Original Investigations

Depth Perception and Location of Brain Lesions

D. Lehmann and P. Wächli

Neurologische Universitätsklinik (Direktor: Prof. Dr. G. Baumgartner), Kantonsspital Zürich

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Summary. Depth perception was examined in 50 patients with brain lesions and in 16 controls using a polaroid test (Titmus). Error percentage and response time were measured. Intellectually impaired patients performed significantly worse than intellectually normal patients. On the other hand, location of the cerebral lesion (right, left, or generalized) had no significant effect; zero error percentages were observed among intellectually normal patients even with right or left parietal lesions. Intellectually normal patients did not differ from healthy controls.

Key words: Depth perception — Brain lesion — Localization of neuropsychology.


Quantifying tests which are simple to administrate, and which indicate functional disturbances of circumscribed brain areas reliably, would be very useful in neurological diagnosis. However, a long history of attempts to localise higher nervous functions in circumscribed brain areas is contrasted by investigations which demonstrate the importance of the integrity of the whole brain or large portions of it for specific functions (Meyer, 1974).

Visual perception of depth is one of several functional components of spatial orientation. There are single unit studies on the processing of horizontally disparate visual information in restricted cortical areas (Joshua and Bishop, 1970). Clinical observations of disturbances of stereoscopic perception (Benton, 1969) typically implicated the parietal areas, most often of the right hemisphere (Oxbury et al., 1974), although there is no complete agreement on laterality (Battersby et al., 1956; Gloning, 1965). General alteration of mental functioning and some disturbance in the visual input channel, as field defects (Bay, 1953), have been discussed as factors contributing to disturbance of depth perception (Battersby et al., 1956).

Testing with random dot stereograms according to Julesz (1964, 1971), Carmon and Bechtold (1969) and Benton and Hécaen (1970) reported that disturbances of depth perception were preferentially associated with lesions of the right hemisphere. In 1972, Rothstein and Sacks reported more severe disturbances of depth
perception in 2 cases with left parietal lesions than in 8 cases with right parietal
damage, employing a polaroid stereo test (Titmus stereo test, Titmus Optical Co.
Petersburg, Virginia, USA).

In the present paper we investigate depth perception in patients with unilateral
and with generalized brain damage, and in subjects without CNS disturbances,
using a series of 9 Titmus stereo test figures of differing horizontal disparities.
The numerical data obtained were used for statistical comparison. Percentage
of wrong responses ("error percentage"), and mean response time were chosen
as measurements of quality of performance.

**Methods**

**Patients and Controls**

All patients with unilateral brain lesions available during the data collection period were
examined (23 cases). Ten (6 tumors, 4 vascular lesions) had lesions in the right hemisphere,
13 (8 tumors and 5 vascular lesions) in the left. In addition, we examined 27 patients with
generalised disturbances or midline lesions with the diagnoses: multiple sclerosis (7), cerebro-
vascular disease (6), epilepsy (5), parkinsonism (3), and debility, multiple metastases, cephalae,
bulbar syndrome, sequelae of CO intoxication, hydrocephalus with craniocephalic dysplasia
(1 each). In addition we included 16 patients suffering from peripheral neurological syndromes
as controls. The latter two groups were chosen at random from hospitalized patients.

Fifteen normal subjects and 5 patients were used in a preceding pilot study, in order to
establish the procedure of examination.

**Test Arrangement**

The Titmus stereo test set consists of various targets on polaroid foil which can be seen
in depth when viewed through polaroid glasses. We used the house fly target for demonstration,
and the 9 four-ring-targets for testing. The 9 targets were mounted on black cards. Each target
consists of 4 rings of 5 mm diameter in a diamond arrangement, so that there is an upper,
lower, left, and right ring. When viewed through polaroid glasses, 1 of the 4 rings in each
target is seen as being nearer to the observer. The position of this nearer ring varies between
targets. The horizontal disparities available are 650, 325, 163, 114, 81, 65, 49, 41 and 33 sec
arc at 50 cm distance. The seated patient observed the targets through a 10 × 10 cm window
in a black box of 50 cm length. The box had a target frame on the wall opposite to the window.
The targets were illuminated by a 40 watt tungsten bulb at 35 cm distance.

**Procedure**

Following an unstructured interview with review of the case history, an orienting ex-
amination of the visual fields (finger test), and monocular reading tests to 4 min arc letter
extent with correcting glasses (if patient had glasses), were performed. Next, using the polaroid
glasses, the house fly was shown and, after several seconds, the patient was asked to touch
the wing of the fly. Then the patient was seated in front of the box, and the testing procedure
was practiced using the two target cards with the largest disparities. The patient was instructed
to call out the position of the nearer ring as quickly as possible after the start of card exposure.
The 9 test cards were shown in 4 random series, with the restriction that card No. 9 (smallest
disparity) was not to be shown as first of a series. The experimenter put the test card with
a cover into the frame, then withdrew the cover with the word "start", and simultaneously
started a stop clock to measure the response time. If there was no response within 30 sec, the
next card was shown. The whole procedure took between 25 and 30 min.

**Data Reduction**

The following values were computed for each patient:

1. Percentage of errors or missing responses for each horizontal disparity,
2. Percentage of errors or missing responses for all 36 exposures,