Supporting Information

Raznahan et al. 10.1073/pnas.1316911111

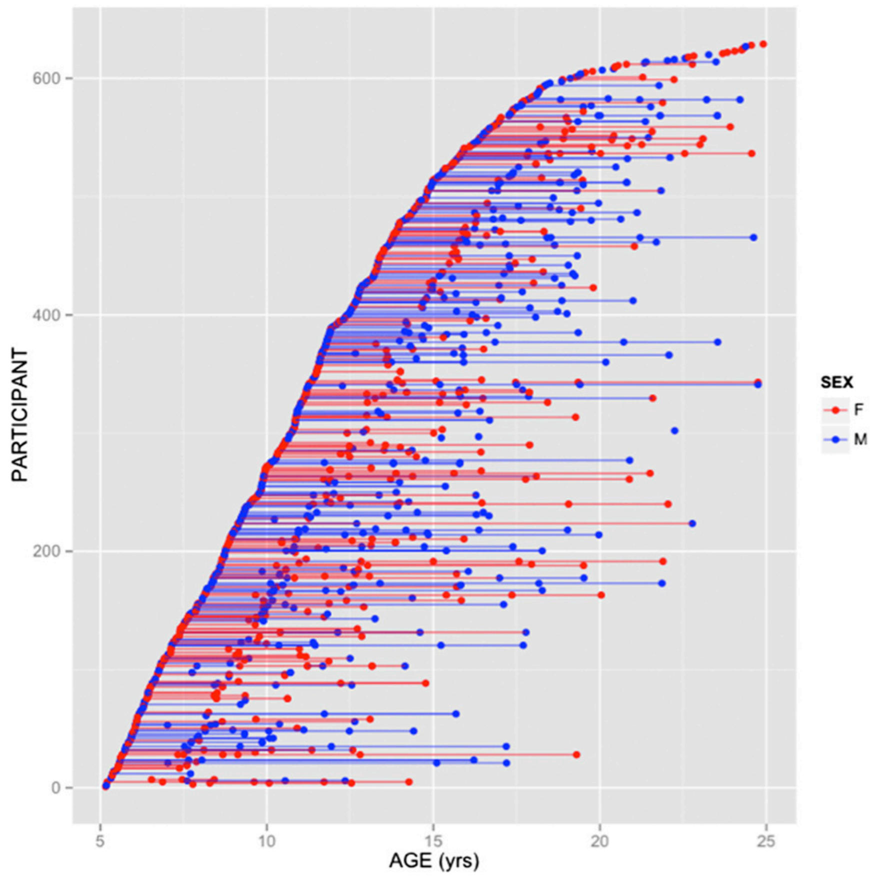


Fig. S1. Distribution of scans per person by sex across the study age span. Each point denotes a scan; horizontal lines connect scans from the same individual. Red, female; blue, male.

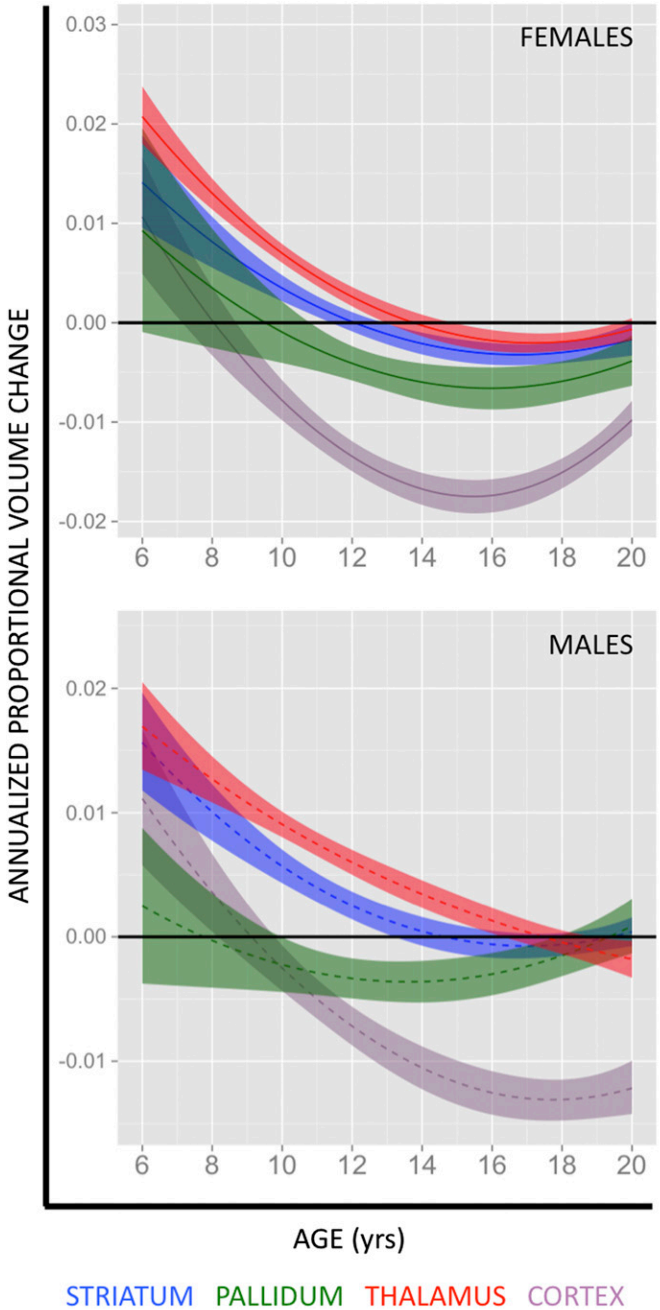


Fig. S2. Plots of annualized proportional volume change by age for each structure in males and females. The lines plotted here are derivatives of the group-estimate curves for structure volume by age and focus on how rates of volume change alter with advancing age. Shaded ribbons around each curve denote 95% confidence intervals. The horizontal black line is zero change, and the trajectory for each structure first crosses this line at the age at which peak volume is reached. Note how annual rates of volume change in the cortex and annual rates of volume change in subcortical structures are closer to converging by early adulthood in females than they are in males.

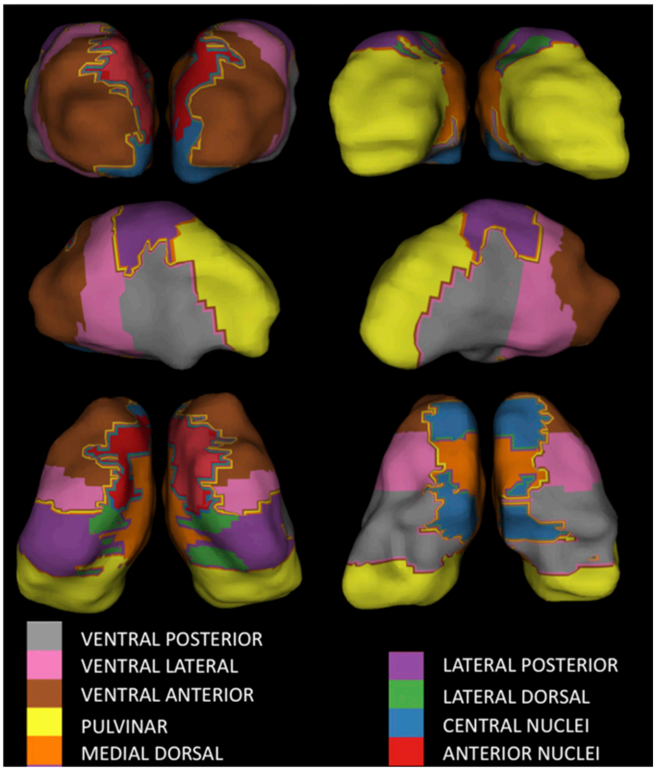


Fig. S3. Surface-projection of thalamic subnuclei based on expert neuroanatomic labeling of serial histology (1).

1. Hirai T, Jones EG (1989) A new parcellation of the human thalamus on the basis of histochemical staining. *Brain Res Brain Res Rev* 14(1):1–34.

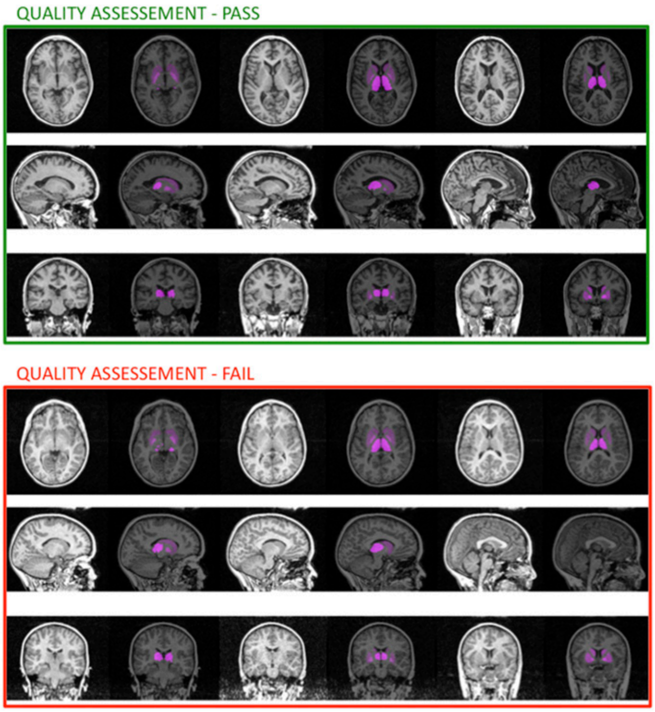


Fig. S4. Examples of quality-assessment montages for the subcortical morphometry pipeline. Axial, sagittal, and coronal series show segmentation for a "pass" and "fail" rated scan on quality assessment. Note the improperly defined inferiolateral thalamic border evident in the first coronal view of the "fail" scan.

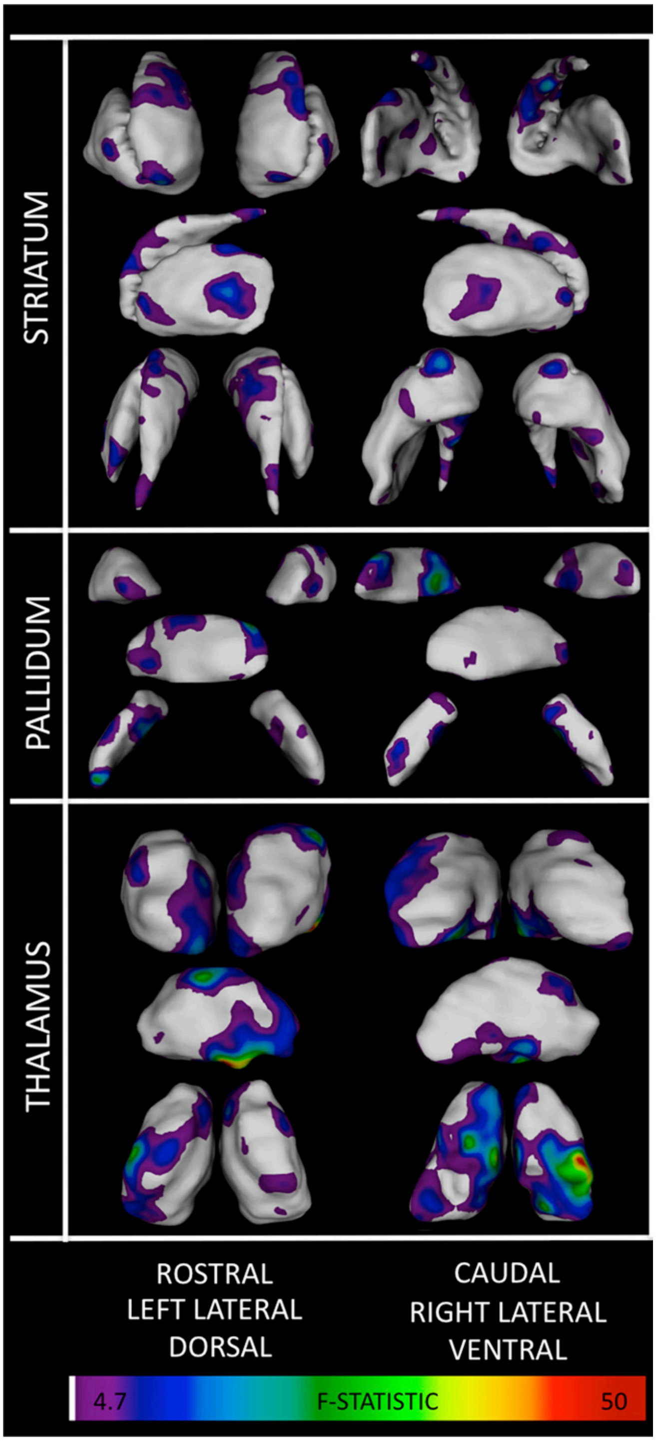


Fig. S5. Maps of significant quadratic age effects. Colored regions denote significant quadratic effects of age on local surface area after FDR correction for multiple comparisons. Linear age effects were preferred in the analysis of local age and age*sex effects as (*i*) they showed a significant relation with local surface area over a greater proportion of the subcortex than quadratic effects and (*ii*) confidence intervals for age-at-attainment of peak surface area within foci of prominent quadratic effect consistently extended beyond the age range of our sample.

Table S1. Participant characteristics

Characteristic	Data
No. of individuals	618
Sex	306 female/312 male
Handedness, no.	
L	94
R	524
Race, no.	
Caucasian	525
African-American	50
Asian	12
Hispanic	17
Other	14
IQ, mean (SD)	113 (12.5)
SES	72
Total no. of scans	1,172
No. of scans, no.	
1 scan	280
2 scans	190
≥3 scans	148
Age distribution of scans, y	
Mean (SD)	13.1
Range	5.2–24.9

SES, socioeconomic status as measured by Hollingshead Scales (1).

1. Chakravarty MM, et al. (2009) Comparison of piece-wise linear, linear, and nonlinear atlas-to-patient warping techniques: Analysis of the labeling of subcortical nuclei for functional neurosurgical applications. *Hum Brain Mapp* 30(11):3574–3595.

Table S2. Results for statistical models of global volumetric change

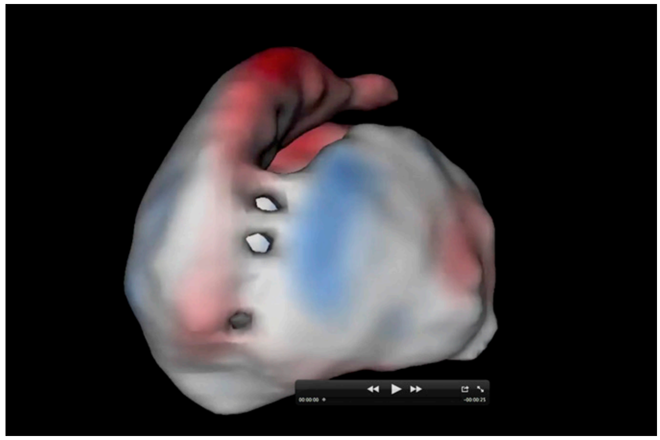
				Sex difference in shape		Sex difference in height	
Structure	Order	Age term (F)	*P*	L. ratio	*P*	T value	*P*
Striatum	Cubic	25.9	<0.0001	22.7	<0.0001	10.1	<0.0005
Pallidum	Cubic	7.9	0.0004	7.9	0.05	10.4	<0.0005
Thalamus	Cubic	23.5	<0.0001	34.1	<0.0001	9.9	<0.0005
Cortex	Cubic	46.3	<0.0001	29.7	<0.0001	14.5	<0.0005

Dependent variables were bilateral striatal, pallidal, and thalamic volume. Test statistics and associated *P* values were derived using mixed models to fit polynomial curves to anatomical data.

Table S3. Results of preliminary analyses interrelating IQ and subcortical volume

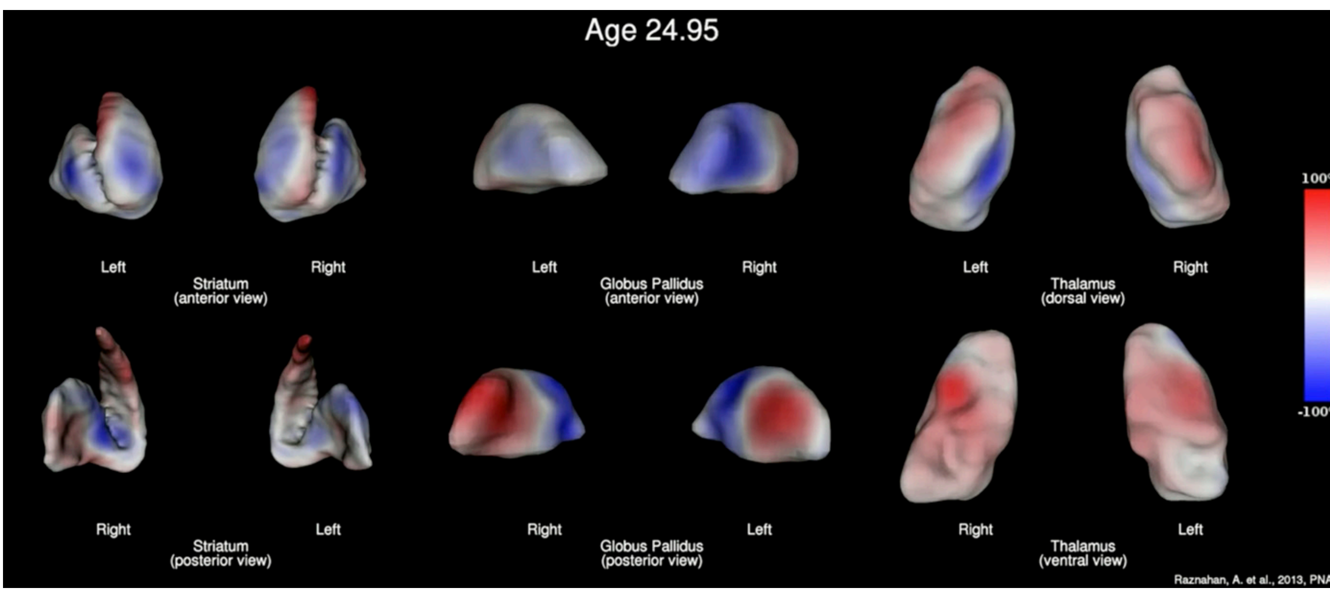
	Standardized main effects of IQ within cubic age model (per 1 point increase in IQ)			
	Not covarying for total brain size		Covarying for total brain size	
Structure	Beta	*P*	Beta	*P*
Striatum	0.0076	0.014	−0.002	0.4
Pallidum	0.0074	0.014	−0.0005	0.9
Thalamus	0.01	<0.0005	0.001	0.6

This table includes standardized coefficients for the main effect of IQ on each subcortical volume, within the context of a cubic model for age effects. The beta coefficients indicate the standard-deviation shift in each subcortical structure volume that accompanies a 1-point increase in IQ. Notice that these effects are relatively modest in magnitude (i.e., a 10-point difference in IQ is accompanied by a 0.1 SD change in thalamic volume) and weaken further (as well as loosing statistical significance) when interindividual differences in total brain volume are taken into account by inclusion as a covariate. Interactions between IQ and age in predicting subcortical volumes were not examined.



Movie S1. Regional differences in subcortical maturation. The left striatum, pallidum, and thalamus are assembled in anatomical space and shown rotating in the axial plane, from a left anterior oblique perspective. As in Fig. 2*A*, these are unthresholded maps where color encodes regional differences in the direction (blue, contraction; red, expansion) and rate (greater saturation, faster change) of linear surface-area change with increasing age.

Movie S1



Movie S2. Maps of evolving local expansion and contraction with age for the striatum, pallidum, and thalamus. These movies show areal differences (blue, contraction; red, expansion) relative to a 5-y-old baseline (white), across striatal, pallidal, and thalamic surfaces. Areal differences are expressed as a percentage of the peak absolute surface area change value observed within each structure.

Movie S2