Effects of interaural time differences in fine structure and envelope on lateral discrimination in bilateral electrical hearing

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Localization of sound sources is partly based on interaural time differences (ITDs). For lower frequencies, the neural stimulation pattern is synchronized to the phase of the carrier signal. Interaural difference of the phase, so called fine structure ITD, is important for determining the lateral position of the sound source. Bilateral cochlear implant (CI) listeners currently use stimulation strategies which encode ITD in the temporal envelope but which do not transmit ITD in the fine structure due to the constant phase in the electrical pulse train.
To determine the necessity for encoding ITD in the fine structure, ITD-based lateralization discrimination was investigated with CI listeners and normal hearing subjects at different pulse rates for various combinations of independently controlled envelope ITD and fine structure ITD. Amplitude modulated pulse trains with a modulation rate of 13Hz were used. Results show that the fine structure ITD had the strongest impact on lateralization discrimination at lower pulse rates, with significant effects for pulse rates up to 800 pulses per second. At higher pulse rates, lateralization discrimination depended on the envelope ITD only. It is concluded that bilateral CI listeners benefit from transmitting fine structure ITD at lower pulse rates.