Time Cues and Auditory Perception in Birds

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Introduction

In order to make sense of the multitude of sounds constantly occurring around you, you utilize cues present in the environment. Temporal (time) cues are important in the process of stream segregation, enabling your auditory system to separate and organize sounds based on their source. The current study focused on this ability in budgerigars (*Melopsittacus undulatus*) to examine the effect of both serial position and ratio of asynchronous and synchronous tone sequences. This experiment was designed to determine 1) if there was an early/late bias towards segregation, 2) at what point in the sequence does the perception of one stream turn into two streams, and 3) whether or not frequency cues have an effect on segregation of concurrent tone sequences.

Method

Apparatus

The budgerigars were tested within a wire cage placed inside of an attenuating chamber, lined with foam to reduce reverberations. The birds perched at the front of the cage near a loudspeaker (Fig. 1). The perch was directly in front of two microswitches on which the budgerigars made their responses.

Fig. 1

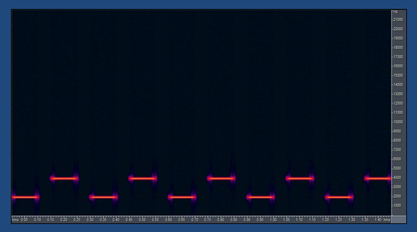
Training

The budgerigars were trained using operant conditioning with food as reinforcement to complete a two-choice identification task. They were trained to first peck the left key to initiate a trial and had a 2 second window in which to respond. During this phase, the stimuli that were presented were endpoint stimuli. These stimuli were either 100% asynchronous or 100% synchronous. (Fig. 2) They were rewarded with food on 80% of trials they correctly identified. If the stimuli were incorrectly identified, a blackout period of 5 seconds prevented them from initiating another trial. They were moved on to testing after reaching 85% accuracy on at least 300 trials.

Testing

Once the budgerigars reached criteria for testing, they were required to complete the same task with the addition of probe stimuli (Fig. 3). The probe stimuli were presented 20% of the time, the endpoint stimuli making up the remaining 80%. There was no "right" and "wrong" answer for the probe stimuli, therefore they were reinforced regardless of their response. They were still required to make correct identifications for endpoint stimuli.

Stimuli

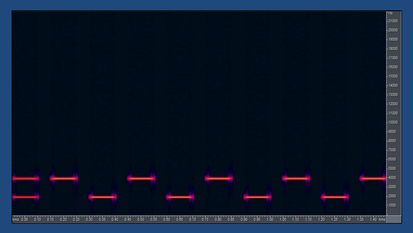


Asynchronous Endpoint

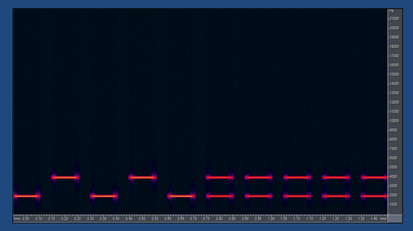
Synchronous Endpoint

Fig. 2 Stimuli used as targets for training and endpoints during the testing phase

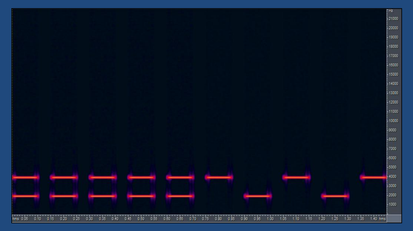
1 Asynchronous 9 Synchronous



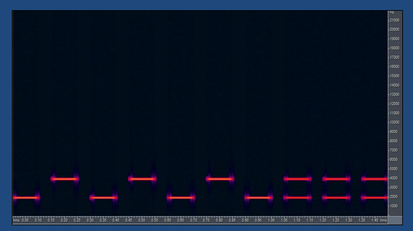
1 Synchronous 9 Asynchronous



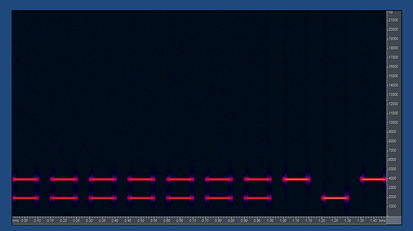
5 Asynchronous 5 Synchronous



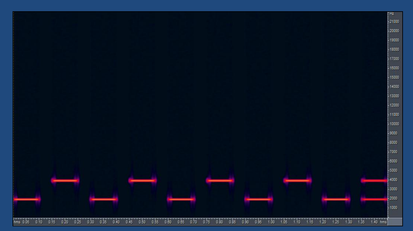
5 Synchronous 5 Asynchronous



7 Asynchronous 3 Synchronous



7 Synchronous 3 Asynchronous



9 Asynchronous 1 Synchronous

9 Synchronous 1 Asynchronous

Fig. 3 Several stimuli used as probes during the testing phase

Results

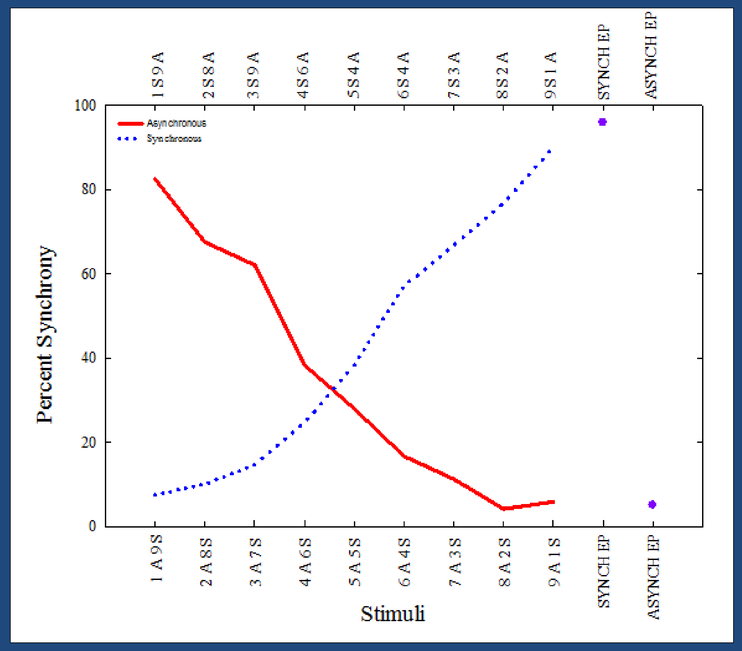


Fig. 4 Mean percent of trials reported as synchronous for stimuli beginning with synchronous (red solid line, bottom axis) and asynchronous (blue dotted line, top axis)

Conclusions

- The serial position of the tones did not play any role in the budgerigars' categorization of the probe stimuli
- The budgerigars utilize only ratio cues when deciding between asynchronous or synchronous in this categorization task
- The process of stream segregation is a primitive one in comparison to other auditory perception, such as call perception, for which the beginning of a call is more important than the end

Acknowledgements

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