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Rehabilitating mental representations:

A genuinely “blind” study

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Patients with spatial neglect fail to detect, orient, or respond to stimuli from a spatially confined region.¹ The syndrome often produces conspicuous behavioral deficits and most frequently follows right hemisphere injury, resulting in unawareness of the left space or body or disinclination to move or gaze leftward or activate the left-sided extremities. Although overt signs of neglect may resolve swiftly, neglect poses obstacles to successful rehabilitation and is strongly associated with a loss of independence.² Because severe neglect behaviors may be temporally remote from rehabilitation outcome, clinicians may have difficulty appreciating the relevance of understanding the theoretical basis of spatial cognitive deficits.

Nearly 30 years ago, Bisiach and Luzzatti³ described two individuals with right brain damage whose neglect affected contralesional mental imagery. When patients described from memory the buildings viewed from one end of a plaza in Milan, they failed to mention those on the left. Asked to take a perspective from the opposite end, however, they now failed to recall what they described from the first vantage, but mentioned new sites on the right. This imaginal, or representational, neglect has been interpreted in terms of bias in generation or exploration of spatial mental images. Their findings provided unequivocal evidence that spatial neglect was not simply a perceptual abnormality but, rather, disrupts how the brain integrates sensory information into a topologic map of the physical world.

Mental representations allow us to flexibly manipulate spatial information. For example, the brain readily accommodates transitions between different spatial reference frames (i.e., person centered vs object centered), across multiple dimensions (i.e., horizontal, radial, vertical), and over a range of distances (i.e., personal, peripersonal, extrapersonal).⁴ Dysfunction of such relatively discrete processing systems may account in part for the diversity of neglect-related behaviors. The precise relationship between the neural substrates of representation and perception remains an area of considerable interest and controversy.⁵ Reports of double dissociations suggest at least partial independence: some patients with representational neglect interact normally with their spatial environment, whereas others with clinical neglect retain functional spatial imagery.

In this issue of *Neurology*, Rode et al.⁶ attempted to ameliorate representational neglect by manipulating perception. Previous studies, which they review, indicated that representational neglect could be modified by having patients draw objects from memory with their eyes closed. Remarkably, patients' renderings without vision were more complete than those with eyes open, containing more elements from the neglected side. Rode et al. employed a different

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measure of spatial imagery, asking patients to name towns in France as they visualized a “mental map” of the country. Although control subjects with their eyes closed generated more town names, equally distributed around the geographic meridian, patients did not show this effect and failed to name more towns from the neglected (i.e., western) part of the country.

Although counterintuitive, the notion that perceptual input aggravates neglect is not without foundation and, again, suggests that it is not merely a perceptual disturbance. Previous experiments suggest that sensory deprivation may actually attenuate neglect behavior. For example, when Chedru⁷ asked patients with right brain lesions to tap all keys on a keyboard, their tendency to strike right-sided keys under visual guidance was eliminated when vision was obscured. Similarly, Hjaltason and Tegner⁸ found that having patients with left hemispatial neglect perform line bisection tasks in darkness reduced rightward deviation compared to normal illumination. Another study compared target cancellation using conventional serial marking vs erasure of targets.⁹ Patients with neglect canceled more contralesional targets when erasing rather than marking them. Such findings demonstrate how hemispatial neglect causes patients to behave as though pathologically attracted to ipsilesional stimuli, either due to reflexive attentional “capture,” failure to disengage attention toward contralesional space, or both. Reducing sensory-driven, automatic orienting reduces both sources of spatial bias.

Why then did Rode et al. fail to replicate an improvement in representational neglect in their study? Modality of response may be important. Their methods avoid execution of spatially based motor operations (i.e., drawing). Perhaps the “distraction” of visual input manifests primarily when representation guides somatomotor actions, beyond those involved in generation and mental exploration of an internal spatial map. If so, neglect might have been reduced had investigators asked patients to draw maps of France from memory with their eyes closed. It is also possible that drawing tasks may tax object-centered frames of reference, whereas mental geographic descriptions depend primarily on person-centered coordinates.

Despite the negative results, the article by Rode et al. reminds us of two important issues. First, although development of effective neglect rehabilitation programs remains a work in progress, numerous practical means to modify neglect behavior have already been identified. For individual patients, such techniques may be useful in a rehabilitation setting. Conceivably, further advances may inform rehabilitation strategies that use limited sensory deprivation in a manner analogous to constraint-induced treatment of hemiparesis.¹⁰ Second, the study reminds us of the profound implications of mental representation: our instantaneous experience of the world is at least “once removed” from its physical attributes. Representations comprise the content of thinking—the means by which we carry the external world within. As such, disordered mental representations in neglect may exert influences beyond spatial cognition, including numeric operations, syntactic processing, and inference.¹¹ Rather than an isolated deficit of sensory topology, spatial neglect may distort our internal world and its verbal, logical, and symbolic relation to the world around us. Imagine that.

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