AB010. The effect of visual conditioning on cortical map plasticity: a wide-field calcium imaging study

Guillaume Laliberté, Elvire Vaucher

École d'Optométrie, Université de Montréal, Montreal, QC, Canada
Correspondence to: Elvire Vaucher, PhD. École d'optométrie-Université de Montréal, 3744 Jean-Brillant, Montréal, QC H3T 1P1, Canada. Email: elvire.vaucher@umontreal.ca.

Background: Visual conditioning can refine the response of neurons in the visual cortex and higher visual and cognitive processing of a presented stimulus. This process results in increased sensitivity for that stimulus. The development of new optical imaging technology in the field of neuroscience has led to important advances, notably to better define the functional organization and plasticity of visual areas. The objective of this project is to determine the effect of daily visual conditioning with an oblique sinusoidal grating on the distribution and amplitude of cortical responses. For this, we use wide-field calcium imaging on awake mice, allowing for the observation of responses to a stimulus throughout the entire cortex in real time.

Methods: C57BL/6 mice, expressing the GCaMP6s calcium reporter gene, are used to longitudinally measure neuronal activity via wide-field calcium imaging. Spontaneous activity at rest, as well as cortical responses to visual stimuli consisting of sinusoidal networks with orientation (0, 30°, 60° and 90°), spatial frequency (0.03, 0.12, 0.24 and 0.48 cpd) and contrast (100%, 75% and 50%) variables are recorded to establish cortical maps, as well as tuning curves. Subsequently, the baseline function of the cortex, as well as the cortical representation of visual stimulation (30° or 90°, 0.03 cpd and a contrast of 50%, 75% and 100%) are studied in the animal before, during, and after daily monocular conditioning, consisting of a specific sinusoidal network (30°, 0.03 cpd and 100%) over a period of 7 days. The variations in intensity and activation specificity of various visual cortical areas are calculated according to the visual conditioning and compared to an orientation stimulus for which the animal has not been conditioned (90°).

Results: The cortical activation curves show a greater sensitivity of response for stimuli having horizontal or vertical gratings (0 and 90°) than for oblique gratings (30° and 60°) at low spatial frequencies (0, 0.3 and 0.12 cpd). However, this trend does not occur with high spatial frequencies (0.24 and 0.48 cpd). Finally, although the intensity of activation varies in a way that is not proportional to the contrast of the stimulation, it would have no influence on the perception of the orientation of the stimuli. Conditioning at a 30° stimulus results in greater activation of the primary visual cortex and some extra-striate visual areas, as well as greater amplification of the ipsilateral cortical responses to the presentation of the visual stimuli.

Conclusions: In conclusion, the results demonstrate that visual conditioning would allow for plasticity and consolidation of higher visual pathways.

Keywords: Calcium imaging; visual conditioning; resting state

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