- What is the problem/topic of research?
- What had been done previously and how does the current work approach it differently?
- What are the major new findings?
- What are the broader implications for neuroscience?
- What are possible future directions of research?

Thursday 5/12 “Seeing and Deciding: Neural Mechanisms of Perceptual Choice” William T. Newsome

This lecture is a summary of the speaker’s research on the neuro-mechanism of decision making. The speaker and his team started research on monkey area MT and decision making back in the 80s, they summarized important point from their past research, including biasing the choice of the monkey with electrical stimulation of certain direction selective column of area MT, and how activity in area LIP resemble what we suppose a decision variable will be. He will get to new data of single trial dynamics in Friday’s lecture which I’m not sure if I will have chance to attend.

During the lecture however, what become evident is how little we know about the detail of this decision making process, despite average trial data be well explained by various mathematical models. As questions from audience pointed out, monkey has been heavily trained, and the LIP activity only act as decision variable when monkey is concentrated on the task. Besides, there’s unanswered questions like what exactly is this area integrating as evidence, weighted activity from a population or, according to a recent model, summing from a group of neuron each making binary choice.

One lesson we can learn from this talk is that mathematical model is helpful for the understanding of a neuronal process, but fitting the (averaged) data is almost the first step into understanding a certain process. Understanding of the underlying circuit, detailed computation implementation and single trial data is always the most challenging, and what we need to work the hardest for.

Talk 2: online, TDLC archive

Howard Eichenbaum: The Hippocampus: Memory in Time

This talk aim to answer the question that how is episodic memory is achieved in brains. The primary focus is hippocampus. Previously people found that hippocampus contain cells that respond to certain location when animal is exploring the environment. However, an odor ordering test paradigm indicates that hippocampus is also important for remembering the relative timing of events. To investigate this, the speaker used a variation of the classic maze running experiment by adding a tread mill in one path in the maze. This decouple time and space in this task. The result is that they see cells responding to the duration the mouse stays on the tread mill. There’s additional problem that those cells may be coding the distance the rat have traveled on the tread mill, so the speaker imploded a tread mill with random speed. Analysis of results indicates that there are indeed cells that strictly code for time in hippocampus, but most cell actually code for a mixture of time and space information. Olfactory task confirmed that time coding cells are indeed coding for time. Question remaining are where does the information about time come from, since no sensory organ sense time, it must be a result of high order processing, or an internal clock in the animal. The study also find that some traditionally will be called grid cells also code
for time during modified maze task, so those cells are not as simple as previously believed. This remind us that a type of cell responds to a certain stimuli doesn’t mean that’s the only response that cell is capable of giving.

Talk 3, 5/13 Changes of Mind: Detecting Covert Mental States in Neural Population Activity

William T. Newsome

This is the third of the series “Eye, brain and decision”. In previous research they believed that they found what correspond to decision variable in monkey brain. Recently they aim to record from population of neuron and predict the action of monkey on single trial. Since LIP is deep inside the brain and hard to make population recording, they made an arm reaching version of the random dot discrimination task and record from pre-motor and motor cortex of monkey. They used two 10*10 electrode array, similar to what we see in barrel cortex paper, do spike sorting to separate different cells, this result in about 200 channels, each give response of a cell in cortex. They count spikes for all the cell in a time bin of 50ms before the time the monkey makes a decision, and trained a regression classifier to predict the action of the monkey based on the population activity. This classifier gives a confidence value, which they call “decision variable”, which is very informative of the monkey’s decision. The same classifier is useful for a long period of time on a certain monkey. The classifier is then applied to the population activity over the entire trial (time bin 50ms) to reflect the monkey’s decision over time. Its indicative of monkey’s decision because if you let the monkey to choose a when decision variable reach a bond, you have a high probability to predicting the monkey’s decision if this bound is high. Then they investigated the so called “change of mind” in monkey: if decision variable change sign (sign indicate tendency of decision) they stop the trial and let monkey choose, decision variable is equally informative of monkey’s choice. This study is pioneering in the sense that it uses single trial data and tried to decode the covert mind state of the monkey, but it still left the question of whether what they are seeing is motor planning or decision process. The speaker’s opinion on this issue is that decision making is at least in this task non-separable with motor planning, and it’s very unlikely that another brain area make the decision and keep pre-motor and motor cortex informed of its current decision.