Modulation of auditory responses by modality-specific attention in rat primary auditory cortex

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Introduction

Does attending to a sound modulate the neural representation of that sound in auditory cortex? What's the underlying mechanism?

In order to answer these questions, we established a simple rodent model of modality-specific attention. Here we describe results from experiments in freely moving rats in which we used tetrodes to record neural responses in primary auditory cortex (area A1) while subjects performed this behavior.

Two alternative choice task

Tone 1: low frequency

Tone 2: high frequency

Modality-specific attention task

Cross-modal attentional modulation in rat primary auditory cortex

Examples of positively modulated neurons

Examples of negatively modulated neurons

Group statistics

33.9% (304/898) units with statistically significant on response

19.1% (58/304) of ON-responsive units showed modulation of on response

20.1% (61/304) units showed modulation of spontaneous firing rate

	spontaneous	Tone evoked responses
enhanced:	9.87 %	9.60 %
suppressed:	10.20 %	4.93 %
total (unit-tone):	20.07 %	14.53 %
total (units):	20.07 %	19.08 %

304 responsive units >3Hz
correct trials only
p<0.05, Wilcoxon rank sum test

Modulation of tone evoked responses

Summary

1. We have established a simple rodent behavior model for studying modality-specific attention.
2. Modality-specific attention can strongly modulate neural responses evoked by exactly the same auditory stimulus in rat primary auditory cortex.

Methods

Long-Evans rats (150g → 300~400g)

Two alternative choice paradigm:

auditory → blocks of auditory / olfactory → blocks of auditory / olfactory with distracters

Low frequency ~6kHz, High frequency ~14kHz

Reward: ~30μl water

Odorant: R(-)-2-Octanol and S(+)-2-Octanol

Training time: ~6 weeks

Criteria: performance >80%

Tetrode recording