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Why are some patients with severe neglect able to copy a cube? The significance of verbal intelligence

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Abstract

Cube-copying is often used to assess constructional ability of brain-damaged patients and the influence of unilateral spatial neglect is often pointed out in patients with right hemisphere lesions. However, some patients with severe neglect perform cube-copying satisfactorily. The aim of the present study is to identify the factors that affect the performance of cube-copying in patients with left unilateral spatial neglect. Constructional performance was investigated in 100 patients with unilateral spatial neglect using a task to copy the Necker cube. The relationship of the patients' cube-copying performance to the severity of their neglect, as well as other factors (verbal intelligence, age, duration after onset of the disease, educational level, lesion site, piecemeal approach, and side of starting to copy) was analyzed. Twenty-two normal subjects also participated in this study as controls. Among many factors adopted for analysis, neglect severity and verbal intelligence were found to be primary factors affecting the cube-copying performance of the patients with unilateral spatial neglect. The effect of neglect severity on cube-copying performance was apparent in the patients whose verbal intelligence was deteriorated, but was not observed in the patients with preserved verbal intelligence. Similarly, the effect of verbal intelligence on cube-copying performance was apparent in the patients with severe neglect, but not in the patients with mild neglect. We conclude that constructional ability in the copying of a cube is determined by verbal intelligence, as well as by the severity of unilateral spatial neglect.

Keywords: Unilateral spatial neglect; Cube-copying; Verbal intelligence; Neglect severity; Constructional disability

1. Introduction

Cube-copying is often used to assess the constructional ability of brain-damaged patients, since the three-dimensionality of a cube enhances their copying deficit [6]. Most studies using the cube-copying task have reported the influence of unilateral spatial neglect among patients with right hemisphere lesions [2–6,11,20,21,28]. Patients with left unilateral spatial neglect typically copy the right half of a cube and leave the left side unfinished. However, we occasionally encounter patients with severe neglect who are able to copy a cube, while some patients with mild neglect are unable to do so (Fig. 1). Factors may exist, other than neglect severity, that affect the performance of neglect patients in copying three-dimensional models. Many studies have suggested that disorders of visual perception result in the copying disability among patients with right hemisphere lesions [2,5,11,20]. While this may be true for some neglect patients, one report suggests that most neglect patients with preserved perception failed to copy the left side of the stimulus [10]. In other studies, intelligence has been shown to affect the copying performance of right and left brain-

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damaged patients [3,7,11,28,29]. It is important to note that severe neglect results in a poor performance on non-verbal tasks, such as the performance subtests of the Wechsler Adult Intelligence Scale-Revised (WAIS-R) [31] or Raven's Coloured Progressive Matrices [22], which were used for assessment of intellectual ability in the above-mentioned studies. The aim of the present study is to examine the association between neglect severity and cube-copying performance, and to specify any other factors, independent of neglect severity, that influence the cube-copying performance of neglect patients.

2. Methods

2.1. Subjects

The subjects were 100 right-handed Japanese patients with a right hemisphere stroke, who showed left unilateral spatial neglect in at least one test of our screening battery. The screening battery included the line bisection [8,24] and line cancellation [1,9] tests, as well as the copying of a daisy with blades of grass 6 cm away on both sides [25,26]. In each test, the patient's neglect was scored as either 0 (absent), 1 (mild), 2 (moderate) or 3 (severe) according to the scales of Levine et al. [13] and Ishiai et al. [8]. The sum of the scores of the three tests was treated as the total neglect severity, with the most severe neglect having a score of 9. The patients were divided into two neglect groups: 59 patients, whose total neglect severity was 3 or less, were classified as the mild neglect group (mean score = 2.1 ± 0.7); and 41 patients, whose score was 4 or more, were classified as the severe neglect group (mean score = 6.2 ± 1.7). All patients were assessed with the WAIS-R, Japanese edition [31]. No significant difference was observed in the verbal IQ between the mild (mean = 84.9 ± 11.1) and severe (mean = 87.2 ± 14.2) neglect groups. Fifty-seven patients had a dense left homonymous hemianopia on confrontation testing. Fourteen patients had an incomplete left homonymous hemianopia, and 24 had a left inferior quadrantanopia. The remaining five patients showed no visual field defect or left-sided extinction on double simultaneous stimulation. Computed tomographic scans or magnetic resonance images showed that all subjects had lesions that involved the right parietal lobe primarily and, to some extent, one or more of the frontal, temporal, and occipital lobes. The age of the patients varied from 35 to 84 years (mean 61.2). The length of time since the onset of the stroke ranged from 0.5 to 77 months (mean 8.0), and the years of education ranged from 6 to 19 years (mean 11.0).

Twenty-two healthy controls, matched with the experimental patients in age (mean = 61.2 years, range = 45–72) and educational level (mean = 11.5 years, range = 7–16), also participated in the study. All control subjects were right-handed, and had no clinical signs or history of brain disease. They were tested with our screening battery and showed no evidence of unilateral spatial neglect.

All patients and control subjects used their right hand in each test. All subjects gave informed consent to participate in this study.

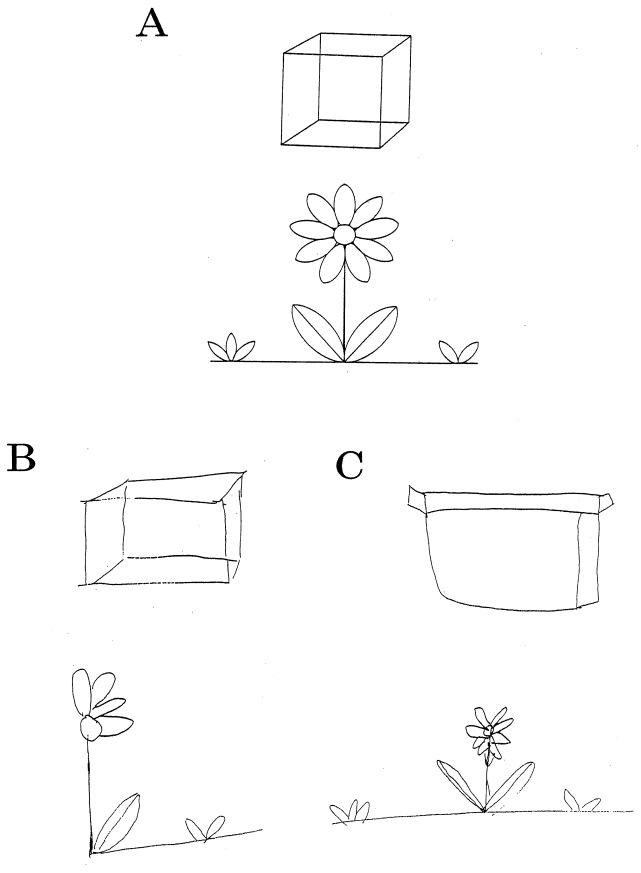

Fig. 1. Examples of perfect and imperfect copies of a cube. A: Models. B: Copies for a patient with severe neglect whose total neglect severity (for the explanation, see the text) is 8. C: Copies for a patient with mild neglect whose total neglect severity is 2.

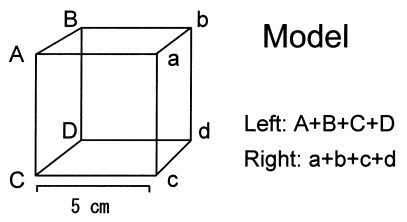

Fig. 2. The model to be copied (Necker cube). Vertices A, B, C, and D represent those located on the left side of a cube, and vertices a, b, c, and d represent those located on the right side of a cube.