Can you Hear Me Now? The Effect of Early Auditory Environment on Perception and the Cortical Representation of Sounds.

Abstract

Previous studies have indicated that rearing rats in an environment with only specific auditory frequencies can drastically alter cortical patterning and in vivo imaging of these rats have indicated abnormal tonotopic mapping in the primary auditory cortex. However, little is known about the effects of abnormal auditory cortical development on behavior and sound perception in mice. We developed a Go/No-Go operant conditioning task to test the ability of Mus musculus to differentiate between two tones. C57Bl/6 mice reared in repetitive playback of 7kHz tone during development were compared to controls raised in a normal acoustic environment. Our findings suggest that mice exposed to tonal stimuli during their auditory critical period were better at perceiving fine differences between two stimulus tones around the frequency that they were raised in. This operant conditioning task was then utilized to test C57Bl/6 mice reared in the ultrasonic calls of BTBR T+tf/J, a mouse model of autism with a restricted vocal repertoire. We compared the discrimination abilities of these mice to control mice reared their own strain's ultrasonic adult male vocalizations. Our findings suggest that C57Bl/6 mice exposed to BTBR T+tf/J ultrasonic vocalizations early in life are better at perceiving fine differences betweenC5TBll6 calls and BTBR T+tf/J calls. To better understand the cortical regions activated by the sound stimuli during the differentiation tasks, c-Fos, an immediate early gene that is a marker for neuronal activity was examined. c-Fos-GFP transgenic mice were exposed to various types of sound stimuli and c-Fos activation pattern in the primary auditory cortex (A1) was visualized. The results suggest that imaging of fluorescent c-Fos in transgenic mice exposed to certain acoustic stimuli may provide a viable technique to better understand A1 activation patterns in response to auditory stimuli. Studying auditory development and investigating effects of early experience on sound perception in adulthood may help unlock the mystery of neurodevelopmental disorders in which communicative problems are a key symptom.