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Selective attention and the TN1: A katydid's internal alarm system

In katydids (Orthoptera, Tettigoniidae), the auditory system is used both for finding mates and avoiding predation by bats. Because female katydids approach calling males at night when bats are active, they must hear a bat call in the presence of a mating call, and be able to tell the difference between the two. Bat calls and mating calls differ in their pulse rate and carrier frequency, with bat calls occurring at a low pulse rate with high frequency and mating calls occurring at a high pulse rate with low frequency. The TN1, or t-shaped neuron 1, conducts bat call responses to the brain, yet can respond to mating calls as well because it is sensitive to both high and low frequencies. This neuron has been shown to function in bat avoidance, but previous research has not considered how it responds to bat calls in the presence of mating calls. Here, we studied the selective attention of the TN1 in Neoconocephalus retusus for bats by presenting bat calls during a playback of a mating call. In order to see the response of the TN1 to a bat call in the presence of a mating call, we played continuous mating calls with intermittent bat calls while recording the neuron's responses. The neuron showed response to mating calls only at the beginning of the playback, quickly adapting to this stimulus, while continuously responding to bat calls. The selectivity of the response occurs over a wide range of intensities (60-80 dB SPL), and is so strong that it can even detect a bat call played 12 to 18 dB softer in relation to the mating call. In order to quantify this response, we first looked at contralateral inhibition, which is one of the features of auditory response in katydids that allows the animal to locate mating call stimuli. Cutting the contralateral hearing nerve did not alter the selective responses in TN1. Therefore, contralateral inhibition is not important for selective attention. The next factor we looked at was the difference in frequency between the mating call and bat call. We saw that the bat call and mating call have to be at different frequencies to elicit a selective response, with one below and one above 20 kHz, but it does not matter which call is at the higher frequency. Our results indicate that the katydid has been able to adapt to the ecological situation of finding mates while avoiding predation, and that this is accomplished by the first interneuron in the auditory pathway, the TN1.