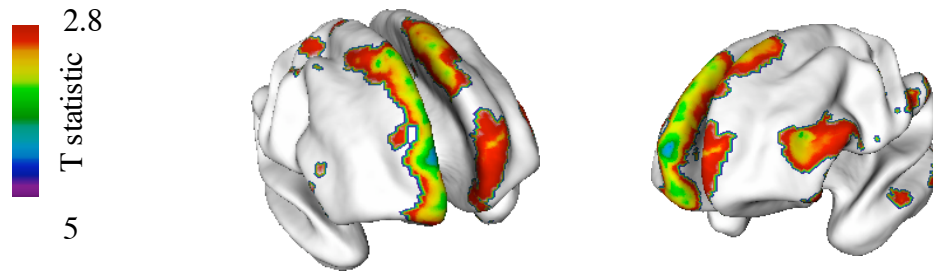


Supplementary Figure: Interaction between age terms and IQ

Cortical thickness was regressed against IQ, age terms (linear, quadratic and cubic age) and the interaction of IQ and age terms. The t statistics for the interaction terms were visualized through projection onto a standard brain template. Regions where there was a significant interaction (applying a $fdr\ 0.05$) of IQ with the cubic age term are shown below; the interaction of IQ and the squared, but not the linear, age term was significant in the same regions. The analyses suggest that IQ significantly modulates the effect of the polynomial age terms on cortical thickness predominately in the prefrontal cortical regions.



Supplementary Table 1. Pearsons’s correlations between IQ and mean cortical thickness for each cortical region.

Correlations for the entire group (N=307) and for each age group are given. The final column shows regions where the correlations differed significantly between age groups. The negative correlation between IQ and cortical thickness in young childhood is replaced by positive correlations from late childhood onwards. This changing relationship between IQ and cortical thickness with age reaches significance throughout most of the prefrontal cortex.

		Entire sample (N=307)	Age groups				Group difference [†]
			Young childhood (N=77) A	Late Childhood (N=77) B	Early Adolescence (N=76) C	Late Adolescence (N=77) D	
Frontal							
Superior	R	0.01	-0.30*	0.34	0.07	0.10	A<B
	L	0.02	-0.23	0.22	0.10	0.20	A<B
Middle	R	0.06	-0.27	0.29	0.15	0.20	A<B, A<D
	L	0.07	-0.21	0.24	0.16	0.25	A<B, A<D
Inferior	R	0.05	-0.27	0.30	0.10	0.19	A<B, A<D
	L	0.05	-0.27	0.24	0.14	0.26	A<B, A<D
Medial	R	0.01	-0.22	0.15	0.10	0.13	A<B
	L	0.02	-0.20	0.25	0.13	0.19	A<B
Precentral	R	0.04	-0.22	0.28	0.08	0.13	A<B
	L	0.02	-0.18	0.17	0.05	0.15	
Medial orbitofrontal	R	0.02	-0.23	0.13	0.10	0.15	
	L	-0.02	-0.24	0.18	0.04	0.06	
Lateral orbitofrontal	R	0.01	-0.22	0.15	0.10	0.13	
	L	0.07	-0.20	0.25	0.13	0.19	
Cingulate	R	0.05	-0.17	0.18	0.10	0.14	
	L	0.03	-0.14	0.16	0.08	0.08	
Temporal							
Superior	R	0.03	-0.23	0.17	0.09	0.17	A<B
	L	-0.02	-0.22	0.14	0.02	-0.02	A<B
Middle	R	0.04	-0.19	0.22	0.07	0.07	A<B
	L	0.07	-0.21	0.26	0.15	0.14	A<B
Inferior	R	0.02	-0.25	0.19	0.11	0.10	
	L	-0.01	-0.31	0.19	0.05	0.08	

Periamygdaloid	R	0.03	0.07	0.02	0.09	-0.12	
	L	-0.02	-0.06	0.03	0.04	-0.10	
Parahippocampal	R	0.06	-0.08	0.16	0.14	0.00	
	L	0.11	0.07	0.23	0.08	0.02	
Uncal	R	0.07	-0.03	0.21	0.09	-0.01	
	L	0.06	0.03	0.15	0.02	0.01	
Insula	R	0.02	-0.11	0.11	0.05	-0.01	
	L	0.01	-0.19	0.16	0.06	-0.06	
Parietal							
Postcentral gyrus	R	0.02	-0.18	0.24	0.09	0.07	
	L	-0.01	-0.16	0.20	0.10	0.08	
Superior lobule	R	0.02	-0.14	0.24	0.12	0.03	
	L	0.03	-0.14	0.27	0.10	-0.03	
Supramarginal gyrus	R	0.05	-0.18	0.23	0.08	0.19	
	L	0.06	-0.20	0.33	0.07	0.09	A<B
Angular gyrus	R	0.06	-0.02	0.27	0.10	-0.06	
	L	0.01	-0.17	0.33	0.03	-0.02	A<B
Precuneus	R	0.02	-0.07	-0.02	0.08	-0.02	
	L	-0.01	-0.15	0.04	0.11	-0.06	
Medial occipitotemporal	R	0.04	-0.17	0.16	0.07	0.13	
	L	0.01	-0.18	0.03	0.11	0.04	
Lateral occipitotemporal	R	0.07	-0.18	0.25	0.11	0.11	
	L	0.06	-0.19	0.26	0.05	0.13	A<B
Occipital							
Pole	R	0.03	-0.02	0.14	-0.02	0.09	
	L	0.14	0.13	0.29	0.16	0.09	
Superior	R	0.07	-0.08	0.21	0.06	0.01	
	L	0.06	-0.07	0.31	0.14	0.00	
Middle	R	0.06	-0.08	0.31	0.09	-0.02	
	L	0.10	-0.14	0.40	0.21	0.05	A<B
Inferior	R	0.06	0.00	0.22	-0.05	0.08	
	L	0.13	0.01	0.39	0.13	0.07	
Lingual	R	0.05	-0.17	0.31	0.09	-0.04	
	L	0.05	0.03	0.17	0.01	0.02	
Cuneus	R	-0.01	-0.14	0.14	0.08	-0.15	
	L	0.02	-0.04	0.15	0.04	-0.04	

*Correlations with a nominal significance of $P < 0.05$ are highlighted in bold.

† The correlations for each subregion were Z-transformed and the difference between the Z scores for each age group, and its significance, was calculated. Group differences which survived the adjustment for multiple comparisons are shown in the final column (e.g. A<B indicates that there is a significant difference between the early and late childhood groups).

Supplementary Table 2: demographic and neuroimaging details of subjects.

	IQ group- average	IQ-group High	IQ group- superior	Test of significance
Number of subjects	115	101	91	
Number of scans	220	188	221	
Male (%)	64 (55%)	58 (57%)	53 (58%)	$\chi^2=0.15$, $p=0.93$
Handedness – right left ambidextrous	102 8 5	91 4 6	81 5 5	$\chi^2=1.2$, $p=0.88$
Socio- economic status	45.5 (18.9)	39.3 (18.2)	31.9 (15.2)	F(2,291)=14.1, $p<0.001$ Superior>high ($p=0.01$) Superior>average ($p<0.001$) Average>high ($P=0.03$)
Full scale IQ – mean (SD)	100 (6.9)	114 (3.5)	128 (6.6)	
Full scale IQ range	83-108	109-120	121-149	
Scanning details				
1	115	101	91	
2	62	54	62	
3	30	24	38	
4+	13	9	30	
Age at each scan (years)				
1 Mean (SD)	11.1 (3.7)	11.7 (3.8)	10.9 (3.4)	F(2,304)=1.2, $p=0.31$
2	13.2 (3.9)	13.6 (4.2)	13.2 (3.7)	F(2,175)=0.16, $p=0.85$
3	15.6 (3.4)	15.1 (4.6)	15.6 (3.8)	F(2,89)=0.10, $p=0.90$
4+	18.7 (4.7)	17.2 (5.7)	19.2 (4.8)	F(2,49)=0.57, $p=0.57$

Supplementary methods.

Demographic and neuropsychological details. Age appropriate IQ test were used: the WPPSI-III for children 4 to 6; the WISC-III for 6 to 17 years; and the WAIS-III for 18 and above. For longitudinal analyses the subjects were split into three IQ groups, and the ranges we used overlap substantially with standard and widely used divisions of Wechsler scale (low average and average IQ range 80 to 109; high average 110 to 119; and superior and high superior greater than 120)³¹. Further demographic details of each of the IQ groups is given in supplementary Table 2. The mean IQ for the entire group was 113.3 (SD 12.9) and the mean age at time of first scan for the entire sample was 13 years (SD 4.5 years) with ages ranging from 3.8 to 25.4 years. Handedness was determined using the PANESS³², and socio-economic status from the Hollingshead Scales³³.

Neuroimaging details. Imaging parameters of the magnetic resonance images were: echo time of 5 ms, repetition time of 24 ms, flip angle of 45°, acquisition matrix of 256 x 192, number of excitations equals 1, and 24 cm field of view. Head placement was standardized as previously described³⁴. Registration into standardized stereotaxic space was performed using a linear transformation³⁵ and segmentation into white matter, gray matter, cerebrospinal fluid and background through use of an advanced neural net classifier³⁶. Cortical thickness was estimated in native space, the measure thus giving an unadjusted estimate of absolute cortical thickness. Every cortical point can be assigned to one of 56 separate cortical regions on the basis of a probabilistic atlas, and thus

analyses correlating IQ with the mean cortical thickness for each subregion were possible³⁷. Statistical analyses were performed using SPSS version 11 (SPSS Inc, Chicago, Ill), except for the mixed-model random regression analyses, which were performed with the statistical package R (<http://www.r-project.org/>).

Supplementary notes

Additional references

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