

Evoked electromagnetic responses to speech and non-speech sounds

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My talk includes two studies. A first study is a cross-linguistic study using Japanese and American English speakers. A second study is a developmental study using a pure tone (500Hz)

1) A Cross-Linguistic Study

Linguistic experience affects speech perception. Adults have difficulty in perceiving differences between speech sounds not used in their native language. We recorded neuromagnetic responses from native American English (AE) and native Japanese (J) speakers while they were passively listening to /ra/ and /la/ sounds (present in English, but absent in Japanese). Two stimulus durations were used, short (110 ms) and long (150 ms). The short stimuli were terminated in the middle of the transition from the consonant to the vowel of speech sounds (they could nevertheless be clearly perceived as either /ra/ or /la/ by AE speakers). A clear mismatch field (MMNm) peaking at approximately 170 ms post stimulus onset was observed in both sets of speakers for the short-duration stimulus regardless of the sounds. The MMNm was largely reduced for the long-duration stimuli in both sets of speakers as we reported for J speakers in our previous study (Koyama et al., 2003). In the short-duration stimulus session, MMNm was followed by a second component only for AE not for J speakers. The present finding might indicate that memory trace for consonants is not robust compared with vowels.

Koyama et al. (2003), Neuroimage 18: 962-974

2) Developmental Study

Gaps in continuous sounds play important roles for speech perception. They are important for perception of voiceless consonants (i.e. /k/, /p/, /t/) and Japanese special mora. We recorded ERPs to short gaps and compared those for children with those for adults. Subjects were eight adults (20-40 years old) and eight school age children (8-12 years old). There were six gap conditions with durations of 8, 16, 32, 64, 128 and 256 ms embedded in a continuous tone and six tone conditions with durations of 8, 16, 32, 64, 128 and 256 ms. The frequency of all the tone was 500Hz. EEGs were recorded from Fz, Cz, Pz, T3, T4 and left and right mastoids referring to the nose tip. The ERPs for the gap onsets differed between the children and the adults. For the children, sustained responses starting 100 ms after the gap onset were observed for all the durations (negative going at Fz, Cz, Pz, T3 and T4 and positive going at the mastoids). For the adults, a deflection peaking 100 ms after the onset (N1) was clearly observed only for the durations of 8, 16, and 32 ms. In contrast, the ERPs for the onset of the tones were similar between the children and the adults. The N1 component was observed for all the duration both in the children and in the adults. These findings indicate that the time course of development differs between brief tone processing and detection of gaps in a continuous sound.