Pergamon

PII: S0028–3932(96)00105–4

Neuropsychologia, Vol. 35, No. 5, pp. 583–589, 1997

Printed in Great Britain
0028–3932/97 $17.00+0.00

Influence of perceptual and semantic conflicts between the two halves of chimeric stimuli on the expression of visuo-spatial neglect

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(*Received* 15 *October* 1995; *accepted* 2 *October* 1996)

Abstract—We investigated how perceptual and semantic relationships between the left and right half of chimeric stimuli influence overt and covert visual processing by asking eight right brain damaged (RBD) patients with hemispatial neglect to identify complete, half-, and chimeric drawings. Chimeric stimuli belonged in one of four categories defined according to the perceptual and semantic relatedness between the two compounding hemi-figures. Thus, the hemi-figures could be related both perceptually and semantically, only perceptually, only semantically, or neither perceptually nor semantically. Although patients often appeared to base their report on the right part of the chimerics, the number of errors was minimal when conflicts between the two hemi-figures were maximal. Moreover, perceptual conflicts, which mainly affect the perception of the shape, appeared to influence the performance more than semantic conflicts. Since the analysis of shape incongruency is probably accomplished at early levels of information processing, the result suggests that preattentive analysis is largely spared in the experimental patients and that, in our task, bottom-up factors more than top-down factors modulate the expression of left neglect. © 1997 Elsevier Science Ltd.

Key Words: visual processing; chimerics; hemi-inattention.

Introduction

Right hemisphere lesions, particularly when involving the parietal lobe, typically disrupt the ability to orient to, act upon, and perceive stimuli delivered to the contralesional part of the space [18, 31]. Patients with such an impairment, referred to as unilateral left neglect, appear to lack conscious information about stimuli in the contralesional space. Such an impairment, however, may depend on the experimental tasks [20, 28, 29, 32], as well as on the salience [36], or the lexical status [3, 9, 28] of the experimental stimuli.

There is much clinical and experimental evidence to suggest that, even if explicit knowledge of contralesional stimuli seems to be lost, information gleaned unconsciously about such stimuli can drive cognitive [5, 7, 11, 12, 21, 25] and emotional performance [24]. Recent studies in which patients were asked to analyse chimeric figures provided a useful, simple way to analyse overt and covert processing in neglect patients [8, 10, 26, 33, 34]. Even though this kind of paradigm may be used to disentangle possible selective influences of perceptual (low-level) and cognitive (higher-order) factors on hemispatial neglect, this issue has been hitherto largely unaddressed. Buxbaum and Coslett [10] tested the accuracy of neglect patients in analysing chimerics in which the two halves belonged in the same (e.g. two animals) or different semantic category (e.g. animals–common objects). They reported that semantic relatedness between the two halves of chimerics induced a trend towards a higher number of left-side omissions. Drawings in the same semantic category, however, also shared perceptual relations (e.g. two hemi-animals may reproduce a prototypical four-leg outline). Therefore, the influence of semantic and perceptual variables may not have been disambiguated.

To determine whether the poor left-side report is influenced by semantic and/or perceptual variables, we tested with a simple bedside test, eight right brain damaged (RBD) patients with hemispatial neglect. Patients were

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asked to describe complete, half-, or chimeric drawings in which the two compounding halves could have perceptual and semantic relationships, only perceptual, only semantic, or neither semantic nor perceptual relationships. Theoretically, such manipulations of chimerics can allow us to determine the possible different contribution of perceptual and semantic clues to the expression of neglect symptoms, and consequently the putative levels at which information processing is impaired in neglect.

Method

Subjects

Eight right-handed patients, five men and three women, drawn from a series of RBD patients admitted to the Rehabilitation Unit at Civic Hospital, Negrar, between December 1995 and April 1996 participated in the study. Their age and education ranged from 56 to 82 years (mean 71.7 ± S.D. 8.6) and from 3 to 8 years of school (mean 5.2 ± S.D. 1.4). Patients, previously informed that the test was not part of any therapeutic programme, gave their informed consent. Signs of widespread mental deterioration, assessed by means of the MMS examination [14], were absent in all patients. The sites of the lesions were documented by means of radiological (CT or MRI) exams. All patients had ischaemic lesions except patient M.G. who suffered from a haemorrhage. Visual field defects and visual extinction were assessed by using a standard confrontation test [6] in which patients were required to detect the wiggle of the examiner's index forefingers. A random sequence of 10 single (five in the left and five in the right hemifield) and 10 double stimuli was delivered. Patients who detected at least three out of five single contralesional stimuli and missed more than three out of 10 contralesional stimuli during simultaneous double stimulation were considered as affected by extinction. Visual extinction was detected in seven out of the eight patients. Patient M.G. showed a left homonymous hemianopia. The presence of visual neglect was ascertained by means of a series of six tests, namely the Albert's cancellation test [1], a reading test [2], a sentence copying test, drawing from copy and from memory tasks [17], and a clinical test for assessing the presence of magnetic attraction of eyes (or head) towards the ipsilesional side elicited by lateralised visual stimuli [15]. Additional clinical and radiological information for each patient is provided in Table 1.

A right-handed man (E.J., age 77 years, schooling 18 years) with right temporo-parietal and basal ganglia damage served as control. This patient, tested about 2 months after his stroke, did not show any sign of neglect or visual extinction.

Materials

The experimental stimuli were black and white figures, selected from the graphic library of a standard software package (Harvard graphics, 3.0), and printed on A4 pages. The six basic, complete figures used in the test reproduced animals (horse, cow, rooster, bird, elephant, pig). The complete figures, centred on the paper, were oriented leftwards (in six trials) or rightwards (in six trials). Half-stimuli, always made by using the anterior part of each complete figure, could be in the left (six trials) or the right part of the paper (six trials). The anterior part of the complete figures was used to make the right part of chimerics.

Chimeric figures were divided into in four groups according to the perceptual and semantic relationship between their compounding halves. In the first group, non-related chimeras (NRC), there was neither semantic nor perceptual relationship between the two halves of each chimerics (Fig. 1a). Thus, the two half-figures belonged in different semantic classes (e.g. the anterior part of an animal was joined with the posterior part of a vehicle) and their outlines differed substantially from the corresponding complete figure (e. g. the four leg pattern of the cow with the wheel-like outline of a bike). The second group, called semantically related chimerics (SRC) was generated by juxtaposing two anterior half-figures belonging to the same semantic class as in Fig. 1b. In this case, the semantic relation was still present but the resultant outline of the chimera was inconsistent with the general structural plan of the complete figures. The third group, called perceptually related chimeras, PRC, was made by juxtaposing half-animals and half-non-living objects (see Appendix). In spite of the absence of semantic relatedness between the two compounding half-figures, the resulting chimeric had a shape similar to that of the correspondent basic figure (Fig. 1c). The fourth group, called perceptually and semantically related chimeras (PSRC) consisted of drawings made by hemi-figures belonging to the same semantic category (animals) and positioned in such a way that the outline of the resulting figure had some relationship with each original, complete figure. For example, the chimera made by the anterior part of a horse and the posterior part of a cow was not only made by two hemi-animals but also maintained a plausible four-leg outline pattern typical of both animals (Fig. 1d).

Table 1. Clinical and demographic data of the experimental patients. Plus indicates an impaired performance; minus indicates a normal performance

Patients	V.E.	Alb.	Read.	Copy	Mem.	Writ.	M.A.	Lesion site
L.T.	+	−	−	−	−	−	+	F-T-P-BG
B.M.	+	−	−	−	−	−	+	T-P
I.V.	+	−	−	+	−	−	+	F-T-P
C.C.	+	+	+	+	−	−	+	F-T-P
A.C.	+	+	+	+	n.p.	−	+	P-BG
M.C.	+	+	+	+	+	+	+	F-T-P
M.G.	*	+	+	+	+	+	+	P-O
A.G.	+	+	+	+	+	+	+	T-P

Note: V.E. = visual extinction; * = visual field defect; Alb. = cancellation test; Read. = reading test; Copy = drawing from copy; Mem. = drawing from memory; Writ. = sentence copying test; M.A. = magnetic attraction of eyes or head towards stimuli in the right hemispace; n.p. = not performed; F = frontal; T = temporal; P = parietal; O = occipital; BG = basal ganglia.

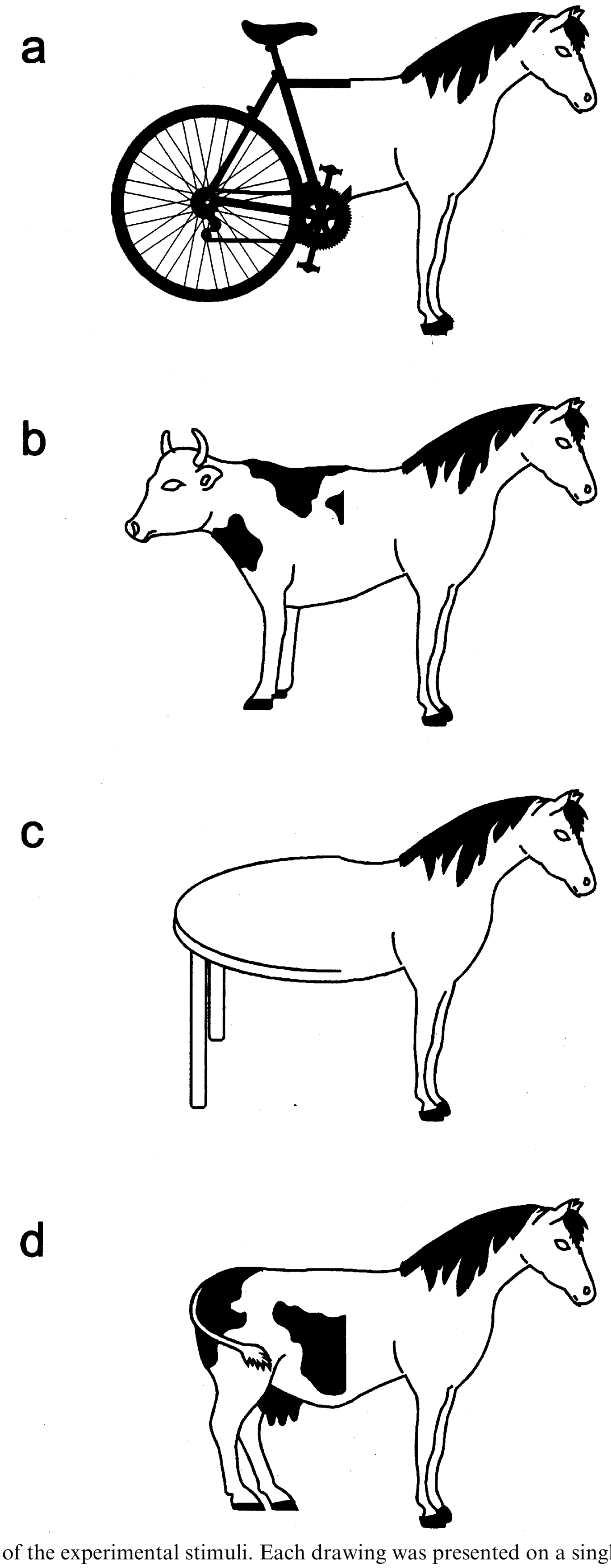

Fig. 1. Representative examples of the experimental stimuli. Each drawing was presented on a single sheet of paper. Figures (a), (b), (c) and (d) refer to NRC, SRC, PRC and PSRC, respectively.

The above manipulation of chimerics was made with the aim to differentiate perceptual and/or semantic effects possibly modulating patients' performance. A list of the chimeric figures used in the experiment is reported in the Appendix.

Procedure

Each patient was presented with a random sequence of 48 stimuli. On 12 trials the stimuli were complete figures (six leftward and six rightward oriented). On 12 trials stimuli were half-figures (six lying in the left and six in the right hemispace). On 24 trials stimuli were chimeric figures, belonging in one of four categories. The categorisation of each chimeric stimulus was decided *a priori* by the experimenters. To avoid biases (even unconscious) related to a knowledge of the hypothesis under investigation, we asked 10 naive observers to assign each chimeric stimulus to one of the four pre-defined categories according to the perceptual and semantic relatedness between the two compounding halves. The sorting made by these subjects largely overlapped that made by the experimenters.

Patients, previously informed that the experimental stimuli could consist of complete, half or odd (i.e. "made by two different parts") drawings, were asked to identify verbally each stimulus. A full description of each stimulus was scored as a correct response. For example, the expected response for a stimulus like that in Fig. 1b was "I see the anterior part of a cow and the anterior part of a horse". When the stimuli were not described appropriately (e.g. the description was based on the right part only) patients were requested to label the stimuli as complete, half or odd. Patients were encouraged to detail as much as possible the reasons for their choices. Not only we analysed quantitatively the number of the hits, but we also examined in detail verbal report of each patient. Ericson and Simon's work [13], in fact, showed that verbal responses can be considered as reliable data. Each sheet of paper with the stimuli was aligned with subjects' body midline. Head, eye and body movements were not restrained. Exposure time of the stimuli was unlimited. No feedback about the accuracy of performance was given to the patients at any time. Each patient was tested in one experimental session that lasted about one hour.

Results

The performance of the control subject was flawless. All patients identified correctly the complete figures. Seven (out of eight) patients were flawless when reporting on the half-figures lying in the left space. By contrast, patients typically made errors when presented with the half-figures lying in the right space and with the chimeric stimuli.

Analysis of correct responses.

Table 2 reports the accuracy of patients' performance.

A two-sample *t*-test was used to assess whether or not the accuracy in reporting half-figures was higher in the left than in the right hemispace. Although the inspection of raw data suggested a higher accuracy when half-figures were in the left hemispace, this difference turned out to be insignificant ($P = 0.13$).

Differences in accuracy related to the type of chimeric stimuli were evaluated by entering the number of correct responses in a one-way ANOVA with levels corresponding to the four classes of chimeric stimuli (NRC, SRC, PRC and PSRC). There was a significant main effect [$F(3, 28) = 35.74$, $P = 0.0001$] indicating that the number of hits differed in the four classes of stimuli. *Post-hoc* comparisons, using the Newmann–Kuels procedure (alpha level defined at $P < 0.05$), showed that: (1) the accuracy on PSRC was lower than on the other three classes of stimuli; (2) the accuracy on PRC was lower than SRC and NRC (which, in turn, did not differ from each other).

Table 2. Number of the hits scored by neglect patients in each stimulus category

	Type of stimuli					
Patients	Half in L	Half in R	NRC	SRC	PRC	PSRC
L.T.	6	6	4	5	2	0
B.M.	6	6	6	5	1	0
I.V.	6	4	4	4	1	1
C.C.	6	6	5	2	2	0
A.C.	6	5	5	4	0	1
M.C.	3	4	5	5	2	1
M.G.	6	2	4	6	3	1
A.G.	6	5	6	5	3	2

Note: Half in L = half-figures in the left hemispace; Half in R = half-figures in the right hemispace; NRC = nonrelated chimerics; SRC = semantically related chimerics; PRC = perceptually related chimerics; PSRC = perceptually and semantically related chimerics.

Analysis of the type of errors

The only kind of error recorded for half-figures, consisted in pathological completions, i.e. reports of half-figures as complete. Three types of error were recorded for chimeric stimuli. *Type* (*a*) was when figures were labelled as complete and only the right part of the stimulus appeared to drive the response; this type of error, corresponding to pathological completions, was the most common (56.7% out of the total number of errors) and it was present in all patients. Although this type of error was recorded for stimuli belonging in all chimeric categories, it tended to be higher when the perceptual differences between the two half-figures were low (e.g. 58.8% for PRC and 61.9% PSRC vs 55.5% for NRC and 33.3% for SRC). *Type* (*b*) was when figures were named according to the right half and labelled as complete, but the neglected part also seemed to influence the response. Some examples of this type of error are provided below. Three patients reported that an anterior half-cow on the right and a posterior hemi-horse on the left was a calf (and not a cow as they did for the correspondent complete figure).

Analogously, one patient reported that the chimera made by a hemi-horse on the right and hemi-cow on the left was a filly, probably because of the presence of the udder in the left hemi-figure.

Moreover, the figure of a hemi-rooster on the right and a hemi-fan on the left was named by two patients (B.M. and M.G.) as a nice peacock. Errors falling in this category suggest some degree of covert processing of the overtly neglected stimuli. This type of error was not uncommon, accounting for 38.1% of the total number of errors and being present in all patients and in all chimeric categories. *Type* (*c*) was when chimeras were labelled as right half-figures. This kind of error, made up only 5.2% out of the total number of errors and it was observed only in three patients (namely, M.C., I.V. and C.C.).

Discussion

The main aim of the present study was to assess with a bedside clinical test, whether or not perceptual or semantic relationships between left and right half of visual stimuli have a different influence on the elicitation of hemispatial defects. Such an approach may help to shed light on the levels of analysis (i.e. perceptual or semantic) at which visual processing may be selectively affected in neglect patients.

The performance of the control patient was perfect in all stimulus categories. No patient ever misidentified complete figures thus suggesting that the non-spatial mechanisms underlying picture recognition and naming were not altered in these patients. It is worth noting, however, that the perfect recognition of complete figures does not necessarily imply a fully aware processing of the complete array. Peru *et al.* [26], by using figures similar to that of the present study, found that neglect patients may be unable to report details on the left side of complete figures which, by contrast, were identified correctly.

The experimental patients made several errors when recognising both half- and chimeric figures. When presented with a half-figure in the right space, patients often reported it as complete, i.e. they filled in the empty left side (pathological completion [35]).

This behaviour is not surprising since neglect patients, typically impaired in processing information from the contralesional side of space overtly, do not necessarily present with any disturbance of general intelligence and tend to interpret the world around them coherently [27]. Completion may even take place when there is no conflicting information on the left (e.g. in half-figures). A trend towards a better performance for half-figures lying in the left than in the right space was observed. This result, in line with previous reports [22, 23], would suggest that the absence of stimuli in the right space may ameliorate the performance of neglect patients.

When there is a conflict between the two halves of a stimulus, e.g. for chimerics where left and right information may be incompatible, processing of the left-side information is more likely to occur. Our study showed that this may be the case. In fact, the results indicate that errors were significantly higher for PSRC (where the two chimeric halves were semantically and perceptually related) than the other three chimeric categories which were characterised by stronger perceptual and/or semantic conflicts.

It is assumed that there are several different steps in visual information processing, tapping different perceptual and cognitive resources. Each step may be selectively related to increasingly complex analyses, ranging, for example, from detection of elementary visual features to their binding in complex visual objects and scenes [30]. Early stages of analysis are related to preattentive vision and concern global computations like figure–ground segregation; by contrast, later stages related to attentive vision, concern the more detailed analyses which eventually lead to recognition and naming of objects and places, and which require increased perceptual and cognitive efforts [19]. The problem arises as to what levels of impairment can best explain our results. Were the preattentive level impaired, all categories of chimeras would have been analysed with the same accuracy. In agreement with previous studies [12, 16], our data seem to indicate that preattentive levels of processing, such as those involved in figure–ground segregation, are largely spared in our patients. Indeed, when the general outline of the experimental stimuli presented a gross left–right incongruency (like for SRC and NRC), the number of errors was significantly lower compared with PRC and PSRC where such incongruency was definitely smaller. The comparable accuracy for SRC and NRC would suggest that there is no semantic relatedness effect and that once preattentive analysis has been successful, higher-order variables are largely immaterial. It is worthy to note, however, that errors for PRC (where a perceptual relation stood in contrast with a semantic conflict) were significantly lower than for PSRC (characterised by the absence of both semantic and perceptual conflicts). Thus, although semantic factors may influence the performance, bottom-up factors predominate over top-down factors. This result does not imply, however, that top-down influences can be understated. Behrmann *et al.* [3, 4], for example, examined the reading performance of two neglect patients and found that reading impairments were linked to perceptual factors in one patient and to higher-order variables, such as the lexical status of the stimulus, in the other.

Although most errors indicated that the performance of our patients was driven by information gathered consciously from the right side, errors indicating implicit processing of left-side information were not uncommon. As previously reported [26], the approach based on the analysis of verbal reports indicates that unconscious processing of left-side information is not infrequent among neglect patients. Type (c) errors (i.e. labelling chimeric stimuli as half-stimuli) is somewhat paradoxical because neglect patients typically tend to complete half-figures pathologically. Paradoxical responses in neglect patients have been reported by Vallar and co-workers [33]. These authors asked neglect patients to chose between one complete (e.g. a dog with the anterior part in the right space) and one chimeric figure (a half-dog in the right space and the anterior half of a horse in the left space). Thus, the two figures differed only in their left part. Neglect patients who reported to see two identical dogs, were asked by the examiners to say which dog looked similar to a horse. Theoretically, this instruction could have induced a bias towards the dog–horse stimulus. A minority of patients, however, made their choice against the experimental bias. The neuropsychological implications of such behaviour deserve further investigation. It seems plausible, however, that paradoxical responses represent a form of avoidance of the left half-figure perchance because of an unconscious detection of the incongruency between left and right half-hemi-figures. Thus, whatever the meaning of paradoxical responses is, such responses may be considered as instances of implicit processing. Indeed, the systematic avoidance of a stimulus in the absence of the awareness of its presence, does suggest that the above stimulus must have been processed.

Acknowledgements—We wish to thank Dr G. Di Pellegrino and one anonymous referee for their helpful comments on the manuscript and Mr M. Veronese for his skillful help with the preparation of the figures. This research was supported by funds from the M.U.R.S.T. and the Consiglio Nazionale delle Ricerche, Italy.

References

1. Albert, M. L. A simple test of visual neglect. *Neurology* **23,** 658–664, 1973.
2. Barbieri, C. and De Renzi, E. Patterns of neglect dissociation. *Behavioral Neurology* **2,** 13–24, 1989.
3. Behrmann, M., Moscovitch, M., Black, S. E. and Mozer, M. Perceptual and conceptual mechanisms in neglect dyslexia. *Brain* **113,** 1163–1183, 1990.
4. Behrmann, M., Moscovitch, M. and Mozer, M. Directing attention to words and nonwords in normal subjects and in a computational model: Implications for neglect dyslexia. *Cognitive Neuropsychology* **8,** 213–248, 1991.
5. Berti, A. and Rizzolatti, G. Visual processing without awareness: Evidence from unilateral neglect. *Journal of Cognitive Neuroscience* **4,** 345–351, 1992.
6. Bisiach, E., Vallar, G., Perani, D., Papagno, C. and Berti, A. Unawareness of disease following lesions of the right hemisphere: Anosognosia for hemiplegia and anosognosia for hemianopia. *Neuropsychologia* **24,** 471–482, 1986.
7. Bisiach, E., Meregalli, S. and Berti, A. Mechanisms of production, control, and belief fixation in human visuospatial processing: Clinical evidence from unilateral neglect and misrepresentation. In *Quantitative Analyses of Behavior*, M. L. Commons, R. J. Herrnstein, S. M. Kosslyn and D. B. Mumford (Editors). LEA, Hillsdale, 1990.
8. Bisiach, E. and Rusconi, M. L. Break-down of perceptual awareness in unilateral neglect. *Cortex* **26,** 643–649, 1990.
9. Brunn, J. L. and Farah, M. J. The relation between spatial attention and reading: Evidence from the neglect syndrome. *Cognitive Neuropsychology* **8,** 59–75, 1991.
10. Buxbaum, L. J. and Cosslet, B. Neglect of chimeric figures: Two halves are better than a whole. *Neuropsychologia* **32(3),** 275–288, 1994.
11. D'Esposito, M., McGlinchey-Berroth, R., Alexander, M. P., Verfaellie, M. and Milberg, W. P. Dissociable cognitive and neural mechanisms of unilateral visual neglect. *Neurology* **43,** 2638–2644, 1993.
12. Driver, J., Baylis, G. C. and Rafal, R. Preserved figure–ground segmentation and symmetry perception in a patient with neglect. *Nature* **360,** 73–75, 1993.
13. Ericsson, K. A. and Simon, H. A. In *Protocol Analysis*: *Verbal Reports as Data*, Rev. Edn. MIT Press, Cambridge, MA, 1993.
14. Folstein, M. F., Folstein, S. E. and McHugh, P. R. Mini-Mental State. *Journal of Psychiatric Research* **12,** 189–198, 1975.
15. Gainotti, G., D'Erme, P. and Bartolomeo, P. Early orientation of attention toward the half space ipsilateral to the lesion in patients with unilateral brain damage. *Journal of Neurology*, *Neurosurgery*, *and Psychiatry* **54,** 1082–1089, 1991.
16. Grabowecky, M., Robertson, L. C. and Treisman, A. Preattentive processes guide visual search: Evidence from patients with unilateral visual neglect. *Journal of Cognitive Neuroscience* **5(3),** 288–302, 1993.
17. Halligan, P. W., Cockburn, J. and Wilson, B. A. The behavioural assessment of visual neglect. *Neuropsychological Rehabilitation* **1,** 5–32, 1991.
18. Heilman, K. M., Watson, R. T. and Valenstein, E. Neglect and related disorders. In *Clinical Neuropsychology*, 3nd Edn, K. M. Heilman and E. Valenstein (Editors), pp. 279–336. Oxford University Press, New York, 1993.
19. Julesz, B. Preattentive human vision: Link between neurophysiology and psychophysics. In *Handbook of Physiology*, V. B. Mountcastle, F. Plum, and S. R. Geiger (Editors), Vol. V, pp. 585–604. American Physiological Society, Bethesda, 1987.
20. Karnath, H. O., Schenkel, P. and Fischer, B. Trunk orientation as the determining factor of the 'contralateral' deficit in the neglect syndrome and as the physical anchor of the internal representation of body orientation in space. *Brain* **114,** 1997–2014, 1991.
21. Làdavas, E., Paladini, R. and Cubelli, R. Implicit associative priming in a patient with left visual neglect. *Neuropsychologia* **31,** 1307–1320, 1993.
22. Làdavas, E., Umiltá, C., Ziani, P., Brogi, A. and Minarini, M. The role of right side objects in left side neglect: A dissociation between perceptual and directional motor neglect. *Neuropsychologia* **31,** 761–773, 1993.

23. Mark, V. W., Kooistra, C. A. and Heilman, K. M. Hemispatial neglect affected by non-neglected stimuli. *Neurology* **38,** 1207–1211, 1988.
24. Marshall, J. C. and Halligan, P. W. Blindsight and insight in visuo-spatial neglect. *Nature* **336,** 766–767, 1988.
25. McGlinchey-Berroth, R., Milberg, W. P., Verfaellie, M. and Alexander, M. P. Semantic processing in the neglected field: Evidence from a lexical decision task. *Cognitive Neuropsychology* **10(1),** 79–108, 1993.
26. Peru, A., Moro, V., Avesani, R. and Aglioti, S. Overt and covert processing of left side information in neglect patients investigated with chimeric drawings. *Journal of Clinical and Experimental Neuropsychology*, **18,** 621–630, 1996.
27. Seron, X., Coyette, F. and Bruyer, R. Ipsilateral influences on contralateral processing in neglect patients. *Cognitive Neuropsychology* **6,** 475–498, 1989.
28. Sieroff, E., Pollatsek, A. and Posner, M. L. Recognition of visual letter following injury to the posterior visual–spatial attentional system. *Cognitive Neuropsychology* **5,** 427–449, 1988.
29. Smania, N. and Aglioti, S. Sensory and spatial components of somaesthetic deficits following right brain damage. *Neurology* **45,** 1725–1730, 1995.
30. Treisman, A. The perception of features and objects. In *Attention*: *Selection*, *Awareness*, *and Control. A Tribute to Donald Broadbent*, L. Weiskrantz and A. Baddeley (Editors), pp. 5–35. Oxford University Press, Oxford, 1993.
31. Vallar, G. The anatomical basis of spatial hemineglect in humans. In *Unilateral Neglect*: *Clinical and Experimental Studies*, I. H. Robertson and J. C. Marshall (Editors), pp. 27–59. Lawrence Erlbaum, New York, 1993.
32. Vallar, G., Bottini, G., Rusconi, M. L. and Sterzi, R. Exploring somatosensory hemineglect by vestibular stimulation. *Brain* **116,** 71–86, 1993.
33. Vallar, G., Rusconi, M. L. and Bisiach, E. Awareness of contralesional information in unilateral neglect: Effects of verbal cueing, tracing and vestibular stimulation. In *Attention and Performance XV*, C. Umiltá and M. Moscovitch (Editors), pp. 377–391. MIT Press, Cambridge, MA, 1994.
34. Young, A. W., Hellawell, D. J. and Welch, J. Neglect and visual recognition. *Brain* **115,** 51–71, 1992.
35. Warrington, E. K. The completion of visual forms across hemianopic field defects. *Journal of Neurology Neurosurgery and Psychiatry* **25,** 208–217, 1962.
36. Weintraub, S. and Mesulam, M. M. Visual hemispatial inattention: Stimulus parameters and exploratory strategies. *Journal of Neurology Neurosurgery and Psychiatry* **51,** 1481–1488, 1988.

Appendix

List of the chimeric drawings employed in the study. The Left/ Right subheading indicates the spatial position of each hemi-figure compounding the chimeric stimulus. The labels Anterior and Posterior refer to the part of the corresponding complete figure used for making the chimeric stimulus. The sign # indicates figures in which no standard anterior–posterior partition is possible. Legend as for Table 2.

NRC Left · Right Posterior · Anterior	SRC Left · Right Anterior · Anterior	PRC Left · Right # · Anterior	PSRC Left · Right Posterior · Anterior
Bike · Horse	Cow · Horse	Raquet · Elephant	Cow · Horse
Truck · Elephant	Elephant · Cow	Gun · Cow	Horse · Cow
Old car · Pig	Horse · Rooster	Table · Horse	Bird · Rooster
Motorbike · Cow	Rooster · Bird	Guitar · Bird	Rooster · Bird
Plane · Rooster	Pig · Elephant	Fan · Rooster	Elephant · Pig
Ship · Rooster	Bird · Pig	Clock · Pig	Pig · Elephant