<Special Lecture>

**SIGNIFICANCE OF NONVERBAL COGNITIVE ABILITIES
IN APHASIC PATIENTS**

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The question of the status of cognitive functions in aphasic patients is one of considerable clinical and theoretical importance. However, it is a question that has been complicated by historical factors, particularly by the age-old controversy about the nature of the relationship between language and thought.

For centuries many philosophers and students of linguistics equated human thought (particularly abstract reasoning and imaginative thinking) with language functions and they maintained that it is impossible to conceive of human thought without speech. However, other philosophers and linguists disagreed with this formulation. Although they conceded that speech is closely related to intellectual function, they insisted that the relationship was one of association and not identity. In their view, speech performed a “sign function” for thought and enabled the contents of thought to be communicated. This is, of course, the “common-sense” view that speech is an instrument for the expression of thought and not thought itself.

After Broca’s discovery of the association between aphasic disorder and disease of the left hemisphere, the controversy regarding the nature of the relationship of language to intelligence was brought into the field of medicine. This was unfortunate but it occurred. The question was now posed in the form of whether or not the aphasic patient was necessarily impaired in intellectual function. As was the case with the philosophers and the linguists, two opposing schools of thought emerged.

The “cognitive” school, the leading members of which were Hughlings Jackson, Pierre Marie, Henry Head and Kurt Goldstein, viewed aphasia as being primarily an intellectual disorder. Each of these neurologists had a somewhat different idea of the specific nature of the intellectual defect shown by aphasic patients. However, all were in agreement that there was an indissoluble bond between speech and thought. The linguist, Max Mueller, stated the thesis quite simply, “To think is to speak low, to speak is to think out loud”. Hughlings Jackson was equally emphatic, “Speech is a *part* of thought”. Therefore a person who is deprived of speech is necessarily crippled in his thinking.

The members of the opposing “associationist” school, among them Paul Broca, Carl Wernicke and Jules Dejerine, were equally emphatic in denying that aphasic patients were necessarily impaired in intellect, even though they were well aware that many aphasics did show defects in abstract reasoning and other cognitive functions. Wernicke’s famous statement expresses their position. “Nothing could be worse for the study of aphasia than to consider the intellectual disturbance associated with aphasia as an essential part of the disease picture”.

This controversy between some of the most eminent neurologists of the late 19th century and

early 20th century was never resolved. It proved to be a quite fruitless debate. Although Jackson, Marie and Head were correct in assuming that human thought is crippled if a person is deprived of the use of verbal symbols in thinking, their assumption that all patients in the diagnostic category of aphasia have lost the capacity to think in verbal terms was surely unwarranted. In fact, unbiased observation indicates that many aphasics are capable of verbal mediation in performing intellectual operations despite their disabilities in expressive and receptive speech.

Let us first consider two extreme examples. At the one extreme there is the patient with the disability known as aphemia, apraxia of speech or cortical dysarthria. Despite his quite evident difficulty in oral speech expression and reading aloud, his preserved capacity for verbal mediation in thinking is shown by his normal understanding of oral speech, his ability to read with understanding and his ability to write (if his motor status makes it possible for him to write). At the other extreme is the patient with pure word deafness who cannot understand oral speech but whose preserved capacity for verbal mediation is demonstrated by his intact expression, writing and reading.

Of course, it is true that many neurologists and speech specialists do not consider that patients with aphemia or word deafness are "true" aphasics. Aphemia (or speech apraxia) is viewed as only a disorder of speech articulation and word deafness is considered to be a higher-level auditory defect.

However, many patients who *are* clearly aphasic show patterns of linguistic performance that indicate at least some preservation of the capacity to use verbal symbols in thinking. Thus, significant discrepancies in the level of different linguistic performances in aphasic patients are not rare. Many aphasic patients (of either the Wernicke or the Broca type, that is, both fluent and non-fluent aphasics) write better than they speak; or they speak better than they write. Some patients show a remarkable preservation of the ability to read with understanding within the context of grossly disordered oral speech expression and marked defects in the understanding of oral speech.

Patients with jargon aphasia generally show significant impairment in the understanding of oral speech and they are also likely to show diverse intellectual defects. Some are certainly demented. Yet there are jargon aphasics (with unawareness of their defect) who understand oral speech and who perform well on tests of abstract thinking (such as the Raven Progressive Matrices and the sorting tests of Goldstein) that make demands on the capacity for verbal mediation.

The fact is that *no* generalization can be made about the cognitive capacities of "the" aphasic patient. Some patients show complete intactness of intellect, some show a general impairment of intellect (that is, dementia of greater or lesser degree) and some show specific defects (that is, impairment in certain cognitive functions but not in others).

Aphasia and Cognitive Impairment

The cognitive defects shown by aphasic patients can be divided into two categories. The first category includes those defects that are shown almost exclusively by aphasic patients and only rarely by nonaphasic patients with brain disease. The second category includes those cognitive defects that are shown by both aphasic and nonaphasic patients.

The most prominent defects in the first category, i.e., those shown by some aphasic patients but only rarely by nonaphasic patients, are shown in Table 1. They include two types of apraxia: inability to execute gestures on command or to imitate these gestures; and inability to demonstrate the use

Table 1 Cognitive deficits of aphasic patients

<i>Apraxia of Gesture.</i>	Inability to salute, comb hair, brush teeth, etc. on verbal command or to imitate these actions when made by the examiner.
<i>Apraxia of Use.</i>	Inability to show how to use a hammer, a key, a knife, etc. (with or without the presence of the object).
<i>Sound Agnosia.</i>	Failure to recognize nonverbal meaningful sounds such as the barking of a dog, the ringing of a bell, a train whistle, etc.
<i>Defective Recognition and Expression of Pantomime.</i>	Failure to recognize pantomimed actions or to use pantomimic language.

of objects, such as a key or a hammer.

Another type of deficit shown almost exclusively by aphasic patients is so-called "sound agnosia", that is, failure to recognize nonverbal meaningful sounds, such as the ringing of a bell or the barking of a dog. Most patients with word-deafness and many Wernicke aphasics show this deficit. This is clear evidence that their impairment in understanding extends beyond the area of language to encompass lack of understanding of nonverbal auditory stimuli.

Some aphasic patients show difficulties in the expression and understanding of pantomimed or symbolic actions. Thus a patient who knows sign language may lose this ability, as was demonstrated in the instructive case report of Hamanaka and Ohashi (1974). The disability may be broader in scope and involve failure to understand the meaning of simple pantomimes, such as pretending to use a cup or to comb one's hair.

It should be kept in mind that, although these defects are shown almost exclusively by aphasic patients, they are not shown by most of them. Only a minority of aphasic patients will be found to be apraxic or show disturbances in the recognition of environmental sounds or pantomime.

Table 2 shows some of the more prominent defects in the second category, i.e., defects which are seen in both aphasic and nonaphasic patients. First there is impairment in learning and memory. Limitations in the ability to learn new information and, once it has been learned, to retain that information is surely the most prominent defect shown by *all* patients with brain disease. It is also the most prominent defect shown by older normal people (Arenberg, 1978; Benton, Eslinger & Damasio, 1981).

Almost equally frequent is a slowness in information processing. This retardation in the rate of information processing is clearly disclosed in reaction time studies which show that both patients with brain disease and older people process information much more slowly than do younger normal persons (Benton, 1977; Botwinick, 1978).

Impairment in abstract reasoning, as measured by appropriate nonverbal tests, such as Raven's

Table 2 Cognitive defects of aphasic and non-aphasic patients

Impairment in learning and short-term memory
Slowness in information processing
impairment in abstract reasoning
Visuoconstructive disability (Constructional Apraxia)
Impairment in visual discrimination (e.g., Faces, Complex Figures)

Progressive Matrices, object-sorting tests and color-form sorting tests is also frequent in both aphasic and nonaphasic patients (Lezak, 1976). However, it is well to keep in mind that the level of performance on some of these tests is significantly related to educational level and that many normal subjects who are poorly educated experience difficulty with them. Thus it is necessary to take account of a patient's educational background in deciding whether a poor performance indicates pathological defect.

Visuoconstructive disabilities (so-called constructional apraxia) are shown with high frequency by nonaphasic patients with right hemisphere strokes. Among patients with left hemisphere strokes, those who are not aphasic rarely show constructional apraxia. Among aphasics, the highest frequency of visuoconstructive deficit is shown by patients with significant defects in the understanding of speech (Benton, 1973; De Renzi, 1982).

Finally, defects in visual discrimination, such as the inability to distinguish faces or to identify complex visual configurations, are shown by both aphasic and nonaphasic patients (Hamsher, Levin & Benton, 1979; Meier & French, 1965).

Significance of Cognitive Impairment

Let us address the question of whether or not the occurrence of these cognitive defects in aphasics possesses pathological or clinical significance. There has not been a large amount of investigative work on this question. However, a number of studies suggest that performance on some cognitive tasks is related to the locus and extent of the lesion and to certain aspects of aphasic symptomatology. In addition, performance on other cognitive tasks has been found to be related to the rate and extent of recovery from aphasic disorder after stroke.

A few examples may be considered. One example is pantomime recognition. Figure 1 shows an item in a standardized test of pantomime recognition which we developed some years ago. The patient watches a man pretending to play a violin on a television screen. At the same time, he has before him a card showing the four objects in Figure 1. He is instructed (verbally and by gesture) to point to the object that the man in the videotape is pretending to use. There are four choices—the correct choice and three incorrect choices. One incorrect choice shows an object that is semantically related to the correct object—in this case, another musical instrument, a trumpet. Another incorrect choice shows an object that is not related to the correct object but one that can be used for another action—in this case, a gun. The last choice shows an “impossible” object that cannot be used for an action—in this case, an anchor.

When this test was given to a sample of aphasic patients about two to three weeks after their stroke, it was found that a surprisingly large number (30–40 percent of the group) performed defectively (Varney, 1978). The errors made by these patients were not random. Over 80 percent of the errors involved pointing to the semantically related object, for example, pointing to the trumpet instead of the violin in the item illustrated in Figure 1 (Varney & Benton, 1982). Thus the failure of these patients appeared to be due to a semantically vague understanding of the pantomimed action rather than to confusion or failure to understand the task. These semantic errors in interpreting the nonverbal messages from pantomimed actions may be compared to the aphasic patient's imprecise understanding of a verbal message when he points to a knife instead of a fork, or to a cup instead of a

Figure 1 Item 6 of the Pantomime Recognition Test. Patient views a man pretending to play a violin on a television screen. At the same time he is requested to point to the object on this multiple choice card which the man is pretending to use.

glass.

The aspect of aphasic symptomatology which is most closely related to pantomime recognition is the ability to read. Patients who fail to recognize pantomimed actions invariably show severe defects in reading. In contrast, some patients with defective pantomime recognition show only slightly impaired understanding of oral speech. Nor do patients with defective pantomime recognition necessarily show other indications of so-called "asymbolia" (Varney, 1982). For example, they may perform well on the Raven Progressive Matrices.

Another correlate of defective pantomime recognition is demonstrated by CT scan findings that most of these patients have lesions that involve the parieto-occipital territory of the left hemisphere. It has also been found that, in the course of recovery from aphasia, pantomime recognition and reading ability improve together. If pantomime recognition remains defective, then reading will remain defective.

Many aphasic patients show impairment in abstract reasoning, as measured by an appropriate nonverbal test such as the Raven Progressive Matrices. A study by Reinvang (1981) investigated the relationship between the performance of aphasic patients about four months after stroke with their performances about 13 months after stroke. His interest was in determining the degree to which neurological status, severity of aphasia and nonverbal cognitive test performance at the first examination would predict the degree of recovery from the aphasic disorder as measured nine months later.

The major findings of this study were as follows:

- 1) The majority of patients showed a moderate improvement in language abilities over the course of the nine months interval between the examination at four months after stroke and the examination 13 months after stroke. However, some patients showed very marked improvement over this nine months interval. Other patients showed very little or no improvement over the nine months interval.

Figure 2 Three-dimensional constructional praxis test.
Each model is presented to the patient who is requested to build an identical model with blocks placed at his disposal.

- 2) Performance on the Raven Progressive Matrices four months after stroke was significantly related to the degree of improvement over the nine months interval. Those patients who had performed well on this nonverbal test of abstract reasoning tended to improve more in language functions than did those patients who had performed poorly on the test. Briefly stated, performance on the Raven test was found to have some prognostic value. On a statistical basis, performance on the test predicted which patients were or were not likely to improve in language function. In contrast, the Performance Scale of the WAIS had minimal predictive significance. Performances on a motor skill test and the presence of sensory or motor deficits were found to have no predictive significance with respect to the degree of recovery.

The implications of one other cognitive deficit shown by some aphasic patients, namely, constructional apraxia, will be mentioned. Figure 2 shows a three-dimensional block building test which we standardized for clinical use. As will be seen, three block models are presented to the patient who is required to build them from blocks placed at his disposal.

1967). Non-aphasic patients with left hemisphere disease only rarely perform defectively on this test. However, many aphasic patients, particularly those who show significant impairment in oral verbal comprehension, also perform defectively as shown in Table 3 (Benton, 1973). We found, in two successive series of cases, that approximately 50 percent of aphasic patients with impaired oral verbal comprehension (sensory aphasia in the old terminology) performed defectively on this particular constructional task.

Table 3 Three-dimensional constructional apraxia in relation to side of lesion and aphasic disorder (Adapted from Benton, 1973)

Classification	N	Frequency of failure*		
<i>Left hemisphere disease</i>				
A. Aphasic with severe receptive defect	9	66.7%	} 50% } 12.5% } 32.4%	}
B. Aphasic with moderate receptive defect	9	33.3%		
C. Expressive aphasia only	8	12.5%		
D. Not aphasic	8	12.5%		
<i>Right hemisphere disease</i>				
E. Not aphasic	14	35.7%		

* Performance level exceeded by 99 per cent of control patients.

Naturally the question arose as to whether there were any characteristics that differentiated those sensory aphasics who performed defectively from those who performed normally. We suspected that age might be an important factor but it proved not to be significant. Premorbid intelligence, as measured by educational level, also was not different in the two groups. The two factors that were related to success or failure on this constructional praxis task were the locus of the lesion and the presence or absence of a visual field defect. The highest frequency of failure (70 percent) was found in aphasic patients with parietal or temporo-parietal lesions *and* visual field defects. The next highest frequency of failure (45 percent) was found in aphasic patients with parietal or temporoparietal lesions but without visual field defects. In contrast, aphasic patients with temporal or fronto-temporal lesions showed a significantly lower frequency of failure (22 percent).

Thus the occurrence of failure on a test of constructional praxis carried with it implications about the locus (and possibly also the extent) of the lesion caused by the stroke.

Some Conclusions

As has been mentioned, there has not been very much clinical research on the question of the significance of the status of cognitive functions in aphasic patients. However, the studies that have been done, as exemplified by the investigations reported in this paper, suggest that performance on nonverbal cognitive tests may have important implications along a number of dimensions. Some nonverbal cognitive test performances are associated with specific aspects of aphasic symptomatology, as, for example, pantomime recognition, which is closely related to reading ability. In this case, intact pantomime recognition appears to be a necessary basis for the preservation or the recovery of reading ability in the aphasic patient.

Other nonverbal cognitive performances, such as the capacity for abstract thinking, have prognostic value with respect to the extent of recovery from aphasia, as shown by the study of Reinvang.

Still other nonverbal cognitive performances provide indications of the locus and extent of brain dysfunction caused by stroke, as exemplified by the findings of our study of constructional apraxia in aphasic patients.

Certain conclusions can be drawn from the empirical findings on this topic of cognitive function in aphasic patients. The first is that the evaluation of the aphasic patient should always include an assessment of his cognitive abilities, as measured by appropriate nonverbal tests, in order to achieve a complete picture of the patient's mental status. An examination which is restricted to the assessment of his linguistic functions is not sufficiently comprehensive.

Secondly, more systematic research on a number of questions needs to be done. The significance of nonverbal cognitive performances for the question of the locus and extent of brain dysfunction is one such question. Some neurologists believe that the occurrence of nonverbal cognitive defects such as, for example, constructional apraxia, implies that there is widespread dysfunction involving both cerebral hemispheres and extending beyond the morphological alterations of the left hemisphere disclosed by radiography. Critical studies involving independent measures of right hemisphere function in aphasic patients (e.g., cerebral blood flow determinations, electroencephalography, evoked potential measures) are required to evaluate this possibility.

The prognostic significance of nonverbal cognitive performances is another question that needs to be further explored. Studies, such as that of Reinvang (1981), have indicated that the cognitive status of aphasic patients does have prognostic implications. What is needed now is more detailed study that will identify the specific cognitive performances that have prognostic implications for the recovery of specific aspects of language function.

Finally, the implications of cognitive functions for the direction which aphasic rehabilitation should take needs to be examined. Speech therapy with the aphasic patient is based on the premise that his linguistic defects can be alleviated by special teaching procedures. If this premise is valid, then there is no *a priori* reason to doubt that it is also valid for the nonlinguistic defects which the patient may have. That is, his nonverbal defects (e.g., in pantomime recognition, constructional performance or abstract reasoning) may also be alleviated by special teaching procedures. In some cases, it appears that nonverbal cognitive defects are at least a partial determinant of the patient's speech problems. Aphasia rehabilitation in these cases should include training of nonverbal cognitive functions as an integral component of the total therapeutic program.

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