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Cognitive Neuroscience Weekly

Cognitive neuroscience is a highly exciting relatively young discipline of science that aims at solving brain-mind interrelationships in both health and disease. This blog is targeted as a source of inspiration for enthusiastic students, cognitive neuroscientists, and others interested in cognitive neuroscience by highlighting some recently published findings of interest.

1/19/2013

Cortical areas tracking the speech amplitude envelope revealed by electrocorticographic recordings

Research on auditory features that contribute to speech comprehension has pointed out the importance of temporal cues and the slow amplitude envelope. Specifically, manipulating the speech amplitude envelope degrades recognition of speech sounds and comprehensibility of sentences and, further, it has been shown that speech comprehension is relatively preserved even when the frequency content is disrupted if the speech amplitude envelope is preserved. While previous studies have shown that electrical potentials generated by neural activity during listening to speech correlate with the speech envelope, and that the degree of this correlation predicts speech comprehensibility, it has not been determined precisely which cortical regions track the speech envelope.

In their recent study, Kubanek *et al*. (2013) recorded electrical activity intracranially with electrode grids placed on left-hemisphere cortical surface in five epileptic patients undergoing pre-surgical mapping of seizure foci. During recording, the subjects listened to four short stories narrated by a male voice. The stimulus amplitude envelope was computed as the sound power in consecutive 50-ms time windows, as was power of high-frequency gamma activity (75-115 Hz) for each of the recording electrodes. The results show that the speech amplitude envelope is most faithfully tracked by human non-primary auditory cortex that surrounds the primary auditory cortex located within the confines of the Heschl's gyrus, and that the gamma-band signal in these recordings correlates best with the speech envelope. Using non-speech control stimuli, the authors further demonstrated that the non-primary auditory cortical areas, while also tracking amplitude envelope of melody, do track more specifically the speech amplitude envelope. Higher-order structures (superior temporal gyrus and inferior frontal cortex), in contrast, tracked the speech amplitude envelope more weakly but at the same time even more specifically than the non-primary auditory cortical areas.

These findings provide important further knowledge on the cortical mechanisms underlying processing of speech amplitude envelope. The results reveal cortical areas that track the speech amplitude envelope, and further suggest that there is a processing hierarchy with the non-primary auditory cortical areas tracking the envelope of speech more robustly but less speech-specifically than superior temporal gyrus and posterior inferior frontal gyrus (*i.e.*, Broca's area) that are considered higher-order language areas.

Reference: Kubanek J, Brunner P, Gunduz A, Poeppel D, Schalk G. The tracking of speech envelope in the human cortex. PLoS ONE (2013) 8: e53398. http://dx.doi.org/10.1371/journal.pone.0053398

Posted by Iiro P. Jaaskelainen at 10:50 AM

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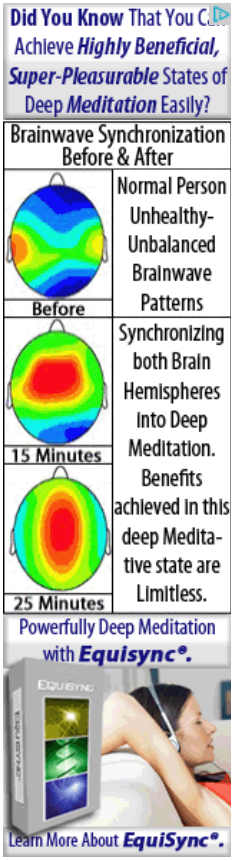

ABOUT ME

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I am a cognitive neuroscientist at the Brain and Mind Laboratory, Department of Biomedical Engineering and Computational Science, Aalto University School of Science, Finland. Prior to joining Aalto University, I have worked at the University of Helsinki and Harvard Medical School / Massachusetts General Hospital. I have conducted cognitive neuroscience studies since the mid-1990s using EEG, MEG, fMRI, and psychophysics, with a relatively wide range of interests from perceptual and cognitive functions, including emotions and social cognition, in healthy humans to cognitive deficits in psychiatric and neurological disorders. I have also been involved in psychopharmacological studies addressing the neurotransmitter basis of human perceptual and cognitive functions. If any questions or comments, ideas on the blog, that you would like to share with me, please do not hesitate to contact me at "iiro.p.jaaskelainen (at) gmail.com" For a general introduction to cognitive neuroscience, there is an e-book written by me that is freely downloadable at http://bookboon.com/en/textbooks/healthcare-science/introduction-to-cognitive-neuroscience

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