Supplemental Material

Functional brain growth trajectories across the first decade of life from a single longitudinal cohort

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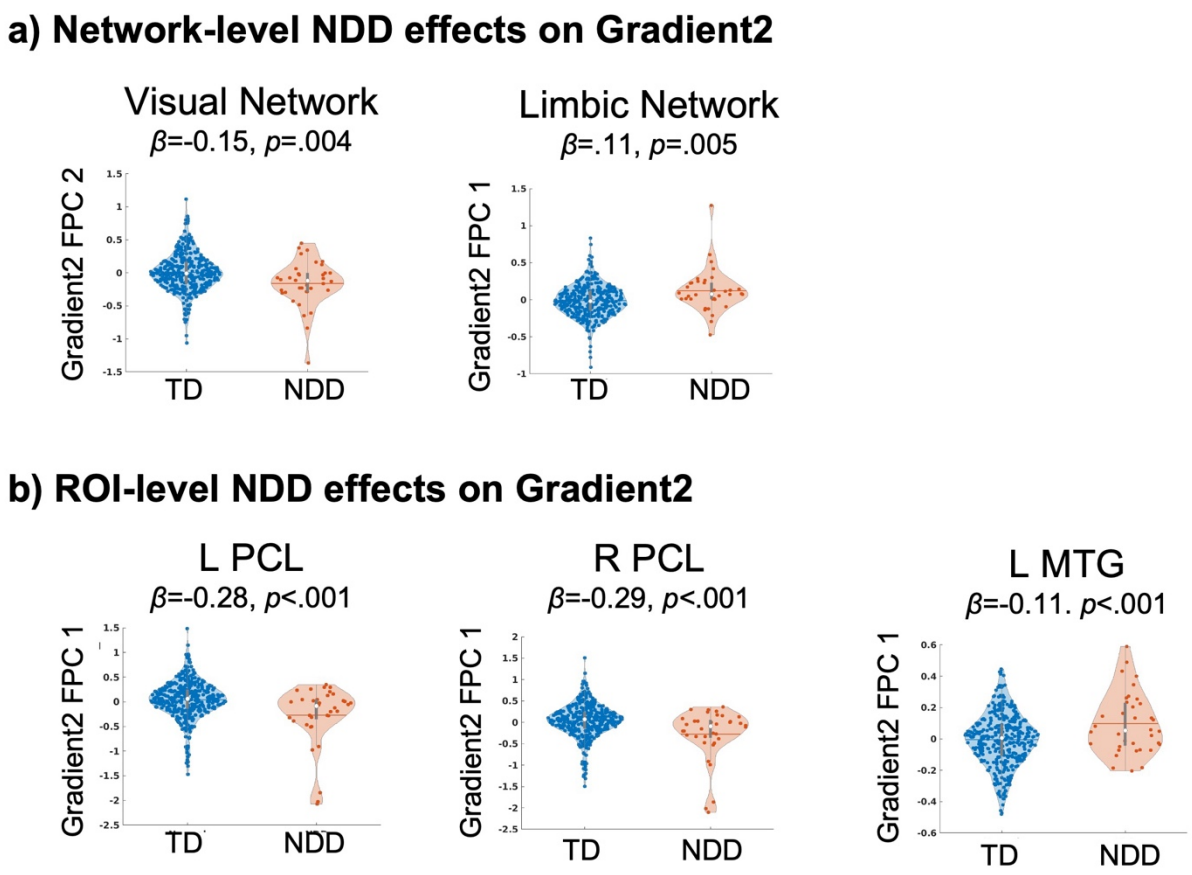

Figure S1. Altered functional gradient development in children with neurodevelopmental disorders: network- and ROI-level effects. Group differences were observed in the longitudinal growth trajectories of the primary-to-transmodal gradient (Gradient2) between typically developing controls (TD) and children later diagnosed with neurodevelopmental disorders (NDD). Functional principal component (FPC) scores derived from multivariate sparse functional principal components analysis (mSPFCA) were used to quantify trajectory deviations across networks and regions of interest (ROI). At the network level, significant effects after false discovery rate (FDR) correction were observed in the visual and limbic networks (**a**). At the ROI level, significant effects after FDR correction were observed in the left paracentral lobule (PCL), right PCL, and left middle temporal gyrus (MTG) (**b**).

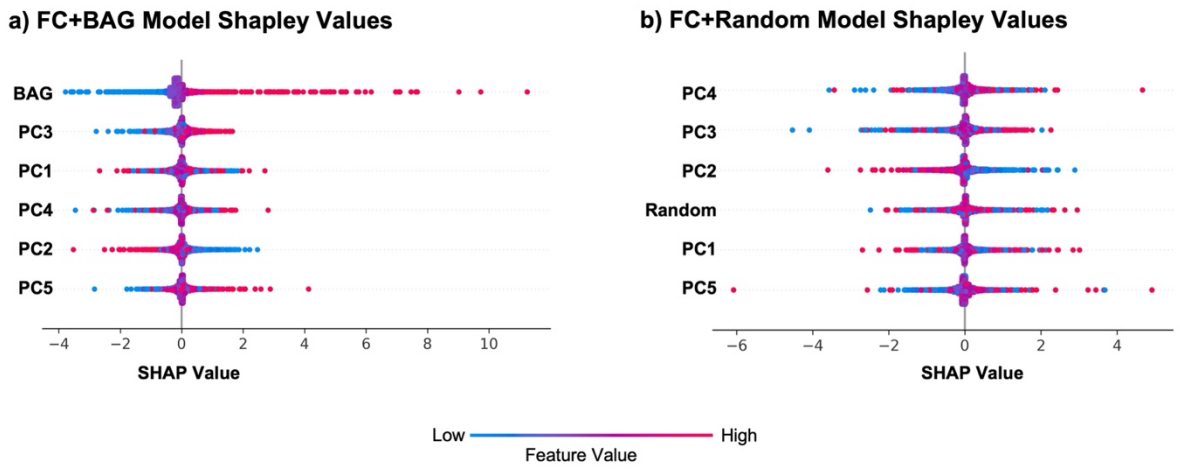

Figure S2. Feature importance plots. In the FC+BAG classification model, brain age gap (BAG) was the most influential feature (**a**). In the FC+Random classification model, the random feature (a random Gaussian feature matched to the mean and standard deviation of BAG to control for model improvement associated with adding an extra feature dimension) ranked substantially lower (**b**), confirming that BAG contributes meaningful classification information rather than reflecting a dimensionality artifact.

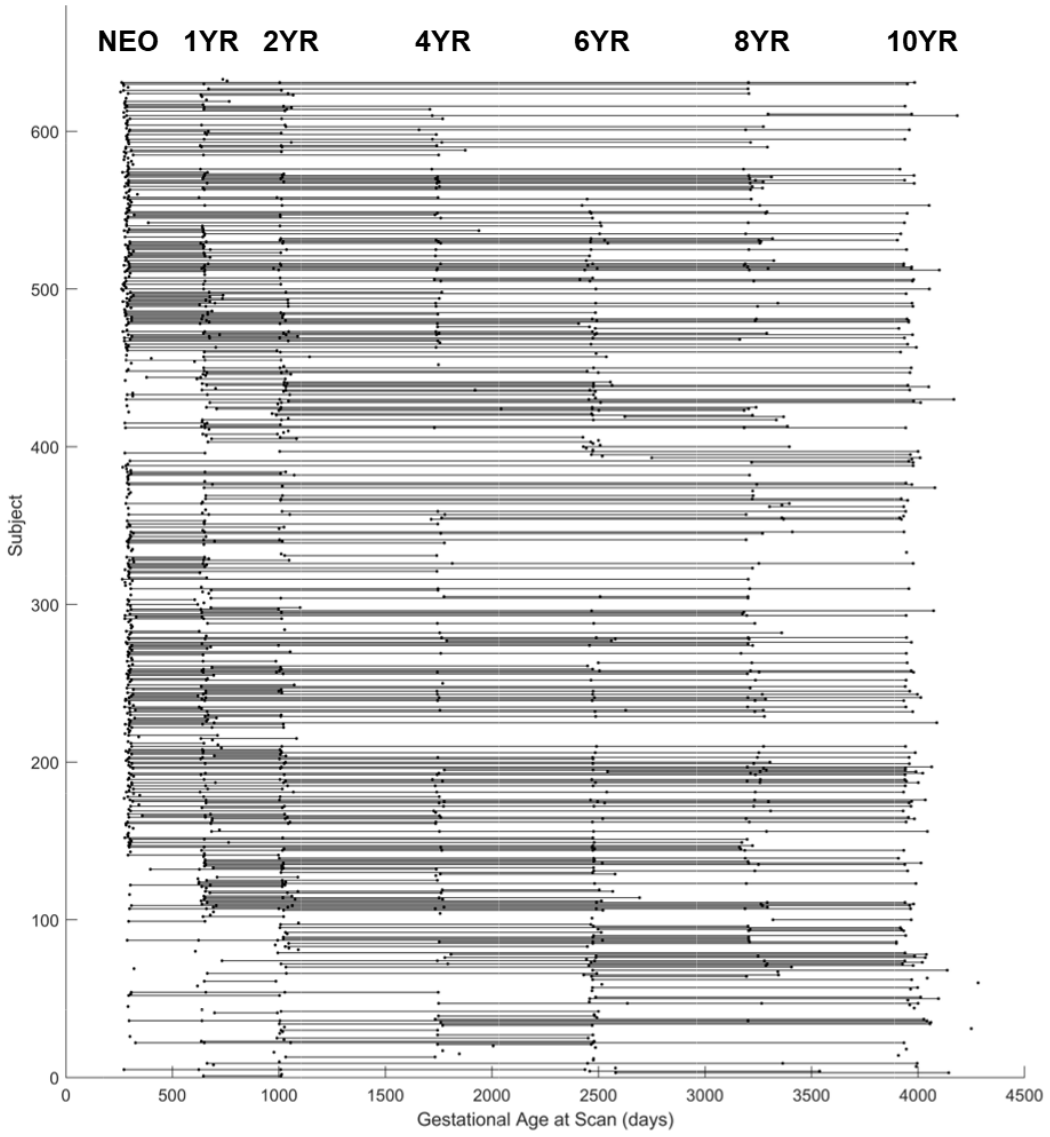

Figure S3. Distribution of good quality rsfMRI scans across all timepoints. The distribution of gestational age at scan for all included infant subjects (n=633 totaling 1476 datasets across neonates [NEO], 1-year-olds [1YR], 2-year-olds [2YR], 4-year-olds [4YR], 6-year-olds [6YR], 8-year-olds [8YR], and 10-year-olds [10YR]) whose image quality passed the quality control procedures is shown. Each dot represents a successful resting-state functional magnetic resonance imaging scan, and dots along each line represent all the available longitudinal scans for a given subject.

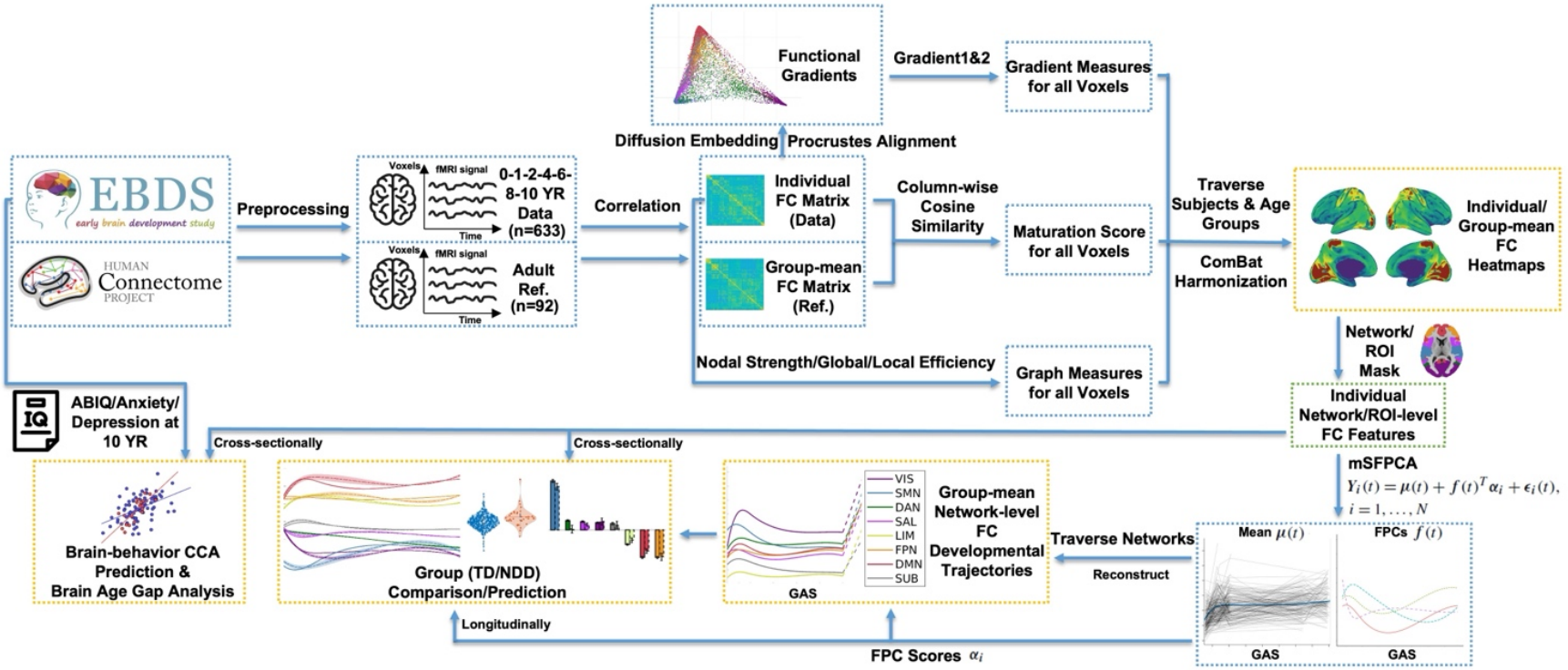

Figure S4. Methods schematic. After preprocessing, a voxelwise functional connectivity matrix was generated for each rsfMRI scan. Fun1ctional connectivity maturation score, graph theory measures (nodal strength, nodal global efficiency, nodal local efficiency), and functional gradient scores were derived for each voxel from the voxelwise FC matrix. Scanner, mean framewise displacement (FD), and scan length were regressed out for each voxel to form heatmaps for each functional connectivity measure. Group-mean heatmaps were then derived from individual heatmaps. Network-level functional connectivity features were obtained from individual heatmaps, after which multivariate sparse functional principal components analysis (mSFPCA) was used to generate functional principal components

(FPCs) and derived FPC scores. Individual trajectories were then reconstructed, and group-level trajectories were obtained. Group comparison between typically developing controls and neurodevelopmental risk subgroups (neurodevelopmental diagnosis [NDD] and maternal psychiatric diagnosis [MPD]) were conducted both longitudinally and cross-sectionally. Brain-behavioral CCA predictions and Brain Age Gap analysis were also conducted.

Table S1. Subject demographics.

	All n=633	TD n=379	NDD n=36	MPD n=100	Autism n=14	ADHD n=27
Sex (Male/Female)	341 / 292	190 / 189	29 / 7	60 / 40	13 / 1	21 / 6
Birthweight (g)	2958.51 (695.17)	3095.31 (556.27)	3049.89 (796.59)	3082.76 (638.12)	2920.00 (724.86)	3091.85 (783.82)
Gestational age at birth (days)	264.04 (18.60)	269.31 (12.52)	261.78 (19.91)	268.04 (15.89)	257.71 (19.55)	263.81 (19.29)
Maternal education, years	14.85 (3.48)	15.65 (3.23)	13.81 (2.63)	11.92 (3.06)	14.14 (2.98)	13.89 (2.64)
Mother's Race & Ethnicity						
White	480 (75.83%)	301 (79.42%)	27 (75.00%)	59 (59.00%)	12 (85.71%)	20 (74.07%)
Black	143 (22.59%)	69 (18.21%)	9 (25.00%)	41 (41.00%)	2 (14.29%)	7 (25.93%)
Asian	8 (1.26%)	7 (1.85%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Indigenous/AI-AN	2 (0.32%)	2 (0.53%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Hispanic	72 (11.37%)	44 (11.61%)	2 (5.56%)	10 (10.00%)	2 (14.29%)	0 (0.00%)
Father's Race & Ethnicity						
White	442 (69.83%)	281 (74.14%)	19 (52.78%)	46 (46.00%)	9 (64.29%)	14 (51.85%)
Black	161 (25.43%)	77 (20.32%)	13 (36.11%)	49 (49.00%)	4 (28.57%)	10 (37.04%)
Asian	14 (2.21%)	12 (3.17%)	0 (0.00%)	1 (1.00%)	0 (0.00%)	0 (0.00%)
Indigenous/AI-AN	6 (0.95%)	2 (0.53%)	1 (2.78%)	2 (2.00%)	0 (0.00%)	1 (3.70%)
Hispanic	82 (12.95%)	44 (11.61%)	5 (13.89%)	15 (15.00%)	1 (7.14%)	4 (14.81%)
rsfMRI Timepoints						
Neonate	372	226	14	57	8	7
Gestational age at scan (days)	295.27 (16.90)	295.19 (14.68)	295.43 (10.30)	301.74 (17.00)	293.25 (8.35)	298.00 (11.60)
Scanner (Allegra/Trio)	295/77	172/54	10/4	51/6	5/3	6/1
1-Year-Olds	273	149	14	47	6	10
Gestational age at scan (days)	657.82 (25.59)	660.23 (25.69)	655.93 (19.57)	655.96 (29.80)	653.83 (25.97)	660.70 (18.48)
Scanner (Allegra/Trio)	212/61	112/37	12/2	37/10	5/1	9/1
2-Year-Olds	220	111	19	37	9	14
Gestational age at scan (days)	1022.19 (24.06)	1021.29 (22.91)	1018.74 (16.24)	1021.62 (26.83)	1023.56 (12.32)	1018.21 (16.95)
Scanner (Allegra/Trio)	163/57	78/33	18/1	30/7	8/1	14/0
4-Year-Olds	125	80	4	16	1	3
Gestational age at scan (days)	1758.76 (47.04)	1759.80 (48.66)	1749.00 (13.54)	1772.56 (63.30)	1739.00 (—)	1752.33 (14.43)
Scanner (Allegra/Trio)	28/97	17/63	1/3	6/10	0/1	1/2
6-Year-Olds	175	99	16	20	4	14
Gestational age at scan (days)	2487.54 (43.53)	2482.10 (42.54)	2496.44 (38.32)	2493.70 (40.56)	2507.75 (55.03)	2500.79 (39.01)
Scanner (Allegra/Trio)	33/142	17/82	4/12	2/18	1/3	4/10
8-Year-Olds	155	96	13	22	4	11
Gestational age at scan (days)	3247.08 (60.35)	3252.88 (61.22)	3230.92 (38.69)	3214.45 (28.50)	3234.75 (47.68)	3233.91 (41.41)

Scanner (Trio/Trio-NewProtocol/Prisma)	22/24/109	16/16/64	2/2/09	3/4/15	1/1/2	1/2/8
10-Year-Olds	156	103	13	11	3	12
Gestational age at scan (days)	3977.39 (60.89)	3976.73 (56.90)	3982.08 (77.10)	3986.27 (110.40)	4042.33 (90.88)	3983.17 (80.42)
Scanner (Trio/Trio-NewProtocol/Prisma)	6/30/120	5/21/77	1/4/8	0/4/7	1/0/2	1/4/7
Behavioral Outcomes (8 years)						
GA at behavioral assessment (days)	3252.16 (63.17)	3254.86 (60.60)	3258.71 (52.75)	3225.73 (43.32)	3258.25 (56.58)	3256.85 (51.22)
SB-5 ABIQ standard score	103.42 (12.71)[a]	104.36 (12.76)[a]	103.38 (12.24)[a]	98.32 (12.42)[a]	106.38 (10.93)[a]	104.35 (12.89)[a]
SB-5 WM standard score	105.00 (11.63)[b]	107.61 (11.03)[b]	101.71 (11.88)[b]	97.29 (11.60)[b]	101.62 (15.10)[b]	102.15 (11.89)[b]
BRIEF WM T-score	52.50 (10.22)[c]	50.07 (8.46)[c]	63.91 (9.58)[c]	57.46 (10.59)[c]	58.62 (11.64)[c]	65.05 (8.97)[c]
BASC-2 Anxiety T-score	49.91 (10.39)[d]	47.39 (9.09)[d]	53.64 (13.20)[d]	54.24 (11.22)[d]	51.00 (8.83)[d]	53.50 (14.06)[d]
BASC-2 Depression T-score	50.42 (11.38)[e]	47.44 (8.56)[e]	58.91 (16.40)[e]	60.44 (16.03)[e]	57.25 (15.83)[e]	57.63 (16.11)[e]
Behavioral Outcomes (10 years)						
GA at behavioral assessment (days)	3978.18 (62.75)	3978.64 (62.96)	3975.82 (69.43)	3973.30 (78.35)	3990.00 (73.55)	3978.00 (74.17)
SB-5 ABIQ standard score	103.46 (11.05)[f]	104.53 (10.40)[f]	102.86 (9.28)[f]	101.92 (11.78)[f]	100.75 (7.65)[f]	104.00 (9.76)[f]
SB-5 WM standard score	106.69 (10.62)[g]	108.32 (10.68)[g]	103.68 (11.89)[g]	101.19 (8.35)[g]	106.00 (9.41)[g]	103.50 (11.90)[g]
BRIEF WM T-score	52.21 (10.37)[h]	50.56 (9.63)[h]	62.95 (7.93)[h]	58.23 (10.71)[h]	60.43 (7.50)[h]	62.94 (8.44)[h]
BASC-2 Anxiety T-score	50.71 (9.26)[i]	49.87 (8.93)[i]	52.65 (8.41)[i]	53.12 (10.62)[i]	53.29 (9.27)[i]	51.62 (7.93)[i]
BASC-2 Depression T-score	50.61 (10.59)[j]	49.04 (10.12)[j]	57.85 (14.19)[j]	57.24 (13.15)[j]	62.14 (16.10)[j]	56.06 (12.50)[j]
[a] *n with SB-5 ABIQ data (8yr)*	*248*	*146*	*24*	*41*	*8*	*20*
[b] *n with SB-5 WM data (8yr)*	*246*	*144*	*24*	*41*	*8*	*20*
[c] *n with BRIEF WM data (8yr)*	*240*	*141*	*23*	*39*	*8*	*19*
[d] *n with BASC-2 Anxiety data (8yr)*	*246*	*145*	*22*	*41*	*7*	*18*
[e] *n with BASC-2 Depression data (8yr)*	*247*	*145*	*23*	*41*	*8*	*19*
[f] *n with SB-5 ABIQ data (10yr)*	*214*	*133*	*22*	*25*	*8*	*18*
[g] *n with SB-5 WM data (10yr)*	*228*	*143*	*22*	*27*	*8*	*18*
[h] *n with BRIEF WM data (10yr)*	*233*	*150*	*20*	*26*	*7*	*16*
[i] *n with BASC-2 Anxiety data (10yr)*	*215*	*135*	*20*	*25*	*7*	*16*
[j] *n with BASC-2 Depression data (10yr)*	*215*	*135*	*20*	*25*	*7*	*16*