EDITORIAL COMMENTARY

Right hemisphere contributions to attention and intention

One of the hallmarks of circumscribed brain damage is that behaviour is selectively impaired for just a subset of cognitive abilities. A frequent concomitant of acute damage to the right hemisphere in humans is the disorder of unilateral neglect, in which patients lose awareness for sensory events arising from the left (contralesional) side of space. Such neglect has been attributed to an impairment of selective attention, the capacity by which relevant sensory inputs get selected from competing irrelevant ones for further processing by the brain. Contralesional sensory events that are not selectively attended generally elude the patients' awareness, as sometimes happens with neurologically healthy people when they miss relevant target information from one location if distracted by a salient, but irrelevant, event elsewhere.

Despite recent progress in understanding neglect, several important questions remain: Does neglect only impair processing of information from the contralesional side of space, or are ipsilesional inputs compromised too? Does it affect patients' intentions to make limb movements towards the contralesional side (for example, while using their ipsilesional hand to perform cancellation and line bisection tests), over and above any purely perceptual bias? Can selective attention, intention, and awareness be localised to specific brain regions? These questions are tackled in the paper by Kim *et al* (this volume, pp 35–8). They report data on five right hemisphere patients who apparently had neglect which was more severe on the right (ipsilesional) side than on the left, as measured by spatial errors on a horizontal-line bisection test. Importantly, the authors did not see any such "ipsilesional neglect" on a visual cancellation test, implying that the phenomenon is task-specific. Moreover, some patients showed contralesional neglect acutely, but then switched to a pattern of ipsilesional neglect as they recovered. Thus the attentional impairments shown by a given patient may not be characteristic of a particular kind of neglect. Rather, they probably reflect a combination of factors, both neurological (such as diaschisis and hypoperfusion within the damaged hemisphere) and cognitive (such as any compensatory strategies), which evolve over the immediate period after stroke.

A particularly innovative aspect of the study by Kim *et al* is their technique for dissociating attentional and intentional contributions to neglect. Patients viewed a video monitor of their own hand as they performed their bisections. The visual feedback they received via the monitor was either spatially congruent (such that a hand movement to the left corresponded to a leftward movement on the monitor, and vice versa), or spatially incongruent (such that the directions of movement on the monitor were opposite to the directions of the hand in space). Three of the five patients, all with frontal lesions, showed ipsilesional neglect in both the congruent and incongruent conditions, implying that the direction of the patients' limb movements determined their bias, rather than the direction of visual feedback from the monitor. This finding accords with previous claims of directional motor biases in frontal patients with contralesional neglect (see Mattingley and Driver[1] for a review).

But questions have been raised regarding the interpretation of data from such "spatial-opposition" tasks.[1] Many neurological patients, particularly those with frontal damage, find such incompatible tasks difficult, and may show biases that arise for reasons unrelated to any putative motor bias. A recent study which manipulated attentional and intentional components without setting them in opposition found that neglect patients with right inferior parietal damage were impaired in making leftward limb movements to targets in left hemispace, independent of their left sided perceptual deficit[2]; by contrast, neglect patients with right prefrontal damage showed no motoric bias, only a perceptual one. This fits with recent single cell recordings from awake monkeys showing intention related activity in a subpopulation of posterior parietal neurons.[3]

Such findings have led to the hypothesis that the inferior parietal lobe is critical for the earliest stages of motor planning, and that it plays a key part in modulating selective attention.[4] The study by Kim *et al* provides a timely reminder that attention and intention probably involve a complex interplay between several brain areas, and that disorders of awareness such as unilateral neglect are far from being fully understood.

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2 Mattingley JB, Husain M, Rorden C, *et al*. Motor function of human inferior parietal lobe revealed in unilateral neglect patients. *Nature* 1998;**392**:179–82.
3 Snyder LH, Batista AP, Anderson RA. Coding of intention in the posterior parietal cortex. *Nature* 1997;**386**:167–70.
4 Driver J, Mattingley JB. Parietal neglect and visual awareness. *Nature Neuroscience* 1998;**1**:17–22.