## HOW THE BRAIN STORES, LEARNS, AND PERFORMS SEQUENCES OF COGNITIVE AND MOTOR BEHAVIORS

Intelligent behavior depends upon the capacity to think about, plan, and execute sequences of events. Whether we learn to understand and speak a language, solve a mathematics problem, cook an elaborate meal, or merely dial a phone number, multiple events in a specific temporal order must somehow be kept in mind temporarily in working memory. Once events are stored temporarily in a working memory, they are then grouped, or chunked, through learning into unitized representations that encode whole sequences of events; e.g., word and action sequences. How these working memory sequences and chunked plans interact together during cognitive information processing and motor performance remains one of the most important problem confronting cognitive scientists and neuroscientists today. This project predicts how the layered circuits of prefrontal and motor cortex carry out working memory storage, sequence learning, and voluntary sequential item selection and performance. In particular, Stephen Grossberg and Lance Pearson of CELEST Thrusts 1 and 3 (Learning in Visual Perception and Recognition, and Learning in Cognitive-Emotional Interactions and Planned Sequential Behaviors) have developed a neural model called LIST PARSE (Laminar Integrated Storage of Temporal Patterns for Associative Retrieval, Sequencing and Execution) to explain and quantitatively simulate cognitive data about immediate serial recall and free recall, including bowing of the serial position performance curves, error-type distributions, limited temporal extent for accurate recall, and word and list length effects. LIST PARSE also qualitatively explains cognitive data about temporal grouping, variable presentation rates, phonemic similarity, presentation of non-words, word frequency/item familiarity and list strength, distracters and modality effects. In addition, the model quantitatively simulates neurophysiological data from the macaque prefrontal cortex while monkeys carried out sequential sensory-motor imitation and planned performance.