NEURONAL RESPONSES IN THE ANTERIOR OLFACTORY NUCLEUS DURING A COMPLEX ODOR MEMORY TASK.

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Introduction

The anterior olfactory nucleus (AON) is thought to be important for olfactory memory (e.g. Aqrabawi & Kim, 2018, Nat Comm; Levinson et al, 2020, Behav Neurosci), but no studies have examined neurophysiological responses of AON neurons in awake behaving subjects performing complex olfactory memory tasks. Here, we trained rats to dig for a buried treat in cups of odorized digging medium and we recorded AON neuronal responses using custom microdrives containing 24 independently moveable tetrodes. Eighteen pure odorants served as cues and the rats were trained on two different lists of 12 odors in different contexts (black or white boxes). Within each odor list, half of the odors were rewarded and the other half were not. Half of the odors were common to both lists, but their predictive value was reversed. For each trial, we placed a single cup containing one of the odor cues into the box and the rat was allowed to approach the cup and dig or turn away from the cup in order to initiate the next trial. Errors were recorded if the rat dug in a non-rewarded cup or failed to dig in a rewarded cup. Recording sessions consisted of 144 trials, half from list 1 in the white box and half from list 2 in the black box. Thus, the rats had to remember whether each odor was rewarded or not under the rules of the current odor list and context conditions. Rats learned to perform this task at a high level (>90% correct, on average). For each neuron and odor, we computed a t-statistic (Student's t) as a measure of the reliability of odor-evoked firing across trials and we used a criterion of 1 standard deviation from the pre-odor mean to classify meaningful odor resposnes. Our results indicate that AON neurons are strongly engaged during odor sampling and they exhibit a complex array of responses which likely play a key role olfactory memory processes.

Methods

Tetrode Recordings in the AON.





The AON is a potential source of top-down influence on olfactory memory. We recorded neuronal activity in the AON during an olfactory memory task using tetrodes (tracks in the AON are highlighted).



Rats learned to dig in cups containing rewarded odors, according to a context-dependent rule (white or black box). Muscimol inactivation of the AON significantly impaired performance.

Results











terns or from firing patterns during the intertrial interval (pre-stimulus).

Conclusions

 AON neurons exhibit complex responses to odor cues in a context-dependent odor memory task.

 AON population responses carry information about a variety of task variables, including the odors, their valence and the context.

 These results indicate that the AON plays a key role in olfactory memory.

