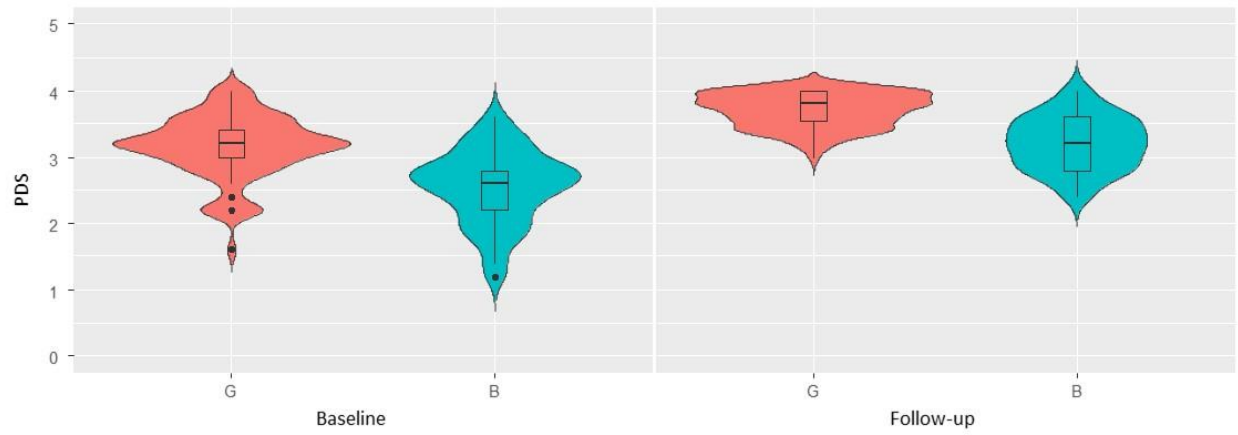
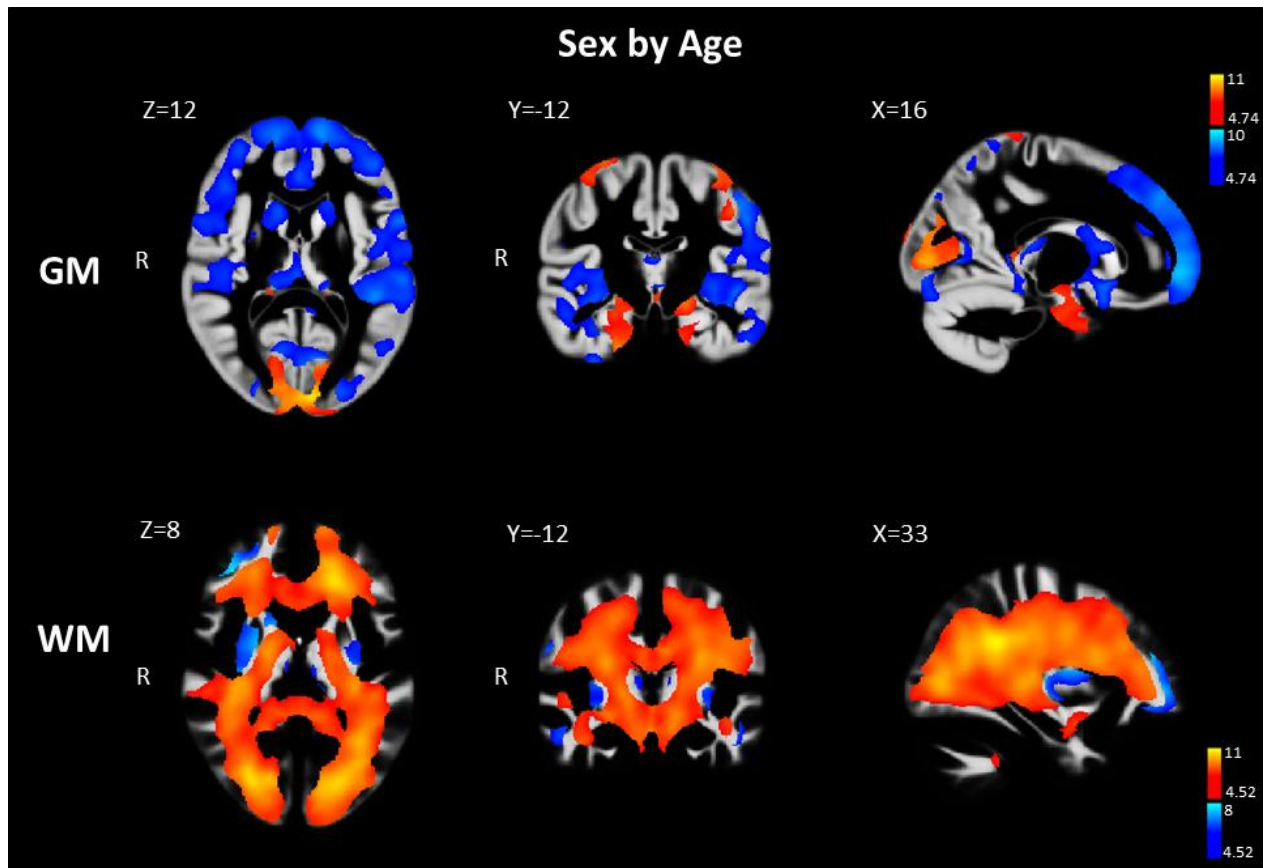


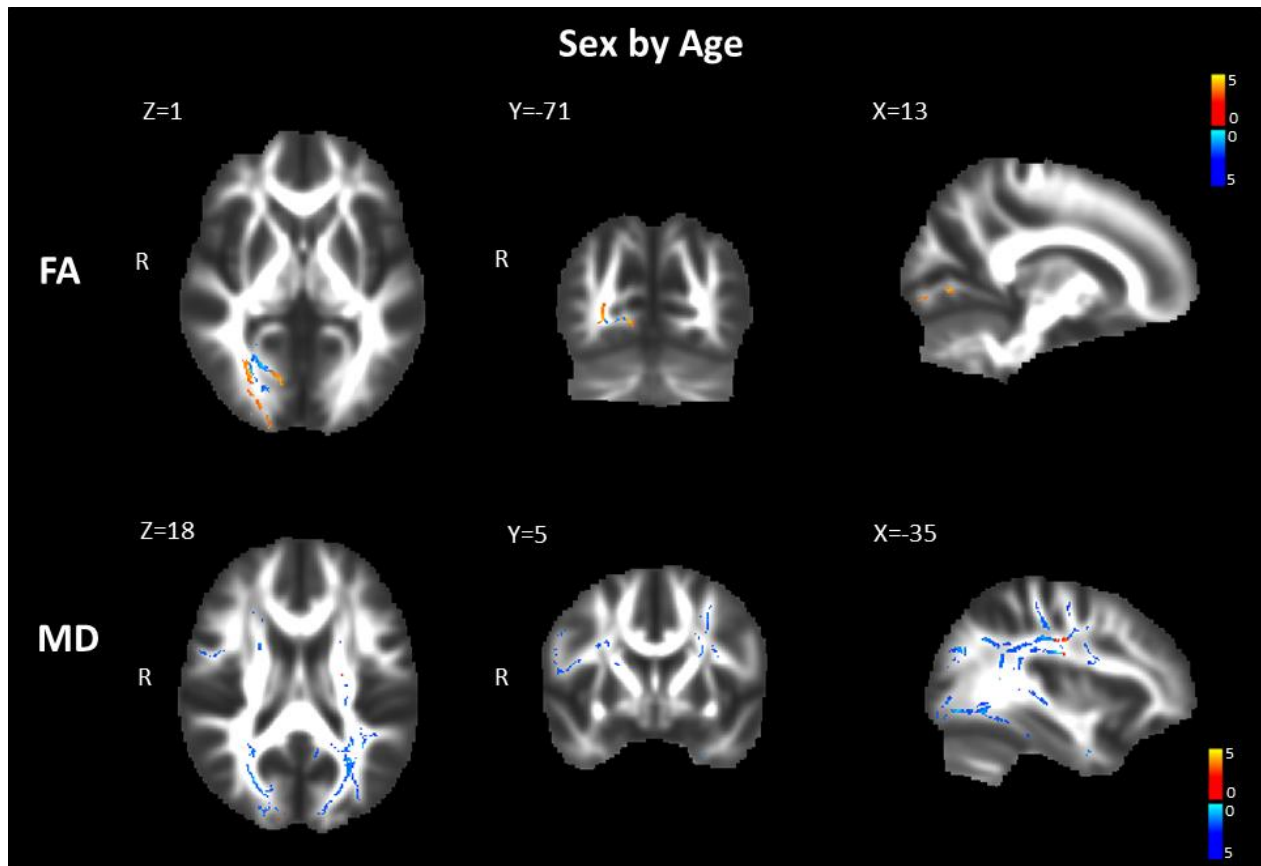
Supplementary Figure 1: Flow diagram with inclusion/exclusion criteria for imaging analyses. ^a: Quality control based on visual inspection of the images checking for instrumental artifacts and anatomical anomalies. ^b: Quality control based on cerebral volumes and voxel-wise covariance. ^c: Quality control based on signal dropouts, head motion and eddy currents corrections, and tensor fitting computation.



Supplementary Figure 2: Violins plots of the PDS at baseline and follow up for girls in red and boys in blue.



Supplementary Figure 3: Voxel-based sex-by-age interaction for GM (top row) and WM (bottom row). Steeper decreases in girls than boys in blue-light blue color scale and steeper increases in boys than girls in red-yellow color scale are superimposed on the sample mean GM and WM images. Color scales represent t-values ($p < 0.05$ FWE corrected). R: Right; GM: Grey Matter; WM: White Matter.



Supplementary Figure 4: Voxel-based sex-by-age interaction for FA (top row) and MD (bottom row). Steeper decreases in boys than girls in blue-light blue color scale and steeper increases in girls than boys in red-yellow color scale are superimposed on the sample mean FA image. Color scales represent t-values ($p < 0.05$ FWE and TFCE corrected). R: Right; FA: Fractional Anisotropy; MD: Mean Diffusivity.

Supplementary Table 1: Effect of PDS by sex on self-report questionnaires.

task	measure	Sex	score change (per PDS point)	t-test (degree of freedom)	p-value	interaction sex-by-PDS p-value
SDQ	total difficulties	boys	0.017	t(6.18) = 0.027	0.97	0.80
		girls	0.21	t(5.71) = 0.34	0.74	
	internalizing	boys	0.43	t(1.91) = 0.80	0.51	0.34
		girls	0.95	t(1.88) = 1.74	0.23	
	externalizing	boys	-0.45	t(170.33) = 1.17	0.24	0.52
		girls	-0.79	t(172.12) = 2.06	0.04	
	emotion	boys	0.083	t(4.56) = 0.26	0.80	0.073
		girls	0.80	t(4.26) = 2.52	0.061	
	conduct	boys	-0.12	t(62.79) = 0.61	0.54	0.85
		girls	-0.17	t(50.74) = 0.86	0.39	
	peer	boys	0.35	t(1.70) = 1.23	0.35	0.43
		girls	0.14	t(1.68) = 0.51	0.66	
	hyperactivity	boys	-0.32	t(171.76) = 1.11	0.26	0.43
		girls	-0.63	t(173.68) = 2.20	0.028	
DAWBA	separation anxiety	boys	0.10	t(300.9) = 0.95	0.34	0.31
		girls	0.25	t(300.90) = 2.33	0.020	
	depression	boys	0.10	t(57.7) = 0.61	0.54	0.22
		girls	-0.17	t(63.7) = 1.04	0.30	
	generalized anxiety	boys	0.09	t(5.35) = 0.97	0.37	0.76
		girls	0.13	t(4.68) = 1.37	0.23	
	conduct disorder	boys	0.17	t(175.64) = 1.96	0.050	0.19
		girls	0.015	t(177.9) = 0.17	0.86	

Notes: PDS: Puberty Developmental Scale; SDQ: Strengths and Difficulties Questionnaire; DAWBA: Development and Well-Being Assessment.

Supplementary Table 2: Effect of age by sex on self-report questionnaires.

Task	Measure	Sex	Score change (per year)	T-test (degree of freedom)	P-value	Interaction sex-by-age p-value
YSI	Positive characteristics	boys	0.26	t(4.97) = 1.59	0.17	0.03
		girls	-0.18	t(3.36) = 1.20	0.30	
	Positive actions	boys	-0.24	t(2.64) = 0.95	0.41	0.81
		girls	-0.30	t(2.03) = 1.28	0.32	
	Total positive attributes	boys	0.009	t(33.15) = 0.033	0.97	0.16
		girls	-0.50	t(23.69) = 2.01	0.055	
SDQ	Total difficulties	boys	-0.044	t(1.699) = 0.133	0.90	0.95
		girls	-0.059	t(1.42) = 0.19	0.87	
	Internalizing	boys	0.10	t(1.22) = 0.33	0.78	0.35
		girls	0.28	t(1.14) = 0.86	0.52	
	Externalizing	boys	-0.16	t(154.42) = 1.21	0.22	0.31
		girls	-0.34	t(153.66) = 2.85	0.0048	
	Emotion	boys	-0.004	t(1.29) = 0.022	0.98	0.089
		girls	0.22	t(1.18) = 1.07	0.45	
	Conduct	boys	-0.082	t(16.4) = 1.12	0.27	0.54
		girls	-0.14	t(11.33) = 2.11	0.057	
	Peer	boys	0.11	t(1.48) = 0.92	0.48	0.51
		girls	0.054	t(1.33) = 0.45	0.71	
Hyperactivity	boys	-0.084	t(154.80) = 0.81	0.41	0.36	
	girls	-0.20	t(153.98) = 2.72	0.024		
DAWBA	Separation anxiety	boys	0.04	t(301.00) = 1.01	0.31	0.86
		girls	0.05	t(300.9) = 1.38	0.16	
	Depression	boys	-0.001	t(34.81) = 0.02	0.97	0.23
		girls	-0.09	t(24.63) = 1.77	0.08	
	Generalized anxiety	boys	0.02	t(2.83) = 0.62	0.57	0.50
		girls	0.05	t(2.09) = 1.49	0.26	
	Conduct disorder	boys	0.06	t(2.32) = 1.66	0.21	0.41
		girls	0.03	t(1.80) = 0.86	0.48	

Notes: YSI: Youth Strengths Inventory; SDQ: Strengths and Difficulties Questionnaire; DAWBA: Development and Well-Being Assessment.

Supplementary Table 3: Model fitting using AIC and BIC values on self-report questionnaires.

task	measure	model				
		age		age + PDS		p-value
		AIC	BIC	AIC	BIC	
YSI	Positive characteristics	1222	1257	1229	1286	0.65
	Positive actions	1346	1381	1354	1411	0.76
	Total positive attributes	1539	1574	1545	1602	0.45
SDQ	Total difficulties	1724	1761	1733	1792	0.75
	Internalizing	1464	1502	1473	1533	0.76
	Externalizing	1456	1493	1465	1525	0.89
	Emotion	1281	1319	1288	1347	0.46
	Conduct	1008	1045	1018	1077	0.90
	Peer	1017	1054	1028	1088	0.97
	Hyperactivity	1275	1312	1281	1341	0.48
DAWBA	Separation anxiety	552	590	558	618	0.39
	Depression	878	915	887	946	0.80
	Generalized anxiety	514	551	526	585	0.99
	Conduct disorder	523	560	532	592	0.86

Notes: YSI: Youth Strengths Inventory; SDQ: Strengths and Difficulties Questionnaire; DAWBA: Development and Well-Being Assessment.

Supplementary Table 4: Effect of sex by age on global imaging measures.

imaging	global measure	Sex	change estimate (per year)	t-test (degree of freedom)	p-value	interaction sex-by-age p-value
T1-weighted	GM (cm ³)	boys	-1.74	t(2.34) = 4.53	0.033	1.97e ⁻¹⁵
		girls	-5.16	t(1.88) = 14.11	0.006	
	WM (cm ³)	boys	2.91	t(1.08) = 4.54	0.124	<2e ⁻¹⁶
		girls	0.50	t(1.02) = 0.77	0.57	
DTI	FA	boys	0.0036	t(1.11) = 3.23	0.17	0.078
		girls	0.0027	t(1.09) = 2.53	0.22	
	MD (10 ⁻³ mm ² /sec)	boys	-4.50e ⁻⁰⁶	t(2.91) = 9.21	0.003	0.02
		girls	-3.20e ⁻⁰⁶	t(2.31) = 6.99	0.013	

Notes: DTI: Diffusion Tensor Imaging; GM: Grey Matter; WM: White Matter; FA: Fractional Anisotropy; MD: Mean Diffusivity.

Supplementary Table 5: Model fitting using AIC and BIC values on global imaging measures.

imaging	global measure	model				
		age		Age + PDS		p-value
		AIC	BIC	AIC	BIC	
T1-weighted	GM	2502	2543	2495	2559	0.0047
	WM	2282	2323	2271	2335	0.00098
DTI	FA	2028	1990	2017	1957	0.97
	MD	6214	6176	6205	6145	0.74

Notes: DTI: Diffusion Tensor Imaging; GM: Grey Matter; WM: White Matter; FA: Fractional Anisotropy; MD: Mean Diffusivity.

Supplementary Table 6: Voxel-based sex-by-PDS interaction in GM and WM.

	Cluster level	Voxel level			MNI coordinates space (mm)		
	k	p(FWE) ^a	T	Z	x	y	z
Grey Matter	Increase in boys compared to girls						
	15640	<0.001	9.02	Inf	1	-90	-2
	4710	<0.001	7.83	7.16	-34	-16	66
	9296	<0.001	7.47	6.88	6	-32	-8
	2442	<0.001	7.22	6.68	-48	-77	-26
	3270	<0.001	6.79	6.34	55	-63	-24
	2025	<0.001	6.56	6.15	21	-33	9
	513	<0.001	6.47	6.07	-18	-11	-10
	3013	<0.001	6.45	6.05	38	-16	65
	2393	<0.001	6.35	5.97	22	-11	-39
	1392	<0.001	6.28	5.91	-19	-33	11
	1029	<0.001	5.97	5.65	-17	7	-35
	107	0.002	5.45	5.20	-19	-104	11
	397	0.008	5.16	4.95	19	-39	79
	Decrease in girls compared to boys						
	7512	<0.001	7.34	6.78	-50	-12	48
	13254	<0.001	7.33	6.77	7	2	-10
	15955	<0.001	7.07	6.56	-10	63	-10
	3265	<0.001	6.96	6.47	0	-22	11
	12647	<0.001	6.91	6.43	0	-76	8
	14426	<0.001	6.73	6.29	-8	-94	-7
	3646	<0.001	6.68	6.25	50	-8	49
	6808	<0.001	6.65	6.22	23	-86	-19
	25954	<0.001	6.61	6.19	12	47	45
	547	<0.001	5.99	5.67	-26	-44	-1
	293	<0.001	5.94	5.63	18	-37	-21
	752	<0.001	5.91	5.60	36	-27	50
	5943	<0.001	5.86	5.56	-32	-32	16
	1056	<0.001	5.83	5.53	38	-48	-39
	2741	<0.001	5.83	5.53	-24	-66	64
	554	0.001	5.81	5.51	39	-12	-47
	771	0.001	5.65	5.37	12	23	-10
	880	0.001	5.61	5.34	9	-37	78
	705	0.001	5.58	5.31	60	-30	16
	194	0.002	5.51	5.25	26	-34	-9
	204	0.003	5.42	5.18	-6	-47	-51
	1380	0.003	5.37	5.13	-6	-5	31
	826	0.004	5.36	5.12	45	-18	8
	717	0.004	5.33	5.09	-65	-36	-9
	716	0.005	5.30	5.07	-3	31	26
206	0.005	5.28	5.05	-7	-39	78	
209	0.005	5.27	5.04	-18	-4	55	
271	0.006	5.24	5.02	-55	-8	-33	
172	0.006	5.24	5.01	-3	-23	54	
174	0.006	5.22	4.99	-44	-8	-16	
176	0.009	5.14	4.92	60	-8	23	
583	0.009	5.12	4.91	-52	-26	-18	

	167	0.011	5.07	4.87	-26	-11	-5	
	75	0.012	5.06	4.86	13	6	48	
	81	0.012	5.05	4.85	-42	-40	66	
	82	0.016	4.99	4.79	6	21	-27	
	477	0.016	4.98	4.79	-40	57	-9	
	59	0.017	4.97	4.78	-7	42	-28	
	275	0.018	4.96	4.77	46	32	12	
	171	0.018	4.95	4.76	-51	-1	-3	
	473	0.019	4.94	4.75	-39	48	9	
	89	0.020	4.92	4.73	42	37	-5	
	128	0.022	4.91	4.72	-67	-32	43	
	55	0.024	4.88	4.70	-25	-71	-29	
	66	0.024	4.88	4.70	22	-64	32	
	113	0.025	4.87	4.69	-44	-48	29	
	105	0.026	4.85	4.67	11	43	21	
	70	0.029	4.83	4.65	-9	36	3	
	50	0.039	4.75	4.58	12	-81	50	
			Increase in boys compared to girls					
	384414	<0.001	9.07	Inf	29	-80	6	
	955	0.001	5.51	5.25	-46	-11	-20	
	319	0.006	5.07	4.86	-45	-5	15	
	58	0.011	4.93	4.74	35	-45	-38	
	154	0.011	4.92	4.74	20	15	57	
	203	0.019	4.79	4.61	-34	6	31	
	79	0.023	4.73	4.57	-22	-5	55	
	51	0.026	4.69	4.53	2	-20	-46	
	85	0.029	4.67	4.50	-56	-10	34	
			Decrease in girls compared to boys					
	2551	<0.001	7.42	6.84	26	1	9	
	599	<0.001	6.18	5.83	41	43	4	
	87	<0.001	6.02	5.69	57	-20	37	
	65	<0.001	5.75	5.46	58	-16	31	
	81	0.001	5.67	5.39	12	52	-3	
	409	0.001	5.64	5.36	-54	-32	-13	
	280	0.001	5.48	5.23	-29	-10	9	
	66	0.002	5.41	5.16	-19	-62	-47	
	132	0.006	5.10	4.90	-39	-46	-13	
	111	0.007	5.03	4.83	40	51	-5	
	56	0.008	5.01	4.82	-10	38	-16	
	63	0.025	4.71	4.54	-8	-17	15	

Note: k : cluster size in number of voxels (voxel size = 1 mm^3); MNI: Montreal Neurological Institute.
^aStatistics at voxel level set to $p < 0.05$, family wise error corrected for multiple comparisons, extent threshold $k = 50$ voxels.

Supplementary Table 7: Voxel-based sex-by-age interaction in GM and WM.

	Cluster level	Voxel level			MNI coordinates space (mm)		
	k	p(FWE) ^a	T	Z	x	y	z
Grey Matter	Increase in boys compared to girls						
	15727	<0.001	10.32	Inf	-7	-95	13
	22060	<0.001	8.20	7.45	22	-4	-41
	2440	<0.001	7.97	7.28	-48	-76	-25
	2051	<0.001	7.37	6.81	46	-76	-22
	1653	<0.001	7.23	6.69	20	-34	7
	4387	<0.001	7.03	6.53	-36	-14	64
	2681	<0.001	6.99	6.50	32	-13	74
	545	<0.001	6.46	6.06	20	-44	79
	1772	<0.001	6.07	5.73	-3	-78	-13
	664	0.001	5.79	5.50	-2	-59	-17
	51	0.001	5.66	5.38	-8	-43	-51
	50	0.002	5.52	5.26	46	-5	31
	Decrease in girls compared to boys						
	306990	<0.001	9.75	Inf	-11	63	-9
	2092	<0.001	6.83	6.37	-51	-68	-21
	2404	<0.001	6.59	6.17	19	-32	7
	2779	<0.001	6.58	6.16	32	-84	-19
	1121	<0.001	6.54	6.13	17	-41	3
	563	<0.001	6.43	6.04	-4	-49	-52
	2330	<0.001	6.24	5.87	-19	-49	-6
	861	<0.001	6.07	5.73	35	-28	49
	203	0.001	5.81	5.51	-17	-30	11
	650	0.001	5.67	5.39	41	18	32
	437	0.002	5.62	5.35	13	-52	78
	60	0.011	5.13	4.92	13	6	48
	51	0.022	4.97	4.77	24	-62	32
	White Matter	Increase in boys compared to girls					
575951		<0.001	10.88	Inf	34	-44	28
378		0.014	4.87	4.69	-29	7	-12
120		0.021	4.77	4.60	19	15	59
Decrease in girls compared to boys							
5267		<0.001	7.71	7.07	39	41	9
3133		<0.001	7.37	6.81	27	0	10
307		<0.001	6.62	6.19	-9	-53	27
440		<0.001	6.56	6.14	60	-24	31
2533		<0.001	6.11	5.77	50	-27	-6
813		<0.001	5.93	5.61	-31	-15	2
82		<0.001	5.75	5.46	14	-58	25
329		0.001	5.67	5.39	-15	-26	4
322		0.001	5.54	5.28	-53	-30	-13
261		0.001	5.48	5.23	-49	-13	-23
244		0.005	5.12	4.91	10	-13	10
67		0.007	5.07	4.86	-39	-50	-12

Note: k: cluster size in number of voxels (voxel size =1 mm³); MNI: Montreal Neurological Institute.

^aStatistics at voxel level set to $p < 0.05$, family wise error corrected for multiple comparisons, extent

threshold $k = 50$ voxels.

Supplementary Table 8: Voxel-based sex-by-age interaction in FA and MD.

	Cluster level	Voxel level			MNI coordinates space (mm)			
	k	p(FWE) ^a	T		x	y		
FA	Increase in girls compared to boys							
	996	p < 0.05	4.24		30	-92	-1	
	81	p < 0.05	3.55		14	-71	2	
	Decrease in boys compared to girls							
	284	p < 0.05	4.66		22	-54	-3	
MD	Increase in girls compared to boys							
	312	p < 0.05	3.68		-27	-12	24	
	148	p < 0.05	3.71		-36	-16	28	
	132	p < 0.05	3.56		-9	-85	29	
	127	p < 0.05	3		20	-88	18	
	110	p < 0.05	4.07		-19	-95	-9	
	85	p < 0.05	3.34		-19	-28	0	
	85	p < 0.05	3.33		-27	-56	0	
	76	p < 0.05	3.19		-24	-12	33	
	65	p < 0.05	2.37		15	10	6	
	62	p < 0.05	3		12	-77	24	
	54	p < 0.05	4.05		-23	-48	1	
	53	p < 0.05	3.56		18	-25	2	
	Decrease in boys compared to girls							
		8760	p < 0.05	4.72		-36	-50	16
		871	p < 0.05	4.73		27	-69	19
		819	p < 0.05	3.45		23	32	16
		707	p < 0.05	4.08		14	-85	-8
		666	p < 0.05	3.6		35	-53	33
		468	p < 0.05	3.06		33	0	32
		369	p < 0.05	3.7		46	0	22
		232	p < 0.05	3.5		-14	-87	-10
		228	p < 0.05	3.27		-36	-10	36
		142	p < 0.05	3.79		-11	-76	2
		81	p < 0.05	2.8		-17	-44	3
		77	p < 0.05	3.98		-27	0	-35
	77	p < 0.05	3.44		20	-13	45	
	74	p < 0.05	3.11		33	-61	9	
	70	p < 0.05	4.35		-48	-9	22	
	62	p < 0.05	2.79		-29	-23	-7	

Note: k: cluster size in number of voxels (voxel size =1 mm³); MNI: Montreal Neurological Institute.

^aStatistics at voxel level set to p < 0.05, family wise error and threshold-free cluster enhancement corrected for multiple comparisons.

Supplementary Table 9: Effects of sex by age on Region Of Interest measures.

imaging	measure	region	sex	change estimate (per year)	t-test (degree of freedom)	p-value	interaction sex-by-age p-value
T1-weighted	GM (cm ³)	amygdala	boys	0.006	t(6.19) = 5.31	0.0016	8.81e ⁻¹⁴
			girls	-0.005	t(5.67) = 5.26	0.0022	
		hippocampus	boys	0.024	t(13.08) = 8.05	1.99e ⁻⁰⁶	9.57e ⁻¹⁵
			girls	-0.0094	t(9.44) = 3.37	0.007	
		prefrontal cortex	boys	-0.30	t(74.43) = 7.46	1.29e ⁻¹⁰	1.82e ⁻¹²
			girls	-0.73	t(78.62) = 19.56	<2e ⁻¹⁶	
DTI	FA	uncinate	boys	0.0012	t(5.60) = 2.29	0.064	0.17
			girls	3.00e ⁻⁰⁴	t(4.04) = 0.59	0.58	
		cingulum	boys	0.0070	t(1.28) = 4.23	0.10	0.68
			girls	0.0061	t(1.18) = 4.57	0.10	
		cingulum (hippocampal)	boys	0.0022	t(1.10) = 0.89	0.52	0.01
			girls	-1.61e ⁻⁰⁴	t(1.07) = 0.06	0.95	
	MD (10 ⁻³ mm ² /sec)	uncinate	boys	-3.47e ⁻⁰⁶	t(1.74) = 4.08	0.068	0.25
			girls	-2.51e ⁻⁰⁶	t(1.46) = 3.11	0.13	
		cingulum	boys	-3.75e ⁻⁰⁶	t(2.45) = 8.40	1.07e ⁻⁰⁸	0.16
			girls	-2.89e ⁻⁰⁶	t(2.44) = 7.16	1.88e ⁻⁰⁷	
cingulum (hippocampal)	boys	-4.52e ⁻⁰⁶	t(1.37) = 2.13	0.22	0.21		
	girls	-2.73e ⁻⁰⁶	t(1.25) = 1.32	0.37			

Notes: DTI: Diffusion Tensor Imaging; GM: Grey Matter; FA: Fractional Anisotropy; MD: Mean Diffusivity.

Supplementary Table 10: Model fitting using AIC and BIC values on Region Of Interest measures.

imaging	measure	region	model				
			age		age + PDS		
			AIC	BIC	AIC	BIC	p-value
T1-weighted	GM	amygdala	1003	962	995	932	0.69
		hippocampus	367	326	371	307	0.018
		prefrontal cortex	1339	1380	1338	1402	0.046
DTI	FA	uncinate	1834	1797	1826	1766	0.68
		cingulum	1664	1627	1659	1599	0.40
		cingulum (hippocampal)	1584	1547	1573	1513	0.99
	MD	uncinate	6024	5995	6024	5964	0.73
		cingulum	6123	6086	6116	6056	0.64
		cingulum (hippocampal)	5676	5730	5756	5696	0.99

Notes: DTI: Diffusion Tensor Imaging; GM: Grey Matter; FA: Fractional Anisotropy; MD: Mean Diffusivity.

Supplementary Table11: Regression between YSI and SDQ scores.

YSI	SDQ	p-value	estimate
positive characteristics	internalizing	6.848e ⁻⁰⁵	-0.2273
	externalizing	0.01631	-0.1485
	total	1.212e ⁻⁰⁵	-0.1717
positive actions	internalizing	0.0563	-0.1437
	externalizing	0.1228	-0.1223
	total	0.01895	-0.1201
total positive attributes	internalizing	8.455e ⁻⁰⁴	-0.3602
	externalizing	0.02305	-0.2621
	total	1.385e ⁻⁰⁴	-0.2813

Note: YSI: Youth Strengths Inventory; SDQ: Strengths and Difficulties Questionnaire.