Interactions between central and peripheral vision rely on the retinotopic processing of spatial frequencies

Cynthia Faurite*[1], Eva Aprile[1], Louise Kauffmann[1], Martial Mermillod[1], Benoit R. Cottereau[2], and Carole Peyrin[1]

[1]Laboratoire de Psychologie et NeuroCognition – Université Savoie Mont Blanc, Centre National de la Recherche Scientifique, Université Grenoble Alpes – France

[2]Centre de recherche cerveau et cognition – Institut des sciences du cerveau de Toulouse., Université Toulouse III - Paul Sabatier, Centre National de la Recherche Scientifique – France

Résumé

Visual scene perception is based on reciprocal interactions between central and peripheral information. Such interactions are commonly investigated through the semantic congruence effect. The aim of the present study was to investigate whether congruence effects between central and peripheral vision rely on the bottom-up retinotopic processing of spatial frequencies (low spatial frequencies mainly in peripheral vision and high spatial frequencies mainly in central vision) or on top-down predictive processes (based on the rapid extraction of low spatial frequencies irrespective of their position in the visual field). We presented simultaneously two stimuli of different retinal eccentricity, one central and one peripheral, that could be either semantically congruent (belonging to the same scene image) or incongruent (belonging to two different scene images from different categories). In one experimental session assessing the congruence effect of central vision on peripheral vision, participants had to categorize the peripheral target stimulus (as an indoor or an outdoor scene) while ignoring the central distractor stimulus. In another session assessing the congruence effect of the peripheral vision on central vision, they had to categorize the central target stimulus while ignoring the peripheral distractor stimulus. Distractors were either filtered in low spatial frequencies (LSF) or in high spatial frequencies (HFS) while the target was unfiltered. Preliminary results showed a main congruence effect: mean correct response times were slower when the central and the peripheral stimuli were semantically incongruent than congruent. Importantly, the congruence effect of central vision on peripheral vision was significant only when the central distractor was filtered in HSF while the congruence effect of peripheral vision on central vision was significant only when the peripheral distractor was filtered in LSF. These results support the hypothesis that interactions between central and peripheral vision rely on the bottom-up retinotopic processing of spatial frequencies, although the presence of top-down mechanism in peripheral vision cannot be totally ruled out. This study has important clinical implications for patients suffering from macular degeneration. It suggests that, in addition to the central vision loss, patients may no longer benefit from central-peripheral interactions to process the information in their residual peripheral vision.

*Intervenant

Mots-Clés: Scene perception, central vision, peripheral vision, spatial frequencies, bottom, up processes, top, down processes