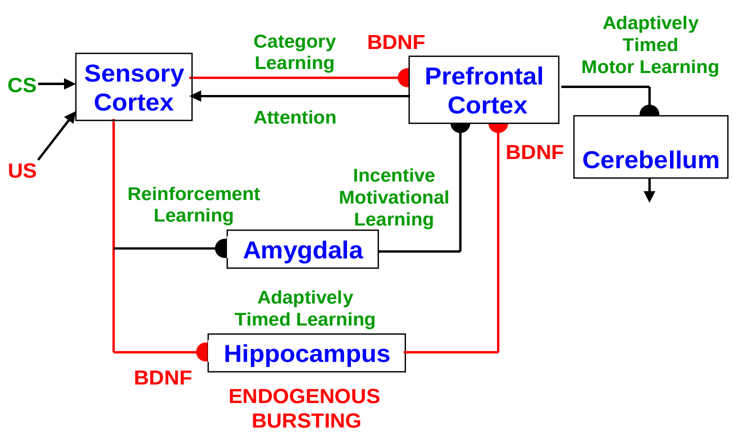
NORMAL AND ABNORMAL LEARNING AND MEMORY: HOW COGNITIVE AND EMOTIONAL LEARNING ARE JOINED TOGETHER

Understanding how the brain can learn and remember, and how this competence fails when a person becomes amnesic, are among the most important issues facing cognitive scientists, neuroscientists, and clinicians today. This competence has led to a number of proposals about how the cerebral cortex and the hippocampus interact together during learning and memory. One popular proposal suggests that experiences are first stored in the hippocampus and then transferred to a more slowly learning cortex. This proposal cannot explain how the hippocampus learns complex events, and it makes hypotheses that are not consistent with known data about the rate of cortical learning and memory. Daniel Franklin and Stephen Grossberg in CELEST Thrusts 1 and 3 (Learning in Visual Perception and Recognition, Learning in Cognitive-Emotional Interactions and Learned Sequential Behaviors) propose a way out of this impasse. This work develops a neural model of how the brain can learn and remember under a variety of temporal and ablation conditions (Fig. 1). The model clarifies how several different types of learning may work together when humans or animals try to learn about what events in the world lead to reward or punishment, and what other events are predictively irrelevant. The model illustrates these themes by simulating data about how humans and animals can learn emotional responses to sensory events. This learning, or conditioning, process exhibits paradoxical properties that other models have not yet explained. The different roles of brain regions like the hippocampus and amygdala in their interactions with cortical and thalamic systems are clarified. Data simulations include the role of the hippocampus in learning during delay and trace conditioning, and also when immediate and delayed hippocampal lesions occur. The model proposes how neural mechanisms of adaptive timing, protein synthesis in the brain (especially of a particular class of proteins called "brain derived neurotrophic factor" or BDNF), attention, and consciousness are linked under these experimental conditions. These mechanisms are important towards understanding mental disorders such as schizophrenia and autism.



The model diagram summarizes how multiple types of learning may cooperate to generate adaptively timed responses during cognitive-emotional learning.