*Supplemental material for online production only*

**APPENDIX**

### ROI Procedures

### Right Cerebellum

The right cerebellum was drawn beginning with the lateral-most coronal slice where the cerebellum could be identified. The superior portion of the cerebellum was defined using the cerebellar tentorium as a guide. The pons was used as the anterior boundary, and the midline of the cerebellar vermis was used to delineate the left boundary of the ROI.

### Right Dentate

The dentate was identified as a grey matter structure that was surrounded by white matter. The dentate was drawn beginning with the brainstem in the axial view, and the midline of the cerebellum in the sagittal and coronal view. The ROI mask was placed over the crescent-shaped figure in the middle of the cerebellar white matter in the right hemisphere. This mask was drawn to include 1-2 voxels of white matter along the grey matter borders, to ensure the mask would capture the dentate connections to white matter pathways that continue to the cortex.

### Left Red Nucleus

The left red nucleus was identified by selecting the anterior-most midbrain slice in which it becomes visible in the axial view, using the cerebral peduncles and substantia nigra as anterior and posterior reference points, respectively. For this structure the T2 image was also used as a guide, as the red nucleus appears grey on T2 images due to iron composition. Similar to the dentate mask, this mask was drawn to include a 1-2 voxel border into the white matter. For neuroanatomical reference, see page Figure 6.10B on page 234 of Blumenfeld (2010).

### Left Thalamus

The massa intermedia or lateral ventricles as relevant defined the right boundary of the thalamus. The posterior internal capsule defined the left boundary of the thalamus. The anterior boundary was defined using the differentiation between the grey matter of the thalamus and surrounding white matter of the internal capsule. Dorsal and ventral boundaries were based on continuous slices of the differentiation between the grey and white matter boundaries on the T1 images, with the posterior commissure as another reference point for the ventral boundary. For neuroanatomical reference points, please see Figure 10-19B on page 144 of Waxman et al. (2009).

### Left Middle Frontal Gyrus (MFG)

The anterior boundary of the left MFG was defined as the anterior portion of the superior frontal sulcus, and the posterior portion was defined by the caudal part of the middle frontal gyrus. The superior frontal sulcus was defined by the dorsal boundary, and the ventral boundary of the MFG was defined as the inferior frontal sulcus.

### Reduced size MFG

The left MFG was reduced in size, after delineation, for efficient network processing. Specifically, the masks used for processing included the first 10-slices of the anterior portion of the MFG. The reduction of the size of the MFG was modeled after the ROI slice procedure described by Ford et al. (2013). While one could argue that a larger ROI is more precise and includes more fiber estimations, it could also be argued that smaller, more precise ROI boundaries increase neuroanatomical specificity. The use of PanTrack for network tractography both between and within structures addresses some of these concerns by decreasing reliance on ROI boundaries while maintaining the specificity of between-structure networking methods. To date, all prior studies using MOW reconstruction and direct structural networking have only used between-structure networking. Even with a reduced size ROI for the MFG, this method is far superior to prior studies that have used a single slice estimate of ROIs (Jissendi et al., 2008), or defined the frontal ROI too broadly as the dorsal anterior half of the cortex (Law et al., 2015a).

### Right MFG

The same parameters described for the left MFG were used in the contralateral hemisphere.

### Right parietal lobe white matter

The right parietal lobe white matter delineations were based on the anatomical guidelines described by Thiebaut de Schotten et al. (2011), and Kamali et al. (2014). The middle of the splenium of the corpus callosum was used as a starting reference point. The triangle shaped fiber pathway at the inferior portion of the top right bundle of fibers in the parietal lobe was defined as the angular gyrus. This fiber bundle was followed on 10 contiguous slices toward the anterior portion of the brain in the coronal view.

### Right temporal lobe

The first coronal slice where the temporal pole could be defined was used as a starting point and the anterior boundary. The dorsal boundary was defined as the superior temporal gyrus. The posterior boundary was defined as the parieto-occipital sulcus. The left boundary was defined as the first sagittal slice where the corpus callosum became visible.

###  ROI Template Method

 The method of ROI template generation was based on Law et al. (2015a), which involved manually drawing the ROIs on 10 healthy controls, registering the ROIs to the standard MNI (Montreal Neurological Institute) ICBM152 brain to create an ROI template, then registering the template to each participant’s native space, and manually editing when necessary (Woods et al., 1998; http://bishopw.loni.ucla.edu/air5). While this technique was successful in a brain tumor population in one prior study (Law et al., 2015a), one possible limitation of this approach was the potential inaccuracies when converting the template image from standard MNI152 space to native space, due to structural brain abnormalities (e.g., lesions from surgical resection, inter-individuals in sulcal anatomy; Ono et al., 1990). However, a systematic semi-automated approach to ROI reduces the time intensive nature of manual ROI drawings and provides a more objective and standardized approach to ROI generation.

Ten (10) healthy controls were randomly selected to develop the ROI templates. The regions of interest were drawn on the FA image for each control, and co-registered T1 images were used as an anatomical guide. All ROIs were delineated by referencing anatomical guidelines provided by neuroanatomical atlases (e.g., Naidich et al., 2008). Then, all images and ROIs were co-registered to the MNI152 brain template. Once all images were in MNI space, each of the ROIs was combined across participants to obtain an average ROI template across the 10 randomly selected controls. Each of these ROI templates was then visually verified and manually edited when necessary to be consistent with the aforementioned ROI boundaries on the MNI152 brain to create the template ROIs.

Next, AFNI’s non-linear registration program was used (Cox, 1996; Cox and Jesmanowicz, 1999) to register each participant’s FA image to the standard MNI152 FA image (1x1x1mm). Following registration, AFNI was used to calculate the inverse normalization warp matrix from MNI152 space to native space. The inverse matrix was then applied to the template ROIs to bring the template ROIs into native space for each participant. Once the ROIs were in native space, each ROI was checked for accuracy. This method was used for all the ROI templates. In general, the template ROIs registered accurately to the participants’ native space based on a visual investigation of the images, and ROIs were manually corrected when necessary. All ROIs were carefully checked and edited after each transformation.