INTERAURAL LEVEL DIFFERENCES ARE DOMINANTLY EVALUATED PRIOR TO MODULATION MAXIMA

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Natural sounds, such as speech, comprise amplitude modulations with onsets, offsets and local maxima. When localizing sounds, binaural information is most heavily weighted at sound onsets (Hafter and Dye, 1983) and the salience of interaural time differences (ITD) is greatest at a point prior to modulation maxima (Dietz et al., 2013). However, the precise temporal distribution of perceptual weights for interaural level differences (ILD) remains unclear. Such an investigation has challenges since it is difficult to manipulate ILDs on short timescales without altering the long-term ILD. The aim of the current study was to characterize the temporal weighting of modulated ILDs, while controlling for short- and long-term ILDs. The results demonstrate that ILDs are more effective when conveyed at points prior to modulation maxima.

The efficacy of ILDs conveyed at different phases of the modulation cycle was studied in two experiments: one using a spatial discrimination paradigm and the other measuring lateralization. The stimuli comprised 4-kHz-carrier tones with 50, 100 and 200 Hz SAM. ILDs were applied to specific phases (30°, 60°, 90°, 120° or 150°) of each modulation cycle by scaling the signal with a 1-ms-long Gaussian window. In the first experiment, the introduced short-term ILDs were varied adaptively, while the long-term ILDs were compensated for, to find the threshold for correctly identifying left-right vs. right-left stimulus movements. In the second experiment, the lateralization percepts elicited by short-term ILD adjustments, without long-term compensation, were compared to those elicited by unmodified SAM tones with long-term ILDs of 0, 1, 2, 4, 7 and 10 dB.

The results from both experiments show that concentrating an ILD around positions on the rising flank around 30° to 60° of each modulation cycle yields more efficient lateralization than when the ILD is concentrated in later parts of the modulation cycle. At low modulation rates ILDs placed on the rising flank are also more effective than when placed at 90° in the energetic maximum of the signal. An ILD produced greater lateralization when concentrated on the rising flank than when its energy was spread across the entire stimulus. Hence, ITD- and ILD-based localization seem to share a similar emphasis of binaural cues around modulation maxima, which is useful for localization of speech and other complex sounds in reverberant environments.

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