Cortical thickness and age-related thinning jointly reveal spatial patterns of granularity

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The human cortex can also be distributed along micro anatomical characteristics into 3-to-5 layered allocortex and six-layered neocortex, respectively older and younger phylogenetically. Neocortical regions are further characterized by the cellular composition of its laminae with different granularity scales. Cortical development patterns partially align with phylogenetical spatial patterns. Aging-related alterations also seem to resemble evolutionary and ontogenetical patterns, with regions maturing later during development exhibiting atrophy earlier. Structural 3D-MPRAGE T1w MR images free of visible movement artifacts from 612 right handed subjects aged between 18 and 85 years were acquired from the database maintained by the NKI. Images were processed in Freesurfer v6.0.0. Cortical thickness (CorT) was obtained for surface ROIs in the Destrieux atlas, encompassing 74 grey matter ROIs in each brain hemisphere. Each morphometric index was used as dependent variable on a linear regression, allowing different slopes and intercepts per sample set and sex and also per interaction of these categories. The dependence between the initial morphometric index, at a base age of 18 years, and its yearly percentage change with age with 18 years as reference was assessed for each region. Principal components (PC) of these two variables were further analyzed for CorT data. All statistical analyses were carried in R x64 3.4.0. For CorT, it becomes clear thicker cortices attain higher percentages of yearly loss, few thicker regions deviate from that pattern, such as the anterior insulas, which are thick yet have small yearly rates of age-related thinning. On the PC analysis in CorT data, the value for each cortical region on the first PC indicates where the region stands in the axis of positive dependence between CorT and CorT percentage change, while the value on the second PC measures deviations from the linear pattern. Based on the spatial distribution of these values, we hypothesize the first value (on the first PC axis) aligns with neocortical granularity and second one appears to indicate cortical type admixture, as allocortex-containing areas deviate from this expected behavior. Neocortical thickness is associated with rates of age-related cortical thinning, thicker cortices decaying faster. Thickness is associated with neocortical granularity, therefore, observing the spatial patterns of association, we show agranular areas tend to have higher rates of thickness atrophy than granular areas. Cortical type admixture might be responsible for deviations from this rule, where we observe cortices containing non-neocortex displaying this behavior.