TDLC Small grant proposal for collaborative research between:

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When searching for a familiar object in a scene, human and non-human primate subjects use their prior experience with that object to guide their search. For example, when searching for a coffee cup, look on tabletops, not on the ceiling or walls. Such knowledge about where to find different types of information is learned through experience, both implicitly and explicitly, throughout life. We designed an eye movement search task where subjects learn to find an invisible rewarded target whose location varies, in a predictable manner, from trial-to-trial (Chukoskie, Schwartz, Sejnowski and Krauzlis, SFN 2005; manuscript submitted). We have found that typical subjects use reward information as a top-down modifier of image salience to choose the most appropriate places to look on subsequent trials (Chukoskie, Schwartz, Albright, Sejnowski, SFN 2007; manuscript in preparation). These behavioral results have launched side-projects in which we study people with Parkinson's disease, and people with autism.

In our plans to relate this search behavior to underlying neuronal correlates, we recognized the advantage of rodent species for awake, behaving neurophysiological studies and the potential of future developmental and genetic manipulations. Studies of spike-timing dependent plasticity offer a biophysical correlate of learning in the rat, but we must build bridges across species to make use of this understanding in human learning. To achieve this end, we plan to develop a behavioral experiment appropriate for the rat, which is analogous to our natural search task in humans and monkeys.

Instead of eye movement search, however, a rat would be foraging in a 177 well arena (controlled for odor: Kirwan, Gilbert, Kesner, 2005). On a given trial, one well would be baited with a food pellet and the rat would have time to search for and harvest the reward. A tone cue would indicate that the trial time had elapsed and that the rat should return to the primary position to initiate the next trial. The baited well would vary trial-to-trial in a manner set by a Gaussian probability distribution chosen by the experimenter. The mean spatial location and the spread of the distribution would change on every session. Video monitoring hardware and software would evaluate and store the position of the rat in the arena. We will evaluate how well a rat can learn to match his foraging area to the reward distribution given in the experiment. If successful, many experimental variants can be tested, such how the rat handles a change in the location of the reward distribution within a single session (explore-exploit). We also hope to use the rat model for recording to assess the contribution that frontostriatal networks make in learning the reward distribution. In addition to recording single units in these regions, local field potentials, and EEG will be recorded, in order to obtain measurements that are more comparable to those available in human subjects. This would represent the first attempt to reverse engineer human electrophysiological phenomena that occur during probabilistic learning in a rodent model.

The Chiba lab has extensive expertise in the realms we seek: rodent behavioral design, data analysis and also electrophysiology. Dr. Chiba has pioneered a successful sequence learning task, in which rats learn to follow and then anticipate lights appearing in a sequence, as well as a visuospatial learning task in which rats' performance reflects the prior probabilities of a Hidden Markov Model (Cordova, Yu, Dayan, and Chiba, manuscript in preparation).

This proposal links investigators in the Sensorimotor and Interacting Memory Systems networks and fits best in Initiative 4, strand 1 (**STRAND 4.1. Are there general principles about the temporal dynamics of learning that can be unified into a coherent theoretical framework?),** and also initiative 3 as rats will engage in active exploration to learn where to find rewards. This project also represents an augmentation of *Project 3.1.4 What is the influence of statistical learning on eye movements in human and nonhuman primates?* Network:SMN. PIs: Terry Sejnowski, Leanne Chukoskie (Sejnowski postdoc)**.** In this instance the rat homologue of a saccade (head direction) can be explicitly examined.

Budget: Most of the resources for this experiment already exist in the Chiba lab. The $1000 would provide seed funding to pilot the behavior for the full-fledged electrophysiology project.