The Role of Experience on Cue Trading in Parakeets

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Introduction

Speech perception is a crucial element in the process of human vocal communication, but there are many unanswered questions about the role speech experience plays in this process. This research investigates if experience with human speech sounds will influence speech perception in budgerigars. Budgerigars are a type of parakeet, common household pets. They are vocal mimics and their experience with human speech sounds can be easily controlled in a laboratory setting. The data were collected from 30 budgerigars that were divided into four different exposure groups: passive group with regular exposure to human speech, no speech exposure group - isolated from all human speech sounds, and two speech trained groups, one group trained to produce words beginning with the target sounds that they are tested on – "d" and "t" and the other group trained to produce non-target sounds. This was to see if there is a difference in the use of speech cues between the different exposure groups.

Hypotheses

1. All the budgerigars are expected to exhibit cue trading behaviors in response to the "d"-"t" test stimuli similar to the behaviors observed in humans.

2. The budgerigars in the speech isolation condition are expected to exhibit weaker cue-trading behaviors than the other groups due to their lack of speech exposure. Any evidence of cue trading abilities present in the isolation group will suggest that there is an auditory mechanism involved in speech perception.

3. The budgerigars in the speech-trained condition are expected to show the strongest cue trading behavior of all three conditions because these birds have been exposed to continuous and extensive speech training.

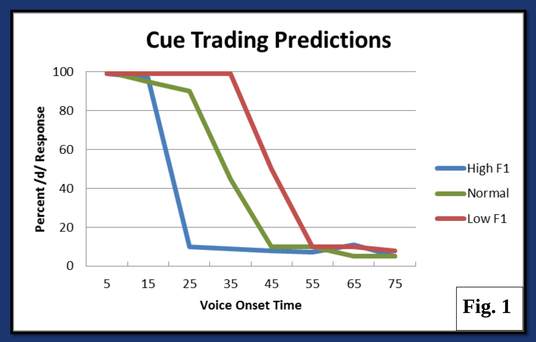


Fig. 1.Cue trading predictions for humans and budgerigars. The category boundary for /d/ is predicted to occur at shorter VOTs for stimuli with high F1 onset frequency (blue line). For stimuli with low F1 onset frequency, the category boundary is expected to occur at longer VOTs (red line). Normal F1 onset frequency category boundary is also shown for reference (green line).

Methods

Auditory Conditions:

1. Speech Isolation- Budgerigars are completely isolated from human speech sounds.
2. Speech Exposure- Budgerigars are passively exposed to human speech sounds.
3. Speech Trained- Budgerigars are trained to produce human speech sounds.
   Speech Trained - Group 1: "eese", "eesh", "oose", "oosh"
   Speech Trained - Group 2: "dash", "dish", "tash", "tish"

The Speech Isolation room as shown in Fig. 2 is equipped with two 70 dB white noise generators that are capable of masking outside human speech sounds. There are additional natural bird sounds being played in the room in addition to these noise machines. There is sound-attenuating foam lining all walls of the room.

Operant Training:

The birds were trained using operant conditioning procedures to perform a left-right identification task. They were trained to first peck the left key to initiate a trial and a variable waiting interval (2-7 s). If the birds correctly assigned the stimulus played to the appropriate key, they were allowed 1.5 s access to food from the hopper. Incorrect trials were given a 5 s blackout of a house light above the cage and no reinforcement was given. The birds are then trained to peck one of the two keys in response to hearing different synthetic speech sounds beginning with either "d" or "t". Birds were moved to testing once they met the criteria of 80% correct or higher on 300 consecutive trials.

Setup:

Following the exposure period, the budgerigars were placed in one of the four identical psychoacoustic testing setups. Inside each setup was a small-animal chamber lined with acoustic foam to minimize reverberations. The birds sat on a perch in the front of the cage with one speaker placed directly above the bird (Fig. 3). Two vertical microswitch response keys extended downwards from the inside of a food-dispensing hopper in front of the bird (Fig. 4). The microswitch was tripped when the birds pecked the colored keys. The behavior of the birds were monitored at all times during testing using an overhead web-camera. The experiments were controlled by a Dell microcomputer operating Tucker-Davis Technologies modules and SykofizX software.

Testing:

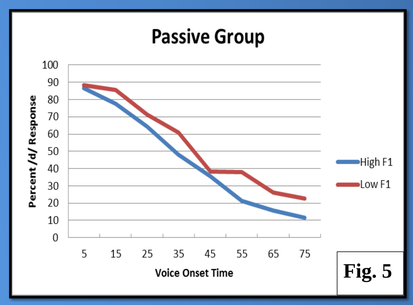
Once the initial identification training was completed, the birds were required to do the same identification task with probe trials introduced approximately 20% of the time. Probe trials were given food reinforcement regardless of the bird's response (since we are trying to elucidate the birds' unbiased perceptions of the stimuli).

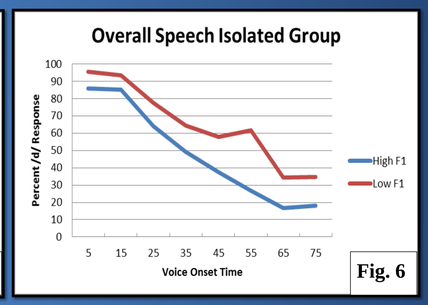
Results

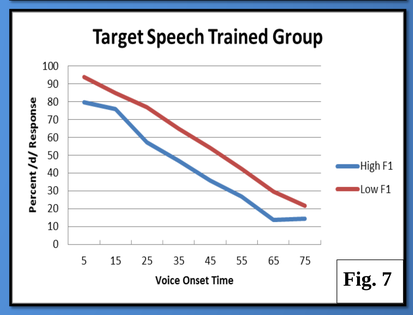
In all the groups of budgerigars, cue trading behavior followed the predicted pattern.

- The boundaries were at longer VOT values when the F1 frequency was low.
- The boundaries were at shorter VOT values when the F1 frequency was high.
- All exposure groups showed this effect, indicating speech experience is not a prerequisite for cue trading of speech stimuli.
- Results suggest that cue-trading abilities might be innate and a due to a general auditory mechanism.

These findings could have very important implications for understanding human speech perception.







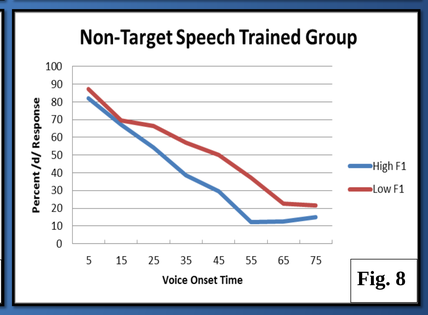


Fig. 5-8. Results for each exposure group averaged within each group.