Measuring the quantity and quality of memory representations

Outcome: Researchers from CELEST, an NSF-funded Science of Learning Center have developed a computational toolbox for measuring the quantity and quality of memory representations. This toolbox includes a data repository, and code that can be used to analyze performance to determine the capacity of a person's memory system (in terms of both the number of items remembered, and how precisely they are remembered). These tools can be used to assess memory under a variety of conditions, including paradigms that are amenable to research with rhesus monkeys.

Impact/benefits: The toolbox was developed by graduate student Jordan Suchow, and postdocs Timothy Brady and Daryl Fougnie, under the supervision of professor George Alvarez as part of a larger collaborative project with research assistant Eve Ayeroff and professors Ennio Mingolla and Earl Miller. This collaborative research is helping scientists understand the basic mechanisms that control and determine what we remember about what we have seen, which is helpful for understanding basic memory function, and could potentially provide important insight into disorders of memory.

Explanation/background: Working memory is our ability to hold information actively in mind, and to manipulate that information for the task at hand. Individual differences in working memory capacity are correlated with many important real world outcomes, such as reading ability, academic achievement, and job performance, and thus working memory appears to be a core cognitive ability. Recently, working memory research has focused on measuring the precision of memory representations in humans, but at present there is no research on this topic in monkeys due to a lack of modeling tools. CELEST scientists have developed new paradigms and modeling tools which enable the identical estimates of memory capacity to be extracted from a wide range of paradigms, including those that can be employed in monkeys. As such, these tools provide a critical advancement that will enable research into the neural correlates of working memory precision, which would provide new insight into the nature of human cognitive capacity limitations.

Get started with the MemToolbox.

The toolbox is a collection of MATLAB functions for modeling visual working memory. In support of its goal to provide a full suite of data analysis tools, the toolbox includes implementations of popular models of visual working memory, real and simulated data sets, Bayesian and maximum likelihood estimation procedures for fitting models to data, visualizations of data and fit, validation routines, model comparison metrics, and experiment scripts. The MemToolbox is released under a permissive BSD license.

http://visionlab.github.com/MemToolbox/