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Scrape, rub, and roll: causal inference in the perception of sustained contact sounds

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Abstract

We experience our soundscape in terms of physical events; for instance, a friend sweeping up after a plate crashed on the floor. The underlying perceptual inferences are typically ill-posed: without constraints, there are infinite possible causes of the observed sound. Thus, a core task for cognitive science is specifying the variables we perceive along with the constraints that allow them to be estimated. We identified sustained contact sounds (e.g., hands rubbing together, scraping a pan) as a rich domain with which to explore perceptual constraints. We developed a simple physics-based sound-synthesis model that can generate a diverse set of realistic scraping sounds. We find that listeners perceive the generative physical variables from scraping sounds, including velocity, motion trajectory, and surface roughness. Further experiments and acoustic analyses will address whether perception is constrained by a holistic generative model of sound or by invariant features that specify each perceived variable.