Human cortical sensitivity to interaural time difference in high-frequency sounds

Abstract:

Human sound source localization relies on various acoustical cues one of the most important being the interaural time difference (ITD). ITD is best detected in the fine structure of low-frequency sounds but it may also contribute to spatial hearing at higher frequencies if extracted from the sound envelope. The human brain mechanisms related to this envelope ITD cue remain unexplored. Here, we tested the sensitivity of the human auditory cortex to envelope ITD in magnetoencephalography (MEG) recordings. We found two types of sensitivity to envelope ITD. First, the amplitude of the auditory cortical N1m response was smaller for zero envelope ITD than for long envelope ITDs corresponding to the sound being in opposite phase in the two ears. Second, the N1m response amplitude showed ITD-specific adaptation for both fine-structure and for envelope ITD. The auditory cortical sensitivity was weaker for envelope ITD in high-frequency sounds than for fine-structure ITD in low-frequency sounds but occurred within a range of ITDs that are encountered in natural conditions. Finally, the participants were briefly tested for their behavioral ability to detect envelope ITD. Interestingly, we found a correlation between the behavioral performance and the neural sensitivity to envelope ITD. In conclusion, our findings show that the human auditory cortex is sensitive to ITD in the envelope of high-frequency sounds and this sensitivity may have
behavioral relevance.