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OUT OF MIND, OUT OF SIGHT:

UNILATERAL SPATIAL DISORDERS IN BRAIN-DAMAGED PATIENTS

JENNIFER ANN OGDEN

A thesis presented to the
University of Auckland
in partial fulfilment of the
requirements for the degree of
Doctor of Philosophy
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"Now o'er the one half-world
Nature seems dead, and wicked dreams abuse
The curtained sleep."

Macbeth II i

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A B S T R A C T

Hemineglect and unilateral extinction on double simultaneous stimulation in humans are neuropsychological disorders which sometimes follow a lesion to the cortex, subcortex or basal ganglia of one cerebral hemisphere. The main symptom is that the patient appears to neglect or be unaware of stimuli which impinge in one half of space relative to the patient's body. The side of space neglected is usually the side contralateral to the brain lesion. This thesis comprises a collection of studies on various aspects of these disorders. Experimental subjects were patients in the Neurology and Neurosurgical Wards of Auckland Hospital. All had clearly defined solitary unilateral brain lesions confirmed by Computerized Tomography.

Chapter 1 provides a historical review of research in the area, defines concepts, reviews recent human and animal research on hemineglect and extinction, and outlines the different theories which have been proposed in order to explain hemineglect.

Chapter 2 describes the methods used in neuropsychological testing, the criteria used in the selection of subjects, the etiologies of the different types of lesions sustained by the patient sample, and the neuropsychological tests used in the various studies.

Chapter 3 is a study of the incidence and severity of visual hemineglect in a group of 56 patients with left-

hemispheric lesions and 45 patients with right-hemispheric lesions. Five paper and pencil tests designed to measure the presence and severity of visual hemineglect were given to these patients. The incidence of hemineglect in the two groups did not differ significantly (50% and 44% in the left and right brain-damaged groups respectively). However, visual hemineglect was found to be more severe after right- than after left-hemispheric lesions. The two groups were found to differ significantly with respect to the loci of lesions most likely to result in hemineglect. In the right brain-damaged group most patients with hemineglect had posterior lesions, and in the left brain-damaged group most patients with hemineglect had anterior lesions. Possible reasons for this are discussed in terms of the effects the lateralization of language representation might have on the representation of spatial functions.

Chapter 4 describes an experiment designed to determine whether patients with unilateral cerebral lesions neglect the contralesional sides of their mental images of the external world. This phenomenon has previously been observed for patients with left-sided visual neglect following right-hemispheric lesions. Twenty control subjects and 16 patients with right- and left-hemispheric lesions were involved in the experiment reported in this chapter. In the 'static' condition they viewed pairs of complex shapes displayed, one shape at a time, on a video-screen controlled by a computer. In the 'dynamic' condition the pairs of shapes apparently moved, one at a

time, behind a narrow vertical slit. In both conditions the subject had to decide whether the two shapes of each pair were the same or different. In fact, some were the same, while some differed on the right and others on the left. In the 'dynamic' condition subjects had to construct spatial images from non-spatial external stimuli before they could make a same/different response. Both right and left brain-damaged groups demonstrated a significant neglect of the contralesional sides of their images of the shapes in that they often gave 'same' responses when the shapes actually differed on their contralesional sides. This has implications for normal imagery processes. It appears that at some advanced stage our images are mapped onto our hemispheres in an analogue fashion. That is, objects or parts of objects that we imagine to be on our left are mapped onto our right hemispheres, and those parts we imagine to be on our right are mapped onto our left hemispheres. If one hemisphere is damaged at a site which is essential to this imagery process, the contralateral half of the external stimulus that is being imagined will be degraded or neglected.

Chapter 5 is a study of auditory extinction in unilaterally brain-damaged patients. In particular the phenomenon of ipsilateral auditory extinction is investigated in detail. Previous researchers have found ipsilateral auditory extinction for dichotically presented verbal stimuli following lesions only of the posterior left hemisphere. It has been hypothesized that a lesion in this area disconnects a posteriorly routed interhemispheric

auditory pathway and that as a consequence, left-ear verbal input is unable to reach the left (speech) hemisphere. In Experiment 1, I tested 53 brain-damaged patients for extinction of digits on a dichotic listening task and found that patients with lesions wholly anterior to the central sulcus in the left hemisphere exhibited ipsilateral extinction as well as patients with posterior left-hemispheric lesions. This finding poses problems for the above hypothesis that relies on a posterior inter-hemispheric pathway, and alternatives to this hypothesis are discussed. In Experiment 2, I tested 16 patients for extinction of dichotically presented non-verbal material (tones) to ascertain whether ipsilateral extinction is restricted to verbal tasks. Ipsilateral extinction was not found on this task for either left or right brain-damaged patients. This suggested not only that ipsilateral auditory extinction is related to the disconnection or disruption of left-ear verbal input from the left (speech) hemisphere, but that the right hemisphere is not essential for the decoding and processing of non-verbal material. That is, I did not find right-ear ipsilateral extinction for non-verbal input in patients with right-hemispheric lesions.

Chapter 6 is the study of multimodal hemineglect and extinction in patients with right- and left-hemispheric lesions. Clinical observations suggest that multimodal neglect may be a single disorder with a common underlying cause, and that the number of modalities affected is dependent upon the severity of the underlying deficit. For

example, patients with hemiasomatagnosia (body hemineglect) are often observed to exhibit visual hemineglect and tactile extinction as well. I tested 50 patients for contralesional visual hemineglect, auditory extinction, tactile extinction and hemiasomatagnosia and computed phi correlation coefficients for pairs of disorders to see if there was any basis for supposing they were caused by the same underlying deficit. As the proportion of patients with hemineglect varied widely from modality to modality, possibly as a result of varying sensitivities of the tests used to measure the different forms of neglect, I also computed tetrachoric correlation coefficients. This measure corrects for varying proportions on the assumption that a normal distribution underlies each dichotomy. The results were inconclusive as the phi-coefficients were generally low and the tetrachoric coefficients very high. Because of the extreme difference between the two forms of correlation it was not possible to come to any conclusions about the 'true' correlations. It may be that at least some forms of hemineglect and extinction are independent of one another and are often found together in the same patients because the lesions overlap modality-specific areas, rather than because they result from the same underlying cause.

Chapter 7 summarizes the studies described in Chapters 3, 4, 5 and 6, and the results are reviewed in the light of some of the more important theories of hemineglect.

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