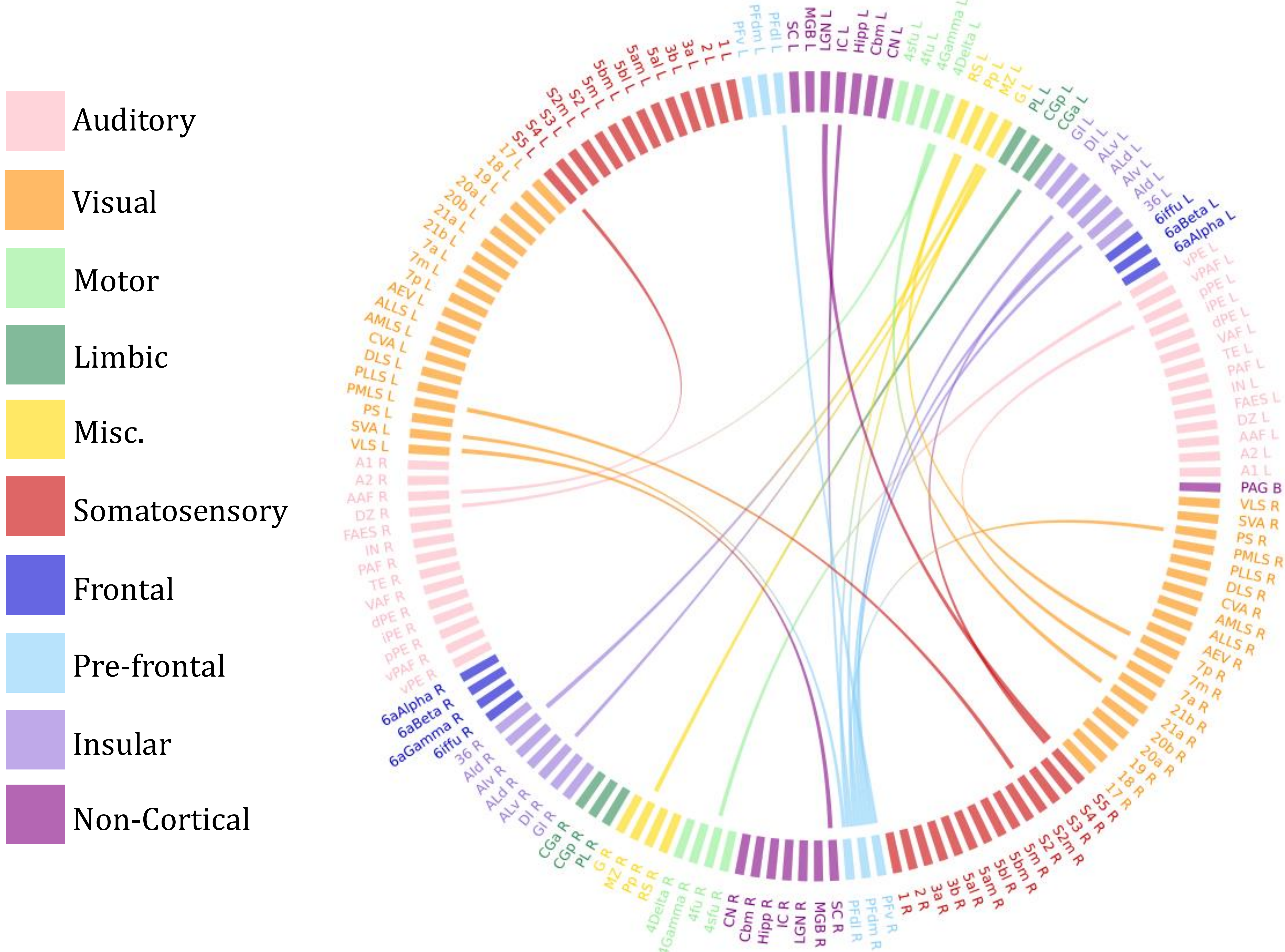


Fig1. Unique Structural Connections: Circos diagram illustrating connections that differ between hearing and deaf brains. Brain regions are grouped by functional system and color-coded accordingly. Despite the visualization of unique connections, only 0.21% of all connections are unique to either group, highlighting that large-scale structural differences are minimal.

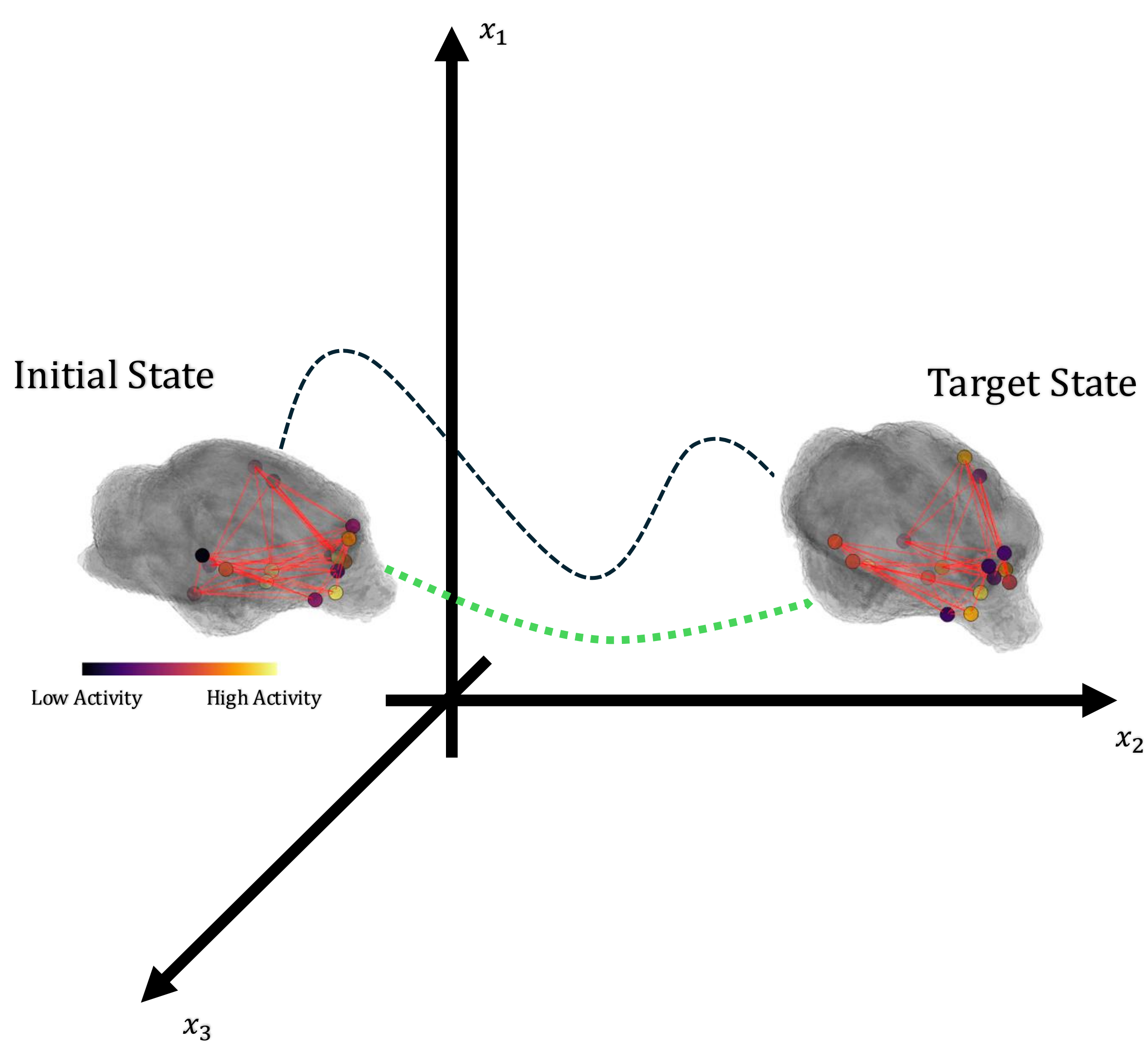
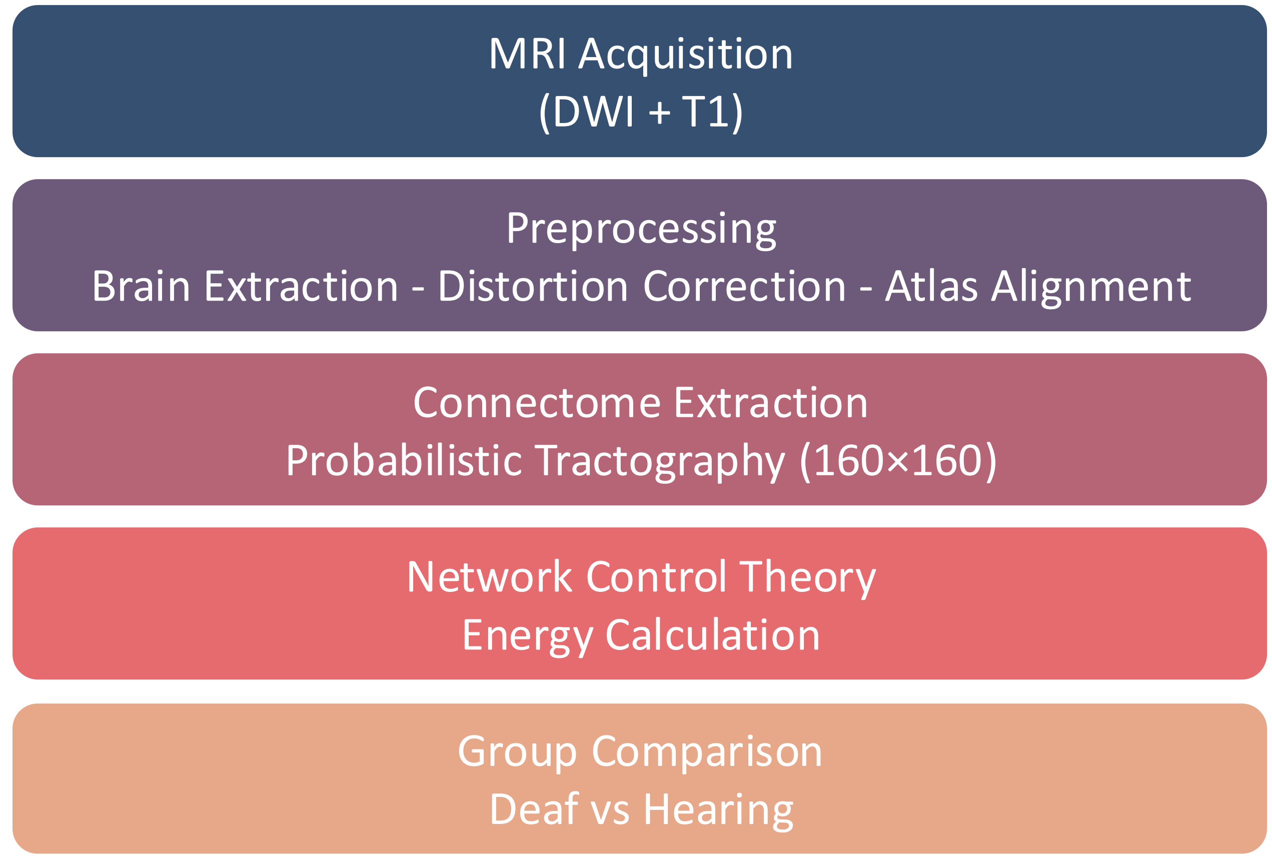


Fig2. NCT conceptualizes the brain as a network of interconnected regions (nodes), where regional activity transitions are driven by control inputs and constrained by anatomical connectivity. Brain states are represented as specific patterns of neural activity in an N-dimensional space, with each dimension corresponding to the activity of a region. State transitions are governed by the structural connectome, and control energy quantifies the cost of transitioning from one state to another [5, 6].

Fig3. Methods pipeline: 12 domestic cats (6 hearing, 6 perinatally deafened) were scanned using 7T MRI. Data included diffusion-weighted imaging (DWI) for white matter tract reconstruction and T1-weighted MP2RAGE for anatomical reference. Structural connectomes were reconstructed and analyzed with network control theory to assess differences in energy efficiency between groups.



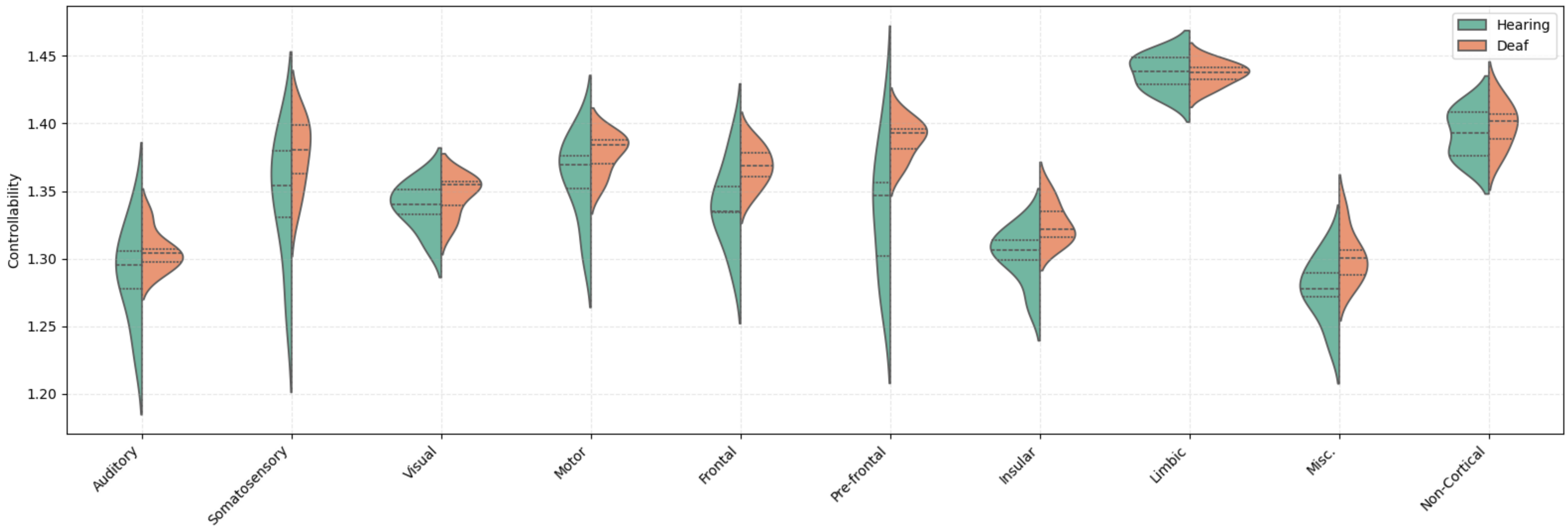


Fig4. Average controllability differences: Cortical surface maps showing regions with significant group differences in average controllability between deaf and hearing cats. Red indicates higher controllability in deaf animals, while blue indicates higher controllability in hearing animals. At the system level, auditory regions exhibited reduced controllability in deaf animals, whereas somatosensory, motor, and prefrontal regions showed increases, suggesting a redistribution of control capacity.

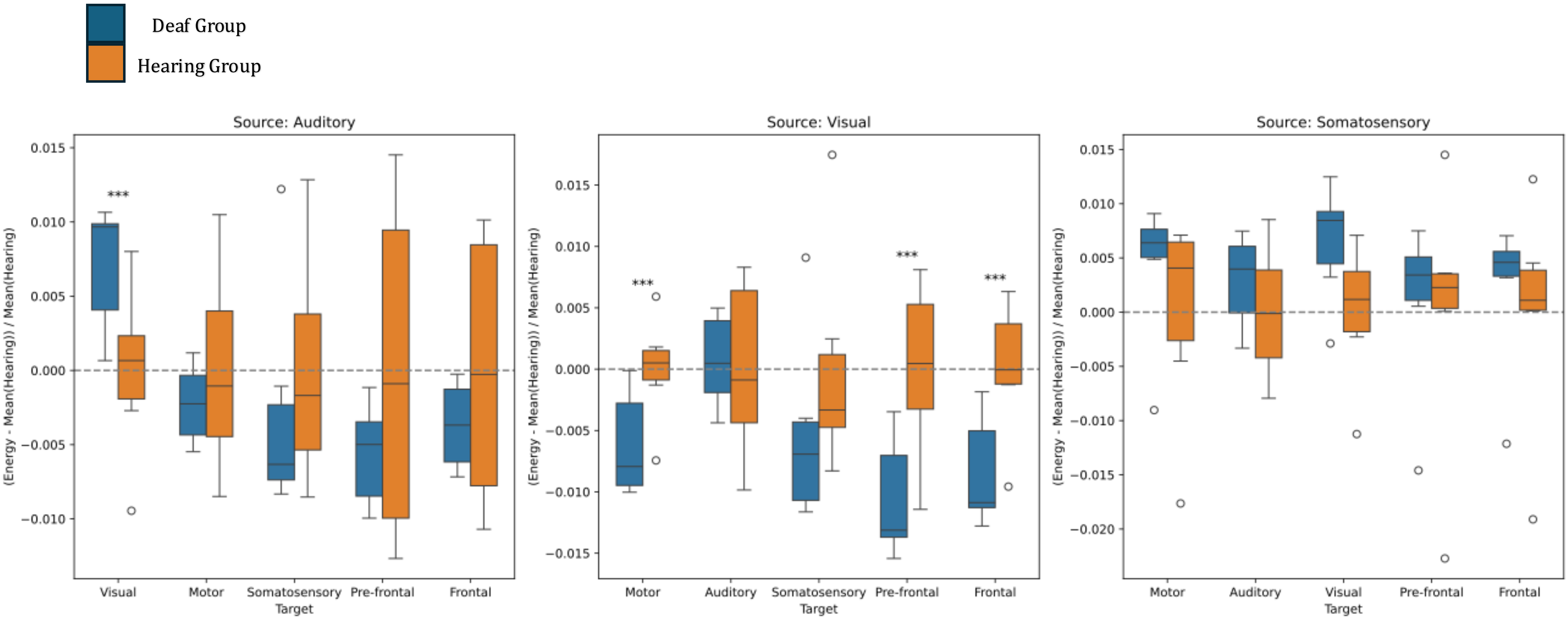


Fig5. Relative Energy Consumption in State Transitions: Although large-scale structural differences were minimal, network control theory simulations revealed subtle reconfiguration of functional dynamics in the deaf brain. Transitions from visual to prefrontal (−1.23%, $p = 0.024$) and visual to frontal regions (−0.78%, $p = 0.026$) required less energy in deaf cats, suggesting more efficient access to higher-order cognitive areas. Visual-to-motor transitions also showed reduced energy demand (−0.38%, $p = 0.112$), whereas visual-to-auditory transitions required more energy (+0.73%, $p = 0.150$). Boxplots compare relative energy consumption between groups; significant differences ($p < 0.05$) are marked with ***.

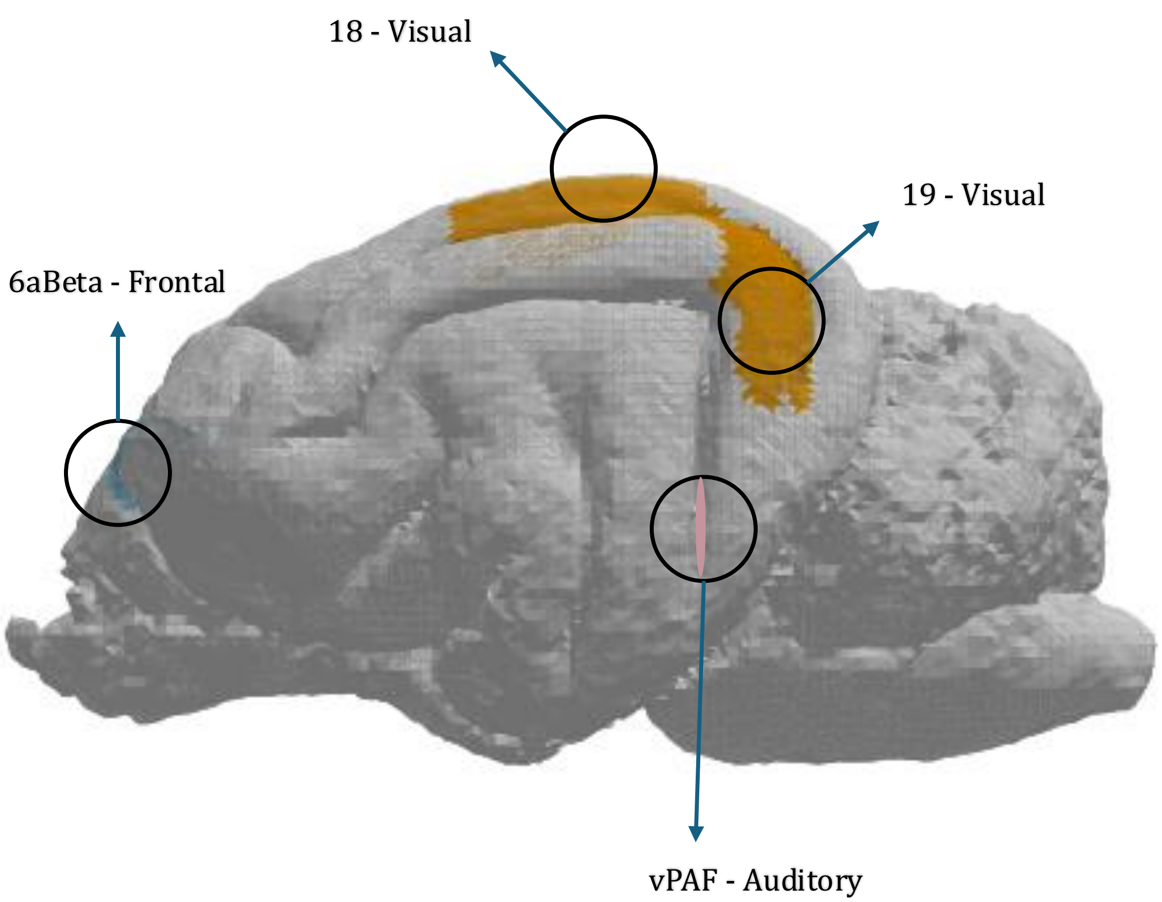


Fig6. Regional contributions to energy efficiency. Brain regions contributing most to energy reductions in state transitions. Left: visual-to-frontal transition, with contributions from areas 18 (Visual), 19 (Visual), and 6aBeta (Frontal) and vPAF (Auditory). Right: visual-to-prefrontal transition, with contributions from area DZ (Auditory) and vPAF (Auditory). (Abbreviations: vPAF = ventral Posterior Auditory Field; DZ = Dorsal Zone)