Spatial neglect is a lateralized disorder with a characteristic failure to explore or react to stimuli presented in contralesional space. Visual extinction, however, is a failure to detect a contralesional target in the presence of a competing ipsilesional stimulus. In contrast to neglect, extinction is apparent only when 2 stimuli compete for the subject’s attention.

Generally it is accepted that spatial neglect occurs predominantly after disruption of the human right hemisphere. The disorder seems to be as asymmetrically represented in the right hemisphere, as are language functions in the human left hemisphere. In contrast, it remained controversial whether extinction follows the same hemispheric asymmetry. In the literature, the opinion prevails that the laterality of visual extinction is not as pronounced as it is for spatial neglect. It has been suggested that the association with damage of the right hemisphere is much weaker in visual extinction than in spatial neglect.

However, the empirical basis underlying this assumption is weak. Whereas the asymmetrical representation has been frequently demonstrated for spatial neglect, to our knowledge only very few studies investigated hemispheric lateralization for visual extinction by comparing directly right-side and left-side stroke patients. Moreover, their results remained controversial. Although Odgen found a preponderance of extinction after left brain damage (16% with left versus 6% with right brain damage), Stone et al reported the opposite pattern (2% after left versus 23% after right brain damage).

The controversial results could be attributable to the fact that the studies included patients with different etiologies (tumor/stroke) or used different clinical methods/cut-off scores for evaluation.

The present study aimed to reinvestigate the question whether visual extinction follows the same hemispheric asymmetry as spatial neglect by comparing the incidence of both disorders—visual extinction and spatial neglect—in a prospective 1-year study assessing a group of acute stroke patients with unilateral left-side or right-side lesions.

Patients and Methods

During a 1-year period, all patients admitted to the Center of Neurology at Tübingen University with acute unilateral right or unilateral left hemispheric brain lesion caused by first-ever stroke were clinically tested for spatial neglect and for visual extinction. Brain lesions were documented by MRI or by spiral computed tomography in all subjects. Patients with bilateral brain lesions, pathological cerebral atrophy, former strokes, patients with tumors, as well as patients in whom imaging revealed no lesion were excluded. Moreover, 11 patients with unilateral right brain damage (RBD) and 14 with left brain damage (LBD) had to be excluded because of poststroke complications inducing coma, death, or marked reduction in vigilance that did not allow the neuropsychological investigation outlined here. The remaining 1-year sample of patients with unilateral LBD or RBD comprised 93 subjects. Clinical and demographic data of these patients are given in the Table.

The patients were systematically assessed for spatial neglect using the “Bells Test,” which has been shown to be a sensitive measure for the exploration deficit of patients with spatial neglect. It consists of a horizontally oriented 21-cm sheet of paper with...
a total of 35 targets (bells) amid 40 distractors, distributed in 7 columns over the whole page. Three of the 7 columns (=15 targets) are on the left side, 1 is in the middle, and 3 are on the right (=15 targets). Patients are asked to cancel all of the targets. More than 5 target omissions located on the contralesional side were taken to indicate neglect. Visual extinction was investigated with the usual neurological confrontation technique, i.e., by using slight wiggling of the index finger(s) in the left or right visual half field. Ten unilateral left or right visual field stimuli were randomly presented with 10 bilateral stimuli. Patients were classified as showing visual extinction when they reported at least 90% of the left or right stimuli on each side correctly, but failed to indicate the contralesional stimulus during bilateral stimulation in $>50\%$ of trials. In patients with visual field defects (assessed using standardized neurological confrontation technique), unilateral and bilateral stimuli were presented in the intact visual field. Aphasia was investigated using a bedside examination that evaluated spontaneous speech, auditory and reading comprehension, picture naming, reading, and oral repetition.18 Neuropsychological examination was performed on average 2.9 days after stroke (SD $=2.7$). All subjects gave their informed consent to participate in the study, which has been performed in accordance with the ethical standards stated in the 1964 Declaration of Helsinki.

Results

In the sample of 93 investigated patients, 42 (45.2\%) had RBD and 51 (54.8\%) LBD. From the patients with LBD, 10 could not be assessed for spatial neglect and for visual extinction because of severe global aphasia. Thus, 42 patients with RBD and 41 with LBD could be formally tested.

The Figure illustrates that the frequency of spatial neglect was very similar to the frequency of visual extinction in the 2 patient groups. In the 42 patients with RBD, 11 showed spatial neglect and 9 patients visual extinction. The difference in frequency for spatial neglect and for visual extinction was not significantly different ($\chi^2_{df=1}=0.2, P=0.6$). In the patients with LBD, only 1 (2.4\%) of the patients had spatial neglect and 2 (4.9\%) had visual extinction. Again, the difference in frequency for spatial neglect and for visual extinction was not significant ($\chi^2_{df=1}=0.27; P=0.58$).

In the group of RBD patients, only 4 subjects exhibited both spatial neglect and visual extinction. In the group of LBD patients, spatial neglect and visual extinction were not observed in combination.

Discussion

Our study aimed to investigate the incidence of visual extinction and of spatial neglect after RBD versus LBD within the same patient sample. Neither in the LBD nor in the RBD group did we find significant differences in incidence for visual extinction compared with spatial neglect.

The question thus arises whether visual extinction and spatial neglect represent the same or distinct phenomena. In the literature the terms “extinction” and “spatial neglect” have been19,20 and still are used21–23 interchangeably, reflecting these authors’ view of seeing no or only little difference between the 2 disorders. Very similarly, other studies described extinction as a mild form of neglect.24–26 Our present observation that the frequencies of spatial neglect and of visual extinction are comparable after left as well as after right hemisphere damage could be taken as an argument in favor of the view that the 2 disorders are manifestations of the same phenomenon.

However, whereas we found comparable frequencies for both disorders in the 2 patient groups, only half of the sample with RBD and none of the sample with LBD showed visual extinction and spatial neglect in combination. Stroke patients presenting either one or the other disorder have frequently been described in previous studies.12,14,15,27–29 The observation of a double dissociation of the 2 phenomena has led to a suggestion contrasting the view outlined here, namely to the suggestion of distinct anatomo-functional systems underlying both extinction and neglect.11–13,30 Supporting anatomical evidence for this latter view derived from a recent study comparing the typical lesion location in patients with visual extinction and in patients with spatial neglect.31 The authors observed closely related but anatomically distinct areas of brain damage in the 2 groups. In the patients with visual extinction, the center of lesion overlap was found more caudally and dorsally in the temporo-parietal junction.

In summary, our present results clearly revealed that the incidence of visual extinction and of spatial neglect was not significantly different, neither with LBD nor with RBD. We thus conclude that visual extinction is as asymmetrically associated with the human right hemisphere as is spatial neglect.

Acknowledgments

The authors are grateful to Monika Fruhmann Berger, Marc Himmelbach, Leif Johannsen, Inga Liepelt, Rebekka Pross, and Regine

---

**Table.** Demographic and Clinical Data of the Patients With LBD or RBD

<table>
<thead>
<tr>
<th></th>
<th>LBD</th>
<th>RBD</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>51</td>
<td>42</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>23 females, 28 males</td>
<td>14 females, 28 males</td>
</tr>
<tr>
<td>Age, y, mean (SD)</td>
<td>65.0 (13.7)</td>
<td>58.6 (12.4)</td>
</tr>
<tr>
<td>Etiology</td>
<td>32 infarct, 9 hemorrhage</td>
<td>37 infarct, 5 hemorrhage</td>
</tr>
<tr>
<td>Time since lesion, d, mean (SD)</td>
<td>2.8 (2.5)</td>
<td>3 (2.9)</td>
</tr>
<tr>
<td>Paresis of contralesional side, % present</td>
<td>80.4</td>
<td>81</td>
</tr>
<tr>
<td>Visual field deficits, % present</td>
<td>7.3</td>
<td>9.5</td>
</tr>
<tr>
<td>Aphasia, % present</td>
<td>68.6</td>
<td>0</td>
</tr>
</tbody>
</table>

---

**Figure.** Frequency of spatial neglect and of visual extinction after unilateral LBD or RBD.
Zopf for their support with the neuropsychological testing of the patients.

Sources of Funding
This work was supported by the Bundesministerium für Bildung und Forschung (BMBF-Verbundprojekt “Räumliche Orientierung” 01GW0641) and the Deutsche Forschungsgemeinschaft (SFB 550-A4).

Disclosures
None.

References
Incidence of Visual Extinction After Left Versus Right Hemisphere Stroke

Elisabeth Becker and Hans-Otto Karnath

*Stroke.* 2007;38:3172-3174; originally published online October 25, 2007;
doi: 10.1161/STROKEAHA.107.489096

*Stroke* is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2007 American Heart Association, Inc. All rights reserved.
Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the
World Wide Web at:
http://stroke.ahajournals.org/content/38/12/3172

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in *Stroke* can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to *Stroke* is online at:
http://stroke.ahajournals.org//subscriptions/