Exercise 4.2: Understanding Neuroscience Papers - Part 2

Upload your answers in PDF format to the moodle by 11.11.2020 (noon)
and provide your name, student ID and email address in the header.

The goal of this assignment is to get a better understanding about the main methods and results in neuroscience. By reading/discussing the papers you will get a feeling for the complexity of the brain, and develop ideas about how we can work towards better understanding it.

1. Form groups of 2-4 people (make sure that each paper is read by at least 1 person in the group). Discuss the main ideas/findings from both papers using your summaries as a guideline.
2. Discuss the following questions within your group. Formulate and submit your answers individually (100 words per answer).
3. Use font size 12 and a line spacing of 1.5. Submit your answers to these questions to the Moodle by 11.11.2020 (noon).

In the paper by Cichon et al:

1. How do branch-specific calcium spikes relate to motor learning?
2. What methodology was used to image dendritic calcium spikes, and what are possible reasons for choosing this approach?
3. What role play NMDA receptors in the observed calcium spikes, and what evidence is provided?
4. Name one manipulation type of cortical inhibition from the paper and explain the resulting consequences?

In each of the following exercises (for the paper by Lak et al) choose the plot option (A, B, C, or D) that best approximates the expected results for the paradigm proposed according to the findings of the paper and related cited work. Each plot presents two traces, one for each condition, of the firing rate of dopaminergic neurons during a trial computed as in the paper (PSTHs Peristimuli histograms from dopaminergic neurons). Explain your choice in each case

1. A cue with 100% probability of reward is presented, followed by a reward delivery.Neural traces are recorded in early phase of training (blue) and late phase of training(red).
2. After learning the association of the cue presented in the first paradigm with the reward, other cue with 30% probability of reward is used in trials interleaved with the previous cue. After many trials of the two types, the neural traces are recorded and averaged for a trial with NO reward delivered: blue for the low probability cue and red for high probability cue.(In the plot "Reward" refers to the time the reward should be delivered, but in this trial there is no reward)
3. In the third paradigm, trials with a 30% (reward probability) novel cue are interleaved with trials with a 30% (reward probability) familiar cue. Neural traces for novel cue trials are in blue, and familiar cue trials in red.
4. The last paradigm introduces two cues within a trial. A second cue is followed in 100% of the trials by the first (previous) one, with the same time structure. Neural traces are recorded in early phase of training (blue) and late phase of training(red) of this new trial structure.

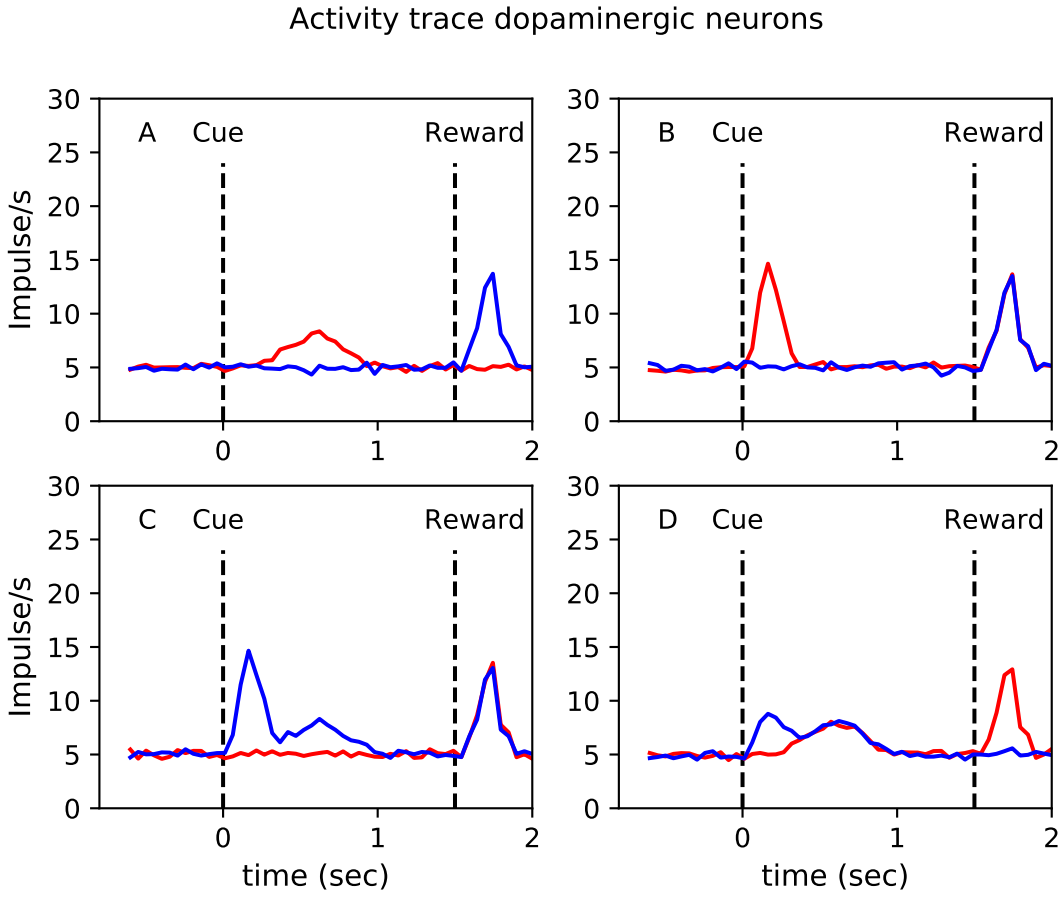

Figure 1: Exercise 1: Blue: average activity in early training trials. Red:average activity in late training trials.

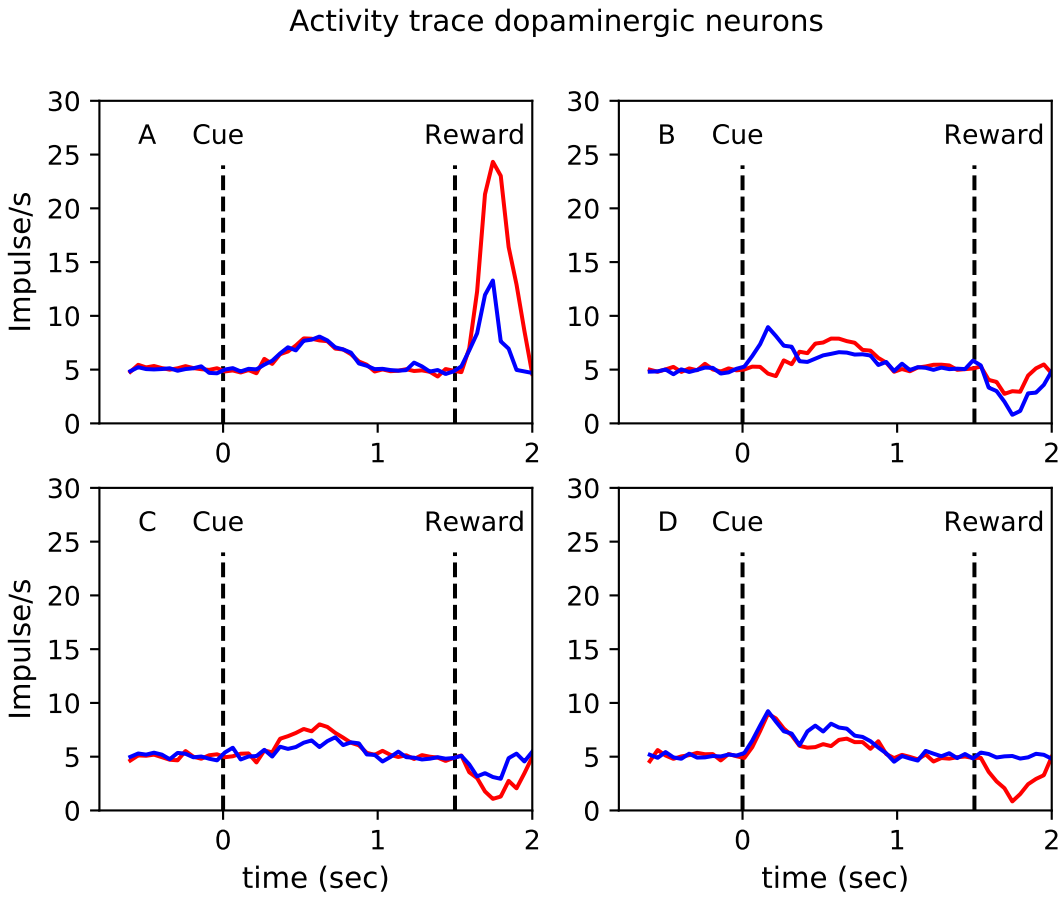

Figure 2: Exercise 2: Blue: average activity for trials with low probability cue. Red: average activity for trials with high probability cue.

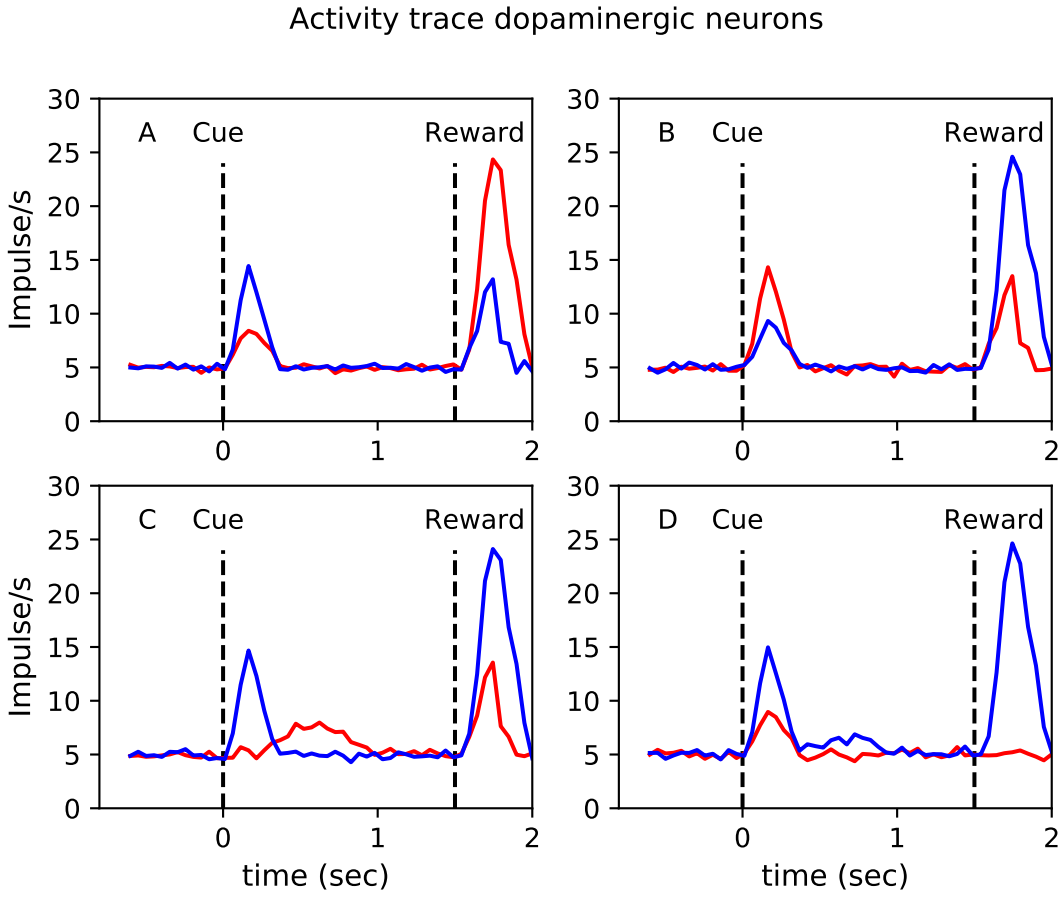

Figure 3: Exercise 3: Blue: average activity for trials with novel cue. Red: average activity for trials with familiar cue.

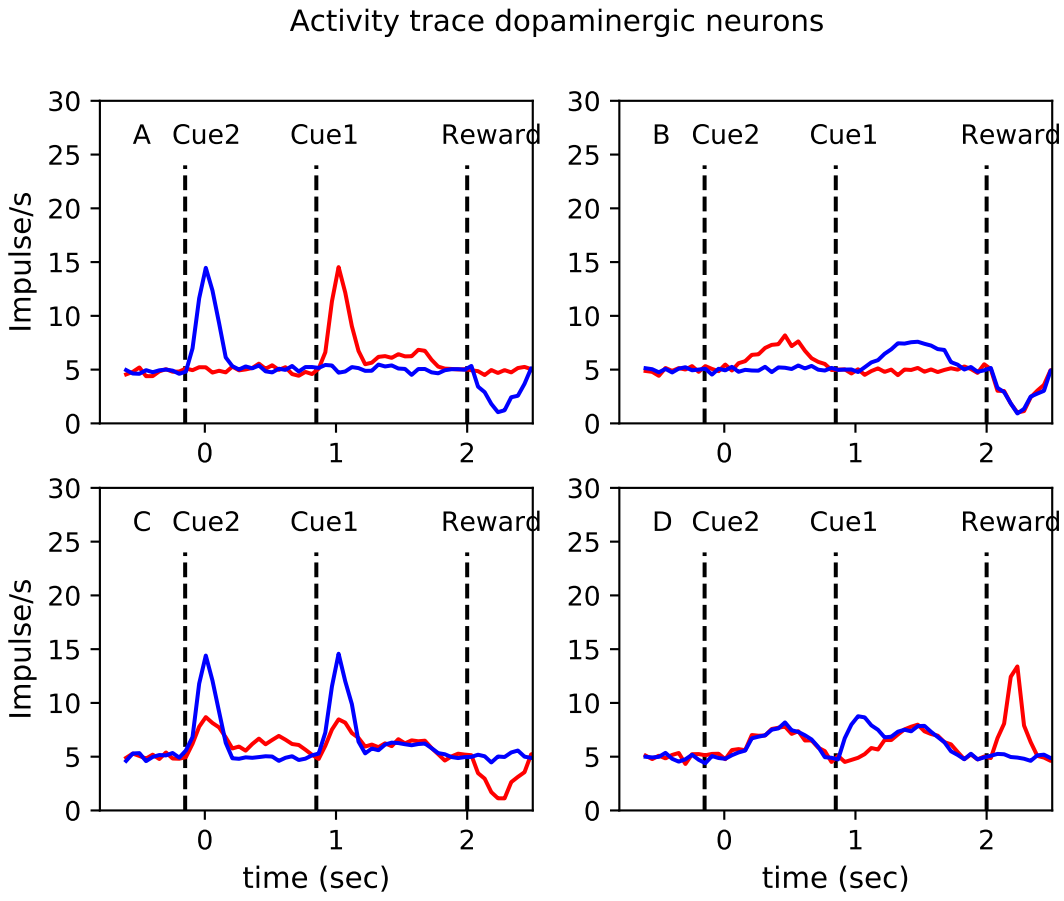

Figure 4: Exercise 4: Exercise 1: Blue: average activity in early training trials. Red:average activity in late training trials.