Asymmetric Intercortical Projections Support The Learning Of Temporal Associations

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Abstract: Neuroanatomists have identified an asymmetry in intercortical connections, with feedforward projections from the sensory periphery tending toward more focused and dense connection patterns in comparison to feedback projections, which tend to be more dispersed. Using a simple computational cognitive neuroscience model of approximately hierarchical processing in sensory cortices, we show how such asymmetric bidirectional connectivity supports the implicit learning of associations over time, with correlated stimuli separated by short delay periods. According to this model, the dynamics of recurrent connectivity in sensory hierarchies supports the persistence of representations of recently experienced stimuli, allowing those representations to become associated with stimuli consistently arriving after a short delay. These learned associations are embodied in feedback connections, with synaptic strengths modified by simple correlative (Hebbian) neural learning mechanisms. Furthermore, the presence of asymmetric forward and backward projections throughout the sensory hierarchy is shown to support implicit learning at multiple levels of featural abstraction.