Neural bases of personal and extrapersonal neglect in humans

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Human awareness of left space may be disrupted by cerebral lesions to the right hemisphere (hemispatial neglect). Current knowledge on the anatomical bases of this complex syndrome is based on the results of group studies that investigated primarily the best known aspect of the syndrome, which is visual neglect for near extrapersonal (or peripersonal) space. However, another component—neglect for personal space—is more often associated with, than double-dissociated from, extrapersonal neglect, especially, in chronic patients. The present investigation aimed at exploring the anatomical substrate of both extrapersonal and personal neglect by using different advanced methodological approaches to lesion–function correlation. Fifty-two right ischaemic patients were submitted to neuropsychological assessment and in-depth MRI evaluation. The borders of each patient’s lesion were delimited onto its own high-resolution anatomical image and then submitted to an automated spatial normalization algorithm. Besides conventional lesion density plots and subtraction analysis, region-based statistical analyses were performed on percentage values of the lesioned tissue also using a new parcellation of the white matter (WM). Data were finally submitted to voxelwise statistical analysis using a recently proposed method (voxel-based lesion–symptom mapping). Results converged in showing that awareness of extrapersonal space is based on the integrity of a circuit of right frontal (ventral premotor cortex and middle frontal gyrus) and superior temporal regions, whereas awareness of personal space is rooted in right inferior parietal regions (supramarginal gyrus, post-central gyrus and especially the WM medial to them). Common but less crucial regions for both neglect sub-types were located in the temporo-peri-Sylvian cortex. We suggest that extrapersonal space awareness critically involves a ventral circuit recently described for the exogenous allocation and reorienting of attention in space. Disruption of personal space awareness, instead, seems to be due to a functional disconnection between regions important for coding proprioceptive and somatosensory inputs, and regions coding more abstract egocentric representations of the body in space. In conclusion, present data strongly support a segregation of personal and extrapersonal spatial awareness in humans, both from a functional and an anatomical point of view.

Keywords: hemispatial neglect; personal; extrapersonal; frontal; parietal

Abbreviations: CR = corona radiata; FEF = frontal eye field; IPL = inferior parietal lobule; MFG = middle frontal gyrus;
SMG = supramarginal gyrus; VLSM = voxel-based lesion–symptom mapping; WM = white matter


Introduction

Spatial awareness has been a topic of great interest for many decades, and hemispatial neglect is the neuropsychological syndrome which best represents the breakdown of such a crucial function in everyday life. Patients with hemispatial neglect, in fact, fail to orient to and explore the portion of space contralateral to their cerebral lesion, even in the