

Speech Comprehension Assessed by Electroencephalography with M-Sequence Technique

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We have developed a new technique for accessing the level of verbal comprehension for a continuous speech using electroencephalogram (EEG). We used a binary m-sequence to modulate continuous speech sound stimuli in amplitude and cross-correlate the EEG response with. The m- (maximum length shift register code) sequence is uniform, uncorrelated ('white') and therefore suited to a variety of signal encoding under a noisy environment. **Methods:** Eight normal-hearing native Japanese-speaking adults participated as subjects with written informed consent. The stimuli were eight 51 second long news, as combinations of three factors: (1) modulated or non-modulated, (2) forward or reverse, (3) native Japanese or incomprehensible Spanish. An eleventh-order binary m-sequence at 40 Hz was used for modulation. Although nearly a half of the content of speech had been eliminated, the modulated forward Japanese stimulus was still comprehensible by itself as a result of perceptual completion. Each stimulus was presented once for each subject binaurally. The subjects were instructed to listen attentively to the news contents. The EEGs were recorded from 17 sites with filtering high cut at 100Hz, and low cut with 0.1 second time constant decay. Circular cross-correlation functions were computed between the EEG and the m-sequence. Subsequently, they were averaged across subjects and were subjected to an independent component analysis (ICA) using an AMUSE algorithm with one sample time delay, to estimate the most characteristic spatial weight distribution. The best distribution was determined based on the topographical representation of the separation matrices and the time-course cross-correlation. The selected weights were used to calculate the component response. **Results and Discussion:** Independent component analysis of the averaged function revealed a component source response which was obtained only for the comprehensible Japanese and not for the incomprehensible sentences. The degree of verbal comprehension can thus be assessed by analyzing EEG responses to a minute long natural continuous speech modulated by the m-sequence