Spatial Neglect: New Issues and Their Implications for Occupational Therapy Practice

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Key Word: rehabilitation

Competent clinical practice relies on scientific theory to explain phenomena and to provide the rationale for rehabilitation strategies. Despite research advances and new insights, no unified theory has yet been offered to explain all aspects of the puzzling neglect syndrome. To find clinical relevance for new discoveries, theoretical models have to be integrated into assessment procedures and treatment strategies. The aim of this article is to briefly review recent theories about spatial hemineglect with emphasis on their potential use for practice, assessment strategies, and rehabilitative approaches.

The syndrome of unilateral neglect has been associated with impaired functional rehabilitation of patients with right-hemisphere damage (Denes, Semenza, Stoppa, & Lis, 1982; Korner-Bitensky, Mayo, & Kaizer, 1990; Kotila, Marja-Liisa, & Laaksonen, 1986; Lehman et al., 1975). Although much has been written about this disorder, what is lacking is the link between scientific discoveries and their practical application in rehabilitation. The present paper will briefly review recent theories and then offer tentative suggestions of how experimental findings might guide clinical practice in remediation programs.

Unilateral Neglect: Symptomatology, Incidence, and Etiology

One of the most striking phenomena following lesions of the nondominant parietal lobe is unilateral neglect of the left hemispace. For patients with the most florid manifestations of hemi-neglect, the side of the body and the physical environment opposite to the lesion do not seem to exist. These patients do not respond to any stimulation that impinges on this half of the perceptual field and do not search this spatial half-field for cues on which spatial orientation depends. Seeming generally indifferent to their environment (Denny-Brown & Banker, 1954; Gainotti, 1972), these patients frequently deny that the extremities contralateral to the lesion are their own and neglect to dress or shave on this side. Their eyes do not orient to the ignored side of the room and they do not attend to events and persons in this half-field; they even leave food on half of their plates or fail to pick up coins on the neglected side. Frequently, these patients will fail to read the part of a sentence that falls in the neglected hemifield or fail to attend to details in drawings on the neglected side; almost always, such patients bisect lines asymmetrically (Heilman, 1979). When confronted with paired visual stimuli, their eyes drift to the side ipsilateral to the lesion (Weinstein & Friedland, 1977), as though their fields of perception were skewed with a bias to the intact side.

The lateral orientation appears to extend even into the intact field of vision where the more lateral of two stimuli is attended to (Kinsbourne, 1977). Yet, the apparent unawareness of one side of body and space cannot be accounted for in terms of sensory or motor deficits but is due to loss of spatial analysis and deficient exploration of space. Mesulam (1981) studied a right-handed left-hemiplegic patient with symptoms of left-sided neglect. When blindfolded and asked to retrieve an object that was placed next to him on either side, the patient’s exploration of the nonneglected space with his paretic hand was “virtually intact”; in contrast, the exploration of the neglected space with either hand was “erratic and haphazard” (p. 318).

With functional improvement, the imperception, or
distortion, of stimuli on the contralesional side may be elicited only during simultaneous stimulation of both sides, that is, extinction to double simultaneous stimulation (EDSS). Although not all of the behaviors described above may be present in one patient, they should be assessed when one tests for neglect and before one plans remediation strategies.

Neglect syndromes typically follow injuries to the nondominant (usually, the right) hemisphere (e.g., Brain, 1941; Costa, Vaughan, Horwitz, & Ritter, 1969; Diller & Weinberg, 1977; Paterson & Zangwill, 1944). The incidence of neglect-related disorders in patients after right hemisphere injuries has been variously reported between 26.7% and 85% (Hier, Mondlock, & Caplan, 1983; Zoccolotti et al., 1989). Neglect is most commonly associated with parietal lobe lesions (Brain, 1941; Critchley, 1949, 1966; Denny-Brown & Banker, 1954; Denny-Brown, Meyer, & Horenstein, 1952), but has also been observed after lesions of the frontal lobe (Damasio, Damasio, & Chang Chui, 1980; Heilman & Valenstein, 1972; Ogden, 1986) and of discrete lesions in subcortical matter (Damasio et al., 1980; Ferro & Kertesz, 1984; Henderson, Alexander, & Naeser, 1982; Hier, Davis, Richardson, & Mohr, 1977; Watson, Valenstein, & Heilman, 1981). Right-sided neglect after left hemispheric damage has been reported less frequently (see Friedland & Weinstein, 1977, for a review); if it does occur, it appears to be less severe and to resolve more rapidly (Albert, 1973; Costa et al., 1969; Gainotti, 1972; Kinsbourne, 1987; Ogden, 1987).

The evidence of differential neglect deficits after right- and left-hemisphere lesions reflects (a) the hemispheric specialization of function, that is, preferential processing of spatial material by the right hemisphere and verbal material by the left hemisphere and (b) a differential involvement of the two hemispheres in the control of attention. Whereas the left hemisphere mediates arousal and attention for the right hemisphere, the right hemisphere seems to be capable of controlling attentional and intentional processes in both the right and left hemispheres (Bowers & Heilman, 1980; Heilman & Van Den Abell, 1979, 1980). Hemineglect after left brain injury may thus be compensated by the intact right hemisphere while this mechanism is not available following right brain damage. Recent data support this notion (Feinberg, Haber, & Stacy, 1990).

Because a lesion disrupts a complete functional system (Luria, 1973), there is no absolute relationship between brain injury and consequent deficit. However, several anatomically connected brain areas have been implicated to account for the heterogeneity of neglect syndromes. A corticolimbic network has been suggested in the process of directed attention to peripheral stimuli (Mesulam, 1981). The parietal lobe contains the anatomical substrate for multimodal integration of afferent input from the contralateral side, including a mechanism concerned with spatial perception (Lynch, 1980). The frontal lobe coordinates exploratory behavior in the contralateral space and is responsible for the motor factors involved in neglect (Mesulam, 1981). The reticular formation and limbic system (mediating the motor factors involved in behavior) contribute the motivational impact to sensory events. Recent neuroanatomical evidence suggests that the anterior cingulum, involved in attention as preparation for action, projects to the premotor area (Posner, Petersen, Fox, & Raichle, 1988; Paillard, 1990).

**Theories of Spatial Neglect and Their Practical Implications**

To account for the spectrum of observed heterogeneous deficits of neglect syndromes, impairment of neural mechanisms has been postulated at one of three levels of information processing (Baynes, Holtzman, & Volpe, 1986): (a) disturbances in sensorperceptual processing (Birch, Belmont, & Karp, 1967; Denny-Brown et al., 1952); (b) disordered internal representation of intrapersonal and extrapersonal space (Bisiach, Capitani, Luzzatti, & Perani, 1981; Bisiach & Luzzatti, 1978); and (c) attentional-orientational impairment (Baynes et al., 1986). Although precise mechanisms are still unclear, prevailing views account for spatial neglect in terms of attentional deficits for spatial orientation (Rizzolatti & Camarda, 1987). Because of their relevance to clinical models, the proposals of three attentional theories are considered below.

Different components of attention may be affected in neglect (Ladavas, Del Pesce, & Provinciali, 1989) and may have to be addressed in a remediation program: (a) arousal-activation mechanisms, that is, the physiological readiness to respond to external and internal stimuli regardless of their spatial position (Heilman & Van den Abell, 1980); (b) orientation and selective attention to contralateral space, that is, the capability to orient toward a spatial position within the contralateral field and the decision-making process of which stimuli to attend to (Mesulam, 1981; Posner, Walker, Friedrich, & Rafal, 1987); (c) the shifting of attention from one target to another (Farah, Wong, Monheit, & Morrow, 1989; Mark, Kooistra, & Heilman, 1988); and (d) intention, the motor activation for responding to a stimulus (Verfaellie, Bowers, & Heilman, 1988a). These components are addressed below.

**Heilman's Hemispatial Inattention Theory**

According to the postulates of Heilman and his coworkers, neglect is an attentional deficit for the contralateral space, caused by a disruption in corticolimbic-recticular connections (Heilman, 1979). Each hemisphere contains its own activating system and is responsible for the arousal and orientation to the contralateral space, for processing sensory information from the opposite side, and for organizing the appropriate response. The right
hemisphere plays a greater role in attention because of its bidirectional capacities, which activates orientation to both sides of space (e.g., Heilman & Van den Abell, 1980). Even in nondysfunctional persons, right-hemisphere superiority involving hemispace has been shown in a variety of tasks, such as pattern recognition (Verfaellie, Bowers, & Heilman, 1988b), tactile bisection (Bowers & Heilman, 1980), and sensory perception (Herman, 1987). Because of the hypoarousal of the lesioned right hemisphere, patients with spatial (sensory) neglect demonstrate sensory inattention in the left hemispace, seem reluctant to perform movements in the left half-field (i.e., unilateral akinnesia), and perform much more poorly in the left than in the right hemispace (e.g., on line bisection tasks) (Heilman & Valenstein, 1979). This deficit can be somewhat ameliorated by having patients perform under conditions of spatial compatibility. In practical terms, this means that patients with spatial neglect are likely to commit fewer errors in the left hemispace when the left hand (rather than the right) performs, because both left hand and left hemispace are controlled by the right hemisphere. Conversely, when the nervous circuits mediating sensorimotor processes (through anatomical connections and those controlling attentional processes in the opposite field are not located within the same hemisphere (e.g., right hand in left hemispace), spatial incompatibility prevails and results in reduced efficiency because of interhemispheric conflict (Bowers, Heilman, & Van den Abell, 1981; Heilman, Bowers, & Watson, 1984). Accumulating experimental evidence is consistent with the concept of spatial compatibility, even in nondysfunctional subjects (e.g., Anzola, Bertolini, Buchtel, & Rizzolatti, 1977; Berlucci, Crea, Di Stefano, & Tassinari, 1977).

Consistent with the theory’s predictions, neglect symptoms increase under certain conditions. Patients commit more errors of stimulus detection with increased task demands. A complex task, such as distinguishing targets from foils, for example, requires more attention than mere detection and results in more errors (Rapcsak, Fleet, & Heilman, 1986). Similarly, a greater number of omission errors are committed when the density of stimuli is increased. In a study by Mark et al. (1988), 10 patients were tested in two versions of a cancellation test. In the experimental test, the patients had to erase lines; in the control test, they cancelled them by drawing over them. Performance improved substantially (as measured by fewer errors of omission) when lines were removed rather than crossed out. Deteriorating performance was also observed with repetitions of trials. One could ameliorate this fatigue effect, however, by giving the patient feedback about his or her performance (Fleet & Heilman, 1986). Directional akinnesia, the inability to initiate movements in or toward the contralateral space, is also accentuated by the presence of stimulus material in the good hemifield. Heilman, Bowers, Coslett, Whelan, and Watson (1985) observed the impairment of eye movements toward the left space in the presence of stimuli in the right hemispace (explanatory mechanisms are discussed in Posner’s hypothesis, presented below); this inability to release the visual grasp on a stimulus in the attended field was still present in a patient 6 months after onset of stroke and long after other neglect symptoms had subsided. That stimuli in the nonneglected hemispace attract the patient’s attention and interfere with performance in the neglected field has also been reported by other investigators (Karnath, 1988; Mark et al., 1988; Posner et al., 1984, 1987). If neglect symptoms can be influenced by environmental manipulation, it should be feasible to ameliorate them through the use of appropriate task strategies (see Table 1).

Kinsbourne’s Hypothesis of Interhemispheric Inhibition and Directional Attention

While Heilman ascribed the imbalance of orientational tendencies to decreased activity of the right (lesioned) hemisphere, Kinsbourne explained it with increased activity of the left hemisphere. Kinsbourne (1970a, 1970b, 1977, 1978, 1987) asserted that neglect is a directional, not a hemispace, phenomenon resulting from attentional bias rather than deficit. In Kinsbourne’s (1978) view, left neglect is more frequently encountered than right neglect because of the innate propensity of humans to orient more to the right than to the left (Gesell [as cited by Kinsbourne, 1987]). Kinsbourne argued that our perceptual and behavioral asymmetries arise from an imbalance in hemispheric activation, thereby inducing attentional bias toward the right side. Proposing a model of reciprocal inhibition between the hemispheres, Kinsbourne suggested that each hemisphere inhibits the other through callosal mechanisms. He proposed that activation of the left hemisphere generates powerful rightward orientation; in contrast, the right brain’s leftward bias is only sufficiently strong to keep the left brain’s rightward bias in check. Damage to the right hemisphere decreases the transcallosal inhibition on the intact hemisphere, thereby causing a pronounced attentional bias to the right, which is much stronger than the leftward bias following left-hemisphere damage.

Because of the more potent rightward than leftward orientation, stimuli within a hemispace may command differential attention. In patients with spatial neglect, the more lateral of the two simultaneously presented stimuli in the intact half-field is preferentially attended to because of the unopposed orientation to the right when the overactive left hemisphere is not mitigated by the depressed right hemisphere (Kinsbourne, 1970b). Left neglect manifestations are exacerbated by the activation of the left hemisphere, for example, by verbal stimulation (reading, writing, speaking, listening) or by head and eye turning toward the right side (Kinsbourne, 1972). Additionally, stimuli in the attended (right) field represent a
powerful magnet, activating the intact left hemisphere (see Table 1). Conversely, a reduction of left-hemisphere activity should mitigate neglect (Heilman & Watson, 1978).

Posner's Covert Orienting Hypothesis

The most recent attentional theory (Posner, 1980) attributes neglect to an impairment of visual attention resulting in the inability to scan the internal representation of space (Bisiach & Luzzatti, 1978). Neglect may be closely related to disturbances in shifting attention from one spatial location to another (Gazzaniga & Ladavas, 1987; Posner, Cohen, & Rafal, 1982). In a series of elegantly designed experiments, Posner and colleagues (1984, 1987) manipulated spatial attention independent of sensory and motor factors in nondysfunctional persons and in parietal poststroke patients. They found that patients with right parietal lesions experienced difficulty in disengaging attention once it had been captured by visual stimuli in the right hemispace or in a central position.

Three components in shifting visual attention are hypothesized: (a) the ability to disengage attention from the current target; (b) the ability to shift attention to a new target; and (c) the ability to focus attention on the new target (Posner et al., 1984; Riddoch & Humphreys, 1987). Posner's theory contends that the cognitive act of shifting attention can be mediated overtly by shifting the gaze or covertly (internal mediation) by orienting attention to an internal representation of space without any visible signs of the involved mental processes.

Covert attention shifts can be facilitated through the cuing of patients with stimuli indicating the likely location of the new target. (A cue may be a brief peripheral light stimulus that activates the contralateral hemisphere.) Examining the attentional performance of their patients with spatial neglect, whose gaze was centrally fixated, Posner and colleagues (1984) found that giving patients valid cues (i.e., cues indicating the correct target location) enabled them to shift attention between contralesional and ipsilesional stimuli. The giving of invalid cues by indicating a location on the opposite side of the fixation point resulted in deterioration of performance, which was measured in reaction times, especially in right-hemispherically damaged patients.

The findings of Posner and colleagues (1984) are consistent with Heilman's (1979) postulation that the right hemisphere controls attentional processes. The findings also support Kinsbourne's (1987) contention of a directional bias, manifested not only between opposite hemispheres but even within the same hemisphere. Unlike Heilman, however, who found no effect of cues on performance (Heilman & Valenstein, 1979), the results of Posner's investigations indicate that one can reorient attention and facilitate attentional shifts by cuing the patient (see Table 1). Most importantly, the results of studies based on Posner's theory demonstrated that some patients with spatial neglect can shift attention from the ipsilesional to the contralesional hemispace as long as their attention is not drawn to the nonneglected side (Riddoch & Humphreys, 1983, 1987).

The evidence for the beneficial effects of cuing is compelling. Riddoch and Humphreys (1983) investigated cuing effects in a line bisection task under four conditions: A digit marked either the right, the left, or both ends of the line and for a baseline condition, no cues were present. Analysis of the data showed that a single left cue significantly reduced neglect by drawing attention to the left field and that this effect was even stronger when the patient had to report the stimulus. Not surprisingly, a single right cue increased neglect while in the dual cues condition (used in Heilman & Valenstein's 1979 study), patients had difficulty shifting their attention to the left once attention had been oriented to the right. Although the results also confirmed a weak hemispace effect (the left end of the lines tended to be more neglected in the left than in the right hemispace or midposition), overall the data supported Posner's findings. Posner's (1980) theory is gaining considerable support from clinical and experimental findings. The effects of cuing indicate (a) that a strong attentional component is involved in neglect; (b) that cuing can ameliorate neglect symptoms; and (c) that improvement of performance when cues are provided offers a parsimonious explanation of EDSS.

Although some aspects of each of the presented theories may be open to criticism, they all have sound formulations, are internally consistent, and, above all, are testable and verifiable. Despite their different conceptualizations of neglect, they are by no means incompatible and in many ways complement each other. There is general agreement that the directional bias of attention results in more pronounced attentional impairment following right, as opposed to left, hemispheric lesions but that this bias can be influenced by appropriate treatment strategies.

Clinical Management of Neglect

Recovery

Although the most profound symptoms of neglect typically improve spontaneously within 3 months (Wade, Wood, & Hewer, 1988), more subtle manifestations such as EDSS may persist for months and years (Heilman, Valenstein, & Warson, 1985; Karnath, 1988). In clinical populations, almost all patients manifesting hemineglect demonstrate tactile EDSS, visual EDSS, or both while the converse does not necessarily hold true (Friedland & Weinstein, 1977). It therefore appears that a common functional mechanism underlies both syndromes (Anton, Hershler, Lloyd, & Murray, 1988; Karnath, 1988).
The mechanisms underlying the recovery of hemi-nattention are not yet entirely understood. It may be that function is gradually restored as the damaged right hemisphere recovers and readapts. Another possibility is that the undamaged left hemisphere compensates by either processing sensory information via ipsilateral pathways or enhancing the capabilities of the right hemisphere through callosal connections (Heilman, Bowers, Valenstein, & Watson, 1987). Whether restoration of function is viewed as an intrahemispheric or an interhemispheric process may influence remedial strategies (restorative vs. compensatory approaches). In any case, because hemineglect affects rehabilitation and may even predispose hemineglect patients to minor trauma leading to hand-shoulder syndrome (Poulin de Courval, Basrauskas, Berenbaum, Dehaut, & Dussault, 1990), early testing for neglect (within a week of cardiovascular accident) is important.

Assessment

Because neglect is a multimodal defect, testing has to be performed in various modalities to determine selective deficits occurring within or across different sensory domains. Although there is experimental evidence of neglect and EDSS in all sensory domains, the phenomena have been most extensively studied in the modalities of vision and touch and with tactual-visual-manipulative tasks. Clearly, deficits in these domains are the most disabling for the patient and most relevant to remediation. Despite the development of more rigorous tests (Van Deusen, 1988), establishment of their reliability and validity is complicated by the fact that neglect phenomena are variable and appear to be task-dependent. Particularly in its stages of improvement (EDSS), the syndrome is characterized by considerable intrasubject and intersubject variability and the symptoms may vary in the same patient with different contexts of the testing situations and at different times of testing (Friedland & Weinstein, 1977).

Clinical testing, although not as sensitive as more formal testing (Stam & Bakker, 1990), is still the most practical method. The earliest observations in clinical testing will likely concern the symptomatology described at the beginning of this paper, that is, the way the patient deals with his or her environment and body parts, with people, and with objects during functional activities.

In the somesthetic mode, the patient (with eyes closed) is touched at various body parts, two stimuli at a time unilaterally as well as bilaterally and in different combinations (to test for EDSS). The examiner can ascertain auditory neglect by snapping his or her fingers. Confrontational techniques are used to test visual neglect. For this purpose, the patient and examiner are seated facing each other; the examiner raises his or her arms (bent at the

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<th>Theorist</th>
<th>Task Rationale</th>
<th>Strategy</th>
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<tr>
<td>Heilman</td>
<td>Enhance the level of performance of the right hemisphere</td>
<td>Use paradigms of spatial compatibility, that is, left hand in left field (both controlled by right hemisphere). (Bowers &amp; Heilman, 1980; Bowers et al., 1981; Heilman et al., 1984) Minimize fatigue with brief training sessions and proper pacing. (Fleet &amp; Heilman, 1986) Set task difficulty realistically (demands beyond the patient’s capacity are likely to increase errors). (Rapcsak et al., 1986; Weinberg et al., 1977) Practice leftward responses initially within the nonneglected (right) hemifield. (Weinberg et al., 1977, 1979) Do not overcrowd hemispaces with stimuli. (Weinberg et al., 1979; Mark et al., 1988; Karnath, 1988) Do not place stimuli in the right space while working in the left. (Karnath, 1988; Heilman et al., 1985) Use salient stimuli and immediate feedback. (Fleet &amp; Heilman, 1986; Weinberg et al., 1977)</td>
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<tr>
<td>Kinsbourne</td>
<td>Reduce interhemispheric balance</td>
<td>Turn head and look to the left. (Kinsbourne, 1972; Weinberg et al., 1977) Use stimuli for which the right hemisphere is specialized (e.g., shapes, lines). (Heilman &amp; Watson, 1978) Remove stimuli likely to activate the intact left hemisphere (e.g., letters, digits). (Heilman &amp; Watson, 1978; Kinsbourne, 1970a) Gradually move target stimuli in the neglected field from a central to a more lateral position. (Riddoch &amp; Humphreys, 1985)</td>
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<tr>
<td>Posner</td>
<td>Practice attentional shifts</td>
<td>Consciously direct the patient’s attention to the neglected left field. (Weinberg et al., 1977; Riddoch &amp; Humphreys, 1983; Posner et al., 1984; Karnath, 1988) Practice the three components of shifting attention initially in the intact field, gradually moving into the neglected space. (Karnath, 1988; Posner et al., 1984) Cue the patient to occurrence and location of the target stimulus in the neglected space. (Posner et al., 1984; Riddoch &amp; Humphreys, 1983) Encourage and reinforce overt gaze shifts in contralesional (leftward) direction. (Heilman et al., 1985; Weinberg et al., 1977) Provide a single meaningful cue in the neglected hemispace and have the patient report it. (Riddoch &amp; Humphreys, 1983) Practice scanning from left to right. (Reuter-Lorenz &amp; Posner, 1990)</td>
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Selected tests are used to assess visual perception, sensory awareness; spatial organization; and the cognitive skills of reading, writing and simple arithmetic. Patients being tested on spatial operations are asked, for example, to perform cancellation tasks, bisection, draw from memory, copy complex figures (Rey-Osterrieth test [Osterrieth, 1944]), perform exploratory and visual matching tasks, and work on block designs. Patients are tested on cognitive skills by reading a paragraph, writing to dictation, and doing simple arithmetic problems (cf. Albert, 1973; Diller, 1980; Horner, Massey, Woodruff, Nailing Chase, & Dawson, 1989; Johnston & Diller, 1986; Levine, Warach, Benowitz, & Cal-vanio, 1986; Ogden, 1987; Vallar & Perani, 1987; Van Deusen, 1988; Weinberg et al., 1977, 1979; Weintraub & Mesulam, 1987). The completed tests not only indicate the nature and extent of the patient's neglect features, but also, when repeated at intervals, can serve to monitor progress during rehabilitation training. Because unilateral neglect is a heterogeneous phenomenon, no singletask can identify the syndrome in all patients, nor will a patient's deficit manifest itself to the same degree in different tests. Usually a variety of tests are employed to determine the extent to which the patient attends to the neglected space. A severity rating can be assigned for each task (Horner et al., 1989), and the patient's remediation program is then designed accordingly.

Microcomputer programs are being developed to assist in the detection and training of visual neglect and extinction (Anton et al., 1988; Robertson, Gray, Pentland, & Waite, 1990). Although computer programs promise to enhance precision in detection of visual deficits (Anton et al., 1988), there is scant evidence that they are more effective than conventional remediation programs. A study of computer-based cognitive rehabilitation of 36 patients with unilateral neglect revealed no significant difference between the group that received computerized scanning and attentional training and the group that used the computer for recreational purposes only (Robertson et al., 1990).

Remediation

Rational methods of rehabilitation are based on accurate analysis of the perceptual deficits (Diller & Weinberg, 1977; Neistadt, 1988). The aim of remediation strategies is to increase the patient's awareness, train the reorientation of attention, and apply training principles to activities of daily living to achieve optimal functioning. The selection of therapeutic strategies depends on (a) the aim of treatment (Horner et al., 1989; Weinberg et al., 1977); (b) the extent of destroyed and reserve brain tissue (Levine et al., 1986); and (c) a sound theoretical base providing the rationale underlying treatment.

When brain damage is not too extensive, that is, when it is confined to small lesions (as confirmed by computerized tomography), a restorative approach may predominate in the remediation program (Horner et al., 1989). The assumption underlying this remedial approach is that recovery is an intrahemispheric process. Given the plasticity of the central nervous system, spared areas in the right hemisphere may be stimulated to take over the function of damaged tissue. With this rationale, the emphasis of treatment is on arousing attentional mechanisms in the right hemisphere (see Table 1).

The use of stimulus material for which the right brain is specialized (e.g., shapes, blocks) should enhance right brain activation as long as stimuli that activate the left hemisphere (e.g., letters, numbers) are kept to a minimum. To integrate the concept of spatial compatibility, tactuomaneuval manipulative tasks can be performed with the use of pegs or rods in the left space with the left hand. Verbal material is avoided, because Kinsbourne's (1970b, 1987) theory contends that language stimuli activate preferentially the left hemisphere, thereby aggravating the deficit of left orientation. The patient's attention is directed to the left hemispace by instructions to turn the head and look to the left (Kinsbourne, 1987). Forewarning the patient enhances stimulus detection and anchors his or her attention, and the placement of a conspicuous stimulus in the neglected space serves as cuing. At the same time, the right space is kept free of stimuli that might distract attention from the left space. Performance is likely to improve when the density and complexity of stimuli in the patient's working area are reduced, when the tasks do not exceed the patient's capacity and are appropriately paced, and when immediate feedback is given. Deteriorating performance signals the therapist to reduce the level of difficulty, slow the pace, or terminate the training session. If a task cannot be performed at all in the neglected space, it may first be practiced in a central position before gradually moving it to the left (see Table 1).

When neglect is severe, as it often is in patients with extensive brain damage, the patient has to be helped to acknowledge his or her problem and then taught methods to compensate for the impairment. The aim of a compensatory approach is the attainment of optimal
function despite persisting deficits through greater involvement of the left hemisphere. It should be noted that although reading, writing, and arithmetic are considered left brain tasks, they all require spatial operations as well. Retraining usually involves a combination of the two approaches because both hemispheres must work in concert to accomplish a task. Retraining procedures are based on principles of learning. Because of the flattened affect of patients with spatial neglect, however, these patients often lack motivation and may need to overlearn selected tasks through repeated reinforced practice.

A remediation program may begin with visual scanning before other perceptual skills are practiced (Gordon et al., 1985; Weinberg et al., 1977). Directional scanning should be performed in a left-right direction with an anchor at the starting point (Reuter-Lorenz & Posner, 1990). Tasks such as searching for targets, tracking targets across the midline, canceling predetermined stimuli, and reading and writing can be used to practice attention shifts. If such tasks are too difficult to perform between fields, they can first be practiced in the intact space, gradually moving leftward. In all tasks, principles of anchoring, cuing, reporting cues in the left space, pacing, controlling the density of stimuli, and reinforcing each accomplishment are likely to enhance level of performance and may later facilitate adaptation to environmental conditions. Spatial organization may be retrained through estimation of distances between rods or comparison of their lengths (Weinberg et al., 1979). During sensory awareness training, the patient practices to acknowledge touch without visual aid. For example, the therapist, standing behind a patient, may touch various points on his body; the patient indicates the location of the perceived touch on a mannequin in front of him (Weinberg et al., 1979). More adaptive social behavior can also be cultivated with the use of learning principles: eye contact may be rewarded, for example, with a smile to increase the probability of its recurrence.

**Activities of Daily Living**

Not surprisingly, visuospatial deficits interfere seriously with activities of daily living (Kaplan & Hier, 1982; Van Deusen, 1988). Unfortunately, training effects do not seem to generalize well to self-care activities (Gordon et al., 1985; Neistadt, 1988) and may have to be relearned in the home setting, where tasks may involve different stimulus material and are no longer practiced under guidance and with selective reinforcement of correct responses.

Patients with spatial neglect also seem to be more accident-prone than do brain-damaged patients without neglect. Webster et al. (1988) compared poststroke patients with and without spatial neglect on wheelchair navigation through an obstacle course. Not only did the group with spatial neglect make significantly more lef-sided errors than the stroke patients without neglect, but they also had more collisions. (Neither errors nor accidents were related to deficient motor control.) Training in scanning improved performance significantly; however, increased complexity of obstacle arrangement in the right hemisphere resulted in increased vigilance toward the right and accentuated the neglect of the left space. Moreover, distances on the left were being underestimated. These deficits may also account for driving impairments (Sivak, Olson, Kewman, Won, & Henson, 1981).

On returning home, the patient has to continue with compensatory self-training. To enhance proficiency, tasks might have to be performed as far rightward as deemed necessary. The working area should be uncluttered and a left anchor should be provided. A left cue may also aid in reading and writing; a ruler (or the patient’s thumb) held vertically on the left margin of the page can serve as an anchor for the beginning of each line. The patient might have to remind himself periodically to turn to the left and scan the left space. Demands should be kept to a realistic level and fatigue avoided. Social interaction will be better appreciated when it takes place on the good side.

No strategy, however, can compensate for the patient’s lack of motivation; most patients with spatial neglect remain to some extent inattentive to the left, and extended rehabilitation efforts seem futile, frustrating, and nonrewarding (Heilman et al., 1987).

**Summary and Conclusion**

A heterogeneous syndrome following damage to (most commonly) the right parietal lobe, unilateral neglect is now recognized as a disturbance of attentional systems. Determination of the brain mechanisms underlying the disorder is the basis for understanding the nature of the resulting impairment and ultimately designing effective remedial strategies. To account for the complex neglect phenomena, three recent theories were reviewed and supportive empirical evidence cited. The discussed theories offer suggestions for remedial strategies; rather than being mutually exclusive, their therapeutic implications appear to complement each other in many respects. Depending on the underlying rationale, remedial approaches can address different aspects of attention, such as hemispheric arousal, orientation of attention, sensory awareness, visual shifting (i.e., locating, fixing, and releasing target stimuli), and visual scanning. Once the nature of the patient’s impairment is conceptualized on the basis of thorough assessment, the aim of effective remediation is to assist the patient in realizing his or her maximal potential during the readaptation process. A combination of restorative and compensatory methods are employed to attain this goal.

Theories, however, need to be tested. Occupational therapists involved in a remediation program of brain-
injured persons are in an ideal position to evaluate the validity of theoretical models by reporting the effectiveness of clinical strategies based on the theory’s predictions. ▲

References


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