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Spatial Unmasking in CBA/CaJ Mice

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Introduction

Communication in a noisy environment is a problem that many animals face. Their surrounding habitats pose a threat to effective communication due to the vast amount of background noise surrounding them. Masking arises when the threshold of audibility of one sound is raised by the presence of another background sound (Dent, Dooling, & Larsen, 1997). An example is the ‘cocktail party effect’ or the ability to focus one's auditory attention on a single person, corresponding to a target signal, among a wide array of conversations, or maskers (Arons, 1992).

The current study examines the ability of CBA/CaJ mice to identify tones, some of which are in their normal vocalization range, in the presence of a background masker. This experiment was designed to determine 1) which frequencies were most disruptive for hearing in noise for CBA/CaJ mice, and 2) if spatial separation of the tone and the masker positively affects their ability to discriminate a tone from the background. Since mice communicate in the ultrasonic range, we hypothesized that their hearing would be less affected at high frequencies than at low frequencies by a noise masker. We also hypothesized that mice would have a higher threshold for tones coming from the same location as the masker, as opposed to spatially disparate tones and maskers.

Methods

Six CBA/CaJ mice were used in this experiment: three males and three females. The mice were kept on a reverse day/night cycle whereby lights were off at 6 am and turned on at 6 pm and were run in the experiments during the dark portion of the cycle.

This project employed a go/no-go procedure in which mice were trained to poke the left response sensor for a variable waiting period. During the go condition, a pure tone stimulus would be then be presented. If the mouse perceived the tone, it was trained to poke the right response sensor, and a hit was recorded. If the mouse did not poke the right response sensor within 2 s, a miss was recorded. During the no-go condition, no stimulus was presented. If the mouse continued poking the left response sensor, a correct rejection was recorded. If the mouse poked the right sensor, a false alarm was recorded. Sessions with false alarm rates of greater than 20% were discarded.

Methods (Cont.)

Figure 1 depicts the setup used in this experiment. The background masker was continuously played, either at 0 degrees, or at 90 degrees to the right of the tone, depending on the condition. The targets were pure tones with frequencies of 8, 12, 16, or 24 kHz. The order of the target tones and their pairings with a front or side broadband noise masker were selected at random.

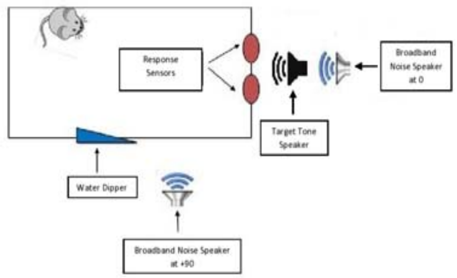

Figure 1. Experimental set-up.

Results

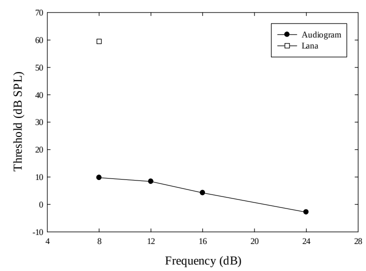

Figure 2. Threshold in the presence of a masker in comparison to thresholds in silence as shown by Radwizon et al. (2010).

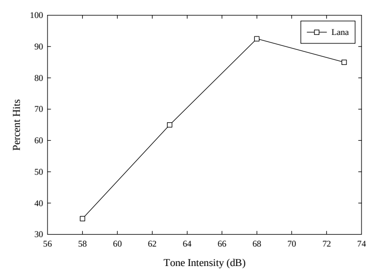

Figure 3. Psychometric function for Lana presented with an 8 kHz tone and a noise masker at 0 degrees.

Results (Cont.)

We expect to see that the mice will show unmasking and that the unmasking should be greater for higher frequencies than lower frequencies. Furthermore, it is expected that thresholds for tones embedded in maskers that are coming from the same location as the tone signals will be higher than thresholds for the maskers at a 90 degree separation from the signals.

Results obtained from this experiment, so far, show that the threshold of audibility for 8 kHz, when the tone and the masker are coming from the same location, stands at 59.5 dB SPL (sound pressure level). At 12 kHz, with a 90 degree separation between the tone and the masker, results are leaning toward a threshold lower than 59.5 dB, which seems to suggest the possibility of the trend of a decrease in threshold with an increase in tone frequency. This project is still a work in progress, and we are expecting to obtain further results in the near future.

Conclusions

- Discriminating tones from a background noise is a relatively hard task for mice. Training for this task has taken almost a year for some of the subjects. Several others were unable to be trained.
- For one mouse at one frequency, the threshold for a tone embedded in noise was significantly higher than for that tone in silence.

References

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Acknowledgements

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