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The Neurobiology of Perceptual Categorization: From Learning to Automaticity

There is overwhelming evidence that humans have available multiple systems for learning new categories. Evidence suggests that the different systems are ideally suited to learning about different types of category structures. In rule-based category-learning tasks the categories can be learned via some explicit reasoning process and the categorization rule is easy to describe verbally. In information-integration (II) tasks, information from two or more stimulus dimensions must be integrated and the optimal strategy is difficult or impossible to describe verbally. Evidence will be reviewed that learning in rule-based tasks is mediated by a system that depends heavily on prefrontal cortex, and that information-integration learning depends critically on the striatum. A recent theory will be described of how information-integration judgments become automatic. Briefly, this theory assumes that there are two neural pathways from the sensory association area that mediates the perception of the stimulus to the premotor region of cortex that mediates response selection. A longer and slower path projects to the pre motor area via the striatum, whereas a faster, purely cortical path projects directly to the premotor area. The theory assumes that because of its greater neural plasticity, the sub cortical path controls early learning, and that the development of automaticity is characterized by a transfer of control to the faster cortical-cortical projection. A variety of simulations will be described showing that the model accounts for some classic single-cell recording and behavioral results.