Investigating Latencies In Acoustic Selection by *Hyla chrysoscelis*

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Background

- In the animal kingdom, acoustic communication serves as a key mode of information transfer. Many species use vocal signals for mating behaviors, territorial aggression, predator evasion, or other factors vital to survival.
- Noise can interfere with this exchange of information, and has been shown to inhibit the abilities of receivers (Shannon et al., 2016).
- Noise leads to errors in detection and discrimination among signals, a phenomenon known as masking (Read et al., 2014).
- **Energetic masking** occurs when there is interference in the inner ear; a signal is undetected in the presence of other noise.
- **Informational masking** refers to an interference of noise in the brain. It leads to errors in signal recognition, despite the signal being detected by the ear.
- Energetic masking makes a sound harder to hear and informational masking makes the sound harder to understand (Bee, 2015).
- The mechanism of energetic masking is not well understood; the goal of this experiment was to fill this gap in knowledge - this is biologically significant in treefrogs.

Model Organism

- Cope's gray treefrog (*Hyla chrysoscelis*) often communicates in noisy environments, provides an opportunity to control for energetic masking, and there is already a great deal of background knowledge on vocal communication in this species (Bee, 2015).
- Frogs possess unique auditory anatomy among vertebrates, which allows for the elimination of energetic masking.
- Temporal properties of acoustic signals have been shown to convey key information to gray treefrogs (Bee and Gerhardt, 2001).
- **Pulse Rate** allows females to discriminate between conspecific (40 pulses/sec) and heterospecific calls
- **Pulse Number** signifies male quality, with a greater number of pulses representing a more fit male

References

Bee, Mark A. (2015). Treefrogs as animal models for research on auditory scene analysis and the cocktail party problem. *International Journal of Psychophysiology,* 95, 216–237.
Bee, Mark A. and Gerhardt, H. Carl (2001). Habituation as a mechanism of reduced aggression between adjacently territorial male bullfrogs (*Rana catesbeiana*). *Journal of Comparative Psychology*, 115, 68-82.
Read, Jade et al. (2014). Fitness costs as well as benefits are important when considering responses to anthropogenic noise. *Behavioral Ecology*, 25 (1), 4–7.
Shannon, Graeme et al. (2016). A synthesis of two decades of research documenting the effects of noise on wildlife. *Biol Rev Camb Philos Soc.* 91, 982–1005.

Objective: to investigate if informational masking leads to increased latencies in making behaviorally important decisions in *Hyla chrysoscelis*

Experimental Methods

Collect actively mating treefrogs from local ponds

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Place female individual in soundproof chamber

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Perform pulse rate and pulse number discrimination tests

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Record frog's choice, path, and latency

Phonotaxis Tests

For both types of test, trials were run where the call was accompanied by a control masker (CM), an informational masker (IM), or quiet (Q) (no alternate noise). The call and the masker were both played from 2 speakers. Energetic masking was controlled.

1. Pulse Rate
-40 pps vs. 30 pps
-45 pps vs. 30 pps
(pulse number constant)

2. Pulse Number
-8 vs. 10
-12 vs. 15
-16 vs. 20
(pulse rate constant)

Analysis

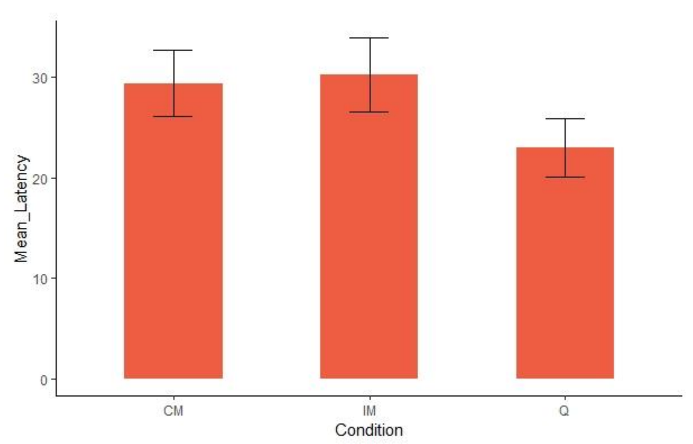
A female's "choice" was marked by the frog approaching a speaker and entering a semi-circle. I specifically analyzed the latency, that is the time taken (s) for the frog to make a choice following the call. For each type of test, a graph was made for latencies of all choices, and a graph was made for latencies only when the frog made the "correct" choice (the conspecific, or more fit male). Note: All frogs who did not make a choice in five minutes were marked as "no response" and this data was excluded from analyses.

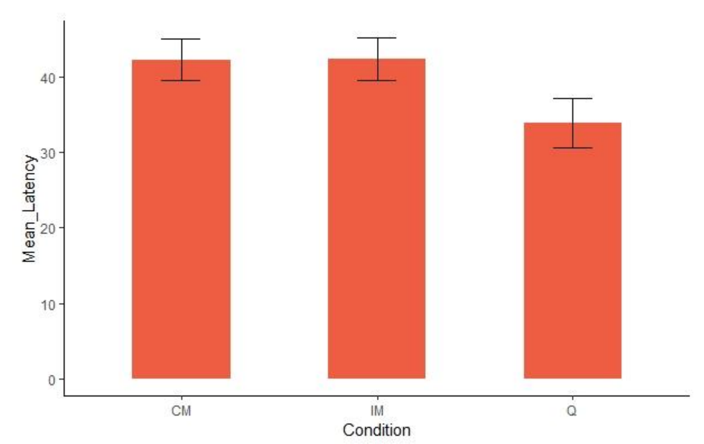
Results

Choice Latencies

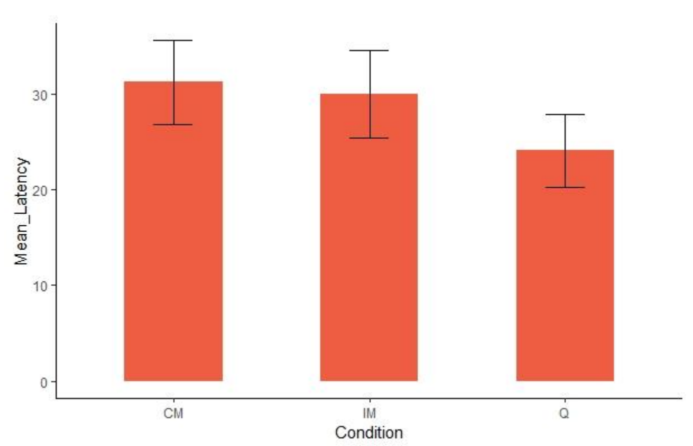
Correct Choice Latencies

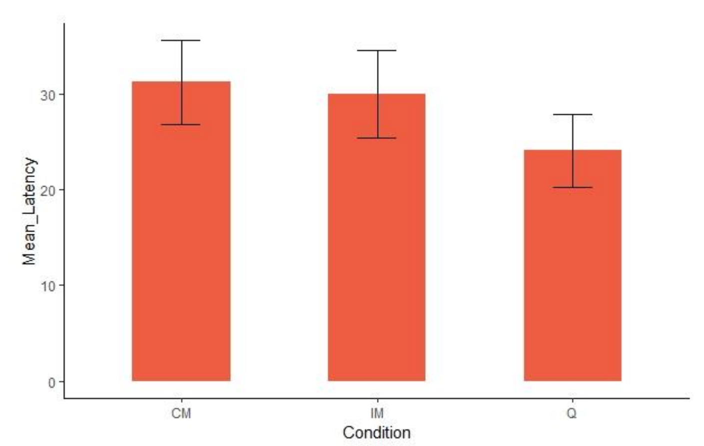
Pulse Rate 40 vs. 30



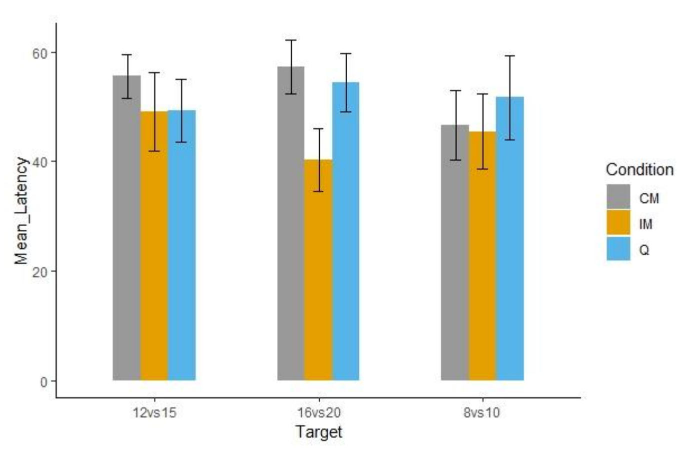


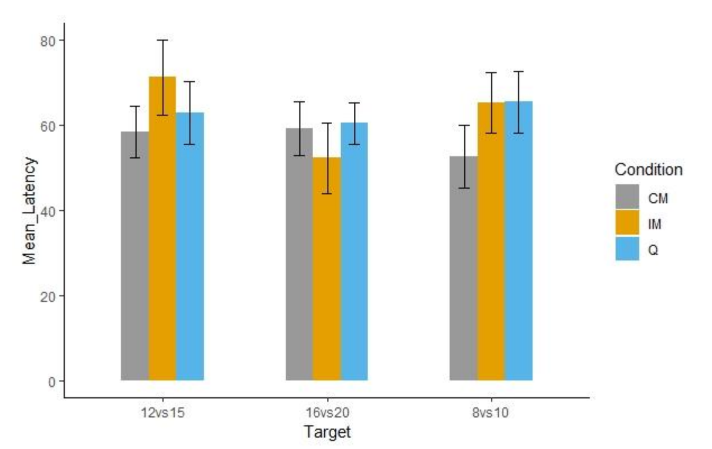
Pulse Rate 45 vs. 30





Pulse Number





Conclusion

It was expected that quiet and control masking would have smaller latency than informational masking. According to the pulse rate graphs above, there was a slight trend for greater latency in the presence of maskers. However, there was little difference between the effect of the Control Masker and the Informational Masker. There was little difference between the graphs produced from all latencies and the graphs produced only from correct choice latencies. Pulse number graphs did not produce a trend.

Note: Preliminary analysis of choice probabilities tells us that females can perform species recognition in informational masking conditions as good as in control and quiet conditions but they have impaired ability to discriminate between individuals of varying quality in informational masking conditions (Gupta, Bee unpublished data). These results are not reflected in latency measures. This might suggest that latencies are not good indicators of female choice in discrimination tests.