Adaptive inhibitory stabilization and its signature in neural synchrony

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Healthy neuronal networks show strong resilience to external perturbations. Key to this resilience is the dynamical balance of excitation and inhibition within these networks, which is organized at multiple timescales, ranging from fast responses of balanced networks to slow homeostasis mechanisms. At an intermediate stage, short-term changes in effective connectivity can play an important role in linking fast neural dynamics to slow compensatory mechanisms. Notably, distinct subtypes of inhibitory neurons are endowed with differential short-term plasticity dynamics, raising the possibility that they might be tailored to provide inhibitory stabilization at specific stages of network dynamics. Here, we show that responses of healthy neuronal networks to repetitive visual perturbations can be governed by adaptive inhibitory stabilization. Adaptive inhibitory stabilization emerges as a result of short-term facilitation of excitatory-inhibitory recurrent interactions, particularly involving somatostatin-positive inhibitory neurons, in response to persistent stimulations. We suggest that weakening of adaptive inhibitory stabilization in older age can contribute to experimentally observed hyperactivity and a shift in the excitation-inhibition balance towards heightened excitation. Moreover, we posit that alterations in adaptive inhibitory stabilization during aging might manifest in neural synchrony. Recent reports link somatostatin-positive neurons to low-gamma/beta oscillations. By reanalysing the data with respect to age, we aim to test and validate this hypothesis. We conclude by discussing the future work to shed light on potential links between adaptive inhibitory stabilization and neural synchrony.