Developmental Aphasia

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As recently as ten years ago, a paper on developmental aphasia would probably have been introduced with arguments either for or against the existence of the syndrome. Although this line of argument may still be heard, most specialists in language disorders of children are more likely to be concerned about the differential symptoms of the syndrome rather than to question its existence. In the broadest possible sense, developmental aphasia may be considered to exist when we can establish that a neurologically handicapped child has failed to establish, or has severe retardation in, the understanding and production of language. In a narrower sense, and in the sense to which we shall address ourselves to the question, we consider that developmental aphasia is relatively specific to language function (absence or severe retardation of this function) and that the impairment cannot be ascribed to one or more of the frequent causes for language impairment. These causes include deafness, mental deficiency, motor disability involving the speech mechanism, or severe personality (emotional) problems.

It is not our intention in this paper to consider the question of differential diagnosis in any detail. Fortunately, articles by A. L. Benton[1] and J. Eisenson[6] cover the question of the identification and differential diagnosis of the aphasic child. In this paper, therefore, we shall emphasize the possible etiology and the perceptual characteristics and intellectual functioning of the child designated as *developmentally aphasic*.

Etiology

In the article by Benton,[1] referred to above, the author postulated two possible types of etiology for developmental aphasia. The first was an underlying impairment for associations or connections in the cerebral system between sensed sound and other cerebral processes through which meanings may be derived. The second postulation stressed the likelihood of the presence of defective perceptual processes which underlie the failure for normal language development. It is often possible for psychologists to demonstrate the second without convincing neurologists about the existence of the first. If, however,

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we take the position that the psychologist, in assessing perceptual functions is really engaged in an *extended neurological,* then establishing perceptual impairment or dysfunctioning implies that the cerebral mechanisms are defective. This is so even though a *routine* neurological does not provide evidence for the other positive findings. This writer accepts the position that developmentally aphasic* children suffer from a primary impairment in those aspects of auditory perception necessary for language to be learned and produced. The impairment in auditory perception may be associated with actual brain damage incurred before birth, during birth, or during the first year to year and a half of life, or because of a delay in cerebral maturation which implicates the auditory centres.

Until fairly recently, clinical impression rather than the results of systematic experimental studies provided the data for our observations in regard to the auditory functioning of aphasic children. Some of the more frequent clinical observations cited in the literature include difficulty in the localization of a source of sound, inconsistency of responses to sound, especially to speech sounds, marked oscillation of auditory threshold, inattention to auditory stimuli, and quick dissipation of attention (Benton[2]).

The Acquisition of Language

By the end of the second year, most children indicate by their behaviour that they understand much of what is said to them by normal speaking adults. In addition, the children are well on their way to speaking much like the adults in their environment, but with enough variation to be speaking for themselves, as well as expressing their special selves as unique members of their environment. By the end of the third year, most children understand not only what is said to them, but are able, instantly, to comprehend an amazingly large number of verbal formulations to which they have had no previous exposure. Thus, we may conclude that normal children are able to listen and understand creatively, and are innovative and creative in their own utterances. Each time a child arranges (formulates) a number of words he has not before so uttered, he is demonstrating creativity in verbal behaviour. Chomsky,[4] in an article on *Language and the Mind,* sums up this position as follows:

> The fact surely is . . . that the number of sentences in one's native language that one will immediately understand, with no feeling of difficulty or strange-

* Hereafter, the single terms *aphasic,* or *aphasia,* will be used rather than *developmental aphasic,* or *developmental aphasia.* It should be understood that a child who has established language may, as in the case of an adult, become aphasic as a result of brain damage. This would constitute *acquired aphasia* in a child. We are not, however, concerned with this problem in this paper.

ness, is astronomical, and that the number of patterns that underlie our normal use of language and that correspond to meaningful and easily comprehensible sentences in our language is orders of magnitude greater than the number of seconds in a lifetime, or the number of seconds in the history of the language for that matter. It is in this sense that the normal use of language is innovative, in fact, potentially infinite in variety.

In the normal acquisition of language a child somehow learns to listen so as to discriminate the sounds and combinations of sounds in the linguistic system of his environment, to isolate some words, and to produce utterances consisting of combinations of words according to a set of *rules* (the grammar) of the language or languages to which he is exposed. Interestingly, though the normal child seems to show awareness of the basic sound units (phonemes) of a linguistic system during the first year of his life, he does not usually become completely proficient in his articulatory ability until he is seven or eight years of age. Along with phonemic and articulatory proficiency, the normal child also learns the melody or intonation of his language. By age eight, perhaps somewhat earlier for girls and somewhat later for some boys, except for vocal pitch range, most normal children speak essentially the way they will as adults. Individually, of course, some children will develop larger comprehension and more productive vocabularies than others, and some will be able to understand and produce more complex grammatically correct utterances than others. Vocal nuances may be better appreciated and productively controlled by some children than by others, so that irony, sarcasm, and the implications of utterances that are conveyed through subtle changes of inflection become individualized acquisitions. Such acquisitions, along with the development of vocabularies, may continue indefinitely through the life of the speaker.

Before considering the specific nature of the perceptual impairments that we consider to underlie the failure for language acquisition in the aphasic child, four brief hypotheses will be stated in positive form in regard to the normal establishment of verbal behaviour.

(1) As far as we presently know, only human beings are capable of learning to use language without being *stimulus-bound* to the events, or replication of the events, that were initially associated with and evoked the original linguistic products.

(2) No theory of learning at present adequately explains the acquisition of language beyond the utterance of single words to identify objective events. Learning theorists as of now, are unable to explain how a child can understand verbal formulations never responded to before, or to produce acceptable verbal formulations never before tried by the speaker.

(3) Concepts of imprinting and readiness are needed to explain the critical period — between fifteen and thirty months of age —

when most normal children establish verbal behaviour. In lower animals behaviour imprinting is considered to be species specific. Imprinting is presumably related to special sensitivities and response potentialities which enable a member of a species to establish new behaviour patterns with a minimum of exposure, effort and opportunity for practice.

(4) The critical period for most normal children for the establishment of verbal behaviour is between fifteen and thirty months. Comprehension of language as manifested by appropriate non-verbal responses is normally established between nine to twelve months.*

Medical and Psychological Findings

Aphasic children vary considerably from one another in regard to objective findings resulting from medical, neurological and psychological assessment. As a total population, however, they are different from other non-verbal children who assess as being primarily mentally retarded or severely hard-of-hearing. The findings that will be summarized are based on examinations of more than two hundred children, of whom seventy-three were designated as aphasic. The examinations were conducted at the Institute for Childhood Aphasia, School of Medicine, Stanford University.

Electroencephalogram findings. Thirty-six of the group were found to have positive electroencephalograms. Twenty-two showed localized abnormalities, of which nineteen were in the left hemisphere. These findings are in general accord with those of Goldstein, Landau, and Kleffner[10] who report that forty percent of sixty-nine aphasic children showed abnormal electroencephalograms. Although these investigators found about the same percentage of abnormalities in their comparison population of one hundred and fourteen deaf children, the aphasics had a higher incidence of focal abnormalities (14.5%) than did the deaf children (6.1%).

Audiological examination. The aphasic child often gives the impression of being either hard-of-hearing or deaf. Objective findings indicate that many, perhaps thirty per cent, do in fact have mild to moderate hearing losses based on results of objective audiometry. However, a typical audiological report is likely to indicate that *the amount of hearing loss based on test findings is not sufficient to explain the severity of the language impairment.* Functionally, the

* For a detailed consideration of the implications of these basic concepts in regard to normal language development see E. H. Lenneberg.[12]

aphasic child with a hearing loss shows impairment for *listening* rather than for the physical reception of sound per se. He is likely to show more impairment for listening to human speech than to animal or environmental noises. In this sense, he appears to have a selective hearing loss. The reasons for this will be considered later in our discussion of the aphasic child's perceptual dysfunctions.

Intellectual functioning. A basic assumption in regard to most aphasic children is that despite their normal intellectual potential they are *intellectually inefficient*. The implication of inefficiency is that the child's performance tends to break down under conditions of *noise*, stress, and awareness of error, more readily than we would expect for a normal child. Performance of aphasic children on standardized tests is characterized by variability. So is performance on learning tasks. A given child's productions for the same task (test item or learning situation) may vary from complete failure at one time to a high degree of success at another. If we assume that a child's best performance is indicative of his intellectual potential, then we would conclude that most aphasic children approximate the norms and the learning capabilities of their peers, at least when the estimates are based on non-verbal situations. Functionally and practically, however, most aphasic children tend to perform below the level of their best efforts.

Behavioural observations of aphasic children when they are involved with difficult test items or difficult learning situations include strong manifestations of perseveration, expressions of hostility directed to the examiner or to the materials at hand, and often considerable hyperactivity. Some children, however, withdraw from continuing with the test or learning tasks rather than act out against the situation.

A highly significant clinical observation of test and learning performance of aphasic children is their tendency to lose sight of an underlying principle needed for the solution of a test task or problem. Thus, if a test item requires that the child arrange a number of figures or cards in an alternating series such as a circle and a cross, a child may arrange half the figures in the required order, and then place the remainder in a random order. A related characteristic performance error is failure to carry over a principle from one test item to another. Thus, even if an aphasic child succeeds in a task — e.g. pointing to the *different* picture on the Columbia Mental Maturity Scale, the examiner cannot assume that the child will know what he has to do on succeeding items. Often it seems that each item is a task unto itself, that the aphasic child has to work out anew, or be reminded by the clinician, that tasks B, C, etc., are but items in a series that will be solved by the application of the same principle employed for task A.

Impairments of Auditory Perception Associated with Developmental Aphasia

Although some aphasic children may have related productive problems (dysarthria and oral apraxia), we believe that the *underlying problem is one of defective auditory perception.* As noted earlier, some aphasic children have objectively determined hearing loss, and most aphasic children are functionally considerably more impaired than the degree of hearing loss would suggest. Beyond the implications of such hearing limitation, aphasic children as a total population are more severely impaired in auditory perception — *in their ability to discriminate and process auditorily those events that constitute speech* — and in their ability to store, retrieve, and derive meaning from oral signals and symbols. In the discussion that follows we will consider some possible bases for these impairments.

Defective capacity for storing of speech signals. We have been able to demonstrate that aphasic children, despite many initial errors, can be trained to discriminate and match isolated speech sounds when discriminations and matchings are based on immediate recall (McReynolds[15, 16]). However, we have also observed that most aphasic children make considerably more matching errors than do their peers when a period of delay is introduced before an opportunity for matching. Our assumption is that the children are not able to store and retain the signals after short periods of delay. In contrast, performance involving responses to mechanical sounds is usually retained. A possible explanation for this observation is that speech signals call for different storage and control than do other kinds of auditory events. Support for this assumption is provided by the results of several studies by members of the Haskins Laboratories.

Dr. Liberman and his associates,[13] based upon their investigations, state:

> The conclusion that there is a speech mode, and that it is characterized by processes different from those underlying the perception of other sounds, is strengthened by recent indications that speech and nonspeech sounds are processed primarily in different hemispheres of the brain.

Impairment of sound generalization in contextual utterance. In the immediately preceding paragraphs we considered the assumption that aphasic children have an impairment in the discrimination of isolated speech signals because of storage-retrieval dysfunction. A second and related impairment is concerned with the nature of speech signals in contextual utterance. Except for one-phoneme words, such as *I* and *a*, our speech tokens consist of combinations of consonants and vowels, or consonant clusters and vowels. In spoken utterance, individual sounds are modified according to their contextual environment. Thus, the *t* of *too* is somewhat different from the *t* of *pit*, or those in *hit it* and *hit that*. Despite these differences, normal children learn to

recognize all of these variants of *t* as essentially the same sound, or at least as having essential similarities more significant than their incidental differences. We know, of course, that phoneticians refer to the basic sound category as a *phoneme*, and the variants as allophones. The capacity for generalization as to speech sound (phonemic) categories we believe to be impaired in aphasic children. If this assumption is correct, then it is likely that aphasic children perceive speech sounds as discrete auditory events. Because no two speakers are precisely alike in their articulatory products,* the child's storage capacity for auditory events is both overtaxed and lacking in a *matching to sample* system to permit him to determine what auditory event he is responding to at any given time. In brief, the child is without functional basic categories for the processing of speech events.

Impairments related to sequencing (rate and order of utterance). Aphasic children may lack the capacity for listening as rapidly as necessary to perceive and process speech. William Hardy[7] refers to the positive ability of normal children to process speech input as *auding* which he defines as *the integrative functions in the brain's management of acoustic information.*

Auding involves such related functions as the ability to discriminate between sounds on the bases of differences in intensity, frequency, and duration as well as the rate at which the changes themselves occur. Unless a listener can do this, he cannot distinguish between words such as *ask* and *ax*, *fits* and *fist*, or understand such statements as *The household pets became pests*, or *Jane bit her fists when she had fits.*

How rapidly must a child be able to listen to be competent in auding? In broad terms, the answer is rapidly enough to make matchings between ongoing auditory events and those events, or *residuals* of events, that have been stored somewhere in his nervous system. He must also be able to keep in mind the *order of events* and be competent in making temporal resolutions. Normally, all of this can be achieved in a small fraction of a second, a matter of milliseconds.

Experimental evidence on both normal and brain-damaged subjects provides us with information as to the minimum interval of time necessary for discrimination (resolutions) to be made between successive signals, the interval necessary for both resolution and temporal order judgment, and the effects of experience in modifying (reducing) minimum time interval between signals for the required

* Actually, no speaker's articulations are precisely the same even for repeated utterances.

judgments. Broadbent and Ladefoged[3] report that the time required for a correct time order judgment between *pip — hiss* and *hiss — pip* was reduced from one hundred and fifty milliseconds to thirty milliseconds after repeated trials on this task. Hirsch and Sherrick[9] found that an experienced subject required an interval of twenty milliseconds to make correct judgments of the presented order of two events — a light and a sound signal — when these events are produced repeatedly in the same order. When such a judgment has to be made on the basis of a single presentation, naïve subjects required about sixty milliseconds for the same percentage (75%) of accuracy of judgment (Hirsch, I. J., and Fraisse, P.[8])

The experiments cited above were performed with normal subjects. Subjects with cerebral pathology required an appreciably longer interval of time for temporal order judgment tasks. Efron[5] found that some aphasic adults required as much as a full second to make correct judgment as to the order of two ten millisecond pulses markedly different in frequency, whereas neurologically normal adults performed this task in approximately fifty-sixty milliseconds. There are, unfortunately, few investigations with children as subjects. The findings, generally, are along the same lines as for adults. Generally, children with aphasic involvements require considerably more time than do normal children to make correct judgments as to the time-order of events. Lowe and Campbell[14] found that a group of aphasoid children, ranging in age from seven to fourteen years, needed a mean time of three hundred and fifty-seven milliseconds for time-order judgments (range from fifty-five to seven hundred milliseconds) compared with a mean time of thirty-six point one milliseconds (range from fifty to eighty milliseconds) for normal control subjects. The specific task involved required the subject to indicate the correct order between two fifteen millisecond sound pulses, one at 2200 cycles per second and one at 400 cycles per second.

Impairments of sequencing and aphasic dysfunction. Both clinical observations and psychodiagnostic test findings tend to support the impression that aphasic children are impaired in their ability to sequence speech events. For some aphasic children, the impairment may be more general and involve the processing of any series (sequence) of events in time and/or space. The impairment is usually less severe for visual events, in part because most visual events are relatively static so that it is possible for a child to look again at and so confirm or correct an impression. It is ordinarily not possible to listen again to a succession of auditory events. Words once spoken, or noises once produced, are ephemeral. They can be reproduced only by retrieval from memory.

Regardless of the manner of production, or modality intake, all linguistic events are temporal and sequential. We cannot understand

language of more than a single sound or a single written signal — and there is very little to be understood with such a limitation — unless we are able to process ongoing events in the light of immediately past events and with anticipation of events about to occur. Each moment of linguistic experience provides the listener (speaker) with an opportunity as well as a need for confirmation or rejection of preceding perceptions and assumptions. The aphasic child is seriously impaired in this game of perceptual and conceptual probabilities. Some possible reasons for this impairment were suggested earlier in our speculations about poor storage capacity for auditory events, and the difficulty related to weaknesses in phonemic and linguistic generalization. It is also likely that the aphasic child has an impairment for the processing of sequences of speech events.

Summary and Implications

If our observations are correct and our speculations tenable, we may regard the aphasic child as one who may be defective in:

(a) storage and retrieval of sounds;

(b) in phonemic generalization;

(c) in sequencing; and

(d) more generally, and more broadly psychologically, in ability to generalize and to apply principles to situations that share a critical and determining common feature.

The aphasic child may be born structurally ill-equipped for the acquisition of verbal behaviour. It would be helpful if at this point, we could indicate with confidence the requisite capacities and the functional structures which enable all but a small percentage of children to begin to speak and to develop verbal behaviour according to the expectations of the concerned members of their environment.

We may speculate but we are by no means certain as to how a child can understand verbal formulations he has never heard before, and to produce his own formulations with considerable confidence that what he says will be understood by others. We assume, of course, that normal hearing acuity, normal perceptual ability, normal sequencing, and a fair amount of intellect are required for the acquisition of language. In regard to intellect, it is important to appreciate that most children who are mentally subnormal, unless the subnormality is profound, nevertheless learn to speak. Yet some children who indicate through non-verbal behaviour that they have *adequate* intelligence, that is, they perform about as expected in situations where verbal mediation is not required — fail to acquire language without direct therapeutic intervention. The aphasic and some autistic children are among those

with *adequate* intelligence who do not learn to acquire language *spontaneously*. Some clinicians and not a few linguists take recourse to a philosophic attitude about what the capacities and structures might be for a child to acquire speech. The position they take is that a child learns to speak because speech is a human species-specific function. So, according to Lenneberg,[11]

> The development of language, also a species-specific phenomenon, is related physiologically, structurally, and developmentally to the other two typically human characteristics, cerebral dominance and maturational history. Language is not an arbitrarily adopted behaviour, facilitated by accidentally fortunate anatomical arrangements in the oral cavity and larynx, but an activity that develops harmoniously by necessary integration of neuronal and skeletal structures and by reciprocal adaptation of various physiological processes.

We do not pretend that all or even most of the evidence needed to explain the lack or severe delay of speech in aphasic children is presently available. What evidence we do have strongly suggests to us that aphasic children are lacking in the basic capacities and in the correlative abilities and integrations necessary for normal language acquisition. Perhaps these children are not *pre-wired* neurologically as well as they should be to integrate what they need, to be proficient receivers and senders of sound signals. Perhaps aphasic children have a slower central nervous system maturation than normal children or even our mentally subnormal children who acquire speech. It is likely that some aphasic children develop perceptual defences because of demands made on their systems which are beyond their capacities at critical times. These are some, but not all of the possibilities which must be considered if we are to understand the nature of the problem of developmental aphasia, and if we are to develop rational and significant therapeutic and training procedures.

Opsomming

Die afatiese kind kan beskou word as defektief in die volgende funksies:

(a) opberging en herwinning van klanke;

(b) fonemiese veralgemening;

(c) opeenvolging;

(d) die vermoë om te veralgemeen en beginsels toe te pas op situasies wat 'n kritieke en bepalende algemene faktor deel.

Hierdie swakhede bemoeilik die aanleer van taal vir so 'n kind; verder kan hy ook gebore wees met 'n strukturele onvermoë om verbale gedrag aan te leer.

Adekwate intelligensie tenspyt, leer die afatiese kind, soos die outistiese kind, nie taal spontaan aan nie. Die subnormale kind daarenteen, leer uiteindelik taal aan mits die subnormaliteit nie té groot is nie.

Alhoewel ons nie oor al die getuienis beskik om die vertraagde spraak in afatiese kinders te verklaar nie, blyk dit tog dat hierdie kinders nie oor die nodige korrelatiewe vermoëns beskik om taal aan te leer nie. Alle moontlikhede moet in gedagte gehou word by die beskouing van die aard van die probleem van ontwikkelingsafasie.

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