# Neuroimaging of speech articulatory motor control in the human brain

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Neuroimaging and articulography (speech movement tracking) are two major tools for studying the neurobiology of speech planning and production. Until now, however, it has not been possible to use articulography and neuroimaging in the same experimental setup because of technical incompatibilities between the two methodologies. This presentation describes our current international (Australia-Canada) collaboration, funded by the Australian Research Council and using a novel articulography system dubbed Magneto-articulography for the Assessment of Speech Kinematics (MASK; *Trans Biomed Eng*., 2016; *63*, 1709) to obtain detailed kinematic profiles of oro-facial movements during speech, while measuring neuromotor brain activity concurrently with magnetoencephalography (MEG). Concurrent kinematic/neuroimaging data were obtained from adults and children while they produced non-verbal utterances (lip smack), simple verbal utterances (/pa/), and complex verbal utterances (/pataka/). Results showed that the MASK system tracked mid-sagittal lip and tongue movements at resolutions comparable to those obtained with conventional speech tracking systems (electromagnetic articulography) at rates up to 50 cm/s with less than 1 mm relative position error and provide detailed profiles of derived kinematic parameters (movement duration, distance and velocity). Speech movements showed maximal cortico-kinematic coherence with source localized brain activities in ventral sensorimotor speech cortex. These results demonstrate that detailed kinematic parameters the speech articulators can be directly and precisely related to measurements of brain activity obtained in the same experimental setup. Recent invasive electrocorticography experiments have demonstrated that these are precisely the kinematic parameters that are encoded in speech motor cortex. This new capability sets the stage for cross-disciplinary efforts between researchers in experimental linguistics and cognitive neuroscience to study and understand the neuromotor control of human speech planning and production.