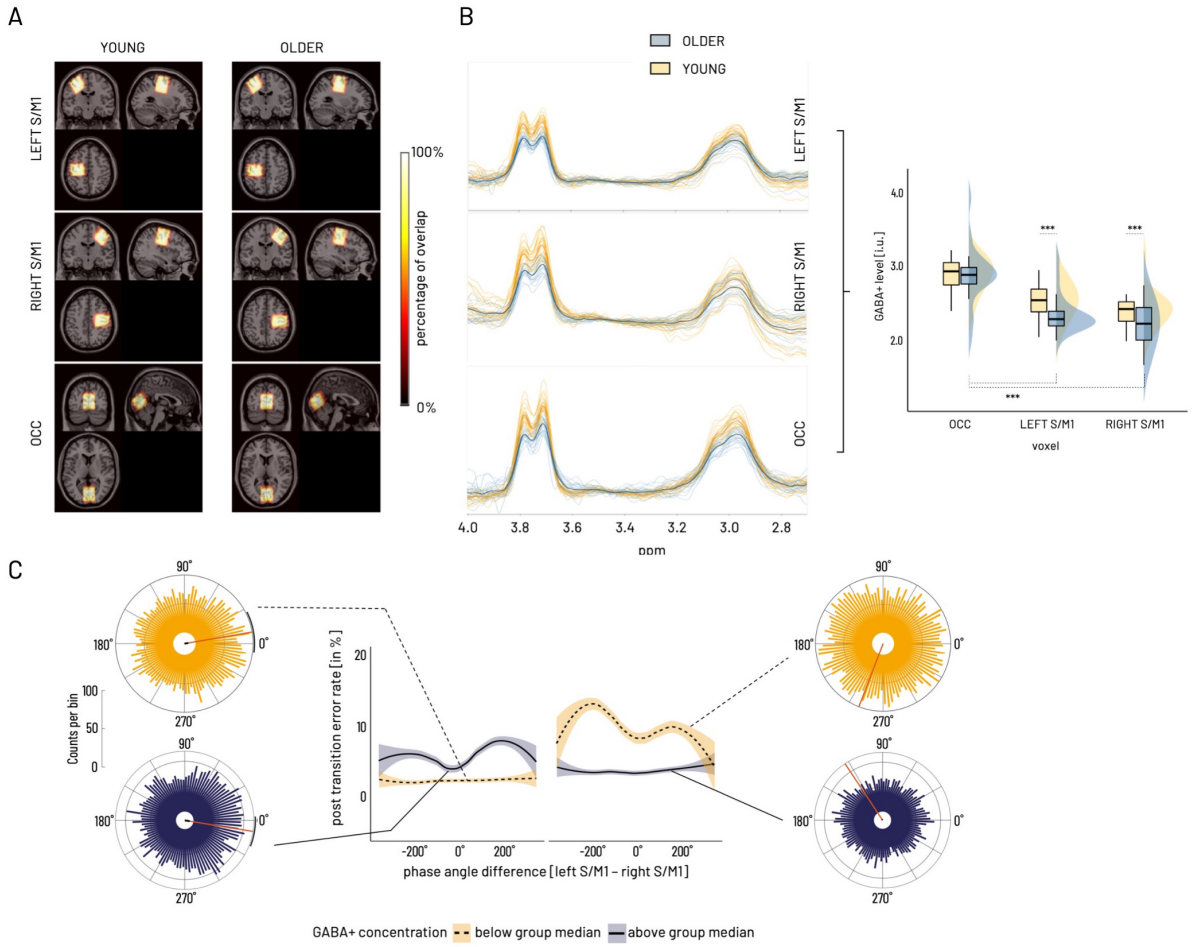
CBI Featured Image – Spring, 2024 – Dr. Heise Lab



The flexible adjustment of ongoing behavior challenges the nervous system's dynamic control mechanisms and has shown to be specifically susceptible to age-related decline. Our analysis integrated behavior and modulation of interhemispheric phase-based connectivity during dynamic motor-state transitions with endogenous GABA concentration in adult human volunteers. We provide converging evidence for age-related differences in the preferred state of endogenous GABA concentration for more flexible behavior. We suggest that the increased interhemispheric connectivity observed in the older participants represents a compensatory neural mechanism caused by phase entrainment in homotopic motor cortices. This mechanism appears to be most relevant in the presence of a less optimal tuning of the inhibitory tone as observed during healthy aging to uphold the required flexibility of behavioral action.

A) Edited Magnetic resonance spectroscopy (MRS) and T1-weighted images were used to extract tissue-corrected GABA levels and additional macromolecules (GABA+) from left and right sensorimotor (S/M1) and occipital (OCC) voxels. Data were acquired using the Mescher–Garwood point resolved spectroscopy (MEGA-PRESS) sequence on a Philips Achieva 3.0 T MRI system. Sum of individual GABA voxels projected into MNI space overlaid on standard brain template. **B)** Individual edited spectra for left and right S/M1 and OCC voxels color-coded for older (blue) and young (yellow) participants. Darker lines present average spectra per group (orange—young, dark blue—older). Boxplots and distributions highlight the significant age-related decline in GABA+ concentration in both sensorimotor voxels, which is absent in the occipital control region. **C)** GABA+ concentration impacts the task-related interhemispheric synchronization of sensorimotor brain rhythms. Phase angle differences were extracted from the EEG signal projected into source space based on the centroid coordinates of the GABA voxels. Mean phase angle differences in the low beta frequency band [15-22Hz] were significantly modulated by age and GABA+ concentration. Rose plots show the histogram of binned phase angle differences (mean direction - red line, 95%CI black circumference). Phase angle differences were significantly associated with subsequent behavioral error in the young with relatively higher and in the older with relatively lower motor-cortical GABA+ concentration. In these subgroups, close to 0˚phase lag was behaviorally beneficial (lower errors), while close to 180˚phase lag was associated with higher performance errors. Analyses contain data from 44 volunteers (older group N = 22, 62–82 years of age; young group N = 22, 21 –27 years of age).