NEUROSCIENCE & PHYSIOLOGY SEMINAR SERIES

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Focal cooling modulates cortical coding via changes in electrical structure of L5 pyramidal neurons

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Focal cooling is a neuromodulatory technique that has been shown to shape neural dynamics and influence behavior. Yet, how cooling impacts cortical circuits remains poorly mapped. In this work, we present a biophysically based account of how L5 pyramidal neurons are impacted by focal cooling from a perspective of neural coding and input-output transformations. Using plasticity protocols, somato-dendritic patch clamping, targeted focal cooling, and two-photon transmitter uncaging as a way of encoding input information streams across the distal tuft and basal dendrites, we show that mild focal cooling with a ΔT of 5°C amplifies plasticity in distal but not basal dendrites in an NMDA and Kv4.2-dependent manner. Given the sensitivity of tuft dendrites to temperature, we show that mild focal cooling could be used to potently modulate top-down integration and proximo-distal coupling across the basal-distal tuft axis. Critically, our results reveal a previously overlooked effect wherein the Kv4.2 channel's sensitivity to temperature could be differentially regulated across dendritic regions to impact coding.

Pizza will be served!