

## **2. Can attention capture visual awareness?**

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In their scholarly and useful review of the literature on attentional capture, Ruz & Lupiáñez conclude that attentional capture is largely automatic process, because it occurs “by default”, in the absence of a specific strategic set, but can be endogenously modulated. In this commentary I will try to interpret evidence from brain-damaged patients with unilateral neglect as resulting from an asymmetry of functioning of processes related to attentional capture, and to propose an important role of these processes in visual awareness.

Left unilateral neglect is a neurological condition occurring after damage to the posterior part of the right hemisphere. Neglect patients live in a halved world, being unable to orient or respond to left-sided events. They bump into furniture on their left side, do not eat from the left part of the dish, and do not answer to people standing on their left. In contrast, they show a pathological, “magnetic” attraction toward right-sided objects. Their attention seems to be captured rapidly and compulsively by right-sided objects, even when these are irrelevant to the current task. For example, in clinical examination, when the examiner briefly moves the fingers of either or both hands in patients’ visual fields in order to test for visual field defect, neglect patients often compulsively look at the hand on their right as soon as it appears in their visual field, before the actual administration of stimuli (Gainotti, D’Erme, & Bartolomeo, 1991). Another example comes from the line cancellation task, in which patients are presented with a sheet containing several lines and asked to draw over all of them with a pencil mark. Neglect patients often omit to cancel left-sided lines. In an ingenious variant of this task, neglect patients had to draw over lines or to erase them, and showed fewer omissions in the ‘erase’ than in the ‘draw’ condition (Mark, Kooistra, & Heilman, 1988). This pattern of results suggests that right-sided lines attracted patients’ attention when they were crossed by a pencil mark, whereas rendering these lines invisible by erasing them obviously nullified this effect, thus decreasing neglect. In a Posner-type reaction time task, the mere appearance of the bilateral placeholder boxes was capable of further slowing patients’ response latencies for left targets (as compared to a condition without boxes), as if the right-sided boxes attracted patients’ attention before the actual targets appeared (D’Erme, Robertson, Bartolomeo, Daniele, & Gainotti, 1992). Taken together, these results strongly suggest that a crucial

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disorder in left neglect is a spatial asymmetry of processes involved in exogenous orienting of attention (Bartolomeo & Chokron, 2002). What can be the functional basis of this bias? A first hypothesis could be that left neglect stems from a disordered mental representation of the left half of space (see, e.g., Bisiach, 1993), such that left-sided objects have a lesser power to attract attention, perhaps as a result of being less perceptually salient than their right-sided counterparts. However, there seems to be no rigid boundary between left (neglected) and right (non-neglected) space in left neglect; rather, patients' performance seems to follow a left-to-right spatial gradient; even in the right, non-neglected space their performance is better for (relatively) right-sided items than for (relatively) left-sided items (Kinsbourne, 1993; Làdavas, Petronio, & Umiltà, 1990). Indeed, Marshall and Halligan (1989) reported that targets could be omitted in a shape cancellation task independently of their position with respect of the midsagittal plane, and concluded that 'right attentional capture' might be a better description of patients' performance than 'left neglect'.

Thus, one can imagine that in neglect a directional (rather than hemispatial) asymmetry of processes involved in attentional capture, with capture from right-sided events being easier and/or faster than capture from left-sided events, is at work. It is beyond the scope of this commentary to discuss the issue of whether this asymmetry results from an excessive facilitation for rightward orienting (see, e.g., Kinsbourne, 1993), or a deficit of leftward orienting (e.g., Heilman, Watson, & Valenstein, 1993; Riddoch & Humphreys, 1987), or both (see Bartolomeo & Chokron, 1999, for data and discussion relevant to this issue). What is of interest here is that an attentional bias primarily affecting exogenous orienting can lead to a dramatic lack of awareness for a huge portion of the patients' space. This is reminiscent of situations in which normal individuals show (less dramatic) forms of unawareness for perceptually salient stimuli, as in the "change blindness" experiments (recently reviewed by O'Regan & Noë, 2001), and suggests that processes underlying attentional capture, such as exogenous orienting of attention, are necessary for our phenomenal awareness of the visual world (Bartolomeo & Chokron, *in press*). It is an interesting possibility that research on attentional capture may eventually shed light on the mechanisms of visual awareness.

Ruz & Lupiáñez review evidence suggesting that attentional capture can be modulated by top-down processes, such as those related to the subjects' goals and strategies. Can neglect patients use these processes to compensate for their neglect? The answer seems to be yes, but has to be further qualified. First, it is well known that a number of patients clinically recover from neglect, either spontaneously or after rehabilitation. Evidence suggests that these patients in fact learn to compensate for an early right attentional capture with a later leftward orienting (Bartolomeo, 1997; Mattingley, Bradshaw, Bradshaw, & Nettleton, 1994), perhaps through the use of an active inhibition for right-sided items (Bartolomeo, 2000). Second, also patients with chronic neglect are able to exert some top-down control on their attentional orienting (Bartolomeo, Siéoff, Decaix, & Chokron, 2001; Duncan et al., 1999; Làdavas,

Carletti, & Gori, 1994; Smania et al., 1998). Perhaps they can do so only in a narrow experimental set, and not in real life, because their endogenous orienting processes are too slow to cope with the ever-changing visual environment of everyday life (Bartolomeo et al., 2001). Thus, (relatively) preserved endogenous processes are apparently insufficient for a full awareness of the visual environment, if attentional capture is laterally biased. Further research on unilateral neglect, perhaps employing some of the clever experimental paradigms reviewed by Ruz & Lupiáñez, may shed further light on attentional capture and on its relationships with visual awareness.

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