

The Minor Hemisphere  
Round Table Discussion

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Introduction

This paper does not reflect the peripatetic nature of the discussion. Itinerant discussants and a meandering moderator required, for the sake of clarity, that it be presented in this form.

Both hemispheres of the developing brain may possess equal potential for the development of speech and language (Lenneberg, 1967; Kinsbourne, 1974), despite anatomical differences in favor of the left hemisphere (Witelson and Pallie, 1973) which continue into later life (Geschwind and Levitsky, 1968). During that time, speech and language may be subserved by either hemisphere (Kinsbourne, 1974). As the brain matures, however, functions are increasingly lateralized; by the end of the first decade of life the early plasticity and equipotentiality are gone and damage to either hemisphere may result in irreversible loss of function. By the beginning of the second decade of life, the left hemisphere is largely dominant for handedness and speech and language functions in the majority of individuals, and the right hemisphere has assumed the major role for visual, spatial, and "nonverbal" functions. The heterogeneity of our species precludes our generalizing from an assumption of absolute dominance for specialized activities, however. We are too often confronted by left handedness (anomalous or not), right hemisphere speech and language dominance, bilateral representation for speech and language, and contradictory dichotic listening results. A plausible explanation for these apparently antithetic findings is that there are gradations of hemispheric specialization, or laterality, ranging from absolute dominance of one hemisphere to equal cooperation between and contribution of both hemispheres (Luria, 1970; Zangwill, 1964). According to Smith (1969), both hemispheres alone are capable of performing functions in which the other hemisphere specialized, although in a somewhat more limited and varying degree. Anderson and Jaffe (1973), as reported by Kinsbourne (1974), suggest that as many as 25 percent of the population habitually decode speech with their right Wernicke's area, as we have long suspected. Rosenbek (1976, personal communication) says he knows who they are.

Compelling theories have been advanced to account for the predominant functional organization of language in the left hemisphere. Moscovich (1976), for example, argues that the left hemisphere exerts a suppressive effect on the linguistic capabilities of the right hemisphere in normals; the right hemisphere is released to serve language when it is isolated from that influence. He suggests that the discrepancy between relatively good performance of the right hemisphere, as seen in split brain subjects (Sperry, 1968) and the poor performance of the right hemisphere on linguistic tasks in normals, may be accounted for by this model. One aspect of Kinsbourne's theory of compensation suggests that this is true for more circumscribed areas as well--areas of the "minor" hemisphere may compensate when a correspondent area in the "major" hemisphere is damaged.

There appear to be inherent weaknesses in both hypotheses, however. It is apparent that not all left hemisphere brain damage which results in aphasia

releases or "disinhibits" corresponding areas for compensation; there are no reported cases of return of functional speech and language in adult patients who have undergone dominant hemispherectomy. There are reports of reduction of speech and language abilities in aphasic patients who have undergone additional damage to the nondominant hemisphere, and Kinsbourne (1974) reports decrements in residual speech and language in aphasic patients under amobarbital injection of the right carotid. Unfortunately, at least for those who subscribe to a theory of right hemisphere compensation for speech and language, he also discovered decreased speech and language abilities in aphasic patients who underwent amobarbital injection of the left carotid artery. Once again, the evidence strongly suggests a graded laterality.

While the reviews for right hemisphere speech and language capabilities are mixed, there is good evidence to suggest that the right hemisphere does perform some functions that are more or less unique, and some that are performed with the participation of the dominant hemisphere. The brief summaries of some of these functions which follow are only that. The interested reader is urged to consult the bibliography provided.

#### Auditory Processing

Studies by Milner (1962), Kimura (1961), Studdert-Kennedy and Shankweiler (1970) and others have demonstrated the superiority of the left hemisphere (right ear) in the comprehension of speech in dichotic listening tasks for most normals. Presumably, the right ear advantage obtained is due to the preponderant role of the left hemisphere in processing verbal material. Acoustic analysis of some of the components of the speech signal, however, may be shared by the right hemisphere, or processed entirely by it. The right hemisphere apparently plays an important role in tonal memory, for example, as demonstrated in temporal lobectomy patients by Milner (1962) and Berlin, Chase, Dill, and Hagepanos (1965), and in certain pitch discriminations (Milner, 1962; Darwin, 1969). An innovative series of studies by Van Lancker (1975) demonstrated a right ear advantage when pitch is used for phonological distinctions in a tone language (Thai), suggesting that while pitch in nonlinguistic contexts may be processed bilaterally or by the right hemisphere, pitch discriminations with linguistic impact are lateralized to the left hemisphere. Other studies have demonstrated a left ear advantage for melodies (Kimura, 1965); chords (Gordon, 1970); and environmental sounds (Curry, 1967).

Normal language perception and the dimensions that term encompasses may involve the active participation of both hemispheres, with the left hemisphere more important for comprehension of language than for expression (Gazzaniga, 1967; Bogen, 1969). Eisenson (1962), in a study of right brain damaged patients, supports the notion that the right hemisphere is important for "high level language functioning." Van Lancker (1975) suggests that the right hemisphere stores and processes holistic phrases, and aids in comprehension of single words, and sentences with redundant phrases. Her dichotic studies demonstrated that both ears deal equally well with automatic words and short phrases and more familiar propositional or high frequency of occurrence words; on a more difficult dichotic linguistic task, "double pairs," a significant right ear advantage was observed. Critchley (1962) suggests that right-hemisphere damaged patients show delayed identification of language in auditory as well as in visual channels, and Swisher and Sarno (1969) and McClellan, Wertz, and Collins (1973) noted deficits in auditory processing abilities in right brain damaged patients.

The studies cited suggest that the right hemisphere contributes to the auditory processing of certain kinds of linguistic stimuli.

### Speech and Language Production

Kinsbourne (1971) and Pettit and Noll (1972) have suggested that the right hemisphere may contribute to residual speech in aphasia, and isolated reports in the literature suggest that speech and language deficits may be seen in lesions of the nondominant hemisphere. Weinstein (1964) found errors in naming by right hemisphere damaged patients which he did not attribute to disordered linguistic ability but rather to a change in the patient's relation to his environment; Marcie, Hecaen, Dubois, and Angelergues (1965) report impairment in repetition of nonsense syllables and words, with articulation errors and defective sentence structure and grammar; deficits have been noted on the Porch Index of Communicative Ability (McClellan, Wertz, and Collins, 1973); Archibald and Wepman (1968) reported aphasic responses on the Language Modalities Test for Aphasia, but did not report site of lesion or speech and language dominance; Critchley (1962) reports disordered articulation, impairment of creative literary work, and difficulty in word finding and learning of novel linguistic material; and Sparks, Helm, and Albert (1974) speculate that the right hemisphere may be involved in speech and language improvement resulting from Melodic Intonation Therapy.

The evidence for the contribution of the right hemisphere to speech and language production is substantial, but not overwhelming. We await the results of more definitive studies.

### Visual Perception, Spatial Perception, and Body Image Disorders

The functional deficits often associated with lesions of the temporal and/or parietal lobes of the non-dominant hemisphere are identified by a jungle of terms and symbols which often overlap. The deficits include: lack of awareness of hemiplegia (anosognosia); apractagnosia (visuospatial disorders); loss of conception of topographical relations (plantopokinesia); inability to recognize faces, including one's own (prosopognosia); integration of complex visual material (simultanagnosia); constructional disabilities; dressing apraxia; difficulties in visual discrimination; and neglect of the left side of the body, or extracorporeal space.

These disorders are more often associated with lesions of the right hemisphere than with the left -- the right hemisphere is the "leading" hemisphere for evaluating and integrating visual information (Joynt, 1975). The subject remains mild controversial, however. Hecaen (1962) and others suggest that many of these disorders may accompany left sided lesions, and may be masked by aphasia (Critchley, 1962). Joynt (1975) believes that constructional apraxia in right hemisphere damaged patients is due to visuospatial perception dysfunction and to "executorial" disabilities in left hemisphere damaged patients, for example. While the left hemisphere is not completely exonerated in such deficits, then, the right hemisphere, particularly the temporal and parietal lobes, are more often implicated.

### Summary

Proponents of the concept of strict lateralization of function are in a precarious position. While there is substantial evidence to suggest a somewhat less than unique role for the right hemisphere in elementary speech, musical abilities, and visuospatial functions, these functions are not homogeneously assigned.

Functional organization of the brain is probably best described as hemispheric preponderance, rather than hemispheric dominance (Joynt, 1975), with functional hemispheric organization varying among individuals.

### Clinical Notes

Speech pathologists interested in the treatment of deficits associated with right hemisphere damage receive little succor or guidance from the literature or from their peers. While we show a willingness to study these patient's deficits (Boone, 1959; Boone and Landis, 1968; Bonkowski, 1969) only a few elect to treat them or choose to report the results of that treatment (LaPointe and Culton, 1969; Leutenegger, 1975). This unwillingness may be due to several factors: an uncertainty of our territorial imperatives, a lack of expertise, or the patient's concomitant behavior deficits.

None of these factors can be lightly dismissed. I am prepared only to argue that in many instances professional help is not available to these patients, and we are in a position to provide services which would otherwise be denied.

A summary of the deficits associated with right hemispher brain damage provided by Leutenegger (1975) includes some which were not included earlier: impaired judgment, impaired time concepts, impaired calculating ability, impaired reading comprehension, dysarthria, and confabulation. Of these, he suggests that the speech pathologist may treat reading, writing, and calculation deficits. I think we can also treat the dysarthric, provide aid to the disoriented, and counseling for the family and patient.

Once we have accepted the responsibility of treating these patients, we are confronted with the problem of diagnosis. Glaring left neglect, for example, may masquerade as left homonymous hemianopsia; reading comprehension may be contaminated by visual perceptual deficits. Selecting the appropriate diagnostic tool may be an even more difficult task. The old standby, Raven's Coloured Progressive Matrices (Raven, 1962), is not all that useful a diagnostic tool, and no standardized diagnostic tests are available which are designed specifically for use with right hemisphere damaged patients. Other measures, such as the Nelson Reading Test, appropriate elementary texts, General Educational Development (GED) study manual, Porch Index of Communicative Ability, informal testing, and serendipitous discovery may be sufficient for baseline measurements. Informal testing should include both copying and drawing figures from memory, copying and writing to dictation, and simple oral reading (The Rainbow Passage, for example). Once the deficits have been indentified, you're essentially on your own. Several suggestions from the scant literature and from our clinic, however, may be helpful.

LaPointe and Culton (1969) report successful treatment of a patient with left visual-spatial neglect, whose greatest difficulty was in omission of details from the left side of drawings; arithmetic calculations; and in reading. Treatment was pragmatic and included drill in copying forms and simple symmetrical pictures, copying written stimuli, and drawing pictures from memory. He was encouraged to recheck his work, using a finger of the left hand as a guide, and to pay particular attention to the left margin of any work.

In our clinic, we find the majority of patients have difficulty in performing even the simplest mechanical aspects of reading; attending to the left margin, moving from one sentence to the next, from one paragraph to the next, and following the meaning of the sentence. We encourage oral reading practice, forcing the patient to attend to the left visual field. We use a brightly colored cardboard guide, in the shape of a carpenter's square, to force attention to both the line of interest and to the left margin. Measures of reading comprehension can be taken, with discussion and, conceivably, testing, following the reading.

Long hospitalization tends to disassociate any patient from the world outside; the right hemisphere patient is particularly vulnerable. Daily orientation sessions in our clinic begin and end with questions about the date, day, time, current events, location of the hospital, home, family member's names, activities, job, avocations, etc. Short newspaper items of current interest can be read and discussed, and typed in larger print if necessary.

In the treatment of the right hemisphere damaged patient, we continually face the concomitant problems of inattention, loss of inhibition, emotional lability, and denial of symptoms. Treatment of these patients is not easy, and sometimes impossible. We admit to persevering in the face of these roadblocks, and find that we're occasionally successful. We may sometimes serve only as a foil to the unrealistic expectations of patient and family, but we rarely feel that our intervention has not been beneficial. Until we learn more about the efficacy of therapy with these patients, we are restricted to our clinical skills and intuitions.

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