Presentation Abstract

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Title: Cortical systems for early semantic processing in word recognition
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Abstract: Much has been discovered about the spatial distribution of neural systems for word recognition on the one hand, and the time course of word recognition on the other. Considerably less is known about how word recognition unfolds in the brain over time and space. We used magnetoencephalography (MEG) to examine the spatial distribution of neural systems for word recognition as a function of time. Word stimuli were of either high or low frequency, and rated as having either high or low imageability. We hypothesized that areas engaged in semantic (word meaning) processing would show activation for high compared to low levels of word frequency and imageability. Participants (N = 10, mean age = 26, all right-handed, native English speakers) were asked to indicate that a letter string was an English word by tapping with the index finger of one hand, or that it was not by tapping with the index finger of the other hand. To ensure similarity in terms of orthographic and phonological characteristics, the 312 pronounceable nonwords (pseudowords) were matched to the 312 words in terms of number of letters and did not differ reliably in terms of bigram and trigram frequency or orthographic neighborhood size. Similarly, across levels of word frequency and imageability, words did not reliably differ in terms of number of letters,
bigram and trigram frequency, orthographic neighborhood size, or spelling-sound consistency. Stimuli were displayed for 400 ms and replaced with fixation. The mean response time (RT) for words (827 ms) was significantly faster than for pseudowords (897 ms, t = 11.9, p < 0.001). Differences in terms of RTs and error rates between levels of word frequency, imageability, and their interaction also followed the typical pattern: a significant main effect of faster RTs for high compared to low levels of frequency and imageability, and a significant interaction, i.e. a greater effect of imageability for low frequency words and a greater effect of frequency for low imageability words. Neuronal responses to words occurred in three waves of posterior to anterior activity, each centered at about 170, 220, and 310 ms. Differences across word conditions occurred primarily in the left angular gyrus (AG), an area identified in a recent meta-analysis as a major component of the lexical semantic system. The greatest difference in this area occurred in an early time window of 110-150 ms, with greater activity for words of high frequency and high imageability compared to those of low frequency and low imageability. Although preliminary, these results suggest that semantic processing begins early in the course of word recognition, and that the left AG is prominently involved in this process.

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