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Separating object resonance and room reverberation in impact sounds

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Abstract

Everyday hearing requires inferring the causal factors that produce a sound, as when we separate the acoustic effects of the environment (reverberation) from those of sound sources. Here we consider perceptual inferences from impact sounds, in which the resonance of a struck object provides cues to its material, but via acoustic effects that might be nontrivial to disentangle from reverberation. We investigated whether and how humans separate the effects of object resonance and reverberation in a material classification task. For comparison, we implemented a Bayesian observer that inferred material from a generative model of object sounds without reverberation. Humans were robust to reverberation, whereas the model was not. However, human robustness was specific to reverberation consistent with the statistics of natural environments. The results suggest that humans use internal models of room and object acoustics to determine their respective contributions to sound, providing an example of causal inference in audition.