Perceptual timing precision in complex sound sequences is shaped by context-target similarity

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Temporal regularities play a crucial role in auditory processing. In complex sounds, such as music and speech, perceptual sensitivity for on-beat events is enhanced, while deviations from expected timing carry important information. To use such temporal information effectively, listeners must evaluate sound onset timing relative to preceding temporal structures –with high perceptual timing precision (PTP). Previous research has shown higher PTP for simple (short risetime) target sounds compared to complex (long risetime) targets. However, the contribution of preceding context acoustics to PTP is unknown. Here, we examined how context acoustics affect PTP. Participants iteratively adjusted the timing of a target sound relative to an isochronous cueing sequence until reaching perceptual isochrony. Experiment 1 (n=21) manipulated cue and target complexity to test whether cue complexity also impairs PTP. Surprisingly, cue–target similarity, rather than cue complexity per se, predicted PTP: when cue and target were identical, PTP was highest –regardless of the sounds' complexity. Mismatching cues and targets reduced precision. Notably, PTP was lower when complex cues preceded a simple target than vice versa. To further evaluate the role of acoustic similarity, Experiment 2 (n=24) independently manipulated similarity in spectral content and risetime. PTP was reduced when cue and target differed in risetimes, but not when they differed in spectral content. Together, our findings show that perceptual timing precision is sensitive not only to the acoustic properties of the target, but also to preceding contexts. We propose that listeners form temporal templates based on preceding cues, against which target sound timing is evaluated. This reveals a hitherto unknown constraint on perceptual sensitivity to rhythmic sound sequences: effective temporal prediction depends not just on rhythmic structure, but on acoustic continuity between context and target.

Keywords: perceptual timing precision, auditory perception, acoustic context, onset timing, predictive processing