NIH-Conte Center Report Summary - 2005

In the enclosed progress reports we describe the progress so far – 20 months after the beginning of the project. We are somewhat underspent in our contract but we expect to catch up with our planned expenses in the second half of the project.

MIT continues to function as home site for the overall effort. Our Conte Center Web site at http://cbcl.mit.edu/cbcl/projects/nih-conte/index.html provides links to publications (see (http://cbcl.mit.edu/cbcl/projects/nih-conte/publications.htm) originating from our project, contains information about workshops (see http://cbcl.mit.edu/cbcl/projects/nih-conte/events.htm) organized by the Conte Center, and reports on our research, as well as information on the researchers involved in our effort (see http://cbcl.mit.edu/cbcl/projects/nihconte/investigators.htm). Feedback from NIH to improve the site and its usefulness to NIH would be highly appreciated!

1. Significance

The top-level goal of our project is to demonstrate the usefulness of computational models that are neurally plausible in providing powerful new insights into key problem of how the cortex works, how learning and intelligence arise from the dynamic interactions within and among its neural circuits and how this is expressed at the behavioral level. At the same time we aim to show that computational models can be a powerful tool in integrating basic research across different levels of analysis from synaptic to cellular to systems to complex behavior. Our specific problem – how the ventral stream in visual cortex underlies object recognition -- is a perfect candidate for demonstrating the power of basic integrative research and to train a new generation of interdisciplinary researchers who span computational, physical, biological and behavioral science. Our project does not directly focus on mental diseases but represent basic research and training that will strengthen the scientific foundations of work on topics central to the public health mission of NIMH. In particular, understanding the structure and functioning of brain circuits underlying normal behavior is clearly critical for shedding light on underlying causes of behavioral abnormalities found in neural disorders and individual differences. In addition, we are beginning to work on visual perception deficits in diseases such as autism and dyslexia; in particular, in a preliminary study independently funded and conducted in a Boston public school, we are attempting to show that daily hand-eye coordination activities can reduce significantly the number of students at-risk for dyslexia.
In our work we are emphasizing the marriage between computation and experiments. In fact, the distinguishing feature of our project is the strong coupling between computational and experimental work on visual recognition. In terms of experimental techniques we have added brain imaging (fMRI) to intracellular and extracellular physiology and visual psychophysics. We have made progress towards our goal of showing that quantitative models of complex neural system, when developed in close cooperation with experimental labs, can be tools to a) think about the problems (some cognitive problems are too complex for the qualitative, simple models used so far); b) make predictions, suggest and plan new experiments; c) analyze and interpret data; d) integrate experimental findings of different types and from different labs, drawing implications for future experiments from multiple sources of evidence.

2. Plans

We plan to hold a meeting of the Conte Center on August 29th and 30th, at the American Academy of Arts and Sciences (August 29) and at MIT (August 30). The outside Board which reviewed our activities at our 2004 meeting will meet again to evaluate our progress during the second year of the Conte Center. The advisory committee is composed of Drs. E. Connors (Johns Hopkins), L. Abbott (Brandeis and Columbia) and M. Livingstone (Harvard Medical). A preliminary agenda is available at our Web site under the URL http://www.ai.mit.edu/projects/cbcl/projects/nih-conte/Meeting_Agenda_2004.pdf. In addition to the 30 or so researchers from the four Institutions directly involved in the project, other researchers from Israel,

Germany and the US who are collaborating with us will participate and give brief talks (on the second day).

This will be the fourth meeting of our group since we started putting the proposal together, and the second official one as a Conte Center and with an external advisory committee. The main function of the meeting will be to further communication and interactions among our groups from MIT, CalTech, Northwestern and Georgetown.