Supplemental Materials

MRI acquisition

All images were performed on a 3.0-Tesla MRI scanner (Philips 3.0T Achieva) using the following imaging parameters: sagittal slice thickness, 1.0 mm; contiguous slices with 50% overlap; no gap; repetition time (TR), 9.9 ms; echo time (TE), 4.6 ms; flip angle, 8°; and a matrix size of 240 × 240 pixels reconstructed to 480 × 480 over a field of view (FOV) of 240 mm.

Image processing for cortical thickness

T1-weighted MRI images were first registered to a standardized stereotaxic space using an offline transformation [1]. Images were corrected for intensity non-uniformity artifacts using the N3 algorithm [2]. Non-brain tissues of the corrected images were removed using a BET algorithm [3]. Using a neural net classifier, the brain images were then classified into white matter, gray matter, cerebrospinal fluid (CSF), and background [4]. The hemispherical surfaces of the inner and outer cortices were automatically extracted using the CLASP algorithm [5,6]. The inner and outer surfaces had the same vertex number consisting of 40,962 vertices on each hemisphere for each participant. The surfaces were transformed back into the native space using a reverse of the linear transformation, and cortical thickness was measured as the Euclidean distance between linked vertices of the inner and outer surfaces using the t-link method [7]. To compare thickness across the participants, the thicknesses were spatially normalized using surface-based registration in which the vertices of each participant were nonlinearly registered to a group template by matching sulcal folding patterns [8,9]. All procedures were automatically processed using CIVET – Montreal Neurological Institute (MNI) image processing software (http://wiki.bic.mni.mcgill.ca/index.php/CIVET) to produce the cortical surface and to

measure its thickness. To increase the signal-to-noise ratio and statistical power, each cortical thickness map was blurred with a surface-based diffusion smoothing kernel with a full-width half-maximum of 20 mm [10].

Image processing for cerebellar volume

We applied the same image processing for the cerebellum as described previously [11]. Briefly, cerebellar segmentation was performed using morphological operators and tissue segmentation. The processes were carried out with functions available in the CIVET pipeline software. First, the cerebellar region was roughly defined by removing the cortical tissue mask from brain images. Then we removed non-cerebellum regions that were not connected to the cerebellum using morphological operators such as erosion, dilation, and opening. A brain stem atlas was also used to separate the cerebellum and brain stem. The segmented cerebellum was masked out using a CSF classification map to exclude the false-positive results. Finally, cerebellar volume was calculated by measuring the volume of segmented cerebellum voxels in native space.

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