall Scores	r	0.074	0.237	0.086
		p	0.329	0.076	0.304
	AVLT-Delayed Recall Scores	r	0.278	0.426	0.323
		p	**0.046**	**0.003***	**0.024**
	AVLT-Recognition Scores	r	-0.079	0.128	-0.054
		p	0.318	0.222	0.374
	MMSE	r	0.038	0.216	0.100
		p	0.411	0.097	0.276
	MoCA	r	0.162	0.064	0.056
		p	0.165	0.352	0.368
aMCI (DF=42)	AVLT-Immediate Recall Scores	r	0.065	0.255	0.096
		p	0.338	**0.048**	0.268
	AVLT-Delayed Recall Scores	r	0.262	0.486	0.166
		p	**0.043**	**<0.001***	0.140
	AVLT-Recognition Scores	r	0.155	0.233	0.000
		p	0.158	0.064	0.500
	MMSE	r	0.145	0.189	0.122
		p	0.173	0.110	0.216
	MoCA	r	0.251	0.265	0.125
		p	**0.050**	**0.041**	0.209
d-AD (DF=28)	AVLT-Immediate Recall Scores	r	0.105	0.032	0.073
		p	0.290	0.434	0.350
	AVLT-Delayed Recall Scores	r	0.061	0.033	0.140
		p	0.375	0.432	0.230

AVLT-Recognition Scores	r	0.062	0.328	0.332
	p	0.372	**0.038**	**0.037**
MMSE	r	-0.001	0.215	0.265
	p	0.498	0.127	0.079
MoCA	r	-0.060	0.130	0.154
	p	0.376	0.247	0.209

Table S26. Partial Pearson's correlations between network topological metrics and clinical performance for age-matched dataset. Partial Pearson's correlations controlled for education were used to assess how network topological metrics related to clinical performance in each group. The bold numbers represent significant correlations at $P<0.05$ without Bonferroni corrections. The star-labeled numbers represent significant correlations at $P<0.05$ after Bonferroni corrections for the number of cognitive test variables (AVLT-immediate recall, AVLT-delayed recall, AVLT-recognition, MMSE and MoCA).

	COV: Education		Strength	Clustering Coefficient	Normalized Clustering Coefficient	Characteristic Path Length	Normalized Characteristic Path Length
NC DF=49	AVLT-Immediate Recall Scores	r	0.061	-0.031	-0.157	-0.059	0.024
		p	0.335	0.413	0.135	0.342	0.433
	AVLT-Delayed Recall Scores	r	0.001	0.120	-0.046	0.022	0.124
		p	0.498	0.200	0.375	0.439	0.192
	AVLT-Recognition Scores	r	0.114	0.071	-0.181	-0.085	0.072
		p	0.213	0.311	0.102	0.275	0.308
	MMSE	r	0.145	0.036	-0.136	-0.183	-0.149
		p	0.156	0.400	0.170	0.099	0.148
	MoCA	r	0.245	0.116	-0.117	-0.196	-0.081
		p	**0.042**	0.209	0.207	0.084	0.286
SCD DF=36	AVLT-Immediate Recall Scores	r	0.160	0.058	-0.291	-0.136	-0.059
		p	0.169	0.364	0.038	0.208	0.363
	AVLT-Delayed Recall Scores	r	0.398	0.138	-0.339	-0.390	-0.215
		p	**0.006***	0.205	**0.019**	**0.007***	0.098
	AVLT-Recognition Scores	r	0.016	0.105	-0.122	0.045	0.139
		p	0.461	0.264	0.233	0.394	0.203
	MMSE	r	0.155	0.349	-0.258	-0.157	-0.117
		p	0.177	**0.016**	0.059	0.174	0.242
	MOCA	r	0.076	0.103	-0.180	-0.124	0.001
		p	0.325	0.268	0.140	0.230	0.499
aMCI DF=42	AVLT-Immediate Recall Scores	r	0.170	0.051	-0.239	-0.092	-0.084
		p	0.135	0.372	0.059	0.276	0.294
	AVLT-Delayed Recall Scores	r	0.328	0.207	-0.423	-0.264	-0.160
		p	**0.015**	0.089	**0.002***	**0.042**	0.150
	AVLT-Recognition Scores	r	0.111	0.361	-0.178	-0.054	-0.137
		p	0.237	**0.008***	0.124	0.364	0.187
	MMSE	r	0.167	0.290	-0.064	-0.129	-0.053
		p	0.139	**0.028**	0.340	0.202	0.367
	MoCA	r	0.211	0.275	-0.129	-0.115	-0.149
		p	0.085	**0.035**	0.201	0.228	0.167
d-AD DF=28	AVLT-Immediate Recall Scores	r	0.066	-0.143	-0.287	0.004	-0.196
		p	0.365	0.225	0.062	0.492	0.150
	AVLT-Delayed Recall Scores	r	0.102	-0.003	-0.024	-0.040	-0.151
		p	0.296	0.493	0.450	0.416	0.213

AVLT-Recognition Scores	r	0.329	0.071	-0.140	-0.302	-0.064
	p	**0.038**	0.354	0.230	0.052	0.368
MMSE	r	0.240	0.144	-0.114	-0.165	-0.062
	p	0.100	0.225	0.274	0.192	0.373
MoCA	r	0.136	-0.068	-0.118	-0.097	-0.111
	p	0.237	0.360	0.267	0.305	0.280

Table S27. Partial Pearson's correlations between network topological metrics and rich club/feeder/local connectivity strength. Partial Pearson's correlations controlled for age and gender were used to assess how network topological metrics related to rich club/feeder/local connectivity strength. The bold numbers represent significant correlations at $P<0.05$. The star-labeled numbers represent significant correlations at $P<0.05$ after Bonferroni corrections for the number of variables (=15).

	COV: Age & Gender		Rich Club Connectivity Strength	Feeder Connectivity Strength	Local Connectivity Strength
DF=220	Strength	r	0.579	0.945	0.977
		p	**<0.001***	**<0.001***	**<0.001***
	Clustering Coefficient	r	0.282	0.564	0.524
		p	**<0.001***	**<0.001***	**<0.001***
	Characteristic Path Length	r	-0.552	-0.884	-0.894
		p	**<0.001***	**<0.001***	**<0.001***
	Normalized Clustering Coefficient	r	-0.568	-0.721	-0.608
		p	**<0.001***	**<0.001***	**<0.001***
	Normalized Characteristic Path Length	r	-0.408	-0.341	-0.242
		p	**<0.001***	**<0.001***	**0.002***

Figures

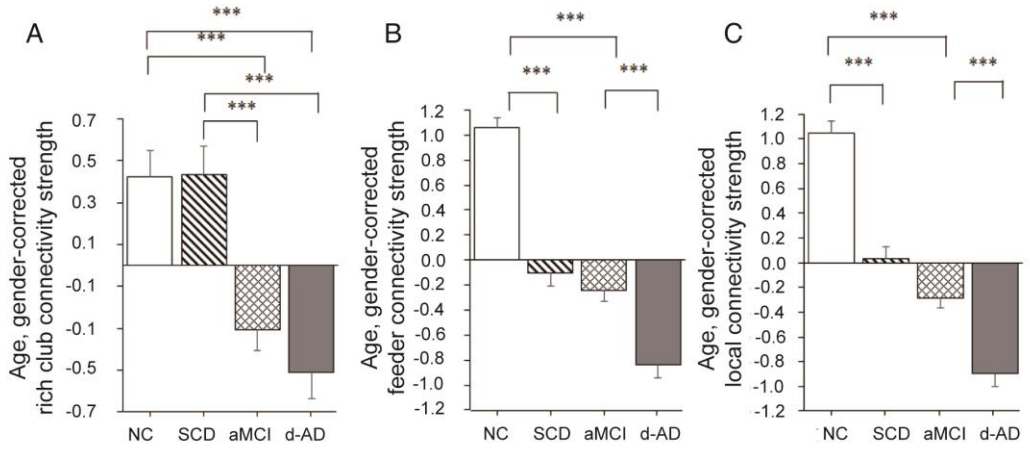

Figure S1. Group differences in rich club networks properties based on individual rich club selection. Bar graphs display the mean (standard error) age and gender-corrected values for (A) rich club, (B) feeder and (C) local connectivity strength (N=183). **P*<0.05, ***P*<0.01, ****P*<0.001.

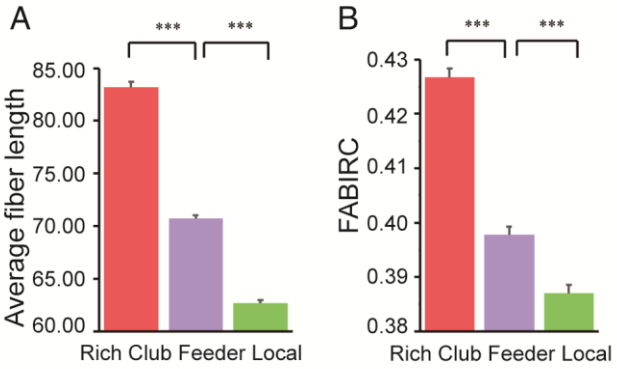

Figure S2. (A) Length of rich club, feeder, and local connections across all the groups of subjects (N=183). Connection length estimated from the fiber length in mm between pairs of connected nodes for each network. (B) FABIRC of rich club, feeder, and local connections across all the groups of subjects (N=183).

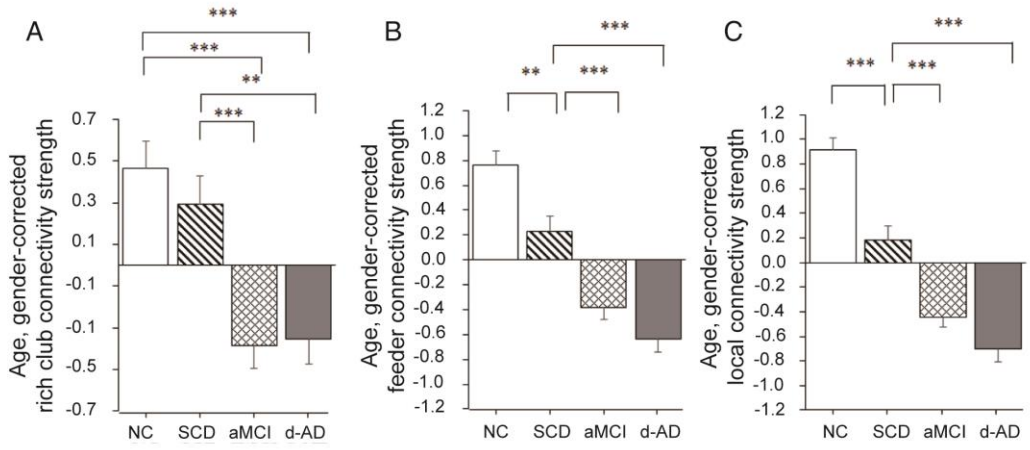

Figure S3. Group differences in rich club networks properties by regressing out average fiber length. Bar graphs display the mean (standard error) age and gender-corrected values for (A) rich club, (B) feeder and (C) local connectivity strength (N=183). **P*<0.05, ***P*<0.01, ****P*<0.001.

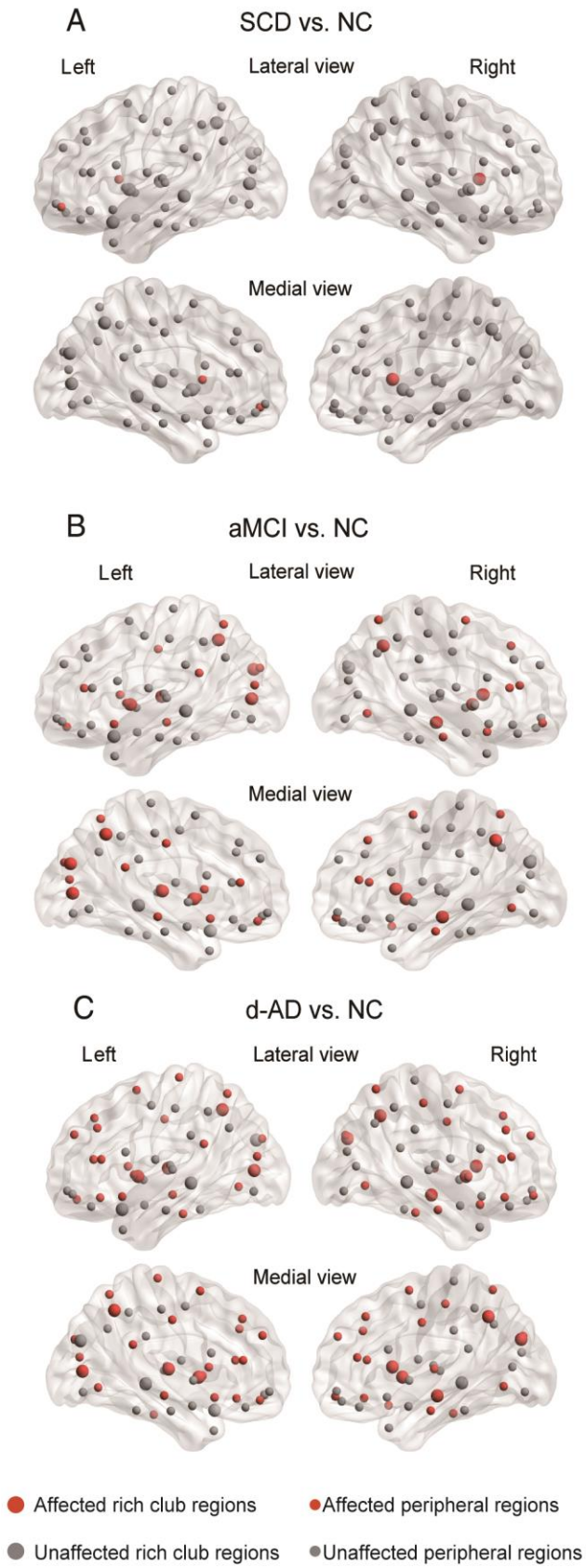
A
SCD vs. NC
Left
Lateral view
Right
Medial view
B
aMCI vs. NC
Left
Lateral view
Right
Medial view
C
d-AD vs. NC
Left
Lateral view
Right
Medial view
Affected rich club regions
Affected peripheral regions
Unaffected rich club regions
Unaffected peripheral regions

Figure S4. Nodes with the highest number of aberrant connections in (A) SCD, (B) aMCI, and (D) d-AD compared with NC. Nodes with the highest number of aberrant connections in each patient groups (range = 11 to 27 aberrant connections), based on two-sample t-test (NC versus each patient groups) with FDR corrected to the P values to correct for multiple comparisons across all edges. Significance was set at $P<0.05$. The red nodes represent the affected nodes in each group.