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Relatively Speaking: Spatial Discrimination Tasks As Tools for Studying Multisensory Integration

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ABSTRACT

Both the visual and auditory systems provide spatial information. Because many objects can be both seen and heard, the brain combines information from each sensory modality to form a single estimate of an object's location. When there is conflict between the cues from a single object, those cues are weighed by their reliability, which usually results in a visually-driven bias of auditory localization, namely the "ventriloquist effect" (1,2). Numerous studies of crossmodal integration have described the phenomenon behaviorally, modeled it (3,4), and explored its neural underpinnings (5). The overwhelming majority of these studies have used absolute localization tasks, for which localization bias is the principal outcome, rather than discrimination tasks (i.e., relative localization), which measure spatial acuity. Studies from our lab suggest this represents a missed opportunity. We have used spatial discrimination to show effects of eye gaze on auditory spatial coding unrevealed by absolute localization tasks (6). This study showed that while auditory localization biases induced by short-term gaze shifts are small and highly dependent on the specific localization task, the same gaze shifts lead to substantial changes in listeners' ability to discriminate the azimuths of two nearby auditory stimuli. We have also used discrimination in tasks where auditory and visual stimuli are collocated, so no localization bias is expected (7). This study goes beyond the typical paradigm of a single pair of audio-visual stimuli with conflicting locations. Instead, it employs a much more naturalistic paradigm that involves more than one stimulus pair, with congruent locations between auditory and visual stimuli. This paradigm makes bias unusable as an outcome (since no bias is expected for congruent locations) but uses spatial discrimination thresholds to learn about audio-visual integration when there is no location conflict. Finally, preliminary studies in our lab have used spatial discrimination tasks to study auditory spatial processing in people with hemianopia (one-sided blindness due to a visual cortical lesion), where studies of auditory localization have suggested normal processing. In summary, using relative localization tasks in studies of audio-visual integration can reveal complementary information to tasks that rely on absolute localization (and thus cue conflicts), potentially even revealing substantial effects where absolute localization may not.

Keywords: Audio-visual integration, psychophysics

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