CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

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Project Number

S1210

Project Title

Role of the Basal Forebrain in Mediating Selective Attention

Abstract

Objectives/Goals

The objective of this project was to determine the role of neurons in the basal forebrain in a learning-dependent behavioral task and the influence of spatial probability distributions on basal forebrain neuronal firing rates.

Methods/Materials

Rats were placed in a circular arena with 36 manually operated LED lights on the perimeter, and rewarded based on successful identification of flashed lights. Neuronal firing data was acquired from two electrodes inserted in the basal forebrain. I analyzed all data in MATLAB by writing code to compare neuronal and performance data. I determined the significance of firing rate modulations at various stages of the task using randomized t-tests between successful and failed trials.

Results

The performance of all rodents closely followed the spatial distribution of stimulus probability. Of the 718 neurons recorded in the substantia innominata and ventral pallidum, 655 could be separated into 6 distinct categories based on firing rate patterns across task phase. 331 of these 655 neurons fell into the task phase associated with attention and memory. Differential firing patterns were observed between successful and failure trials even prior to choice of light and knowledge of outcome via receipt or absence of reward. Approximately 3% of neurons were significantly different in successful and failed trials at take-off, 15% immediately prior to reward, and 44% after the reward phase.

Conclusions/Discussion

Preliminary results suggest that rodents adapt their attention to variable distributions of stimuli, and that many neurons in the basal forebrain have differential event-based firing patterns consistent with a role in intelligent adaptation of attention across task stages. This research also reveals that outcome-specific firing patterns evolve over time and largely depend on spatial distribution of stimuli. Applications of studying this subset of basal forebrain neurons include understanding Alzheimer's and other neurodegenerative diseases and creating effective, targeted treatments for memory and learning-related disorders.

Summary Statement

My project analyzes the role of the basal forebrain in controlling different aspects of selective attention and the influence of various spatial probability distributions on attentional behavior and neuron firing rates in rats.

Help Received

Undergraduate and graduate students at UCSD Dept of Cognitive Science, Nitz Lab helped with data collection; used software at UCSD under the supervision of Professor Douglas A. Nitz