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Introduction

• During the resting period immediately after a learning task, subpopulation of neurons in hippocampus, neocortex and striatum replay their patterns of activity, a phenomenon called reactivation.

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• Reactivation occurs primarily during a quiet awake state and during slow wave sleep. It has been proposed as a physiological substrate for the process of memory consolidation.

 Most experimental paradigms used to evaluate reactivation involve the delivery of positive (rewarding) or negative (punishing) stimuli. The replay of task-dependent information also involves the replay of reward information in nucleus accumbens (Lansik et. al. 2008).

• We hypothesized that the VTA contains neurons that respond differentially to different types of stimuli. We also hypothesize that subpopulations of VTA neurons will reactivate depending on the type of task they were involved in.

2. Methods

Bregma: -6mm

Subjects: Five adult male Brown Norway/Fischer 344 hybrid rats (350-400g) were used. Animals were stereotaxically implanted with a hyperdrive consisting of 12 independently movable tetrodes. Two additional electrodes were implanted in the contra-lateral dorsal hippocampus to obtain an EEG signal. Another two electrodes were implanted in the neck muscle to obtain an EMG signal.

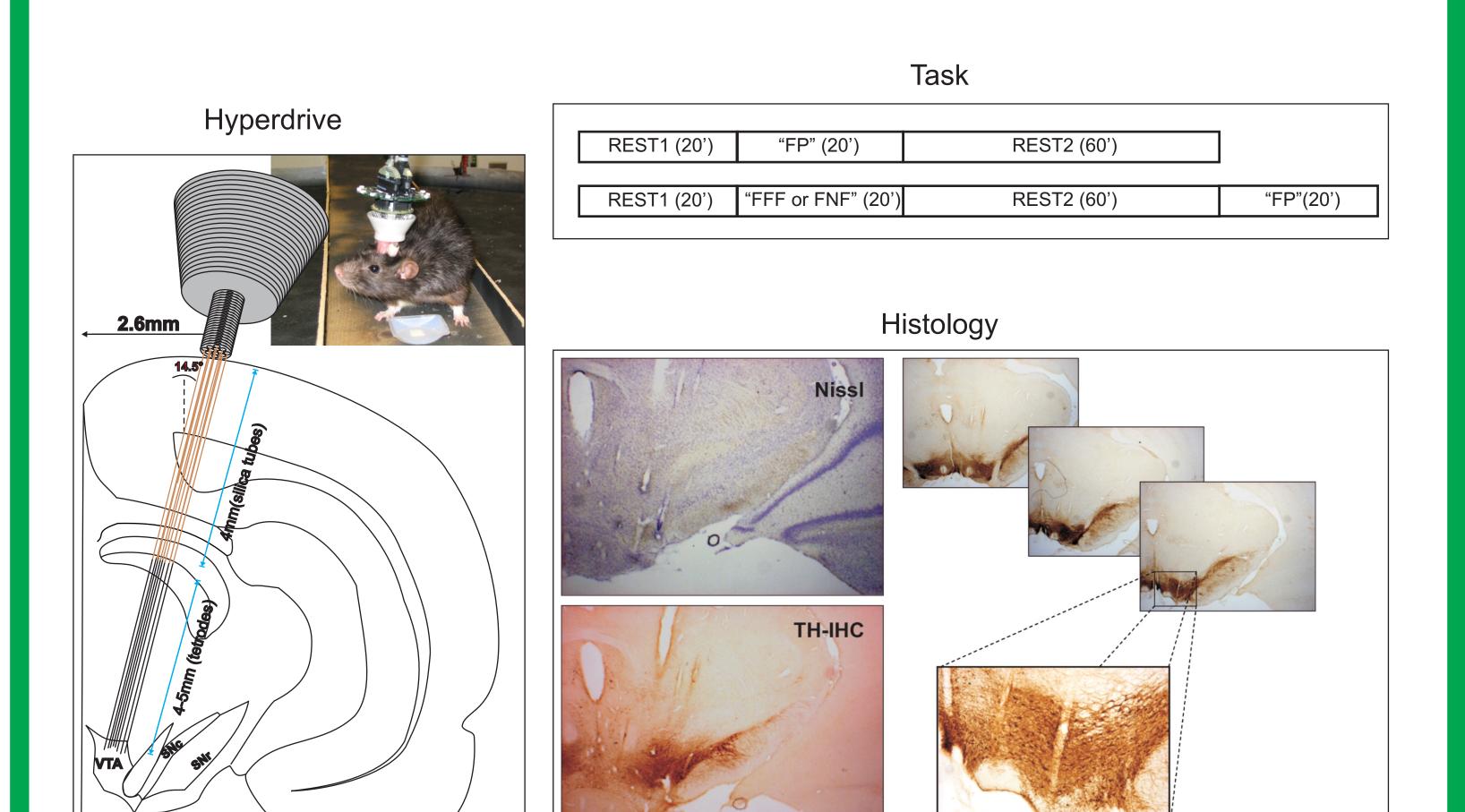
Task and apparatus: Rats ran 3 tasks:

- FP: Rats were kept in a holding pot and ate different kinds of rewards,(20mg regular food, sugar or quinine pellets), randomly delivered with a pair of tweezers.

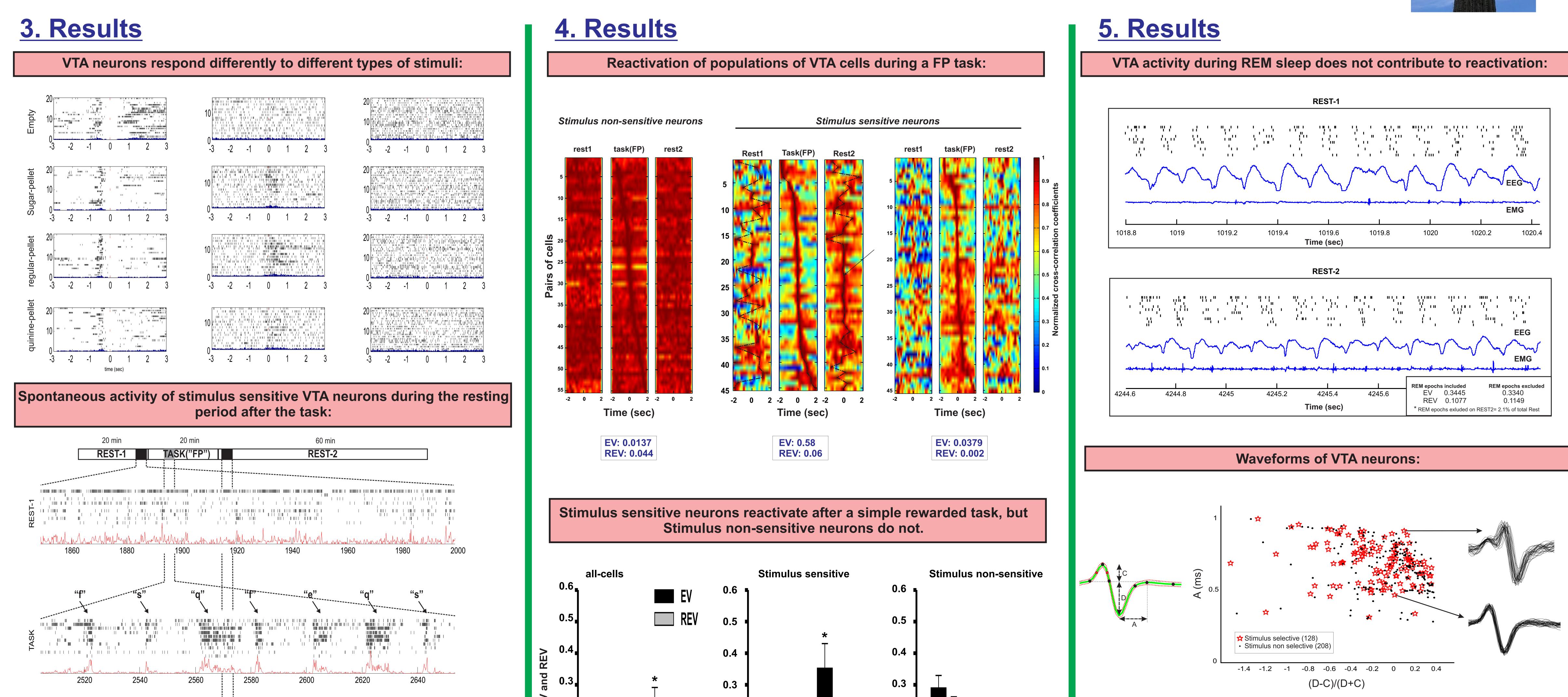
- FFF: Animals were trained to forage for the same rewards dispersed on a 5 feet circular open field arena.
- FNF: Animals were required to forage on the arena but no reward was present.

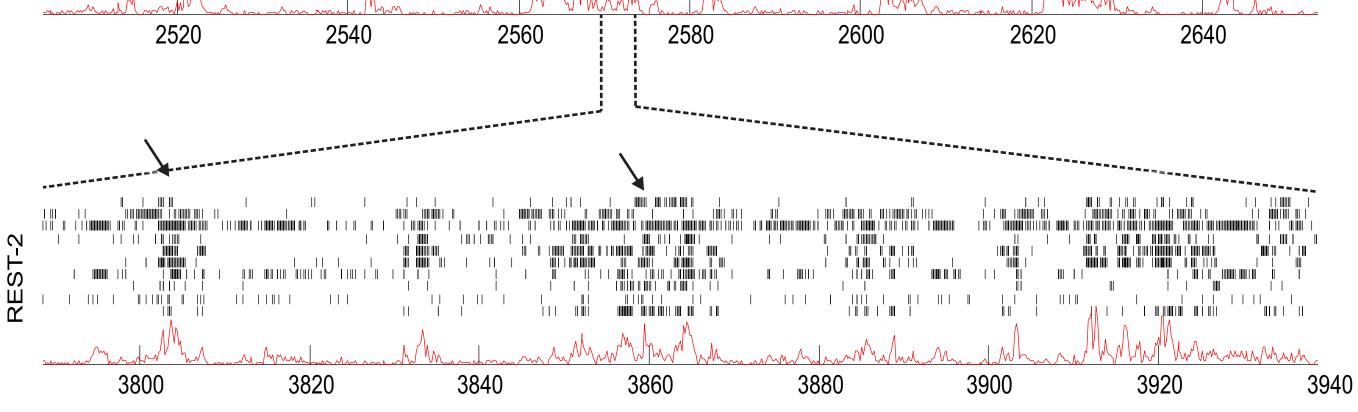
Histology: After the recording was completed an electrolytic lesion was made by passing current (5µA for 10 seconds) on every electrode. The position of the tip of each tetrode was determined by Nissl staining and immunohistochemestry for Tyrosine-Hydroxylase.

Data Analyses: Spikes were cut with Mclust (Redish D.) Reactivation was measured with the explained variance method (Kudrimoti et al, 1999).



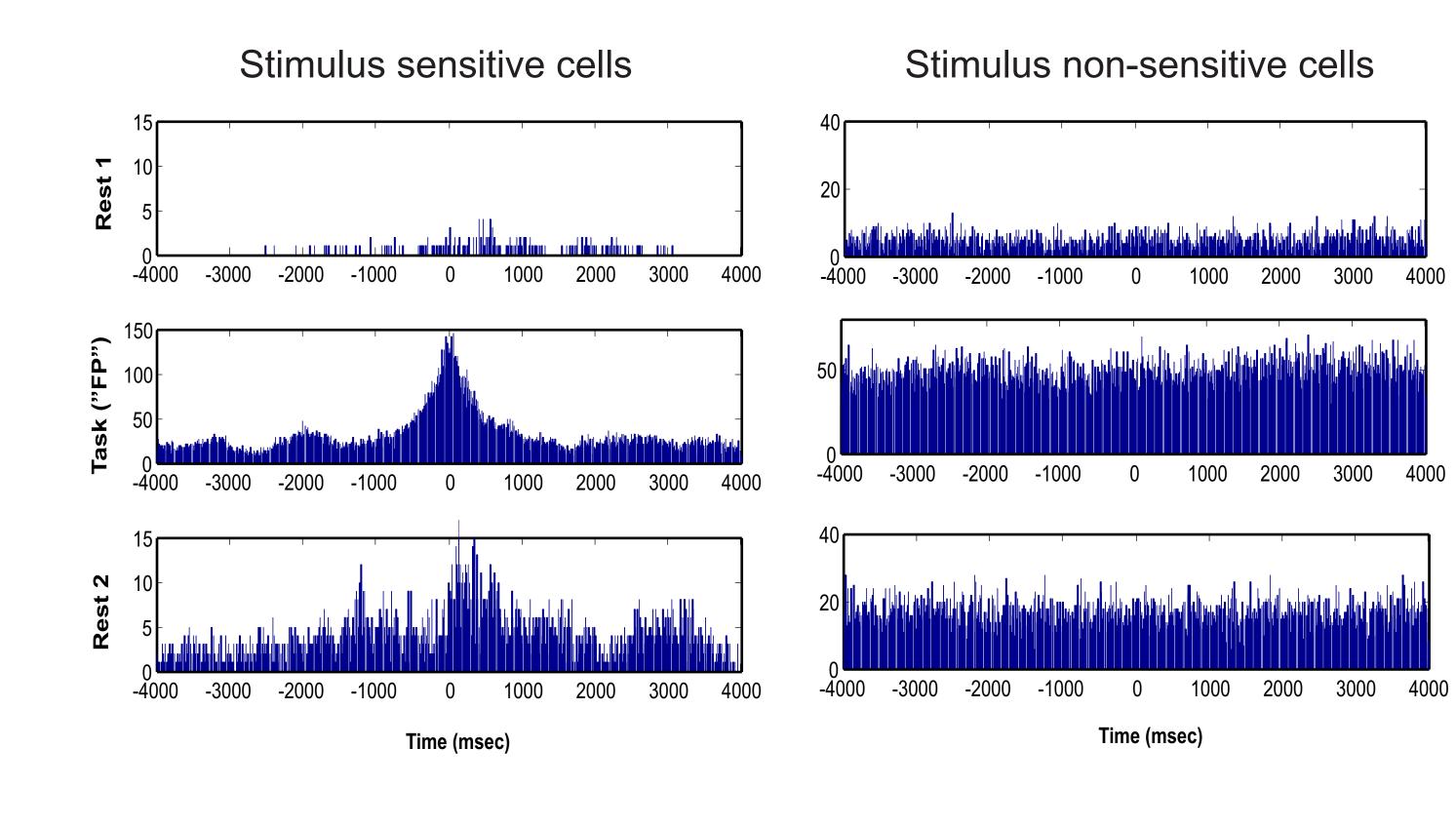
Experience dependent reactivations of ventral tegmental area neurons in the rat José L. Valdés¹, Bruce L. McNaughton² and Jean-Marc Fellous^{1,3}

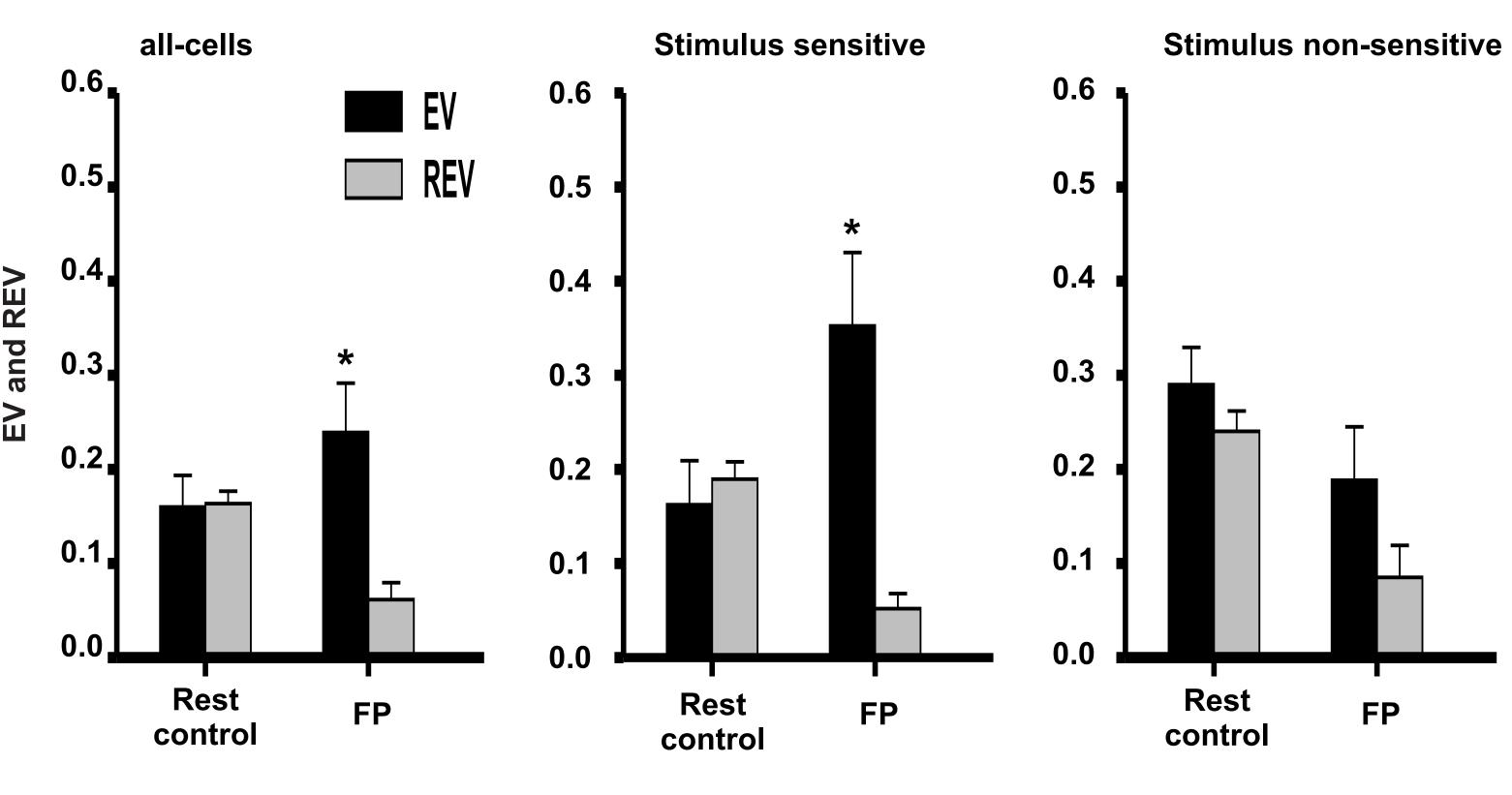




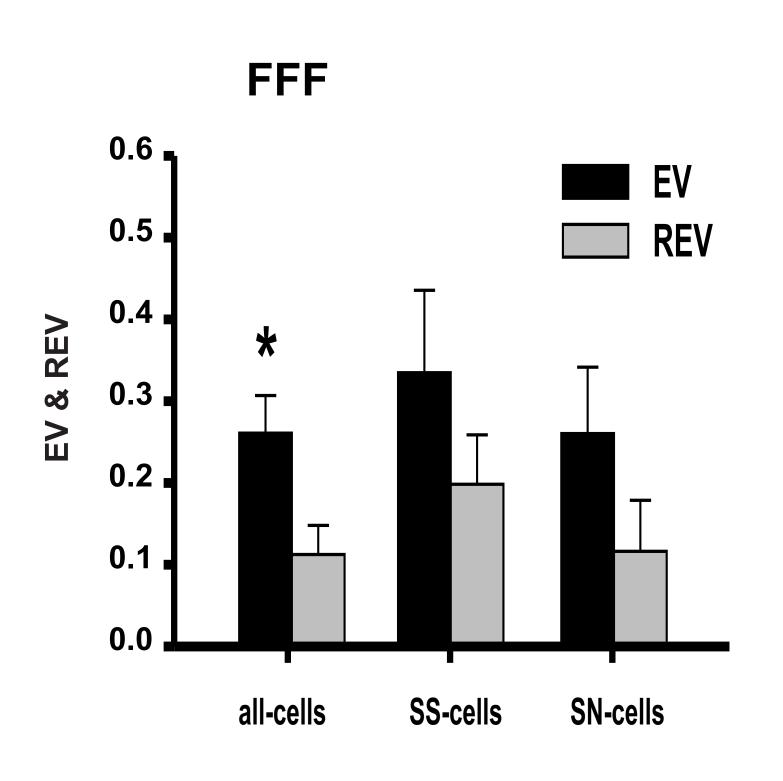
Time (sec)

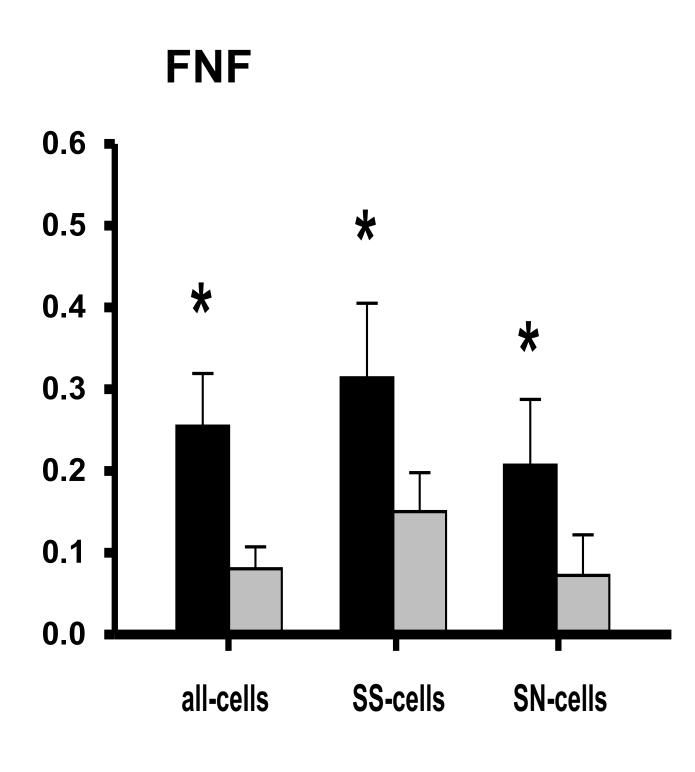
Cross-correlations between stimulus sensitive neurons during the task are also found during the resting period after the task:

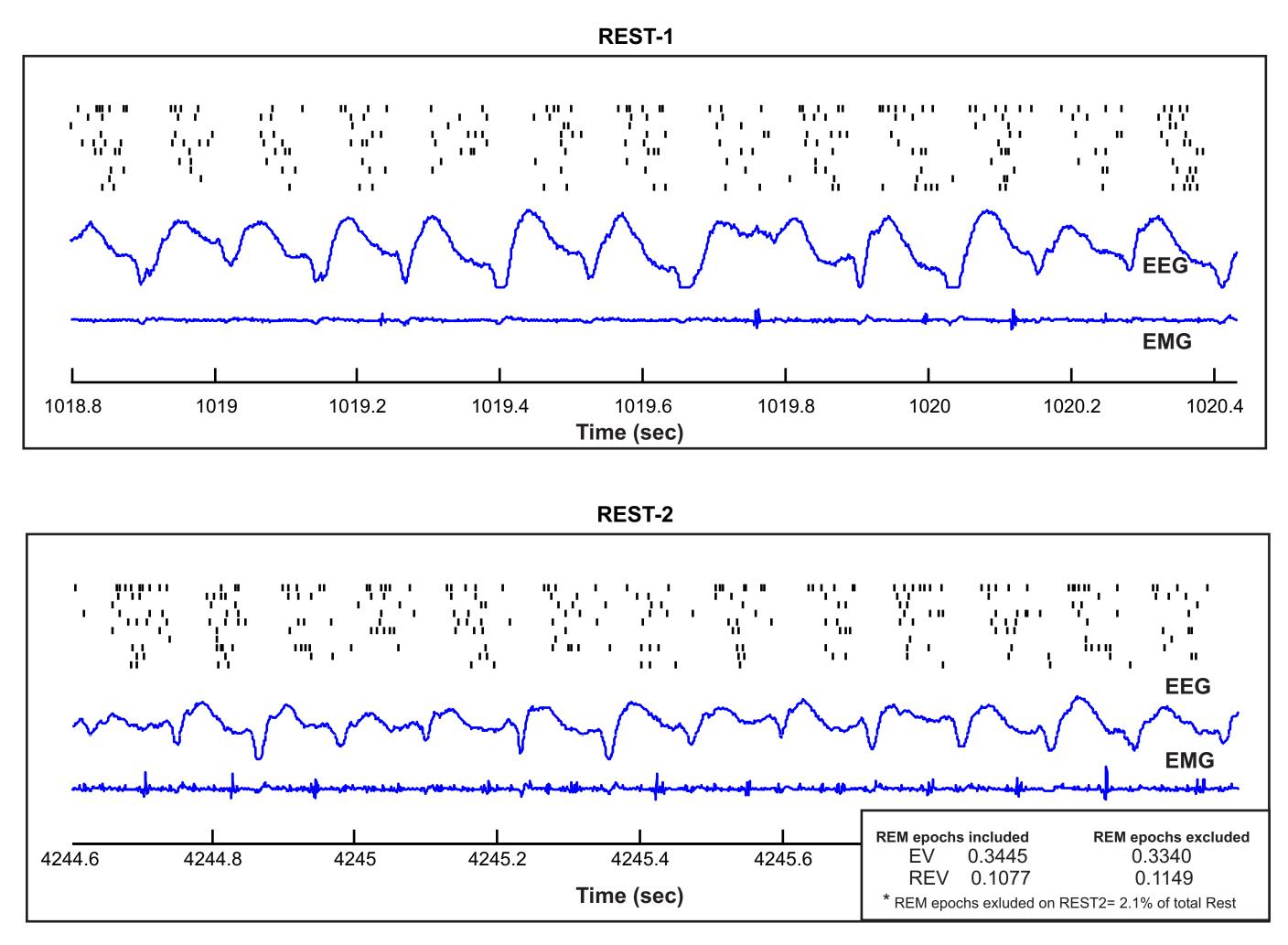




Stimulus non-sensitive neurons reactivate after foraging tasks:







6. Conclusions

• We found 2 different VTA neural populations separable on the basis of their responses to food stimuli.

• The 2 neural populations reactivate during sleep. In a stimulus-driven non-spatial task, stimulus non-sensitive cells do not reactivate significantly but reactivate during foraging where motor activity is involved. Stimulus sensitive cells reactivate if the task involves preferred food stimuli or expectation of stimuli.

 VTA neurons may be phase locked to slow oscillations during REM-sleep. This synchronous activity does not contribute significantly to the EV or REV measures of reactivation.

• We did not find any significant correlation between the waveform of VTA neurons and their selectivity to stimuli.

7. References

Kudrimoti HS, Barnes CA, McNaughton BL (1999). J. Neurosci. 19:4090-101 Lansink CS, Goltstein PM, Lankelma JV, Joosten RN, McNaughton BL, Pennartz CM (2008). J. Neurosci. 28:6372-6382 Roesch MR, Calu DJ, Schoenbaum G (2007). Nat Neurosci. 10(12):1615-24 Mclust, David Redish, University of Minesota, Minneapolis, MN

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