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Brain and Language: The Neural Representation of Words and their Meanings

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Abstract

For a long time aphasia research has been the major source of evidence for understanding how language is organized in the human brain. However, modern electrophysiological and neuroimaging techniques provide new data on language processing in the intact brain. Some, but not all, insights from classic lesion studies have been confirmed by these techniques. The main conclusion is that language-related processes seem to be much more widely distributed than previously assumed.

This presentation reviews recent evidence about the neurobiological organization of words and their meanings. Within Pulvermüller's framework (Pulvermüller, 2002, 2005), meaningful language units are cortically represented and processed by distributed functional webs of neurons, or *word webs*. Current data support the notion that words are laid down cortically as neuron webs with different cortical topographies reflecting their meaning, or more precisely, aspects of their reference. For example, different subcategories of action words elicit differential brain responses. Words semantically related to different parts of the body activate the motor and premotor cortex in a somatotopic manner. That is, reading a leg-related verb such as 'to kick' activates classical language areas as well as motor regions involved in leg/foot movement. Processing of mouth- (e.g. 'to kiss') and hand-related ('to pick') words activates regions of the motor cortex involved in mouth and hand movements respectively (Hauk *et al.*, 2004). Recently, in the Universitat Jaume I of Castellón, Spain, it has been found that reading odour-related words, such as 'cinnamon', 'garlic', or 'jasmine' elicits activation in the primary olfactory cortex, which includes the piriform cortex and the amygdala (Gonzalez *et al.*, 2006). These and other data suggest that word meaning is not confined to just meaning-specific brain regions; rather, it seems likely that semantic representations are distributed in a systematic way throughout the entire brain.

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