Neural effects of iconicity in sign language

Karen Emmorey

Language is fundamental to our species, and yet almost everything we know is based on the study of spoken languages. An investigation of sign language is particularly interesting for theories that propose close links between perceptual-motor experience and language, e.g., "embodied" or "grounded" theories of semantic processing vs. more traditional theories in which arbitrary and amodal symbols are abstracted away from sensory-motor systems. In comparison to spoken languages, sign languages are much more strongly grounded in the body, as evidenced by the pervasive iconicity observed for these languages (e.g., the form of verbs often depicts an aspect of the denoted action). To investigate the neural response to iconic signs, our research team utilized event-related potentials (ERPs) in conjunction with our database of 1000 American Sign Language (ASL) signs rated for iconicity. We examined whether iconic signs exhibit distinct neural signatures for deaf signers, as well as for hearing ASL learners. Results from a series of experiments reveal that there is no "neural signature" that tracks with the strength of iconicity during sign recognition for deaf signers; however, iconicity impacts the neural response during lexical access for novice ASL learners (but not deaf signers) in a translation priming paradigm. For deaf signers, neural effects of iconicity are found in picture-naming and picture-matching tasks, particularly when there is a structural alignment between the ASL sign and the picture (e.g., the ASL sign BIRD depicts a bird's beak and aligns with a picture of a bird with a prominent beak, but not with a picture of a bird in flight). Overall, the results reveal neural consequences for grounding language in the body that may only occur under certain circumstances (i.e., when visual features of a picture map to iconic features of a sign).

Computational methods in theoretical and clinical neuroscience

Mina Teicher

The talk is divided to two parts. In the first part, we shall present a few computational methods we developed for determining synchronization in brain activity, including geometric data mining and singularity theory. In the second part, we shall present algorithms for clinical applications, in particular localizing epileptic focus for patients that do not respond to medications.

Concept representation in the brain

Jeffrey Binder

Storage and manipulation of conceptual knowledge is a principal function of the human brain. The representational format, content, and neural organization of this knowledge are central issues in language neuroscience. Research in recent decades has largely abandoned the traditional AI view of concepts as unitary symbolic representations, given the inherent limitations of this view in relating conceptual content to brain systems or theories of concept acquisition. This review will focus on approaches to word meaning that assume a componential representation corresponding to known experiential (sensory, motor, affective, cognitive) systems in the brain. Contrasting approaches to componential semantic representation will be noted, including traditional feature listing, word co-occurrence methods, and continuous ratings of experiential content. It will be argued that the latter approach provides the most direct correspondence with specific neural systems and therefore a powerful method for understanding large-scale brain organization and acquisition of conceptual content. Recent fMRI studies combining such brain-based representations with multivariate pattern analysis computational methods have yielded new insights concerning concrete noun concept representation in the brain and enabled the first successful machine-learning decoding of neural activation patterns evoked by sentences. Preliminary applications of these methods to understanding the neural representation of abstract concepts, and the possible advantages of a hierarchical, pluralistic representation account, will be discussed.