Distributed resting-state functional connectivity patterns predict language performance in later adulthood

Irene Bellin[1,2], Xueqing Li[1], Arianna Menardi[1,2], Antonino Vallesi[1,2, §]

[1]Department of Neuroscience, University of Padova, Italy

[2]Padova Neuroscience Center, University of Padova, Italy

Authors' ORCID: IB 0009-0009-1543-7794, AM 0000-0003-4385-6848, AV 0000-0002-4087-2845

§ Corresponding author:

Antonino Vallesi
Department of Neuroscience and Padova Neuroscience Center
University of Padova
Padova, 3513, Italy
antonino.vallesi@unipd.it

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APPENDIX A

Reclassified parcels in Language Network

Table A1. Reclassified language parcels included in the language network

Schaefer parcel index	Parcel name	Original Yeo network	Overlap with language network mask (%))
86	7Networks_LH_DorsAttn_FEF_1	DAN	95.8
93	7Networks_LH_SalVentAttn_ParOper_2	VAN	68.6
96	7Networks_LH_SalVentAttn_TempOcc_1	VAN	98.6
105	7Networks_LH_SalVentAttn_FrOperIns_9	VAN	81.2
124	7Networks_LH_Limbic_TempPole_6	LIM	86.3
149	7Networks_LH_Default_Temp_1	DMN	73.4
152	7Networks_LH_Default_Temp_4	DMN	95.5
153	7Networks_LH_Default_Temp_5	DMN	88.4
154	7Networks_LH_Default_Temp_6	DMN	99.6
155	7Networks_LH_Default_Temp_7	DMN	100.0
156	7Networks_LH_Default_Temp_8	DMN	97.8
157	7Networks_LH_Default_Temp_9	DMN	99.1
158	7Networks_LH_Default_Temp_10	DMN	100.0
159	7Networks_LH_Default_Par_1	DMN	100.0
163	7Networks_LH_Default_Par_5	DMN	96.0
166	7Networks_LH_Default_PFC_1	DMN	54.6
170	7Networks_LH_Default_PFC_5	DMN	86.5
172	7Networks_LH_Default_PFC_7	DMN	92.9
175	7Networks_LH_Default_PFC_10	DMN	97.1
178	7Networks_LH_Default_PFC_13	DMN	64.6
183	7Networks_LH_Default_PFC_18	DMN	82.3
185	7Networks_LH_Default_PFC_20	DMN	76.2
189	7Networks_LH_Default_PFC_24	DMN	94.0
232	7Networks_RH_SomMot_2	SMN	67.0
369	7Networks_RH_Default_Temp_3	DMN	52.1
370	7Networks_RH_Default_Temp_4	DMN	52.3
371	7Networks_RH_Default_Temp_5	DMN	56.1
373	7Networks_RH_Default_Temp_7	DMN	72.2

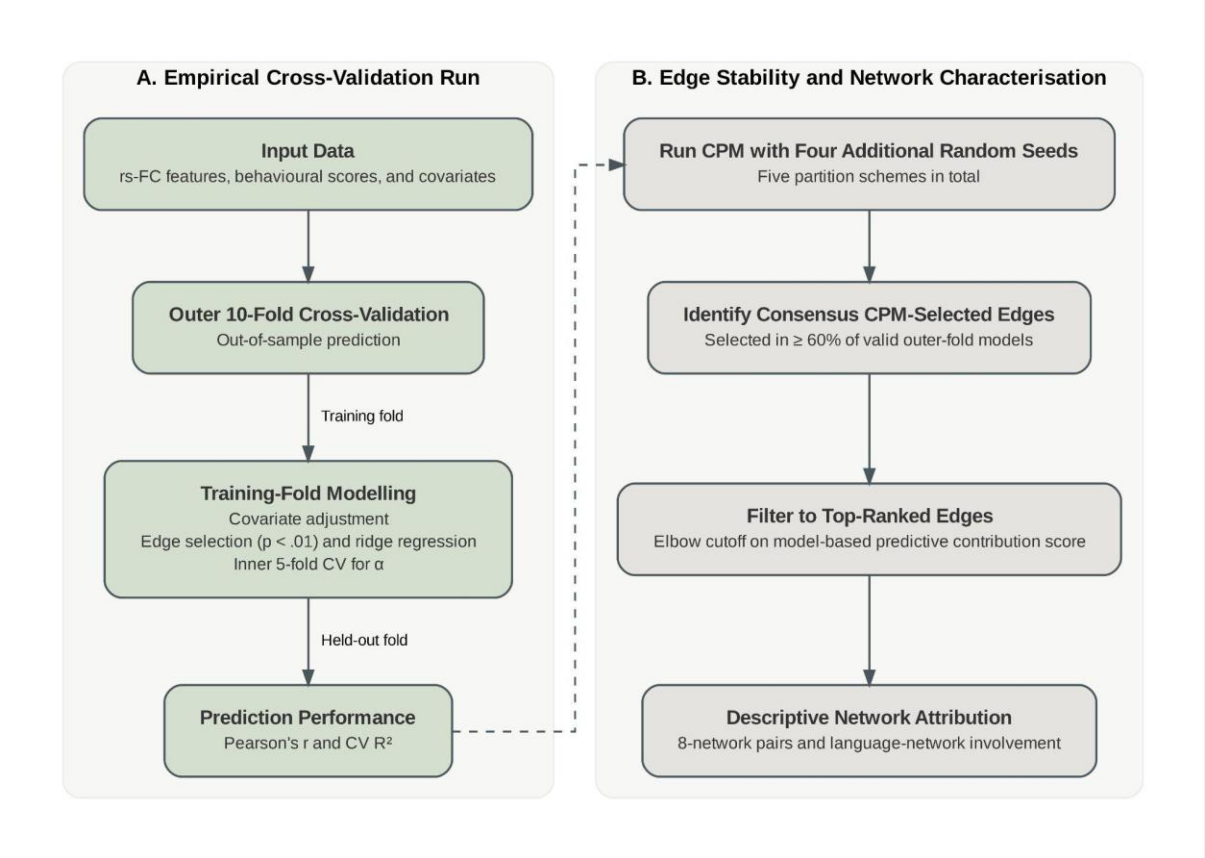
374	7Networks_RH_Default_Temp_8	DMN	99.7

Parcel labels are abbreviated from the Schaefer 400-parcel atlas. Network abbreviations: DAN = dorsal attention network; DMN = default mode network; FPN = frontoparietal network; LANG = language network; LIM = limbic network; SMN = somatomotor network; VAN = ventral attention network; VIS = visual network. The language network mask was derived from Branco et al. (2020).

APPENDIX B

CPM results for TPVT and READ

Figure B1. Overall workflow of adapted CPM model



Panel A summarises the nested cross-validation pipeline. Panel B summarises edge-stability and descriptive network-characterisation procedures across five partition schemes. CPM = connectome-based predictive modelling; CV = cross-validation; READ = NIH Toolbox Oral Reading Recognition Test; rs-FC = resting-state functional connectivity; TPVT = NIH Toolbox Picture Vocabulary Test.

Table B1. CPM prediction performance across covariate-adjustment variants for TPVT

Behavioural measure	Covariates residualised	r	CV R^2	Permutation p	Top-ranked edges, n
TPVT	Age and FD	.289	.051	.001	59
	Education and FD	.228	.019	.001	54
	FD only	.298	.069	.001	61

r = Pearson correlation between observed and predicted model-specific scores across held-out folds; CV R^2 = cross-validated coefficient of determination; FD = mean framewise displacement; TPVT = NIH Toolbox Picture Vocabulary Test. Permutation *p* values were derived from 1,000 permutations.

Table B2. CPM prediction performance across covariate-adjustment variants for READ

Behavioural measure	Covariates residualised	r	CV R^2	Permutation p	Top-ranked edges, n
READ	Age and FD	.242	.017	.001	73
	Education and FD	.195	−.017	.001	31
	FD only	.238	.017	.001	35

r = Pearson correlation between observed and predicted model-specific scores across held-out folds; CV R^2 = cross-validated coefficient of determination; FD = mean framewise displacement; READ = NIH Toolbox Oral Reading Recognition Test. Permutation *p* values were derived from 1,000 permutations.

Table B3. Complete list of Top-ranked edges in the fully adjusted CPM model for TPVT (124 edges)

Rank	Parcel A index	Parcel A label	Network A	Parcel B index	Parcel B label	Network B	Network pair	Model-based predictive contribution sign
1	296	RH SalVentAttn TempOccPar 3	VAN	374	RH Default Temp 8	LANG	LANG - VAN	-
2	12	LH Vis 12	VIS	14	LH Vis 14	VIS	VIS - VIS	-
3	174	LH Default PFC 9	DMN	184	LH Default PFC 19	DMN	DMN - DMN	+
4	134	LH Cont OFC 1	FPN	163	LH Default Par 5	LANG	FPN - LANG	+
5	169	LH Default PFC 4	DMN	176	LH Default PFC 11	DMN	DMN - DMN	+
6	184	LH Default PFC 19	DMN	399	RH Default pCunPCC 8	DMN	DMN - DMN	+
7	72	LH DorsAttn Post 4	DAN	350	RH Cont PFCl 10	FPN	DAN - FPN	+
8	127	LH Cont Par 1	FPN	348	RH Cont PFCl 8	FPN	FPN - FPN	-
9	168	LH Default PFC 3	DMN	176	LH Default PFC 11	DMN	DMN - DMN	+
10	101	LH SalVentAttn FrOperIns 5	VAN	297	RH SalVentAttn TempOccPar 4	VAN	VAN - VAN	+
11	96	LH SalVentAttn TempOcc 1	LANG	339	RH Cont Temp 2	FPN	FPN - LANG	+

12	294	RH SalVentAttn TempOccPar 1	VAN	374	RH Default Temp 8	LANG	LANG - VAN	-
13	131	LH Cont Par 5	FPN	199	LH Default pCunPCC 10	DMN	DMN - FPN	+
14	297	RH SalVentAttn TempOccPar 4	VAN	374	RH Default Temp 8	LANG	LANG - VAN	-
15	296	RH SalVentAttn TempOccPar 3	VAN	373	RH Default Temp 7	LANG	LANG - VAN	-
16	133	LH Cont Temp 1	FPN	179	LH Default PFC 14	DMN	DMN - FPN	+
17	106	LH SalVentAttn PFCl 1	VAN	132	LH Cont Par 6	FPN	FPN - VAN	-
18	106	LH SalVentAttn PFCl 1	VAN	334	RH Cont Par 3	FPN	FPN - VAN	-
19	15	LH Vis 15	VIS	33	LH SomMot 2	SMN	SMN - VIS	+
20	272	RH DorsAttn Post 2	DAN	374	RH Default Temp 8	LANG	DAN - LANG	-
21	106	LH SalVentAttn PFCl 1	VAN	127	LH Cont Par 1	FPN	FPN - VAN	-
22	15	LH Vis 15	VIS	32	LH SomMot 1	SMN	SMN - VIS	+
23	163	LH Default Par 5	LANG	172	LH Default PFC 7	LANG	LANG - LANG	-
24	163	LH Default Par 5	LANG	339	RH Cont Temp 2	FPN	FPN - LANG	+
25	176	LH Default PFC 11	DMN	184	LH Default PFC 19	DMN	DMN - DMN	+
26	12	LH Vis 12	VIS	288	RH DorsAttn Post 18	DAN	DAN - VIS	-
27	282	RH DorsAttn Post 12	DAN	394	RH Default pCunPCC 3	DMN	DMN - DAN	+
28	40	LH SomMot 9	SMN	101	LH SalVentAttn FrOperIns 5	VAN	SMN - VAN	+
29	72	LH DorsAttn Post 4	DAN	258	RH SomMot 28	SMN	DAN - SMN	-
30	130	LH Cont Par 4	FPN	191	LH Default pCunPCC 2	DMN	DMN - FPN	+
31	149	LH Default Temp 1	LANG	187	LH Default PFC 22	DMN	DMN - LANG	-
32	17	LH Vis 17	VIS	251	RH SomMot 21	SMN	SMN - VIS	-
33	137	LH Cont PFCl 3	FPN	199	LH Default pCunPCC 10	DMN	DMN - FPN	+
34	130	LH Cont Par 4	FPN	199	LH Default pCunPCC 10	DMN	DMN - FPN	+
35	199	LH Default pCunPCC 10	DMN	385	RH Default PFCdPFCm 7	DMN	DMN - DMN	-
36	129	LH Cont Par 3	FPN	199	LH Default pCunPCC 10	DMN	DMN - FPN	+

37	199	LH Default pCunPCC 10	DMN	395	RH Default pCunPCC 4	DMN	DMN - DMN	-
38	124	LH Limbic TempPole 6	LANG	351	RH Cont PFCl 11	FPN	FPN - LANG	-
39	152	LH Default Temp 4	LANG	334	RH Cont Par 3	FPN	FPN - LANG	+
40	199	LH Default pCunPCC 10	DMN	333	RH Cont Par 2	FPN	DMN - FPN	+
41	72	LH DorsAttn Post 4	DAN	105	LH SalVentAttn FrOperIns 9	LANG	DAN - LANG	+
42	72	LH DorsAttn Post 4	DAN	128	LH Cont Par 2	FPN	DAN - FPN	+
43	203	RH Vis 3	VIS	282	RH DorsAttn Post 12	DAN	DAN - VIS	-
44	362	RH Default Par 1	DMN	395	RH Default pCunPCC 4	DMN	DMN - DMN	-
45	37	LH SomMot 6	SMN	344	RH Cont PFCl 4	FPN	FPN - SMN	+
46	101	LH SalVentAttn FrOperIns 5	VAN	287	RH DorsAttn Post 17	DAN	DAN - VAN	+
47	199	LH Default pCunPCC 10	DMN	337	RH Cont Par 6	FPN	DMN - FPN	+
48	149	LH Default Temp 1	LANG	186	LH Default PFC 21	DMN	DMN - LANG	-
49	287	RH DorsAttn Post 17	DAN	306	RH SalVentAttn FrOperIns 5	VAN	DAN - VAN	+
50	175	LH Default PFC 10	LANG	296	RH SalVentAttn TempOccPar 3	VAN	LANG - VAN	-
51	169	LH Default PFC 4	DMN	184	LH Default PFC 19	DMN	DMN - DMN	+
52	177	LH Default PFC 12	DMN	213	RH Vis 13	VIS	DMN - VIS	+
53	199	LH Default pCunPCC 10	DMN	370	RH Default Temp 4	LANG	DMN - LANG	-
54	367	RH Default Temp 1	DMN	397	RH Default pCunPCC 6	DMN	DMN - DMN	-
55	296	RH SalVentAttn TempOccPar 3	VAN	383	RH Default PFCdPFCm 5	DMN	DMN - VAN	-
56	296	RH SalVentAttn TempOccPar 3	VAN	372	RH Default Temp 6	DMN	DMN - VAN	-
57	164	LH Default Par 6	DMN	176	LH Default PFC 11	DMN	DMN - DMN	+
58	132	LH Cont Par 6	FPN	306	RH SalVentAttn FrOperIns 5	VAN	FPN - VAN	-
59	163	LH Default Par 5	LANG	368	RH Default Temp 2	DMN	DMN - LANG	-
60	127	LH Cont Par 1	FPN	306	RH SalVentAttn FrOperIns 5	VAN	FPN - VAN	-
61	169	LH Default PFC 4	DMN	376	RH Default PFCv 2	DMN	DMN - DMN	+

62	101	LH SalVentAttn FrOperIns 5	VAN	133	LH Cont Temp 1	FPN	FPN - VAN	-
63	15	LH Vis 15	VIS	100	LH SalVentAttn FrOperIns 4	VAN	VAN - VIS	+
64	160	LH Default Par 2	DMN	339	RH Cont Temp 2	FPN	DMN - FPN	+
65	167	LH Default PFC 2	DMN	168	LH Default PFC 3	DMN	DMN - DMN	+
66	33	LH SomMot 2	SMN	344	RH Cont PFCl 4	FPN	FPN - SMN	+
67	85	LH DorsAttn Post 17	DAN	270	RH SomMot 40	SMN	DAN - SMN	-
68	221	RH Vis 21	VIS	265	RH SomMot 35	SMN	SMN - VIS	-
69	157	LH Default Temp 9	LANG	395	RH Default pCunPCC 4	DMN	DMN - LANG	-
70	296	RH SalVentAttn TempOccPar 3	VAN	385	RH Default PFCdPFCm 7	DMN	DMN - VAN	-
71	64	LH SomMot 33	SMN	85	LH DorsAttn Post 17	DAN	DAN - SMN	-
72	130	LH Cont Par 4	FPN	190	LH Default pCunPCC 1	DMN	DMN - FPN	+
73	131	LH Cont Par 5	FPN	190	LH Default pCunPCC 1	DMN	DMN - FPN	+
74	180	LH Default PFC 15	DMN	213	RH Vis 13	VIS	DMN - VIS	+
75	131	LH Cont Par 5	FPN	191	LH Default pCunPCC 2	DMN	DMN - FPN	+
76	12	LH Vis 12	VIS	282	RH DorsAttn Post 12	DAN	DAN - VIS	-
77	149	LH Default Temp 1	LANG	163	LH Default Par 5	LANG	LANG - LANG	-
78	310	RH SalVentAttn PFCl 1	VAN	334	RH Cont Par 3	FPN	FPN - VAN	-
79	133	LH Cont Temp 1	FPN	199	LH Default pCunPCC 10	DMN	DMN - FPN	+
80	101	LH SalVentAttn FrOperIns 5	VAN	127	LH Cont Par 1	FPN	FPN - VAN	-
81	159	LH Default Par 1	LANG	322	RH Limbic OFC 4	LIM	LANG - LIM	+
82	72	LH DorsAttn Post 4	DAN	306	RH SalVentAttn FrOperIns 5	VAN	DAN - VAN	+
83	191	LH Default pCunPCC 2	DMN	349	RH Cont PFCl 9	FPN	DMN - FPN	+
84	273	RH DorsAttn Post 3	DAN	306	RH SalVentAttn FrOperIns 5	VAN	DAN - VAN	+
85	103	LH SalVentAttn FrOperIns 7	VAN	129	LH Cont Par 3	FPN	FPN - VAN	-
86	199	LH Default pCunPCC 10	DMN	382	RH Default PFCdPFCm 4	DMN	DMN - DMN	-
87	358	RH Cont Cing 1	FPN	367	RH Default Temp 1	DMN	DMN - FPN	-

88	257	RH SomMot 27	SMN	265	RH SomMot 35	SMN	SMN - SMN	-
89	199	LH Default pCunPCC 10	DMN	367	RH Default Temp 1	DMN	DMN - DMN	-
90	212	RH Vis 12	VIS	339	RH Cont Temp 2	FPN	FPN - VIS	+
91	12	LH Vis 12	VIS	275	RH DorsAttn Post 5	DAN	DAN - VIS	-
92	240	RH SomMot 10	SMN	241	RH SomMot 11	SMN	SMN - SMN	-
93	124	LH Limbic TempPole 6	LANG	142	LH Cont PFCl 8	FPN	FPN - LANG	-
94	116	LH Limbic OFC 3	LIM	135	LH Cont PFCl 1	FPN	FPN - LIM	+
95	188	LH Default PFC 23	DMN	339	RH Cont Temp 2	FPN	DMN - FPN	+
96	101	LH SalVentAttn FrOperIns 5	VAN	151	LH Default Temp 3	DMN	DMN - VAN	-
97	157	LH Default Temp 9	LANG	368	RH Default Temp 2	DMN	DMN - LANG	-
98	218	RH Vis 18	VIS	282	RH DorsAttn Post 12	DAN	DAN - VIS	-
99	367	RH Default Temp 1	DMN	390	RH Default PFCdPFCm 12	DMN	DMN - DMN	-
100	306	RH SalVentAttn FrOperIns 5	VAN	334	RH Cont Par 3	FPN	FPN - VAN	-
101	213	RH Vis 13	VIS	288	RH DorsAttn Post 18	DAN	DAN - VIS	-
102	285	RH DorsAttn Post 15	DAN	346	RH Cont PFCl 6	FPN	DAN - FPN	-
103	179	LH Default PFC 14	DMN	318	RH SalVentAttn Med 8	VAN	DMN - VAN	-
104	163	LH Default Par 5	LANG	322	RH Limbic OFC 4	LIM	LANG - LIM	+
105	339	RH Cont Temp 2	FPN	390	RH Default PFCdPFCm 12	DMN	DMN - FPN	+
106	116	LH Limbic OFC 3	LIM	170	LH Default PFC 5	LANG	LANG - LIM	+
107	79	LH DorsAttn Post 11	DAN	180	LH Default PFC 15	DMN	DMN - DAN	-
108	106	LH SalVentAttn PFCl 1	VAN	337	RH Cont Par 6	FPN	FPN - VAN	-
109	133	LH Cont Temp 1	FPN	169	LH Default PFC 4	DMN	DMN - FPN	+
110	159	LH Default Par 1	LANG	339	RH Cont Temp 2	FPN	FPN - LANG	+
111	149	LH Default Temp 1	LANG	150	LH Default Temp 2	DMN	DMN - LANG	-
112	36	LH SomMot 5	SMN	263	RH SomMot 33	SMN	SMN - SMN	-
113	17	LH Vis 17	VIS	265	RH SomMot 35	SMN	SMN - VIS	-
114	159	LH Default Par 1	LANG	338	RH Cont Temp 1	FPN	FPN - LANG	+

115	157	LH Default Temp 9	LANG	381	RH Default PFCdPFCm 3	DMN	DMN - LANG	-
116	169	LH Default PFC 4	DMN	171	LH Default PFC 6	DMN	DMN - DMN	+
117	134	LH Cont OFC 1	FPN	159	LH Default Par 1	LANG	FPN - LANG	+
118	41	LH SomMot 10	SMN	51	LH SomMot 20	SMN	SMN - SMN	-
119	54	LH SomMot 23	SMN	64	LH SomMot 33	SMN	SMN - SMN	-
120	38	LH SomMot 7	SMN	60	LH SomMot 29	SMN	SMN - SMN	-
121	228	RH Vis 28	VIS	306	RH SalVentAttn FrOperIns 5	VAN	VAN - VIS	+
122	157	LH Default Temp 9	LANG	380	RH Default PFCdPFCm 2	DMN	DMN - LANG	-
123	12	LH Vis 12	VIS	280	RH DorsAttn Post 10	DAN	DAN - VIS	-
124	140	LH Cont PFCl 6	FPN	348	RH Cont PFCl 8	FPN	FPN - FPN	-

TPVT = NIH Toolbox Picture Vocabulary Test. Top-ranked consensus edges were derived from the fully adjusted CPM model Parcel A and Parcel B identify the two endpoints of each edge; Network A and Network B indicate their corresponding network assignments. Parcel labels are abbreviated from the Schaefer 400-parcel atlas. DAN = dorsal attention network; DMN = default mode network; FPN = frontoparietal network; LANG = language network; LIM = limbic network; SMN = somatomotor network; VAN = ventral attention network; VIS = visual network.

Table B4. Complete list of Top-ranked edges in the fully adjusted CPM model from CPM for READ (39 edges)

Rank	Parcel A index	Parcel A label	Network A	Parcel B index	Parcel B label	Network B	Network pair	Model-based predictive contribution sign
1	296	RH SalVentAttn TempOccPar 3	VAN	383	RH Default PFCdPFCm 5	DMN	DMN - VAN	-
2	175	LH Default PFC 10	LANG	296	RH SalVentAttn TempOccPar 3	VAN	LANG - VAN	-
3	172	LH Default PFC 7	LANG	296	RH SalVentAttn TempOccPar 3	VAN	LANG - VAN	-
4	172	LH Default PFC 7	LANG	300	RH SalVentAttn TempOccPar 7	VAN	LANG - VAN	-
5	141	LH Cont PFCl 7	FPN	158	LH Default Temp 10	LANG	FPN - LANG	+
6	175	LH Default PFC 10	LANG	300	RH SalVentAttn TempOccPar 7	VAN	LANG - VAN	-

7	141	LH Cont PFCl 7	FPN	157	LH Default Temp 9	LANG	FPN - LANG	+
8	93	LH SalVentAttn ParOper 2	LANG	157	LH Default Temp 9	LANG	LANG - LANG	+
9	184	LH Default PFC 19	DMN	353	RH Cont PFCl 13	FPN	DMN - FPN	+
10	149	LH Default Temp 1	LANG	343	RH Cont PFCl 3	FPN	FPN - LANG	-
11	287	RH DorsAttn Post 17	DAN	383	RH Default PFCdPFCm 5	DMN	DMN - DAN	-
12	130	LH Cont Par 4	FPN	168	LH Default PFC 3	DMN	DMN - FPN	+
13	317	RH SalVentAttn Med 7	VAN	351	RH Cont PFCl 11	FPN	FPN - VAN	+
14	184	LH Default PFC 19	DMN	352	RH Cont PFCl 12	FPN	DMN - FPN	+
15	64	LH SomMot 33	SMN	85	LH DorsAttn Post 17	DAN	DAN - SMN	-
16	161	LH Default Par 3	DMN	339	RH Cont Temp 2	FPN	DMN - FPN	+
17	25	LH Vis 25	VIS	43	LH SomMot 12	SMN	SMN - VIS	+
18	75	LH DorsAttn Post 7	DAN	191	LH Default pCunPCC 2	DMN	DMN - DAN	+
19	105	LH SalVentAttn FrOperIns 9	LANG	157	LH Default Temp 9	LANG	LANG - LANG	+
20	299	RH SalVentAttn TempOccPar 6	VAN	342	RH Cont PFCl 2	FPN	FPN - VAN	+
21	96	LH SalVentAttn TempOcc 1	LANG	141	LH Cont PFCl 7	FPN	FPN - LANG	+
22	30	LH Vis 30	VIS	383	RH Default PFCdPFCm 5	DMN	DMN - VIS	-
23	184	LH Default PFC 19	DMN	383	RH Default PFCdPFCm 5	DMN	DMN - DMN	+
24	124	LH Limbic TempPole 6	LANG	300	RH SalVentAttn TempOccPar 7	VAN	LANG - VAN	-
25	187	LH Default PFC 22	DMN	275	RH DorsAttn Post 5	DAN	DMN - DAN	+
26	173	LH Default PFC 8	DMN	249	RH SomMot 19	SMN	DMN - SMN	-
27	127	LH Cont Par 1	FPN	168	LH Default PFC 3	DMN	DMN - FPN	+
28	161	LH Default Par 3	DMN	275	RH DorsAttn Post 5	DAN	DMN - DAN	+
29	91	LH DorsAttn PrCv 2	DAN	157	LH Default Temp 9	LANG	DAN - LANG	+
30	137	LH Cont PFCl 3	FPN	285	RH DorsAttn Post 15	DAN	DAN - FPN	+
31	138	LH Cont PFCl 4	FPN	388	RH Default PFCdPFCm 10	DMN	DMN - FPN	+
32	173	LH Default PFC 8	DMN	257	RH SomMot 27	SMN	DMN - SMN	-

33	127	LH Cont Par 1	FPN	169	LH Default PFC 4	DMN	DMN - FPN	+
34	137	LH Cont PFCl 3	FPN	297	RH SalVentAttn TempOccPar 4	VAN	FPN - VAN	+
35	148	LH Cont PFCmp 1	FPN	157	LH Default Temp 9	LANG	FPN - LANG	+
36	69	LH DorsAttn Post 1	DAN	151	LH Default Temp 3	DMN	DMN - DAN	+
37	288	RH DorsAttn Post 18	DAN	377	RH Default PFCv 3	DMN	DMN - DAN	-
38	298	RH SalVentAttn TempOccPar 5	VAN	383	RH Default PFCdPFCm 5	DMN	DMN - VAN	-
39	72	LH DorsAttn Post 4	DAN	173	LH Default PFC 8	DMN	DMN - DAN	-

READ = NIH Toolbox Oral Reading Recognition Test. Top-ranked consensus edges were derived from the fully adjusted CPM model. Parcel A and Parcel B identify the two endpoints of each edge; Network A and Network B indicate their corresponding network assignments. Parcel labels are abbreviated from the Schaefer 400-parcel atlas. DAN = dorsal attention network; DMN = default mode network; FPN = frontoparietal network; LANG = language network; LIM = limbic network; SMN = somatomotor network; VAN = ventral attention network; VIS = visual network.

APPENDIX C

Control analysis: Flanker Inhibitory Control and Attention Test

The Flanker Inhibitory Control and Attention Test (Flanker) was analysed as a non-language comparison to assess whether the observed connectivity–behaviour associations were specific to language performance.

C.1 CPM results

Resting-state functional connectivity also predicted Flanker performance. The top-ranked edges differed from those identified for TPVT and READ, although their network-level distribution showed some similarities. DMN–FPN connections were the most frequently represented network pair (12 of 63 edges, 19.0%), followed by within-SMN connections (8 of 63 edges, 12.7%). LANG-involving edges were also present (17 of 63 edges, 27.0%) but did not constitute the majority of the top-ranked edges. The complete edge list and network-level summaries are presented in Table C1 and Figures C1–C3.

Table C1. Complete list of top-ranked consensus edges in the fully adjusted CPM model for Flanker (63 edges)

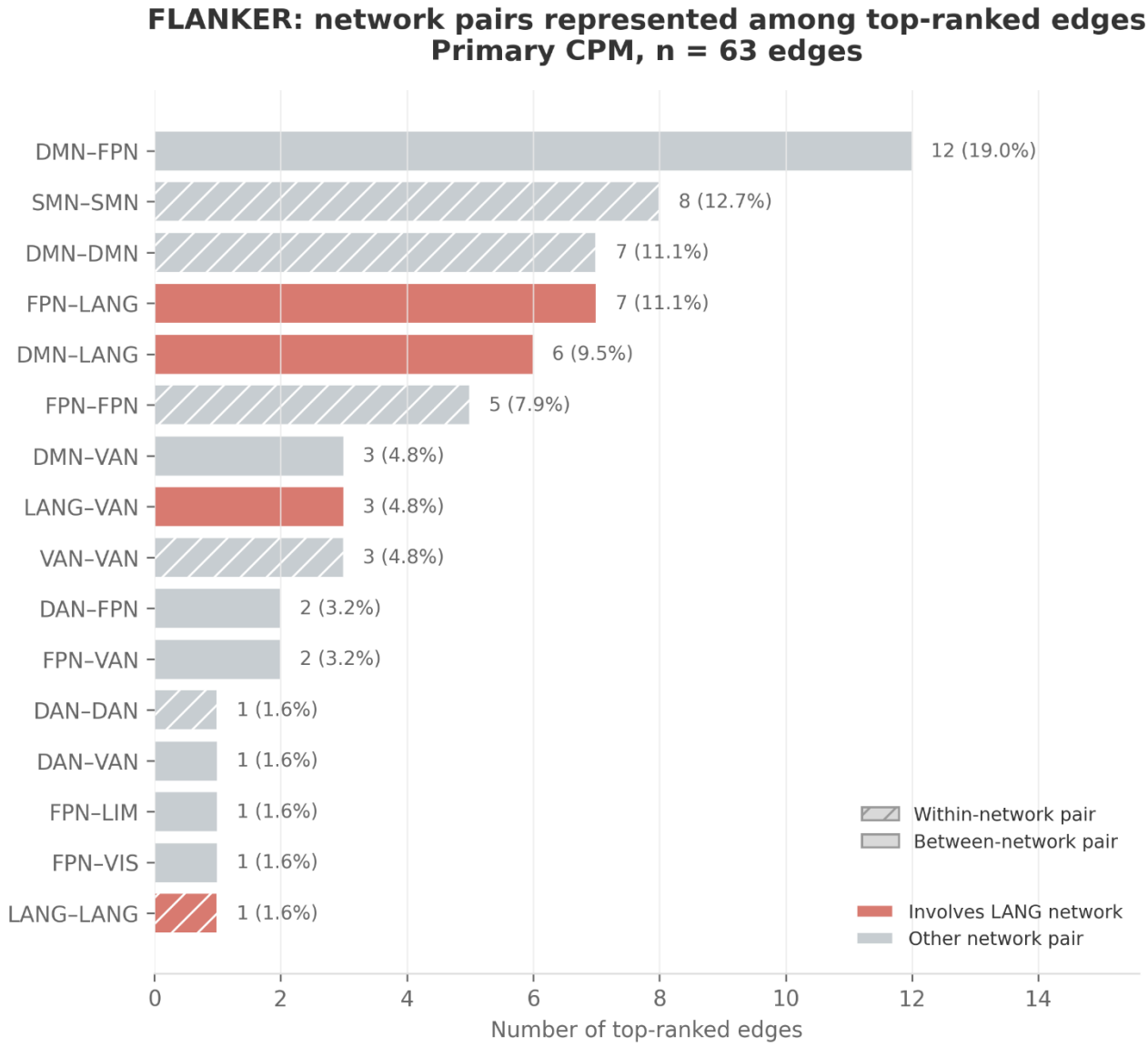
Rank	Parcel A	Parcel A label	Network A	Parcel B	Parcel B label	Network B	Network pair	Ridge coefficient
1	93	LH SalVentAttn ParOper 2	LANG	155	LH Default Temp 7	LANG	LANG - LANG	-
2	163	LH Default Par 5	LANG	296	RH SalVentAttn TempOccPar 3	VAN	LANG - VAN	-
3	179	LH Default PFC 14	DMN	380	RH Default PFCdPFCm 2	DMN	DMN - DMN	+
4	135	LH Cont PFCl 1	FPN	176	LH Default PFC 11	DMN	DMN - FPN	+
5	170	LH Default PFC 5	LANG	296	RH SalVentAttn TempOccPar 3	VAN	LANG - VAN	-
6	131	LH Cont Par 5	FPN	136	LH Cont PFCl 2	FPN	FPN - FPN	+
7	96	LH SalVentAttn TempOcc 1	LANG	366	RH Default Par 5	DMN	DMN - LANG	+
8	256	RH SomMot 26	SMN	263	RH SomMot 33	SMN	SMN - SMN	-
9	141	LH Cont PFCl 7	FPN	159	LH Default Par 1	LANG	FPN - LANG	+
10	342	RH Cont PFCl 2	FPN	378	RH Default PFCv 4	DMN	DMN - FPN	+
11	127	LH Cont Par 1	FPN	164	LH Default Par 6	DMN	DMN - FPN	+
12	170	LH Default PFC 5	LANG	309	RH SalVentAttn FrOperIns 8	VAN	LANG - VAN	-
13	159	LH Default Par 1	LANG	366	RH Default Par 5	DMN	DMN - LANG	+

14	92	LH SalVentAttn ParOper 1	VAN	101	LH SalVentAttn FrOperIns 5	VAN	VAN - VAN	+
15	162	LH Default Par 4	DMN	179	LH Default PFC 14	DMN	DMN - DMN	+
16	136	LH Cont PFCl 2	FPN	333	RH Cont Par 2	FPN	FPN - FPN	+
17	248	RH SomMot 18	SMN	251	RH SomMot 21	SMN	SMN - SMN	-
18	95	LH SalVentAttn ParOper 4	VAN	342	RH Cont PFCl 2	FPN	FPN - VAN	+
19	96	LH SalVentAttn TempOcc 1	LANG	127	LH Cont Par 1	FPN	FPN - LANG	+
20	149	LH Default Temp 1	LANG	378	RH Default PFCv 4	DMN	DMN - LANG	-
21	72	LH DorsAttn Post 4	DAN	141	LH Cont PFCl 7	FPN	DAN - FPN	+
22	127	LH Cont Par 1	FPN	159	LH Default Par 1	LANG	FPN - LANG	+
23	96	LH SalVentAttn TempOcc 1	LANG	133	LH Cont Temp 1	FPN	FPN - LANG	+
24	127	LH Cont Par 1	FPN	364	RH Default Par 3	DMN	DMN - FPN	+
25	151	LH Default Temp 3	DMN	336	RH Cont Par 5	FPN	DMN - FPN	-
26	96	LH SalVentAttn TempOcc 1	LANG	141	LH Cont PFCl 7	FPN	FPN - LANG	+
27	128	LH Cont Par 2	FPN	136	LH Cont PFCl 2	FPN	FPN - FPN	+
28	362	RH Default Par 1	DMN	386	RH Default PFCdPFCm 8	DMN	DMN - DMN	+
29	179	LH Default PFC 14	DMN	309	RH SalVentAttn FrOperIns 8	VAN	DMN - VAN	-
30	130	LH Cont Par 4	FPN	164	LH Default Par 6	DMN	DMN - FPN	+
31	159	LH Default Par 1	LANG	334	RH Cont Par 3	FPN	FPN - LANG	+
32	164	LH Default Par 6	DMN	165	LH Default Par 7	DMN	DMN - DMN	+
33	380	RH Default PFCdPFCm 2	DMN	386	RH Default PFCdPFCm 8	DMN	DMN - DMN	+
34	96	LH SalVentAttn TempOcc 1	LANG	164	LH Default Par 6	DMN	DMN - LANG	+
35	78	LH DorsAttn Post 10	DAN	274	RH DorsAttn Post 4	DAN	DAN - DAN	+
36	40	LH SomMot 9	SMN	251	RH SomMot 21	SMN	SMN - SMN	-
37	180	LH Default PFC 15	DMN	296	RH SalVentAttn TempOccPar 3	VAN	DMN - VAN	-
38	64	LH SomMot 33	SMN	263	RH SomMot 33	SMN	SMN - SMN	-

39	274	RH DorsAttn Post 4	DAN	296	RH SalVentAttn TempOccPar 3	VAN	DAN - VAN	+
40	22	LH Vis 22	VIS	138	LH Cont PFCl 4	FPN	FPN - VIS	-
41	349	RH Cont PFCl 9	FPN	378	RH Default PFCv 4	DMN	DMN - FPN	+
42	242	RH SomMot 12	SMN	251	RH SomMot 21	SMN	SMN - SMN	-
43	179	LH Default PFC 14	DMN	344	RH Cont PFCl 4	FPN	DMN - FPN	-
44	163	LH Default Par 5	LANG	380	RH Default PFCdPFCm 2	DMN	DMN - LANG	+
45	48	LH SomMot 17	SMN	248	RH SomMot 18	SMN	SMN - SMN	-
46	128	LH Cont Par 2	FPN	132	LH Cont Par 6	FPN	FPN - FPN	+
47	175	LH Default PFC 10	LANG	176	LH Default PFC 11	DMN	DMN - LANG	+
48	334	RH Cont Par 3	FPN	364	RH Default Par 3	DMN	DMN - FPN	+
49	72	LH DorsAttn Post 4	DAN	350	RH Cont PFCl 10	FPN	DAN - FPN	+
50	92	LH SalVentAttn ParOper 1	VAN	306	RH SalVentAttn FrOperIns 5	VAN	VAN - VAN	+
51	127	LH Cont Par 1	FPN	160	LH Default Par 2	DMN	DMN - FPN	+
52	348	RH Cont PFCl 8	FPN	377	RH Default PFCv 3	DMN	DMN - FPN	+
53	92	LH SalVentAttn ParOper 1	VAN	300	RH SalVentAttn TempOccPar 7	VAN	VAN - VAN	+
54	367	RH Default Temp 1	DMN	378	RH Default PFCv 4	DMN	DMN - DMN	-
55	382	RH Default PFCdPFCm 4	DMN	386	RH Default PFCdPFCm 8	DMN	DMN - DMN	+
56	295	RH SalVentAttn TempOccPar 2	VAN	350	RH Cont PFCl 10	FPN	FPN - VAN	+
57	244	RH SomMot 14	SMN	246	RH SomMot 16	SMN	SMN - SMN	-
58	127	LH Cont Par 1	FPN	165	LH Default Par 7	DMN	DMN - FPN	+
59	135	LH Cont PFCl 1	FPN	136	LH Cont PFCl 2	FPN	FPN - FPN	+
60	159	LH Default Par 1	LANG	350	RH Cont PFCl 10	FPN	FPN - LANG	+
61	188	LH Default PFC 23	DMN	296	RH SalVentAttn TempOccPar 3	VAN	DMN - VAN	-
62	324	RH Limbic OFC 6	LIM	347	RH Cont PFCl 7	FPN	FPN - LIM	-
63	241	RH SomMot 11	SMN	251	RH SomMot 21	SMN	SMN - SMN	-

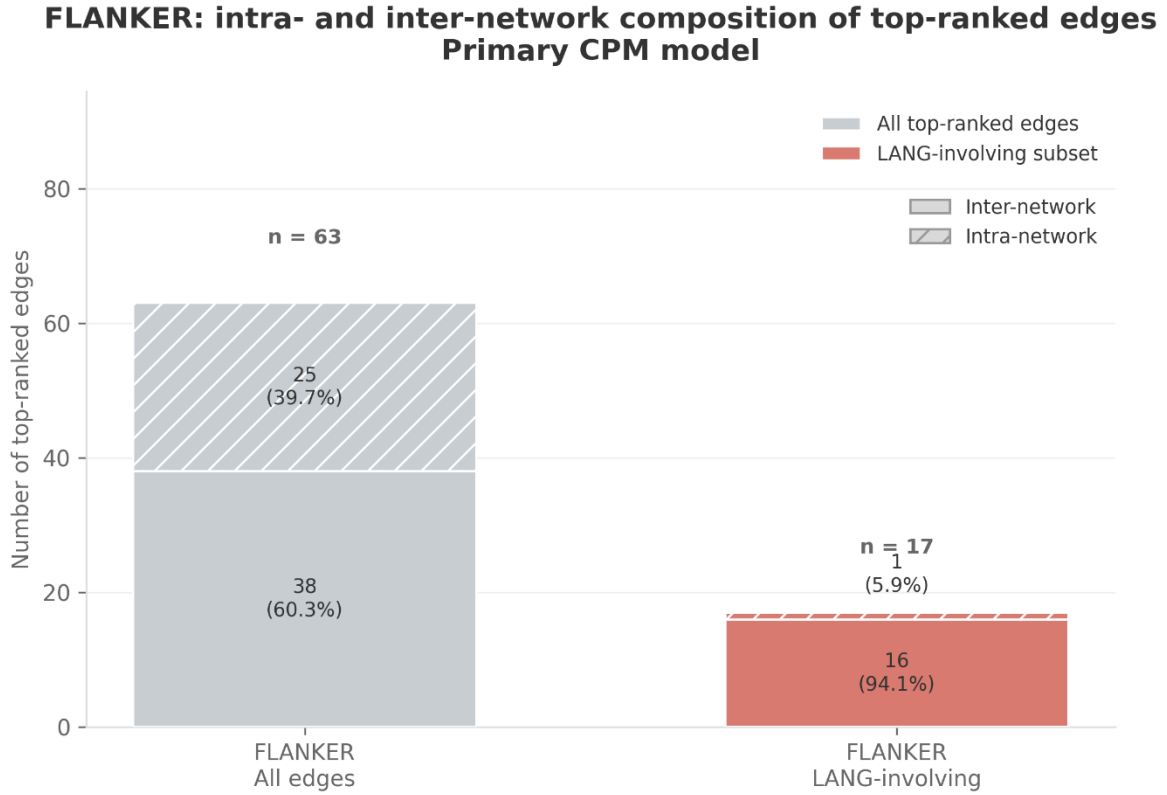
Flanker = Flanker Inhibitory Control and Attention Test. Top-ranked edges were derived from the fully adjusted CPM model. Parcel A and Parcel B identify the two endpoints of each edge; Network A and Network B indicate their corresponding network assignments. Parcel labels are abbreviated from the Schaefer 400-parcel atlas. DAN = dorsal attention network; DMN = default mode network; FPN = frontoparietal network; LANG = language network; LIM = limbic network; SMN = somatomotor network; VAN = ventral attention network; VIS = visual network.

Figure C1. Network-pair representation among Top-ranked edges in the primary Flanker CPM model.



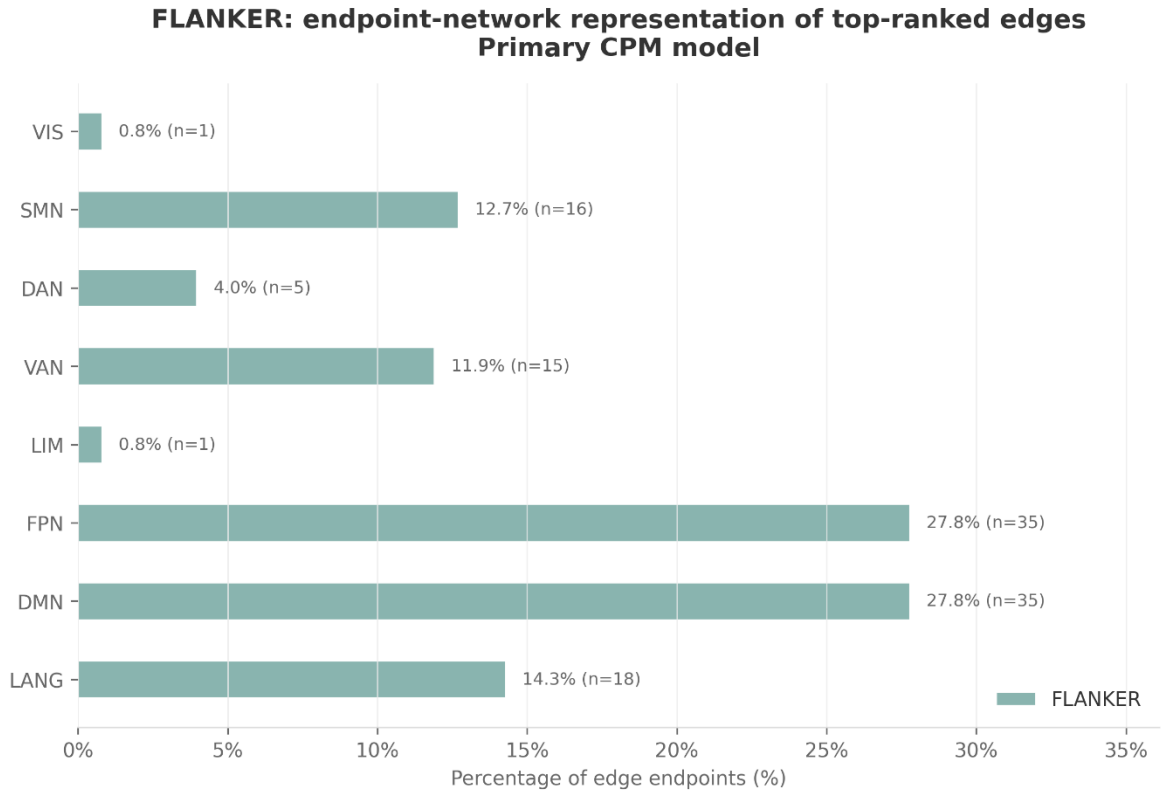
Bars represent the number of top-ranked edges assigned to each network pair in the fully adjusted CPM model for Flanker (n = 63 edges). Percentages are relative to the total number of top-ranked edges in the Flanker model.

Figure C2. Intra- and inter-network composition of Top-ranked edges in the primary CPM models of Flanker



Bars represent the number of top-ranked edges in the fully adjusted CPM models, separately for all top-ranked edges and LANG-involving edges. Percentages are relative to the total number of edges within each bar.

Figure C3. Endpoint-network representation of Top-ranked edges in the primary CPM models of Flanker



Bars represent the number of edge endpoints belonging to each network among top-ranked edges from the primary fully adjusted Flanker CPM models. Percentages are relative to the total number of endpoints of top-ranked edges. DAN = dorsal attention network; DMN = default mode network; FPN = frontoparietal network; LANG = language network; LIM = limbic network; SMN = somatomotor network; VAN = ventral attention network; VIS = visual network.

Table C2. Language network (LANG) global efficiency and Flanker performance

Behavioural measure	**Model R^2**	**Adjusted R^2**	**model F**	**model p**	**Term**	**β**	**SE**	**t**	**p**
FLANKER	.070	.055	4.60	< .001	Efficiency	-0.804	0.443	-1.813	.070
					Age	0.068	0.045	1.516	.130
					Education	0.087	0.020	4.327	< .001
					FD	-0.383	0.499	-0.767	.444

Efficiency × age	-0.038	0.044	-0.860	.390
Efficiency × education	0.054	0.021	2.625	.009
Efficiency × FD	0.217	0.557	0.389	.697

Efficiency refers to LANG global efficiency. Adjusted R^2 = adjusted coefficient of determination; FD = mean framewise displacement; LANG = language network; SE = standard error. All main-effect and interaction terms shown were included in the same GLM.

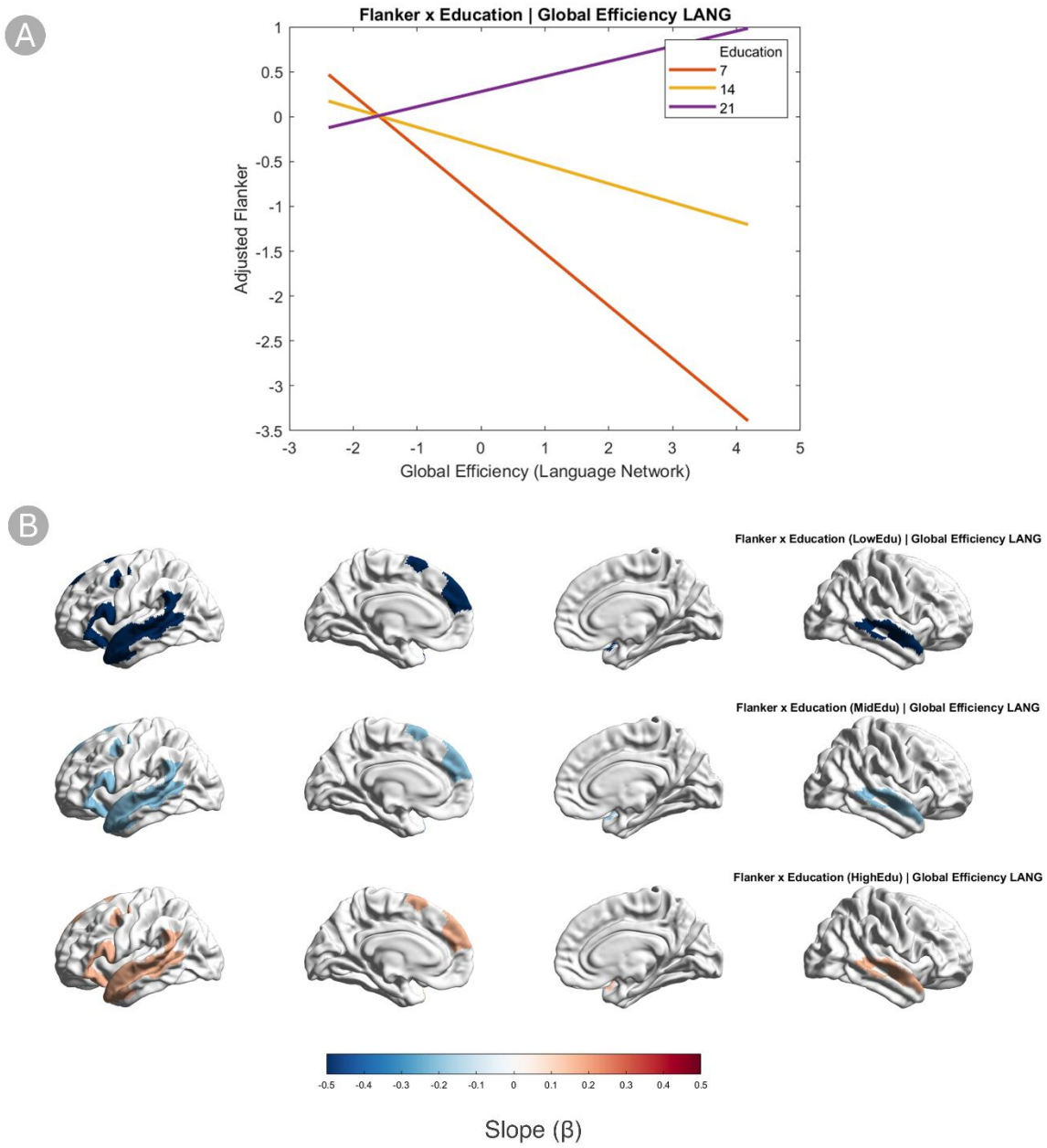
Table C3. Significant Language network (LANG) node-wise participation coefficient (PC) and Flanker performance

Behavioural measure	Model R^2	Adjusted R^2	model F	model p	Parcel	Hemisphere / lobe	Significant term	β	SE	t	p
Flanker	.065	.050	4.29	< .001	152	Left, temporal	**PC**	-0.922	0.446	-2.068	**.039**
	.071	.056	4.74	< .001	153	Left, temporal	**PC × education**	0.052	0.020	2.578	**.010**
	.076	.061	5.05	< .001	155	Left, temporal	**PC**	-1.116	0.455	-2.454	**.015**
	.076	.061	5.05	< .001	155	Left, temporal	**PC × education**	0.061	0.022	2.813	**.005**
	.066	.051	4.34	< .001	156	Left, temporal	**PC × education**	0.051	0.024	2.116	**.035**
	.080	.065	5.34	< .001	158	Left, temporal	**PC**	-1.368	0.501	-2.731	**.007**
	.080	.065	5.34	< .001	158	Left, temporal	**PC × education**	0.073	0.024	3.070	**.002**
	.067	.051	4.39	< .001	175	Left, prefrontal	**PC**	-0.894	0.438	-2.043	**.042**

.066	.051	4.34	< .001	178	Left, prefrontal	**PC**	-0.873	0.422	-2.069	**.039**
.084	.069	5.66	< .001	232	Right, sensorimotor	**PC**	-1.229	0.517	-2.379	**.018**
.084	.069	5.66	< .001	232	Right, sensorimotor	**PC × education**	0.089	0.026	3.420	**< .001**

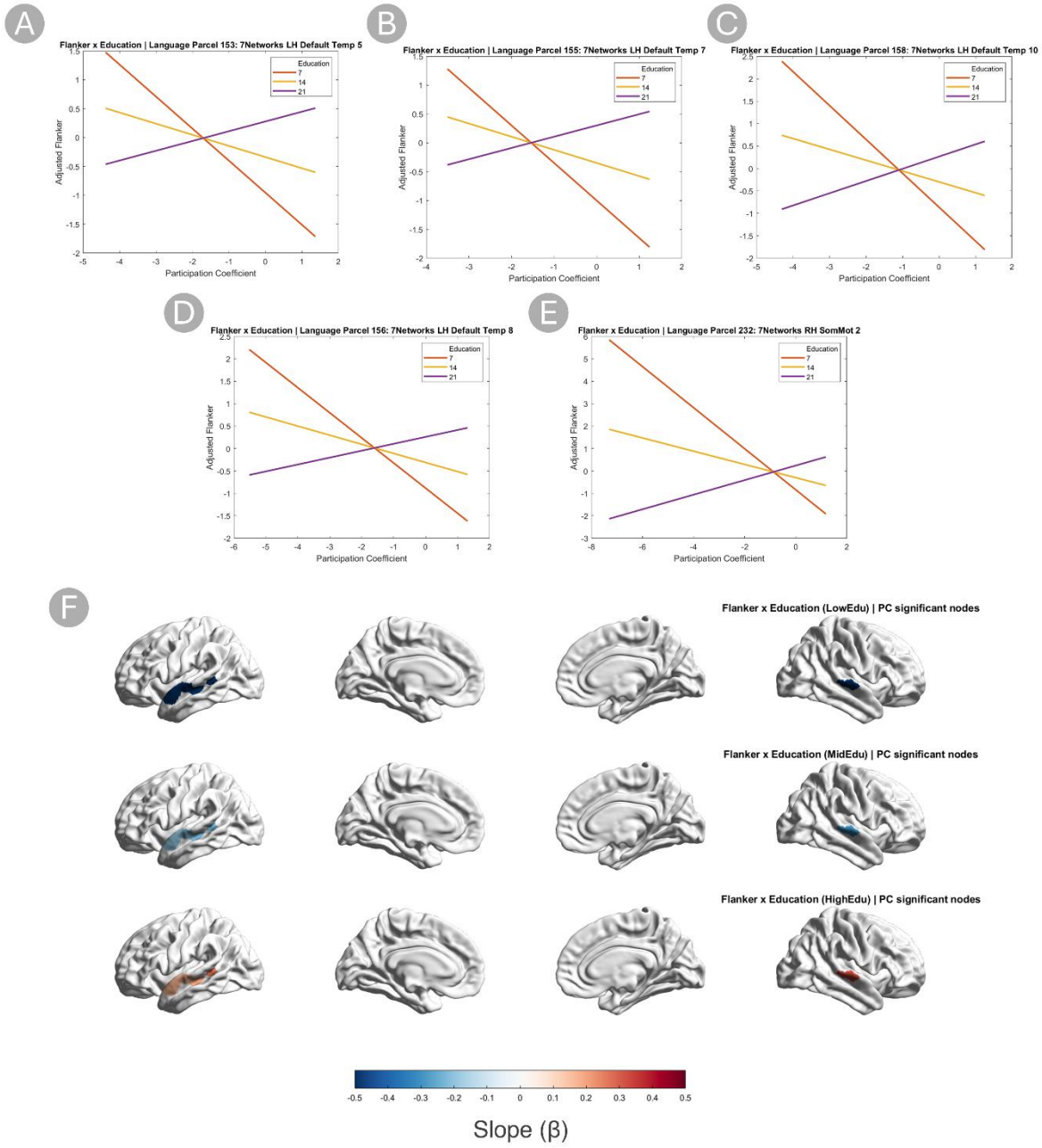
Only significant PC-related terms are shown. Each row reports one significant term from the corresponding parcel-level GLM; consequently, the same parcel may appear more than once. Parcel indices refer to the Schaefer 400-parcel atlas. Adjusted R^2 = adjusted coefficient of determination; LANG = language network; PC = participation coefficient; SE = standard error.

Figure C4. Interaction between education and LANG global efficiency for Flanker



Panel (a) shows model-estimated associations between LANG global efficiency and Flanker performance at 7, 14, and 21 years of education. Panel (b) displays the LANG mask at these education levels, coloured according to the corresponding parcel-specific conditional coefficients for PC. LANG = language network.

Figure C5. Education interactions between node-wise PC and behavioural performance



Panels (a)–(e) show model-estimated associations between PC and Flanker performance at 7, 14, and 21 years of education for parcels with significant PC × education interactions. Panel (f) maps the same parcels at these education levels, coloured according to the corresponding parcel-specific conditional coefficients for PC. PC = participation coefficient.