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The discrimination of fine-scale temporal changes in call-like harmonic stimuli by birds

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Harmonic sounds are a well-studied class of stimuli for determining the ability of the auditory system to respond to fine-scale temporal changes. Zebra finches (Taeniopygia guttata), a favorite songbird model for neurobiologists, produce natural calls rich in harmonics. We tested the ability of zebra finches and other small birds to discriminate fine-scale temporal changes in a synthetic harmonic stimulus using operant conditioning. Our stimuli consisted of single periods taken from the beginning, middle, or end of a zebra finch call that were repeated end-to-end to produce a 200 ms harmonic sound. Periods averaged 1.4 ms in duration. Differences in frequency, relative amplitude, and relative phase of harmonics over the duration of a zebra finch call produce subtle changes in the structure of individual periods. All species tested readily discriminated changes in synthetic harmonic stimuli resulting from the differences between individual periods taken from different locations within a natural call. In a second experiment, birds received a background stimulus synthesized from a period in the middle of a zebra finch call, with targets consisting of synthetic stimuli made from time-reversed versions of the identical period. Birds were even able to detect these time-reversed stimuli constructed from the same period. Our results confirm previous studies showing that birds are sensitive to temporal fine structure cues in call-like harmonic sounds, and suggest that birds may hear such sounds in greater detail than do humans.

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