Research Proposal M2R 2018–2019

Title: Role of sensory working memory in speech motor learning

Background: The need to retain sensory information about prior movements, to enable the repetition of correct movements and the avoidance of errors, is central to motor skill acquisition. This need is particularly clear in speech motor learning which occurs without visual guidance and hence is likely reliant on both auditory and somatosensory working memory. Sensory working memory presumably plays a role in the maintenance of information for purposes of learning. But apart from a small set of studies on working memory in visuomotor adaptation and sequence learning, there has been little work on sensory working memory in the context of motor learning and none that we are aware of in relation to speech motor learning per se. This internship is involved in studies of speech motor learning that focus on the role of sensory working memory in speech. Although working memory is presumably essential for learning, its contribution to speech motor learning is unknown. To illuminate its role, behavioral studies will be planned to test the role of sensory working memory and its associated neural substrates in speech motor learning.

Purpose: To test the hypothesis that individual differences in auditory and somatosensory working memory predict speech motor adaptation.

Method: We will assess the relationship between sensory working memory and speech motor adaptation using a within-subject design. Each subject will undergo both auditory and somatosensory working memory tests and they will also adapt to altered auditory feedback training. We will examine how the performances in the two tests were correlated. This will serve as a check on the possibility that working memory testing affects adaptation.

As the model of speech motor learning, we will study speech motor learning by altering subjects' auditory feedback in real-time during speech production. In the auditory manipulation of vowel sounds, an acoustical-effects software will be used to shift portions of the frequency spectrum of the signal from the microphone and play it back to subjects in real-time. Sensory working memory will be also tested in terms of somatosensory and auditory function in separate sessions. A memory task in both somatosensory and auditory function is similar, that is, to identify whether the target stimulation was in the stimulations of memory set, which are presented before the target stimulation. Small stretch to the lip will be used for somatosensory stimulation. Speech sounds will be used for auditory stimulation.

Outputs: The results will illuminate close relationship between sensory working memory and speech motor learning. The student will learn an original and sophisticated technique of psychophysiological experiment concerning sensory working memory task and speech motor learning model using altered auditory feedback. Those test in the internship will be carried out using Python and Matlab for stimulus presentation and R for statistical analysis. This experiment, if successful, could drive towards studies using TMS and possible developments for speech processing and speech learning.

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Location: LPNC, GIPSA-lab for office and IRMaGe platform at the CHU/Grenoble for experiment

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