

Interactions of Area V5/MT and the Lateral Geniculate Nucleus in the Context of Visual Speech Recognition

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Abstract

Recognizing speech by observing articulatory gestures of the face - commonly referred to as visual speech recognition - relies on complex neural mechanisms of the brain that could extend beyond classical feedforward processing in the visual system. While specific cortical regions are consistently associated with visual speech, the contribution of early visual structures and their modulation by cortical feedback remain largely unexplored. This thesis investigates how the motion-sensitive cortical area V5/MT and the lateral geniculate nucleus (LGN) of the thalamus interact during visual speech recognition. By combining transcranial magnetic stimulation (TMS) and functional magnetic resonance imaging (fMRI), I examined the causal and functional dynamics of corticothalamic feedback within the visual system. Across three complementary studies, I tested (i) whether V5/MT is causally involved in visual speech recognition, (ii) whether task-dependent modulation of LGN responses depends on the functional integrity of V5/MT, and (iii) whether V5/MT-LGN connectivity is dynamically shaped by task demands. Using inhibitory TMS over V5/MT, I found that suppression of this area led to prolonged response times and diminished learning effects during both a visual speech and a simple motion recognition task, compared to stimulation of a control site. These results establish that V5/MT is not restricted to low-level, non-biological motion but is critically involved in processing movements of articulatory gestures. Furthermore, I investigated whether task-dependent modulation of LGN responses depends on feedback from V5/MT. Here, inhibitory TMS over V5/MT was followed by fMRI during a visual speech task and a matched colour recognition task using identical stimuli. When V5/MT was inhibited, the response difference between tasks was significantly reduced compared to control stimulation, indicating that cortical feedback from V5/MT contributes to the modulation of thalamic activity. Although behavioural performance measures of visual speech recognition were not associated to the neural responses, the findings provide novel and causal evidence for corticothalamic feedback affecting the human LGN during active visual tasks. Those patterns were corroborated by the final study, where I applied psychophysiological interaction (PPI) analyses and observed a task-dependent functional coupling between V5/MT and LGN that was modulated by inhibitory TMS. Together, the findings of this thesis demonstrate that V5/MT plays a causal role in visual speech recognition and that corticothalamic feedback contributes to shaping early thalamic processing during complex visual cognition. In specific, certain perceptual parameters might drive such feedback connections that can apply to visual-only speech in particular conditions, but not exclusively. Together, I demonstrate that cortical regions such as V5/MT influence early sensory structures to optimise the processing of dynamic signals in human visual recognition.