Temporal profiles of neuronal responses to repeated tone stimuli in the mouse primary auditory cortex
（繰り返し音刺激に対するマウス一次聴覚野ニューロン応答の時間特性）

Background and Purpose: How the auditory system processes temporal information of sound has been investigated extensively using repeated stimuli. Recent studies on how the response of neurons in the primary auditory cortex (A1) changes with the progression of stimulus repetition, have reported response temporal profiles of two categories: “adaptation,” i.e., gradual decrease, and “facilitation,” i.e., gradual increase. To explore the existence of profiles of other categories and to examine the tone-frequency-dependence of the profile category in single neurons, we studied the neuronal responses of the mouse A1 to the repetition of tone pips.

Methods: We used silicon probes to record from a large number of neurons in mouse A1 and investigated the response of single neurons to five tone trains; each train comprised 10 identical tone pips, with 0.5-sec inter-tone-intervals, and the five trains differed only in tone frequency. Using the peak of the ON response to each tone in a train, we evaluated how the peak response changed with the tone number in the train.

Results: We first confirmed the existence of profiles of both “adaptation” and “facilitation” categories; “adaptation” could be further subcategorized into “slow adaptation” and “fast adaptation” profiles, with the latter being encountered more frequently. Moreover, two new categories of non-monotonic profiles were identified: an “adaptation with recovery” profile and a “facilitation followed by adaptation” profile. Examination of single neurons with trains of different tone frequencies revealed that some A1 neurons exhibited profiles of the same category to tone trains of different tone frequencies, whereas others exhibited profiles of different categories, depending on the tone frequency.

Conclusions: The response temporal profiles of A1 neurons can be divided into five categories: “facilitation”, “slow adaptation”, “fast adaptation”, “adaptation with recovery”, and “facilitation followed by adaptation”. In single neurons, the profile category is either tone-frequency-dependent, or tone-frequency-independent. The temporally and spectrally heterogeneous profiles demonstrated here may be beneficial for the processing of natural sounds.