Talker head orientation discrimination using only auditory cues
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Introduction
The ability of humans to localize sound sources, including speech, has been studied extensively, however less is known about the human ability to determine the physical orientation of a given sound source. It has been proposed that determining a talker’s head orientation (or facing angle) is important for ascertaining whether one is the intended recipient of a warning call or other utterance. We assessed listeners’ ability to detect changes in talker head orientation.

Some studies indicate that extended high frequencies (EHF) are useful for some auditory tasks, but it is widely believed they play little to no role in speech perception. Directivity patterns of human speech and voice radiating from the mouth indicate that high-frequency radiation is increasingly directional. Thus we predicted that EHF hearing in humans improves talker head orientation discrimination ability.

Aim
To assess human listeners’ ability to detect changes in talker head orientation
To examine if access to EHF’s improves talker head orientation ability

Directional Recordings (continued)
Horizontal plane directivity patterns for speech show that low frequencies radiate omnidirectionally, whereas EHF’s are highly directional.

Method (continued)
Procedure:
• One-up, two-down, three alternative adaptive forced-choice task
• Stimuli presented in sound-treated booth over KRK Rokit 8G3 loud speaker, 70 dB SPL @ 1m
• Four tracks (one per talker) in separate runs
• Two conditions tested in separate blocks: full band vs. low-pass filtered @ 8kHz
• Run order within each block and block presentation both randomized
• Reference stimulus = 0° recording
• Test stimulus = Adaptively varied between 180° and 0° recordings based on listener performance (no feedback provided)
• Each run began with easily distinguishable test stimulus of 135° angle
• Step size changed from 45° to 15° after first two reversals; last six reversals averaged to obtain just noticeable difference (JND)

Results (continued)
• Mean JND with EHF = 41°
• Mean JND without EHF = 55°
• Main effect of EHF condition (p = 0.003)
• Main effect of talker, with better performance for F2 and M1 (p < 0.001)
• No effect of talker gender (p = 0.7)

Conclusions
Listeners are sensitive to changes of approximately 40° in talker orientation using only auditory cues. This is less sensitive than what humans have displayed with only visual cues. These findings indicate that auditory cues are available for head orientation discrimination, which may be of greater utility when visual cues are unavailable.

Access to EHF’s improves auditory discrimination of talker head orientation EHF’s potentially serve as salient cue for determining “Are you looking at me?” (i.e., is this vocalization directed at me?)

References