The Brainstem Modulates Sensory Transmission to Primary Somatosensory Cortex in Task-Dependent Ways

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Background: Cutaneous and muscle proprioceptive mechanoreceptors provide critical sensory information to the primary somatosensory cortex (SI) for voluntary hand function in primates. Textbooks describe the thalamus as the main relay for sensory signals from the spinal cord to SI—although the less known cuneate nucleus (CN) of the brainstem, in fact, relays information from the dorsal root ganglion to the thalamus. Given that the CN is known to modulate haptic signals in the cat, we investigated if it also modulates upper limb cutaneous and muscle proprioceptive signals in primates . **Purpose**: To test for differential and contextual modulation in the cuneate nucleus on the way to SI during voluntary wrist flexion and extension movements. **Methods**: We recorded stimulation-evoked local field potentials (SEPs) from the cuneate nucleus (8 electrodes) and the SI (32 electrodes) during stimulation of the sensory (i) deep radial nerve (DR, muscle proprioceptive) and (ii) superficial radial nerve (SR, cutaneous) in during voluntary wrist flexion and extension (Kubota et.al. (2024)). **Results**: The average SEPs have distinct shapes across subregions of CN and SI, and across tasks. During SR stimulation (cutaneous sensory information), with a larger initial negative peak in SEPs, compared to DR stimulation (muscle proprioceptive sensory information). Novel cross-correlations between CN and SI are lower for DR stimuli and tend to peak after cross-correlations for SR stimuli during both flexion and extension. **Conclusion**: Lower correlations in DR may suggest that the DR signal is weakly represented in the SI, compared with the SR signal, which is expected because of the subconscious nature of muscle proprioception.

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Reference: Kubota et al (2024) Modulation of somatosensory signal transmission in the primate cuneate nucleus during voluntary hand movement. Cell Reports 43(3).113884.