Dysgnosias of postural origin

The following two essays are drawn from papers given at an Interdisciplinary Seminar on Language Disorder at Manchester University in September 1967.

Language as an activity divorced from the bodily movements which give rise to general understanding and therefore to the fundamental structures of linguistic function as well as to the conventional speech of everyday discourse is inconceivable to me.

The essays necessarily have a bias towards and emphasis on audition and contain the message that, as with other perceptual modalities, hearing has its 'praxic' (or syntactic or contiguity) aspect in the localisation and identification of sound sources, and an 'associational' (or nominal or similarity) aspect in the recognition of the duration, rhythm, melody, etc, and associations of sounds. However even more fundamental is the notion that through the agency of movement, of the whole body relative to the supporting surfaces and each part of the body relative to every other, the body-image structure and that of its reciprocal, the structuring of the bodily near-space, are formed and developed.

Personal space is structured progressively in terms of all the movements which have explored this space and the degree of interest in and attention to any region of space (through any part of the body) is a measure of its 'knownness' or familiarity as a structure.

The majority of early learned bodily movements do not act specifically on the environment but act on the child's own body in space. The child's interests lie in the regions of space most explored. Only secondarily does the child become interested in the contents of the space and even then at first it is the position of an object relative to him that determines the child's degree of interest in it.

During the early months it is the interest that an object tends to inherit in virtue of its position in space which determines the focus of a child's attention.

Of course once his space is more-or-less fully structured a child's interest in a thing becomes abstracted from its spatial location; however the child must continue actively to move and explore his immediate environment, especially during the period in which he grows bigger and changes shape, if he is to maintain and further sufficient awareness of his body image and of his personal space to develop an adequate understanding of his world. The failure of a child to do so, as a result of primary and/or secondary movement impairment, is a major widespread cause of much of the developmental slowing and distortion to be seen in children with learning difficulties and, as implied in the 1967 papers, of many seemingly incomprehensible behaviours including some in the realm of conventional language and communication.

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The influence of postural anomaly on perceptual growth – some observations and speculations with special reference to audition and the development of speech.

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Introduction

My object is to point out the importance of normal postural evolution on the development of perception, interest in the environment and responsiveness to stimulation ...

… and to indicate how anomalies of posture can in various ways produce or lead to such modifications of behaviour as to cause considerable confusion and consequent error in the assessment and diagnosis of hearing, visual and speech disorders.

I consider that the incorrect 'diagnosis' or assessment of a child's perceptual abilities can and sometimes does lead to a worsening of his condition either by unconscious neglect or misguided treatment by those who have his welfare at heart.

In the very short time at my disposal I must confine myself to a limited extent of the topic and cover this only in a very superficial manner. It will probably become apparent in fact that I am selecting to some extent from a more comprehensive consideration of perceptual anomaly or dysgnosia (a failure in the development of the faculty for finding interest and significance, and deriving meaning from, sensation patterns) including the generalised dysgnosias commonly referred to as 'autistic' states.

I should further point out – as will become obvious later – that I am not a psychologist but a clinical observer basing my views almost entirely on day-to-day observations made over a number of years on some thousands of normally and anomalously developing young children.

Perception and Posture

Numerous organisms are known to possess well-developed perceptual abilities from birth – although these faculties are highly selective, limited in scope and often not capable of progressive modification.

Also prevalent in the animal world are highly efficient discriminative mechanisms which develop as a result of an inevitable maturation of the nervous system with or without the triggering effect of environmental stimulation.

It is fairly clear, however, that in phylogenetically higher organisms – including of course Man – the perception of complex patterns depends to a considerable extent on practice – on the exercise of the sensory mechanisms.

Restriction in the early use of a sensory mechanism may reasonably be expected to result in delay or even arrest of such perceptual development and there is reason to suppose that some of the ground lost in this way cannot later be made up, rather as if there are epochs of growing-life when the foundations of the perceptual skills must be laid down if normal development is to take place; critical periods during which there is a failure to exercise the appropriate discriminative abilities may lead to permanent impairment of these abilities.

We may go further and suggest that in Man the early development of some perceptual modalities is also dependent on the active functioning of other more primary perceptual modalities.

This is to say, there is a sort of hierarchical structuring, certain modalities being basically or initially more important than others over which they take precedence not only in time of maturation but also in urgency or priority of response; and that at root it is the organisation of the sensations gained from the increasingly organised bodily movements in the growing infant which determine whether the secondary perceptual mechanisms can develop normally.

This early perceptual evolution is entirely subject to the appearance of the growth sequences of posture and movement during the early months and continues to be associated with it throughout life.

Going even further, I would suggest that early perceptual abilities not only develop solely in the wake of bodily movement but that they remain, for a while at least, tied to the region of space, relative to the body, in which the movement occurred.

I will attempt to explain what I mean by this a little later but first let me tell you what I mean by some of my terms.

So far I have used the words 'perception', 'perceptual' and 'postural' without definition and without specifying type or modality.

By perception I mean those active processes of selecting and classifying information received from the environment (through the agency of the sensory organs) *which are themselves continually modified and elaborated as a result of their own activities.*

When using the unqualified word 'perception' I refer to perception as a whole or to any variety of perception without distinction.

I will consider the perceptual faculties as falling into four main categories:

the haptic, concerned with touch, pressure, temperature, pain, position and movement sensibility, etc., and the great variety of complex perceptual experiences and discriminations which these make possible individually, or in combination;

the olfactory, which although undoubtedly capable of enormous sophistication, remains largely unexplored in Man;

the visual, including here both vision for form and for colour (although the commonly supposed close primary relationship between these I feel may result largely from their perhaps fortuitously sharing a common end organ);

and the auditory, (which also strikes me as being a mixture of more than one basic modality.)

The order in which I have listed these categories of perception is that in which they seem to me ontogenetically speaking to reach their evolutionary peaks of sophistication as well as that of precedence. Excluding olfaction it is the reverse order of their dependence on one another.

The first category it will be noticed is for the most part concerned with the various energies from stimulating sources close to, in contact with or actually within the organism. The sensory organs are sometimes called contact or proximal receptors.

The other three groups receive energy over considerable distances and depend on their distance receptors or teleceptors.

I shall also use the outmoded terms 'protopathic' and 'epicritic' simply to suggest the difference in quality or degree between the relatively undifferentiated, ill-localised, ill-defined and affect-dominated crude sensations, and the more differentiated, well localised and defined products of sensory activity and elaboration.

By the term *postural* I intend to refer to any or all bodily attitudes and configurations, however short-lived, and to include those transitions which we generally call movements but which may be considered to be smoothly and continuously changing sequences of instantaneous postures.

I here use the word 'meaning' in a very loose way to refer to any shade of significance beyond that which is implied solely by difference or obtrusiveness, from indicative function to symbolic and syntactic signification.

Perceptual development implies a growing facility for finding significance or discerning meaning in the patterns of oncoming signals. Such a process requires not only propensities for selecting, recognising and identifying sensations, and for storing, comparing and associating these with previously received perceptions but also presupposes some means of simultaneously receiving and establishing associations between the various perceptions derived from a single source of stimulation.

In short, normal perceptual evolution requires a more or less efficient means of locating such sources in space.

The ability of an organism to localise a point in space demands a knowledge or awareness of the extent and position of its own form – its *body image'* – and a familiarity with the space surrounding the organism derived from and structured in terms of the active exercise of bodily movements.

Body Image

Body image, (body schema, l'image de soi, l'image du corps, coenaesthesia) is a term used to indicate the personal concept of self – or corporeal awareness.

It represents a knowledge of one's own body; an appreciation of its form, dimensions, limits, scope of abilities, etc., derived from the co-ordination and integration of perceptions of all kinds received and experienced by way of all the sensory modalities.

The body image is the physiological or neurological equivalent of the psychologist's notion of 'self', and the psychoanalyst's conception of 'ego' which was described (early in the century) by Freud as fashioned from the cortical layer of the complex mass of inherited or constitutional mechanisms – in particular the instincts – which Freud summed under the title of 'id'.

Developed as a result of reactions with the environment a knowledge of the external world, and hence of self, is built up as sensations and perceptions recorded (remembered) engrammatically as bodily movements, directions, shapes, spatial and temporal dimensions, weights, temperatures, textures, regularities/irregularities, simplicity/complexity, in terms of the haptic, olfactory, visual and auditory modalities.

This formation is basically a stochastic process but the possible reactions are subject to a variety of constraints especially those imposed by the necessity for homeostasis, the appearance of the various postural reflexes and spontaneous movements together with the restrictions due to the increasingly more speculative and directed activities which result from the learning which accompanies the reward of certain behaviour, as the satisfaction of an appetite.

Presumably an individual's body image is subject to modification throughout life and must certainly continue to develop throughout the years of physical growth and critical biochemical change. The period of greatest change in this structuring of a personal view of self as distinct and definitive, bounded by continents which separate the human organism from his external environment, takes place during the first two or three years. Further structuring and refinement of this private concept of self continues during childhood and adolescence as the environmental influences of everyday life act upon the growing body and its senses and the body is itself manipulated and subjected to myriad changes of posture.

If I might be allowed to romance for a few moments let me say that I conceive of the neonate as initially experiencing no true boundaries, except in some way at the mouth and lips, and pervading all palpable space. The only suspicion of

contact with something extra corporeal is through the sensations elicited by the nipple encountering the lips and mouth and the pleasurable affect which becomes associated with this contact.

Other sensations of internal visceral origin, as unsatisfied appetites, elicit pain or discomfort and are associated with unpleasurable affect – fear, anxiety - pleasurable affect following on their relief or satisfaction.

As the crude affect-dominated sensations become subordinated to the increasingly complex epicritic sensibility modalities, subjective differentiation of the organism from the surroundings with increased perceptual definition results in a sort of condensation and relative shrinkage in size.

Such an evolution requires both maturation of structure and function, and the stimulation and activation of the sense organs. The sensations of touch and pressure due to bodily weight, clothing, maternal clasp and caressive stroking of the skin, warmth, odours associated with mother and feeding, and visual stimulation lead to an increasing awareness of things outside but in contact with self.

From the early post-natal days the child receives visual stimulation from direct light, light-reflecting and bright objects as, for example, a window or the mother's full face at which he will stare unblinking for long periods. He hears a variety of sounds but particularly common are those associated with his mother, her vocalisations and those sounds of movement and food preparation. This visual and auditory stimulation further strengthens the image of self as distinct from a much more extensive environment.

Handling, caressing, stroking, tickling, patting, blowing raspberries against his tummy, passive and active exercise of his limbs, head and trunk all play their part in developing a growing appreciation of his bodily parts, their positions and boundaries.

Exploration occurs at first through active movement and the crude manipulation of objects which fortuitously find their way into the hands, then by more co-ordinated and purposeful exploratory actions followed by visual correlation, and later by primary visual exploration abstracted from the manual operations upon which it once depended.

One might look upon the formation of the body image as an emergence of self from a remote and undifferentiated preliminary condition by way of sensory contacts with the physical world.

At first the component images are partial, insubstantial, tentative, reversible and fugitive; the interacting regions being constantly in a state of flux. However, the concept gradually becomes more certain and permanent with time and experience.

Although the body image normally becomes steadily more definite, definitive and increasingly complex, at least during the greater part of life, it is constantly dependent upon and influenced by the sensory receptor activity.

A certain quantity of incoming information, as arousal signals to maintain an adequate state of awareness and contact with reality, appears to be necessary for normal functioning and should this be reduced below a critical amount under certain conditions internal perceptual activity is freed from control. Probably at some stage of development a certain amount of such arousal activity begins to be generated autonomously by the CNS. In sleep and under conditions of voluntary sensory withdrawal dreams and daydreams are experienced in which the improbable, distorted and fantastic are perceived but are normally clearly distinguishable, at least in retrospect, from reality.

In abnormal states of sensory deprivation or withdrawal, as for example experimental isolation, schizophrenic reactions or arteriosclerotic dementia, a more permanent or long-lasting perceptual deprivation results in hallucinations often not recognised to be such by the sufferer. In the condition I have called 'diminished input syndrome' – commonly seen in cerebral arteriosclerosis – an individual may think and behave rationally and with great insight and intellectual resource during the bustle and noise of daylight hours, but when the lights are dimmed, physical activity and noise reduced, as during the night, he may hallucinate freely as if the normally relatively clear cut line of demarcation between waking and sleeping were blurred or eradicated.

At such times, during a state of diminished sensory input, when in a state of relative or absolute perceptual isolation cut off from the meaningful and undistorted external stimuli which tend to impose sobering restrictions upon the mental processes, the liberation of the imagination leads to an infinite variety of mental associations and behaviour, the nature of which must depend on various factors including the age and perceptual experience of the individual.

Structuring the Environment

This formation of a body image is the reciprocal of the organism's structuring of its own immediate space. The processes might perhaps be better considered as two aspects of one and the same operation or, if in any way dual, at least inseparably interrelated.

The ability to use references relative to fixed points on the body and the use of a learned ability to estimate and reproduce various degrees of turn or angles of torque through which the eyes, head, neck, trunk or whole may be turned, depends on the normal development of the power to assume vertical postures, and precedes the gradual growth of the ability to locate the sources of sounds in space.

From the point of view of biological adaptation I would consider all bodily postural organisation primarily to subserve the functions of perceiving; constructing

complex percepts and abstracting those perceptual distillations which we attempt to differentiate by calling them concepts.

The purpose of the bodily postures seems to me to be, by opposing gravity and other forces, and maintaining bodily forms and actions and reproducing movement patterns, to introduce order into the manner in which the sensory receptors are activated thus making possible the organism's extraction of invariant sensory patterns which process might be considered to be the fundamental component of the learning process.

If we imagine the newly born child, recently enlarged from a thermostatically controlled and pressurised intrauterine world, replete with a brand new set of the various receptor organs, he might be likened in some respects to the human tabula rasa of the seventeenth century empiricists, for although his perceptual development will normally depend very considerably on innate maturational factors, these are mainly of an indirect nature, orientating and exposing the receptor organs to the stimulatory energies of the environment.

It is the structuring of the environment upon which the localisation of and maintenance of attention on objects in external space depends and this progressive ordering requires the formation of certain basic dimensions or co-ordinates to allow of the evolution of a concept of *direction.*

Initially any active change from a stable state or posture must involve opposing gravity, hence the *vertical* dimension would seem to constitute the primary axis and *down-up* the primary direction. The other fundamental axes would be the '*normal*' forming the basis for the *forward-reverse* direction, and rotation in either direction or sense in the *horizontal plane,* leading to the lateral or *left-right directions*. All other planes, directions and bodily movements may be considered, synthesised or analysed in terms of or with reference to these functions.

There are a variety of automatic postural responses present in the newly born or very young infant (such as primary standing and walking, the "orientation" reflexes, and the Moro or "startle" reflex). These reflexes, as the later developing automatic reflexes, must be inhibited before the subsequent definitive motor response patterns can evolve and they often seem to break up or break down into more elementary components from which perhaps the more complex and versatile movements are fashioned.

Gradually appear a variety of reflexes whose function is to establish and maintain the body's proper position in space.

The righting reactions exercise a controlling influence towards the assumption of the vertical posture in lying, sitting, standing and walking, and aligning the eyes, head, neck, trunk and pelvis.

The Equilibrium reactions, appearing somewhat later than the primary righting reactions, consist of complex and highly co-ordinated changes of bodily muscle tone which compensate for or balance the shifts of body mass about the centre of gravity during movement which tends to introduce instability. These become more and more necessary as some-when about six months sitting and a little later standing assume major and urgent importance and the more elaborate righting reactions allow of rotation of the head and eyes and torsion of the body without the more primitive and automatic following of the rotation of the head by that of the remainder of the body.

The reflexes, which depend for their evolution almost entirely on maturational processes in the central nervous system, form the postural and movement basis for the elaborate systems of skilled movements which are learned and upon which the formation of the body image and a structured personal space depend.

Those sensations which are appreciated by an adult as seeming to originate within or at the surface of the body – such as 'touch', 'pain', 'temperature', the position and movement senses, etc., and possibly 'taste' as opposed to the 'distance senses' of vision, hearing and olfaction, I consider together to constitute 'haptic perception' and to allow of such complex perceptual functions as the appreciation and comparison of size, form, weight, consistency, surface regularity and texture, heat-conducive properties, relative distance, direction and spatial position, etc.

Active haptic perception, at least for humans, seems to me to be the fundamental mode of structuring space, and upon which the elaborated distance senses normally depend almost entirely, existing apparently as inferred projections or extensions of the haptic beyond the immediately or readily accessible.

Almost all the information which the sophisticated observer derives from visual observation, with the exception of colour, would normally have originated as haptically perceived information subsequently translated, so to speak, into visual code but still interpretable in the haptic terms and dimensions.

Normally then haptic perception evolves into an increasingly complex system, visual perception following slightly later, in its capacity as a short-circuiting and time-saving mechanism, and allowing a much more rapid and convenient system of reference and economic expenditure of energy. Finally, auditory perception lags still further behind, eventually adding a further dimension of reference and communication at a distance.

Olfaction would not seem normally to become highly elaborated and organised in humans but remains, in our society, largely as a primitive "protopathic" sense poorly defined and localised and intimately associated with the emotions. It would seem to be closely comparable with the haptic, visual and auditory perceptions as they exist in the infant when such stimuli are accompanied

by sensations only of pleasure or unpleasure and are reacted to in an automatic manner.

This order of precedence tends to be maintained when, in direct competition in small children, attention is usually afforded preferentially to the haptic, visual and auditory stimuli in that order, other factors being equal.

The exact manner in which the body image and personal space of any individual are constructed will depend to some extent upon chance factors as well as on the bodily state of structural and functional integrity; however, the postural righting and equilibrium reactions will determine the general form and composition of the region of active contact with the environment during the early months.

Normally the early exploration with the head and mouth, followed by the movements of the upper limbs and later the legs under the influence of gravitational pull will tend to established a concept of verticality and a front surface, "normal" plane and forward direction from which the field of perceptual growth and sophistication gradually extends downwards and to either side below eye level before the space above eye level is conquered; the region of space immediately behind the chest being the last and least adequately explored and structured region.

The structuring will vary too in the amount, elaborateness and refinement of the component perceptual elements present in one part at any one time. In the primary stages of body image formation the earlier the structuring begins in one part the more elaborate and complete that region is likely to be when compared with an area further upwards or towards the rear. Also taking account of the perceptual order of precedence referred to earlier one region may be well endowed with haptic and visual perceptual awareness whilst another is as yet largely experienced only in terms of haptic sensibility.

Only later does the child come to be able to use an external body as a reference to mark or find a point in space. An outward locomotor, visual or auditory extension of a familiarity with the immediate corporeal environment, stored as information about bodily displacements, to regions beyond the direct reach of the limbs, is a necessary precursor of the use of abstracted direction; the appreciation of direction relative to other real or hypothetical loci in space.

Auditory Perception

It is often suggested that the localisation of the sources of sounds is an automatic process which evolves as the central nervous system matures, particularly during the first twelve months.

The young child, it is said, is endowed with a natural interest in sound, so that when old enough he will turn to a sound automatically and repeatedly without

a preliminary period of learning and whether or not his responses are rewarded with the success of visualising or touching the sound source.

This localisation of sound is considered to be an orientation reflex and homologous with similar turning to sounds as occurs in various animals appearing spontaneously at birth, with maturation or through the agency of innate releasing mechanisms.

Such orientation reflexes would be expected to appear spontaneously in all children, failure to materialise being due either to the inability to hear sounds (impairment of the end organ), dysfunction of the basic physiological mechanisms upon which such localising turns depend or to an incapacity to effect the motor response itself.

Disappearance of the orientation response could be due to a subsequent breakdown of these mechanisms or simply to adaptation or inhibition.

Although this may be true up to a point my own observations suggest to me that the orientation reflex to sounds in humans is relatively weak and easily exhausted, requiring continual reinforcement to effect the transition from automatic reaction to full and satisfactory localisation of sound sources.

Innate interest in sound would appear to be very limited, short-lived without reinforcement and subject to very rapid adaptatory or habituation processes.

Just as the primitive 'walking' reflex, 'grasp' reflex, etc., must regress before the outwardly similar but infinitely more versatile basic movement patterns of the mature skills can develop, so the primitive orientation reflexes must regress before higher perceptual abilities can evolve.

Those animals whose automatic and highly specialised perceptual and motor skills appear spontaneously do not further elaborate these faculties and remain incapable of more than the most rudimentary learning.

In cerebral palsied children it is often the continuing presence of a redundant postural reflex which constitutes the main impediment to progress, and it is possible that a similar failure of a primitive orientation to extinguish could on occasion preclude normal perceptual development (e.g. primary autistic conditions).

My own observations support the view that the establishment of meaning in relation to sound is closely linked to interest in the sound and is consequent (contingent) on a more or less permanent association being effected between the sounds and an affectual reward as the satisfaction of an appetite. Important and lasting associations or liaisons of this direct sort occur during the early days and weeks and may occasionally happen later but more usually sounds become linked with some other previously elaborated percept or percepts – haptic or visual.

Thus the baby during the first weeks is a relatively passive and inert organism which may come to associate the sounds of food preparation with feeding

and the relief of his hunger; or the sound of his mother's voice with the pleasurable sensations and comforts her subsequent appearance brings.

Here at first one has the setting up of type I conditional responses, e.g. stirring sounds are first heard and then food is introduced into the mouth and the appetite is satiated. The sounds of food preparation are then liable to elicit masticatory and swallowing movements.

No localisation is necessary.

Gradually the child may come to turn his head in anticipation of the rewarding appearance of mother and food as a visual perception becomes involved but the non-localising reaction to the rattle of a cup and spoon may remain the preferred response to low intensities.

Subsequent finding of meaning in sound appears for the most part less likely to be effected in this simple way and requires a previous knowledge of the sound source in terms of other perceptual modalities.

This necessitates the haptic or visual apprehension/discovery of the sound source and usually first entails its localisation in space.

This being so any process which interferes with the development of the body image or with the haptic or visual structuring of the immediate environment relative to the body, may also interfere with the finding of meaning and interest in sounds. That is to say auditory 'imperception' or 'dysgnosia' ('central deafness') could arise as a direct result of a postural or movement disorder and in the absence of any sensory impairment or 'central' specifically perceptual lesion.

Practical Observations

During free-field tests of hearing on a small child the examination consists of far more than the application of stereotyped tests. Observations are made on his behaviour at all times, towards both planned and adventitious stimulation. The response behaviour of others in the room towards the child is often of paramount importance and this includes the examiner's own feelings.

There are numerous possible reasons for a child's failing to respond in a normal manner towards sounds (I have attempted a rough classification of these see Appendix I) including those based upon postural and movement anomalies.

With the small child in the clinic all information about his perceptual activity must be inferred from the interpretation of his behaviour in various situations, some of which have been contrived.

A segment of behaviour following on the presentation of a suitable stimulus might be reasonably considered as a possible response to the stimulus if: The nature of the behaviour is appropriate or similar to that observed as a response in other children;

The time relation is appropriate and the behaviour segment consistently repeatable;

Or the behaviour accurately localises the source of the stimulus;

however, a failure to elicit an overt response does not necessarily imply an impairment of sensibility for it is only from responsive behaviour that one can infer anything concrete about perception.

It is possible to demonstrate hearing directly but impairment of auditory acuity cannot be demonstrated, only strongly suspected.

Again, with young children one cannot expect to detect thresholds of audibility but must rather measure some sort of threshold of alerting. (See Appendix IV.)

My own interpretations of the levels of perceptual activity in young babies are based on the view that the depth of interest in a stimulus under competitive conditions is a measure of perceptual sophistication and that the relative amount of effort a baby is willing to expend to indulge his interest, or the relative readiness with which he will attend to a stimulus, is a measure of his interest in and understanding of an object, situation or event.

This can be exploited in practice by offering identical stimuli from bilaterally symmetric positions simultaneously or at different times, by varying the direction or distance of the source, etc.

Other evidence of differences in perceptual development between children, in one child at different times or between bodily regions or perceptual modalities in the same child is to be found in comparative studies of specificity and preciseness of responses.

A stimulus may produce a startle reaction (ranging from a short sharp jump to an extended mass reaction), 'stilling' or 'alerting' ('listening attitude'), smiling, co-ordinated and rhythmic moving, vocalisation. Recognition of the quality of the sound may elicit an appropriate or specific response ranging from mouthing and swallowing movements produced by the sounds of stirring, to movement or speech depending on a linguistic understanding.

Localisation of a sound source can range from simple turning towards the side of the sound to immediate and accurate turns to locate a source in any direction. *

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* Note All observations however must be interpreted in the light of a careful evaluation of the child's response limitations. In addition to those due to the child's pre-mature condition, are the pathological problems of postural fixation, weakness or restriction of movement, ataxia, dystonia or disequilibrium, weakness or stiffness of muscles, oculomotor difficulties, refractive errors, opacity and primary field defects, other sensory impairment, etc.

Crude perceptual ability is associated with interest in high intensity relatively undifferentiated stimuli and often with delayed initiation of overt responses which are relatively generalised and ill directed. In older children perception of this kind becomes subordinated to an appetite for more complex patterns with a consequent tendency to suppress the more primitive reactions which become more and more inconsistent despite the high stimulus intensities. (See Appendix II).

Gradually with exercise the localising responses become more immediate, precise and accurate.

Thresholds tend to fall but this quantitative effect is often obscured for some stimuli, as has been said, by a falling off of interest in the crude sensations in favour of the more differentiated.

Using such criteria during the casual consideration of normal infants and during the routine clinical examination of small children – most of whom were referred as possibly mentally retarded or psychotic, for failure to respond normally to sound, or to develop speech or an understanding of the speech of others – the observed behaviour has appeared to be compatible with the thesis that perception, at least during the early months, is closely related to and largely dependent on the movement and postural patterns, being grossly disturbed both quantitatively and qualitatively by abnormal postural development.

I have been particularly impressed by the wide variety of kinds of response to sounds in infants and the relationship between the type of response (variety, appropriateness, degree, immediacy and accuracy of localisation, etc.) on the one hand, and the stimulus nature, intensity, proximity and direction of the source relative to the body on the other;

By the way in which localisation of sound sources and finding interest in the sounds evolve in intimate relationship with and closely follow the gradual assumption of an erect and stable sitting posture;

The manner in which a child's finding interest and meaning in sound can be delayed or modified by postural and movement anomalies including oculomotor, visual field and fixation defects;

And the way in which such delays and abnormal reactions to sound can be corrected in many instances within a short time by the encouragement of active exercise of the neglected movements and regions of bodily environmental space.

From a large number of single observations made casually on small children at various ages, repeated observations on some children and what amounts almost to a longitudinal study of a few over a period of months or years the accumulating evidence seems to support the general account of early postural development previously described.

My own views on children's structuring of the environment are, however, largely based on fragmentary samples, piecemeal observations assembled in an attempt to produce a dynamic whole, however simple and superficial this may seem to be.

Now, as has been said before, this structuring normally proceeds as the various receptors become activated under the patterning influences of the developing system of organised movements and stable postures.

This usually begins with a primary exploration of the region immediately in front of the face and chest with gradual expansion downwards and to the sides followed by extension upwards. The largely random limb movements of the baby in the early weeks rapidly come to follow more probable and defined pathways emerging as directed and controlled grasping by sixteen weeks or so. Reaching in both the supine lying and supported sitting positions and to some extent in prone lying is confined almost wholly to frontwards and towards the legs with early searching about to the sides without organised direction and without visual accompaniment.

As the hand movements become more co-ordinated the main static postures become more stable – at first rigid and readily displaced positions becoming in time states of dynamic equilibrium. From these increasingly more stable rest positions increasingly more adventurous and versatile foraging becomes possible and in time most of the body surface becomes accessible to scrutiny.

The last regions to be explored and fabricated are those to the rear and above the head in the midline and in particular the space immediately behind the chest which is inaccessible to vision and virtually inaccessible to manual investigation.

Simultaneously, as an increasing familiarity with the immediate body-space spreads further to envelop the whole body form, structuring increases in depth, awareness being extended to regions at greater and greater distances from the body surface.

Exploration of a large volume of the body space is only possible for the small child by deviation or rotation of one or more parts of his body relative to the remainder and such exploration cannot take place until the relevant bodily postures are established.

The eyes may be rotated through about 90 degrees in visual following and well over 200 degrees when supported by turning the head on the trunk. From an early stage however turning the head tends to be followed by a body righting reaction which brings the body to alignment with the head.

Manual manipulation is limited to a very simple bi-manual reaching and grasping at about 16 weeks, but by six months the child is normally able to make highly effective one-handed reaching and grasping movements, and explores his

feet when in the supine lying position. Interest and learning is, however, almost entirely confined within the region anterior to the body.

Spontaneous torsion of the trunk appears at about this time (six months) in the lying positions but almost entirely as the first stage of rolling over. Two or more months are to elapse before such twisting of the trunk is utilised by the upright seated child to explore or to retrieve a dropped toy.

Reaching and leaning supplemented by passive transport and later by active locomotion lead to increase in the outward extension of the structured space.

The various perceptions are always most exercised in certain territories of bodily space some regions being relatively less 'well known' in terms of the perceptual modalities to which the parts are least accessible.

At any one time the body image and spatial knowledge is variably complete from region to region, and differentially developed as regards the degree of any particular modality subscribing to the perceptual structure.

At some stage or stages it is possible to demonstrate that stimulus sources evoke quantitatively and qualitatively different responses according to the regions of haptic, visual or auditory space they inhabit.

Thus it may be seen that a measure of perceptual dissociation both between the developing spatial regions and between modalities occurs even in the normally growing child.

My observations suggest to me that the relative degree of attention paid to a particular stimulus depends both on the *nature of the signal* and *the position (i.e. direction and distance) of the stimulus source.*

Almost any stimulus would at first be most likely to be localised and attended to if emanating from the front, and the further to the rear the source is the less likely the child is to find interest in the stimulus.

Concentration of interest is greatest during the early months near to the body within the range of physical reaching with the head, hands and feet and therefore within the regions of body near-space which are structured first.

However, from a fairly early age (3 – 4 months) the depth of awareness is increased through the agency of vision and later audition, which allow vicarious probing further into distant regions.

The proximal layers where structuring is earliest remain the most elaborated regions. A nearby source therefore is more likely to excite attention than a distant one, and in a manner by no means entirely dependent on stimulus intensity.

It is frequently possible in a very young normal child to demonstrate a distance at which a child's visual attention is first captured, another at which more

definite interest is shown and yet another nearer one at which, heralded by a smile, recognition appears. *See Note (i).

That this is at least partly the direct result of developing eye structure, accommodation and binocular co-ordination in no way affects the principle of the child's enlarging usable space. **See Note (ii).

Generally speaking too, a haptic stimulus would take precedence over a visual, and a visual over an auditory one in direct competition so that tactual stimulation of the side of the body in a young child is likely to successfully compete with auditory stimulation from in front.

The regions of developing structure I have taken to calling fields of interest or 'interest fields' for it seems to me that *the interest, or power of a stimulus to compel attention is at first a function of the spatial location of the source and direction of the stimulating energy rather than a property of the stimulus source.* Soon, however, interest is induced in the source itself but in the early stages of normal development the configurations of the interest fields continue to play a pre-eminent role.

If now the assumption that real speech can only follow and parallel the development of comprehension of the speech of others, and understanding of speech presupposes an ability to discriminate and find interest and meaning in other less complex sounds and sequences is allowed, it may be seen that the

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* Note (i)

Proximity appears to be a very important concept for one not infrequently finds in audition too that the stimulus intensities *impressed at the ear* from a distant source may have to be greater than those from a nearer source in order to excite a similar response.

Over a period of time the sphere and range of interest increases for both vision and audition, becoming more and more directly related to the intensity and clarity of the energy received at the receptor organs.

The physical correlates of the subjective experience, in the absence of direct vision, of proximal versus distal – of the nearer as opposed to the more distant – presumably include differences in the acoustics of the signals themselves as well perhaps as other acoustical factors such as subtle influences which the presence of a relatively large absorbing-reflecting body as the human frame must have on ambient sound, in addition to olfactory, thermal and photic stimulation.

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** Note (ii)

It seems likely that comparable structural changes are taking place in the ear during the early months which might well influence auditory response behaviour.

various factors which can influence the rate, manner and form of the body image may also exercise an untoward influence on auditory and speech development.

It is a matter of common observation that in children before they sit sturdily with minimal support the sound intensities required to produce a turning response tend to be greater than with older children, whilst a similar discrepancy in the successful stimulus intensities is usually noticeable between the two ears of the same child.

These early asymmetries of responsiveness which rapidly become less apparent and finally imperceptible to casual observation, appear to be unrelated to cerebral dominance as generally understood.

In routine free-field testing of the hearing it is noticeable that often the child who is unable to sit with minimal support not only turns more readily to one side but may also show a difference between the two sides in his less energetic responses as smiling and vocalising.

This asymmetry is accentuated in pathological lopsidedness and modified in various ways in children with movement disorders.

That the child with a one-sided movement weakness turns less readily towards a sound on his poorer side may not seem particularly surprising and yet he may fail to turn to a stimulus, which has been shown to interest and excite him when impressed from the better side, long after the ability to turn has been established. Furthermore, the changes in facial expression and bodily set may frequently be so different in response to stimulation from either side that a child may be suspected of being unilaterally deaf.

Primary and secondary oculomotor disorders, (with or without impairment of acuity) often produce similar effects when alone or in combination with other bodily movement weakness. For example a baby of perhaps six months of so with a convergent squint may be found to turn readily to ‘quiet’ sounds from one side yet ignore sounds from the other, or show a non-turning response as smiling or mouthing. He may or may not turn to the poorer side when sounds are made ‘louder’ but he does not turn to the ‘better’ side as one might expect if he had a one-sided deafness.

It is noticed however that the baby is really using only one eye – that on the ‘good’ side – the other being lazy. Improvement in the use of the poorer eye with or without correction of the squint, as a result of encouragement exercises results in an apparent improvement in hearing with turning towards the ‘poorer’ side.

Bilateral weakness of outward movement of the eyes, myopia and possibly the use of corrective lenses may confer an appearance of bilateral hearing loss in young children, especially those who are late in sitting or have a general floppiness or weakness.

Commonly one finds that such children are remarkably insensitive to visual stimulation of their peripheral visual fields even by violent agitation of large brightly illuminated sources well forward (to within perhaps 45 degrees of the normal in some children). Here, unlike the case where a stimulus is simply ignored the child will suddenly become aware of the visual source, turn and attend to it.

Such a source will usually be attended to more quickly and further to the rear if accompanied by an audible signal.

With a young child it can usually be confirmed within a short time – sometimes even within a few minutes – that any apparent impairment of auditory acuity is really a disorder of higher perceptual nature by encouraging the exercise of active movement on the poorer side.

An absence of laterally directed turning responses to sound in a child with a double sided movement weakness commonly suggests a bilateral hearing impairment, and an arching of the back in response to a 'loud' sound may be interpreted as a startle reaction when it is in reality a localising exploration of the space with which he is most familiar - originally structured in terms of the movements he at first found the least tiring and of the primitive automatic postures which dominated his early movements.

Such a child might respond by accurately localising a 'quiet' sound within the space above eye level at an age when this would be unusual in a normal child.

As has been said, visual abnormalities too, particularly incoordinations or restrictions of eye movements, exercise similar influences.

For one reason or another a child may tend to use one eye more than the other in his use of vision and this in addition to restricting the visual field to that of one eye is likely also to reduce the lateral movements of the 'good' eye to some extent.

Weakness of the lateral movements of the eyes also diminishes the visual range and tends to confine visual interest to the front.

These conditions are commonly associated with the apparent deafness, ranging from a reluctance to turn to one or both sides to an almost complete disregard of sound from out-of-sight sources, however 'loud'.

Not infrequently are encountered children, usually sharing some evidence of neurological dysfunction and often having a history of early restricted activity, or visual difficulties etc., who fail to respond normally to sound and may appear at first to be profoundly deaf.

Some of these may have had early or continuing difficulties in turning.

Among these conditions is one which is frequently reported to be associated with perceptive deafness – Klippel-Feil Syndrome. This condition is characterised

by a short inflexible neck and is often associated with limitation of arm, trunk and eye movements.

These children are not infrequently found to be not as deaf as they at first appear to be and sometimes fall into the category of the auditory dysgnosic – having difficulty in finding interest and meaning in sound and failing to develop a normal use of speech.

Many other children in this large and multifarious group have visual field disorders, or lateral movement difficulties or have a history of such problems during the early months or years.

Speculations

Observations such as these have commonly been made during examinations primarily designed to investigate a child's failure to respond normally to sound. Abnormal responses range from a failure to show signs of an awareness of sound to a faulty acquisition of an understanding of speech.

If a child consistently fails to respond overtly to sounds of less than certain intensities but responds regularly when the intensities are sufficiently high it is likely that some sort of sound filter is operating at the ear itself producing the conditions we normally consider as deafness or impairment of auditory acuity.

On the other hand a child may be shown to be capable of responding in a normal or near normal manner towards sound yet does not do so consistently. Behaviour of such a kind can range from an appearance of profound deafness to limitation of speech comprehension in the presence of a generally adaptive use of sound and good intelligence.

Conditions in which a child does not behave towards sound in a manner compatible with his intelligence, auditory acuity and emotional disposition are variously referred to as 'central deafness' – 'developmental aphasia' – 'language disorder' – 'auditory imperception' – etc.

All these terms I feel to have shortcomings, even the most acceptable 'auditory imperception' tending to be confined to audition.

I prefer and use the term 'dysgnosia', a neurologic expression derived from 'gnosis' or 'gnosia', rough equivalents of the term 'perception'. The prefix dys- implies a developmental deviation, as opposed to a- (e.g. agnosia, aphasia) which indicates a subsequent loss of function.

The term 'dysgnosia' may be preceded by any qualifying adjective (as haptic dysgnosia, visual dysgnosia) and within the sphere of reference designated by the adjective refers to a sort of ragbag category wide enough to include all that cannot

be accounted for by sensory loss and not implying a preciseness which is not supported by the observed facts. *

I feel that it is extremely important to stress the importance in clinical work of a continuing awareness of the distinction between the structural integrity of a sensory system and the adaptive use which is made of it, for the methods used in early attempts to correct the two forms of malfunctioning may be very different and even mutually vitiatory.

Most sounds, having no permanent meaningful associations, are ignored unless some unexpected quality momentarily confers a transient significance.

Physiological adaptation (habituation) rapidly takes place so that outward and localising (observable) responses tend to occur to unusual sounds or rhythms, to stimuli from unexpected directions or of singularly low intensities. Responses of this kind are likely to occur only once if a sound is repeated and adaptation is accelerated by raising sound intensities.

Whether or not a failure to find interest and meaning in sound can and does continue as a result of some primary dysfunction of the central nervous system mechanisms concerned with association of sounds and meaning, there are clearly other more peripheral and non-specific physiological mechanisms, interference with which could effect the evolution of similar aberrant behaviour.

A brief consideration of possible ways in which sounds come to take on meaning might suggest how some forms of dysgnosia come about and perhaps even indicate a basis for a tenable hypothesis designed to explain some of the vagaries of normal and abnormal auditory development.

It would seem that from a time early in the stage of compulsive-attention-to-the-'strongest'-stimulus-available (the first eight or nine months of life), stimuli are most readily attended to when they emanate from within the most exhaustively structured region of the environment, generally the front.

Whilst these regions have not been completely extended attention will tend to be focussed and confided within a narrowed scope.

For an auditory signal from an obscure region of space to attract attention it may have to be possessed of a very high significance and even then it may fail in its purpose. A combination of information from more than one sensory modality may be required to capture the attention, each of the components by itself being

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* 'Central deafness' may perhaps be of peripheral origin; 'language disorder' is used to refer to conditions which are essentially non-and pre-linguistic. 'Aphasia' in adults is not used for a tendency to ignore even simple sounds – 'auditory agnosia' is the term used.

insufficient to elicit a localising turn (as in an example quoted earlier). [1*]See also myopia note.

In such a case the dysgnosia may be considered to extend beyond the auditory sphere; however audition is likely to suffer the most setback and be the most obviously affected because of its dependence on the haptic and visual but also in virtue of the more energetic nature of auditory responses. See [*]Note

An auditory dysgnosia may be such that a sound which is heard and attended to may have to be brought into the frontal field of haptic and visual interest before its full significance or signification can be educed. It is as if a very complete knowledge of the nature and position of the source must be available before the meaning of a sound can be extracted.

At some early stage of development a sound seems to have meaning, however simple, only in full and simultaneous association with already meaningful images from the source.

Later a knowledge of its location may be all that is necessary for the sound to arouse interest (to awaken meaningful mental images?) and this means that in the

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[*] Note

Myopia – The nature of this condition makes the concentration of attention upon a certain circumscribed region essential. The limited size/extent of the clearly defined region or the mental effort required to maintain this region in clear focus results in actual blurring of retinal images or in reduced attention to images entering the eye from the more peripheral aspects of the field.

Either mechanism alone or perhaps the two mechanisms conspire in sum or product to significantly reduce the amount of exploitable information from the peripheral fields of vision.

The projective extension of structured bodily space may be severely stunted in this way. The probability of a sound source being located is hence very considerably reduced, and when located, of its being within a well explored region of space, small. In association with early movement weakness and retarded sitting and/or fluctuating hearing impairment of even small degree, short sight might be expected to sometimes result in peripheral visual and auditory dysgnosia and delayed speech development.

[**] Note

Haptic perception takes place during active or passive handling, touching or proprioception. An external observer only recognises or infers perception from handling behaviour or reaction to contact etc.

Visual perception is inferred from visual following or appropriate reaction following on recognition of the visual image. The eyes may be opened or closed and *open eyes are commonly assumed to be seeing eyes.*

Because haptic and visual perception are both regularly possible from a very early stage without movement, dysgnosia may be readily overlooked by the casual observer (very common in rubella and encephalopathy) but auditory perception, being so regularly associated with turning responses and combined with the plain fact that ears do not open and close makes a failure to respond to sound fairly obvious from an early stage, particularly when combined with faulty haptic or visual perception!

early months the more readily its source is localised the more meaningful the sound.

At a pathological level a child with a narrow region of interest may understand speech better with the speaker in front of him. This phenomenon in children with limited visual fields who are thought to be deaf is often misinterpreted as lip or speech reading; however, it can be readily shown that covering one's lower face whilst talking influences such children's comprehension little if at all.

Emotional reactions are usually encountered in situations such as these, the child commonly being less anxious when the speaker is in front, but this is almost certainly a result not a cause of the increased facility in understanding and improved performance.

Taking the development of auditory perception alone and ignoring the direct conditioning of associations of sounds with meaning as occurs in very young and passive babies (and sometimes in supposedly remedial techniques), the progressive associating of sound with signification might be roughly and briefly summarised as follows:

A sound may elicit transient attention even without any special association if it has a significance for the hearer based on its unusual or unexpected nature, combination, intensity, rhythm, direction, etc., or change in any of these characteristics.

Such a relatively meaningless sound may arouse a postural response such as a change of 'set' ('alerting', 'stilling', smiling or 'listening'), a startle reaction, 'negative' attitude or, *if the source should be situated within a fairly well structured region of body near-space,* even a localising turn. Even here the turn may be abortive or if complete may fail to result in a finding of interest in the source.

Finding the source is necessary for establishing an association between a sound and other already meaningful sensations emanating from the same source.

Thereafter the sound can become endowed with significance and be capable of arousing prolonged interest – interest sufficient to initiate an anticipatory localising turn to be rewarded by the successful gratification of other senses.

Having acquired meaning in the particular locality or localities in which its source is identified a sound may remain for a while most significant when originating from within these regions even after acquiring a direct meaningfulness in virtue of its association with other perceptual qualities as shape, colour, smell, feel, etc.

Furthermore for a time a sound is likely to be recognised in its full significance, as up to that moment realised, only when combined with visualisation or palpation of the source, rather as low intensity or filtered speech may need

supplementary face reading or other visual concomitants for full interpretation of its content.

As a more elaborate and efficient system of processing auditory stimuli becomes established it is likely that for a while at least a full interpretation of their import is derived from the sounds alone only with a prior or inferred knowledge of the position and nature of their sources.

Even as experienced observers of visual phenomena we recognise that we often need more clues than are actually available within the visual image to identify a source. Sometimes we fail to identify correctly an unfamiliar close-up view or a picture taken from an unusual angle; sometimes by employing remembered experience we make sense of what we see, often correctly but on occasion, as in the case of optical illusions, wrongly.

After all we do not really respond in a meaningful and directed way to the actual stimulus patter impinging on our senses presumably but rather to the conceptual image, previously built up in the mind, which such stimulation evokes within the sensorium.

The finding of meaning in a stimulus must be preceded by sufficient previous associations from which to build such a construct.

The child subsequently reaches a stage when a knowledge of the position of the source from unrealised anticipatory localisation may be adequate and finally a sound may come to be meaningful even to the extent of carrying symbolic signification, alone or in sequential combination with other sounds, without the necessity for the listener's awareness of the exact source locality.

It will be recalled however that in a multiperson conversation even distinctive-voiced speakers may be misidentified if the participants are moving freely about. Again, at a somewhat more fundamental level a strange or puzzling sound may suddenly take on a familiar form once its origin has been discovered or defined.

Sounds impinge upon us from all angles of a sphere and who is to say which are the most commonly utilised and which the most significant of these directions. It seems reasonable to suggest however that any conditions which restrict the ability to locate sources in space by limiting the extent or depth of organised body space or by preventing normal stereotaxis within such regions of awareness, might interfere with the normal genesis of auditory eugnosis or the finding of interest and meaning in sound.

It is also readily possible to hypothesise manifold quantitatively differentiated and qualitatively dissociated states ranging from almost complete perceptual dysgnosia through diverse protean forms to ostensibly single modality conditions, some affecting all but the crudest sensations, others only the complex and symbolic functions.

A possible additional hazard is that some stages of perceptual development may be governed by critical timing. That is to say there could be a critical period within the earlier part of the organism's life span during which certain basic and necessary perceptual processes are established in a manner which is not fully possible later.

Certainly the almost complete inability of some intelligent and apparently intact children to make adaptive use of or even to find interest in sound during their early years and the subsequent but anomalous development of speech by a proportion of these children is compatible with such a possibility.

It is not suggested that such a mechanism is the only or even the most common cause of auditory dysgnosia ('language disorder', 'auditory imperception', 'developmental aphasia', etc.) but is put forward as an alternative hypothesis to the usual, equally vague, 'central deafness' view which implies a primary interruption or disarrangement of pathways within the 'auditory system'.

A number of factors are always concerned in the evolution of normal adaptive functioning and the exact nature, degree and extent of any behavioural anomaly will depend upon the balance of these factors. It is not therefore suggested that a particular postural defect must always lead to the same behavioural pattern. Such a margin of safety seems to be built into the human organism that the odds have to be stacked pretty heavily against an infant's normal progress for a really crippling measure of affliction to result.

Preventative and Remedial Measures

As has been seen normal perceptual development depends on a passive and active interaction with the environment which normally results under the influence of the child's own developing organisation of postures and movement patterns, together with the ordinary handling and stimulation he receives from his parents and others.

The importance of timing in this respect too will be appreciated and it is clear that certain children are liable to fail to develop adequate perceptual organisation.

In particular it is children who fail, for one reason or another, to receive sufficient 'passive' stimulation during the early months, children whose movements are restricted by movement weakness or abnormally high muscle tone, and children whose movements are poorly controlled and unstable who are at risk.

It is not suggested that all such children will necessarily develop gross perceptual abnormalities in the absence of consciously devised and directed treatment. Nor is it to be inferred from what I have said that such measures once instituted will necessarily be adequate or even substantially effective for every child; however, it is likely that the majority of affected children will benefit to some extent from the attention.

The first and most important stage of treatment is the recognition, in particular by the parents, of the child's need and some understanding, however intuitive, of its nature.

Secondly, the early and regular application of appropriate measures designed to enlarge the child's restricted perception normally carried out by the parents and preferably under informed guidance.

Generally under-responsive children

Children such as those whose emergence from the neonatal state of perceptual inaccessibility has been delayed, that is to say the primary autistic conditions (including early infantile autism, rubella embryopathy, and those resulting from early deprivation in weakly and 'damaged' children), are in urgent need of attention.

Unfortunately they are the very children who are often inadequately stimulated for there is not only a biological need for babies to be stimulated, as we have already seen, but the adult also seems to have a biological need for certain responses – 'social' responses – from the child if he is to behave in an adaptive way towards the child.

If the baby fails for some reason to evince these responses he tends to be left alone for long periods. Such a 'good' baby who sleeps well or lies or sits quietly in his cot demanding little attention is commonly not recognised to be abnormal until a year or so old. Sometimes it is only when another biological need, the need for his child to 'talk', appears between twelve and twenty four months that the inadequacy is noticed by the parent.

This reciprocal need relationship between baby and adult presumably has an adaptive function among lower animals where an imperfect specimen represents a liability to the group and is, I consider, the basis of the 'odd feeling' we have about an autistic or schizophrenic subject. We talk of the child's "lack of affect" when we recognise a weak affectual response to him in ourselves.

Such a condition needs to be recognised early and compensated for by studied and painstaking 'normal' treatment of the child.

Children with movement weaknesses

The weak infant will need more handling during the early months than the normal child. Regular manipulation and gentle passive exercise of the movements the child is making are likely to be helpful.

Even more important however is the encouragement of active exercise including the attaining and maintaining of normal upright postures.

Systematic exposure of small segments of weak postural complexes to potentially rewarding if physically tiring attitudes at first for very short periods of time fosters the gradual assumption of autonomous control. For example complete bodily support for all but a droopy head and placement of the child where his raising his face is rewarded by an interesting view will encourage head control.

Presenting a source of interest within a child's already established region of interest but carrying it into a less well explored zone will extend his field of interest in any particular direction by encouraging him to turn and to use his limbs to reach into the less accessible regions.

Children with poor postural control

'Dystonic' – 'athetoid' children have in addition i*mpediments to their responding to sound.* (see Appendix IV)

Of course in referring to these procedures which attempt to prevent or redress deprivation due to postural difficulty I am assuming the child to be continually surrounded by normal experiences as far as possible and not taken up from a hospital bed for his "lessons".

Clearly such children may well require extra help in making some of the associations we call learning. In the early stages this would be given by someone close to the child, as his mother, under guidance from someone familiar with the problems. Later a child may need special techniques which are only available at certain schools. However, I hope that it might be possible by promulgating certain basic information about early perceptual development to prevent some children from the necessity of attending for special education.

S U M M A R Y

Briefly summarising these comments I suggest that movement and visual difficulties which prevent or discourage haptic and visual exploration beyond a certain minimal range consisting of the manually (or pedally) and visually accessible fields generally in front of the child virtually excludes structuring of the immediate environment outside these fields and focuses whatever attention and interest is available within these narrowed regions.

Squints and other oculomotor defects which diminish the extent or clarity of the visual fields, difficulties in rotation of the head or twisting the trunk and limitation of abduction and extension of the arms are liable to result in a situation where the child's whole world is represented by what is in front of him; the regions being out of reach and sight are also, so to speak, out of mind. It should be pointed out that rotation of the body as a whole does not affect the exploration of the body near-space which will, of course, rotate with the child.

Under these conditions stimuli of various sorts arising within what I call an environmental 'interest field' will always take precedence, when in direct competition, over those obtaining in regions of low or no interest; and commonly the latter stimuli will produce only occasional responses often modified in form, responses to stimulus intensities greatly above the thresholds of similar receptors receiving from within the 'interest fields', and often stimuli will be ignored completely.

It is to be noted that I link the concept of 'interest' or the capacity to command attention at this stage, not with particular objects, qualities, etc., but with the region from which their identifying stimuli emanate. It is necessary perhaps to stress again that it is not primarily a deficiency or impairment of receptor function which is concerned here for it is frequently possible to lower the effective threshold value of a sensory system within a matter of weeks and sometimes within minutes by the active exercise of the neglected perceptual field. It is not the location of the receptor organ stimulated but the direction from which the stimulus comes which determines the response threshold at this stage.

The transition states in normally and abnormally developing children are particularly enlightening. For example in the normal young child of say four or five months it is often possible to demonstrate that a sound source readily and overtly localised when on a level with the ear and just out of visual range requires a higher stimulus intensity if a few inches further back or may be completely ignored even at intensities of the order 65 dB. if displaced still further to the rear or upwards.

This effect is greatly exaggerated in neurologically 'damaged' children. For example in mild hemiparesis of early childhood the child, in areas where routine screening for hearing loss is carried out, not infrequently presents with an apparent asymmetric hearing loss, the bodily weakness having been overlooked.

Not infrequently dissociation within the interest fields occurs so that a region which is so to speak visually fertile may be barren ground from the acoustic point of view and yet abut on a region where this situation is reversed or an entirely different state prevails.

It is suggested that such abnormal perceptual states sometimes persist, having a narrowing and debilitating effect on the interpretation of afferent stimulation and producing the auditory and audiovisual dysgnosias commonly referred to as 'congenital auditory imperception', 'developmental aphasia', etc.

Therapy consists in enlarging and consolidating the body image formation and space structuring processes from the earliest possible moment.

The child with movement weakness for example should be encouraged and induced to actively rotate his head and eyes, twist his trunk and reach sideways and behind as much as possible by presenting stimuli, which already interest him under certain conditions, from the boundaries of his prevailing interest fields or

from the midline carrying such interesting materials from the midfront gently towards the sides to facilitate extension of the field or fields of interest.

I would interpret the undoubted value of dancing, mime, and 'music and movement' for 'brain damaged' and mentally retarded children, and the beneficial effects of encouraging the active use of the weak side in the congenitally hemiplegic child in this light. The commonly observed phenomena oddly termed 'tactile extinction' represents 'unfair' competition between interest fields.

DISCUSSION

To Dr. Waldon from Mr. Boothroyd

I was interested in your comment that you felt that hearing tests of many young children indicate alerting thresholds rather than audibility thresholds.

I have found older children who appear to behave in this way in pure-tone testing and frequently there is a history of middle ear disorder and wonder what you think of the thesis that an end organ of variable sensitivity can result in a disturbance of a system in which hearing is the primary alerting or 'watchdog' sense.

Dr. Waldon's Reply

It has been my impression that children whose normal adjustment to auditory stimulation has been adversely influenced in some way over a considerable period of time can come to respond fairly consistently in a manner different from the usual.

Among these, a child who has been subjected to an asymmetric and fluctuating hearing loss (due to middle ear disease) over a considerable period of time may come to behave differently towards different stimuli, e.g. he may continue to behave as if he has a definite level of hearing loss some time after the loss has, in fact, improved or cleared up completely, so that the odd situation obtains of a child who behaves in test situations as if he has a conductive loss yet discriminates speech at even lower intensities!

Anomalous behaviour of this sort in adults would be referred to as 'functional', 'dissociative' or 'hysterical'.

My own (I am aware very naive) explanation of this would entail a child's coming to impose a consistency and stability on what is to him a very uncertain, bewildering, and seemingly fickle environment by learning to respond only to auditory signals of a certain intensity. A child whose overt responsiveness varied with his unrecognised hearing loss would be likely to perplex his parents, teachers, etc., and produce reactions whose variability from the child's point of view would induce in their turn anxiety in the child, a vicious cycle being thus established.

Anything which imposes a consistency on the child's responsiveness to auditory stimulation must go a long way towards breaking this cycle.

As far as I can see, the only way a child could become consistently responsive, despite a fluctuating hearing loss, is to establish a threshold directly related to the physical intensity rather than to loudness.

That is to say subjective clues other than loudness would need to be brought into play in order, so to speak, to label intensity.

In younger children with a history of a prolonged fluctuating hearing loss one may find – long after the loss has cleared up – considerable difficulty in localisation of sound sources together with severe linguistic difficulties as well as an emotional insecurity reaction.

In many respects these children closely resemble those I have previously mentioned whose visual restriction seems to have upset the normal development of speech. Here the localisation difficulty, instead of being due to an imperfectly structured environmental space, results from direct interference with the binaural and other mechanisms normally necessary for locating sound sources.

APPENDIX I

A Classification of the Causes of a Failure to Show the Required Turning and Source-localising Response to a Sound in a Distraction Test of Hearing

Peripheral hearing loss

Conductive hearing loss) Inadequate intensity

Perceptive hearing loss) Inappropriate frequency

Intentional failure to respond in the required manner – an emotional manifestation.

Negative reaction.

Impaired consciousness or perceptual awareness

I Natural sleep – fatigue

II Epileptic and epileptic-like states

Prolonged but clearly demarcated unresponsive or underresponsive states. Responsive between seizures.

Successions of short absences – 'pyknolepsy'. Responsive between seizures. Constantly diminished awareness under 'quiet' conditions. Child often behaves normally under ordinary 'noisy' conditions.

III Drug stupor

(a) Clearly apparent soporific effects of depressant drugs – child noticeably drowsy.

(b) Cryptic effects of depressant drugs – e.g. phenobarbitone, primidone – even in a very small dosage. Often not clearly apparent until the child is released from the drug's influence.

Failure to find interest or meaning in the signal

I Normal absorption in some other distraction.

II Habit of failure to respond to loud and meaningless signals reinforced by regular and uninformed testing from an early age. Sometimes seen in a child of deaf parents.

III Rapid habituation following exposure to one or more examples of the same signal with few, one, or abortive turning responses.

(a) General dysgnosia – Underresponsiveness in whole perceptual sphere, diminished social responsiveness – Isolated child deprived of basic and early perceptual experiences, e.g. Floppy child, very late sitting –

Primary autistic states - Early infantile autism
- Rubella embryopathy syndrome

Other schizophrenic or autistic states of childhood. Secondary regression.

(b) Specific dysgnosia

Auditory dysgnosia – Central deafness – Auditory imperception – "Language disorder"

Speech dysgnosia – "Language disorder"

(c) Regional dysgnosia. Failure to respond to signals from one or more regions of bodily-near-space.

(i) Normal developmental – during early months sounds ignored when coming from a source too far to the rear or above the head.

(ii) Postural anomaly – interfering with the manual, pedal and ocular exploration of the environment, e.g.
Hemiplegia
Tetraplegia
Dystonia
Klippel-Feil Syndrome – Short neck – diminished truncal and cervical torsion, restricted abduction of arms and eyes.
Etc.

<u>Inability to respond</u>

i) Postural or movement difficulty – dystonia, cerebellar ataxia, movement weakness, spasticity.

ii) Initiation or inertial difficulty – dystonia, cerebellar ataxia.

<u>Modified response</u>

Blindness – full turns may be inappropriate – reaching being more adaptive.

<u>APPENDIX II</u>

The changes in behaviour accompanying the development of perception normally taking place during the first year or so may be observed to advantage in certain abnormal children emerging tardily from a primary autistic state.

Here development follows the normal sequences but is greatly extended in time. Furthermore an inevitable degree of dissociation in the various spheres of growth produce differing amounts of phase lag which allows an admirable opportunity for the various developing response patterns to be seen against a background of behaviour not normally found in these associations.

The following brief résumés of two fairly typical examples of such children may help to illustrate the point.

(i) When first seen at the age of eleven months Alistair was extremely remote and under-responsive to auditory, visual, painful and tactual stimulation.

He remained apparently unaware of his mother and father until about the time he began to walk at 18-20 months. His grandmother later remarked "That child was like a log of wood". "Didn't seem to make progress"; "Not alert".

From this autistic and dependent state Alistair made quite remarkable progress. At the age of twenty-one months he was beginning to show more upset as a result of painful stimuli but if in active pursuit of something he still commonly ignored a fall and the disturbance was always short-lived.

At this stage he began to show primitive social tendencies and a need for communication. He continued not to look at his mother when she talked to him which made her feel that she was still not getting through to him; however, if she sang he looked at her face, smiled and vocalised. He now took to screaming imperatively when he needed something and his mother had to interpret these cries from situational clues. At this time he appeared to interpret a firm "no" correctly but only laughed at a shaken head.

By the age of two years he was walking well but still with a wide base and upturned face. He manipulated objects at about a fifteen months level continually exploring the forms, surfaces, textures and mechanisms of various objects as well as the geography of new environments. His concept of the permanence of an object appeared to be very well developed and he would hunt assiduously for a hidden toy. At this time he could spontaneously build a tower of three bricks without difficulty.

He would now drink regularly from a cup held himself but chewing was not established and he continued to spit out solids.

Perception had seemingly undergone a complete change. At the age of two years he was able to visually follow a rapidly moving object such as a brick thrown on to the floor to skid past him at high speed. He was immediately

responsive to tactual stimulation even during a tantrum and cried regularly whenever he hurt himself. Frustrations now upset him so that he threw a paddy when he would previously walk away unconcerned.

At two years and one month he excitedly greeted his parents on their return home from a holiday; behaviour never before witnessed.

By this time he smiled readily at his parents and at me, and made persistent social overtures if ignored. He loved to play 'peep boo' from behind his hands or a convenient door and would pull interlocking bricks apart, immediately offering the components for rearticulation.

When chronologically twenty-eight months old he appeared to be functioning at a level of some eighteen months or so, regularly bringing and even piling objects to climb on to reach an attractive goal, and made use of a stick to rake towards him a biscuit just out of arm's length.

Becoming more discriminating in his play with toys he began at this time to adopt favourites from among them.

Communication has developed fairly rapidly. At about twenty-four months, having achieved some aim, Alistair tended now to look round for approval from anyone who was looking and responded by getting very upset if told fairly fiercely to desist from some activity.

By two years four months he was "talking" to his favourite rabbit toy as he carried it about, feeding or pushing it about in a wagon. Vocalisation had by this time become a usual form of behaviour and much of it could be classified as simple jargon. The only clear articulation recognised by this age was the word "dirty" pronounced a number of times in imitation of his mother's model.

There was, however, clear evidence of Alistair's finding signification in several words including "downstairs", "bic bic" (biscuit), "mummy" and "daddy".

(ii) Simon made great progress from an autistic pattern of behaviour in which at the age of fourteen months he was generally very under-responsive to stimulation and clearly did not 'know' or take any interest in his mother.

At this time only high intensity, relatively crude stimulation tended to produce a response. Bright light sources, violent pummelling or tickling and rough handling and throwing about produced signs of enjoyment whilst less intense stimuli were ineffectual.

Over a period of time an evolution in the responsiveness to lower intensity and more complex stimulation has taken place.

For example, when I first saw him Simon responded visually only to very brilliant source of light such as the sun. Later he stared fascinated by

brightly reflected surfaces, sometimes holding such surfaces and rotating them at arm's length. Later largish patches of saturated colour took his fancy and he showed a predilection for reds. Gradually after being attracted to strident patterns and tartans he came to examine with great interest the threads and tiny objects which he held and orientated delicately in his finger tips. By this time he was able to visually follow a rapidly moving object.

Simultaneously a similar sophistication in other perceptual modalities took place. By eighteen to nineteen months surfaces and textures were being explored more and more systematically by rubbing, scratching and picking, and objects examined, compared and taken to pieces. He became more responsive to pain and as a social awareness grew up began to bring his injuries to others for sympathetic consideration (twenty months).

By this time Simon had begun to find ways of procuring the objects of his desire when out of reach. Available apparatus was used to climb on and a table-cloth pulled to bring a prize nearer.

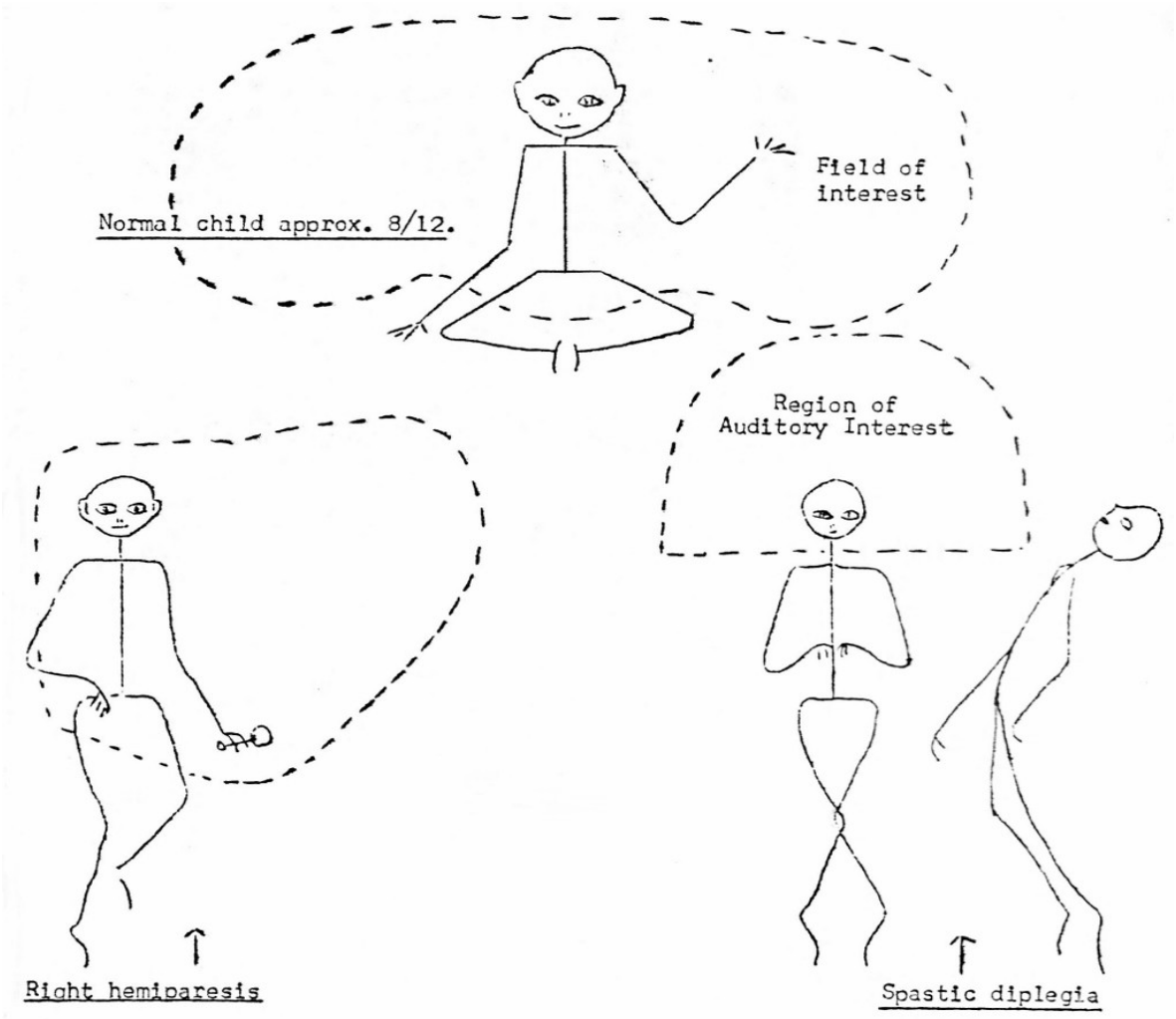
Within a month he was bringing a chair or stool from elsewhere to aid his climbing to less accessible situations.

Primitive social interaction developed further so that by 22 months he would invite participation in simple games such as 'peep-boo', and he came to miss his familiars when not with him.

As is commonly the case with children who have been under-responsive the increased responsiveness and enlarged exploratory and experimental attitude created considerable domestic difficulty and hardship for his mother on her own in a small house but there is no doubt that it represents very considerable improvement in Simon's level of adaptive functioning.

Unlike Alistair Simon has made much less use of his hearing although he has more recently been demonstrated to be able to respond to low intensity sounds and sometimes seems (according to his mother and grannie) to respond to the emotional qualities of their voices or perhaps even to his own name.

APPENDIX III



Example of Spatial and Modality Dissociation

Tracey is able to sit unsupported on the floor if carefully arranged in a suitable position and to move herself about on her back. She is also able to get about in a 'walking' device of some sort and has recently begun to progress in a forwards direction.

She does not make adaptive exploratory excursions however; neither does she move to secure a distant object.

Her behaviour in my clinic towards sensory stimuli in general and to sound in particular reflected this experiential deprivation.

Tracey now exhibits more interest in sound than previously and the human voice is far and away the most attractive sound for her. In response to voice at about 30/40 dB. she sometimes turned to localise the source if close enough. At other times she smiled and vocalised in response, or rocked in time

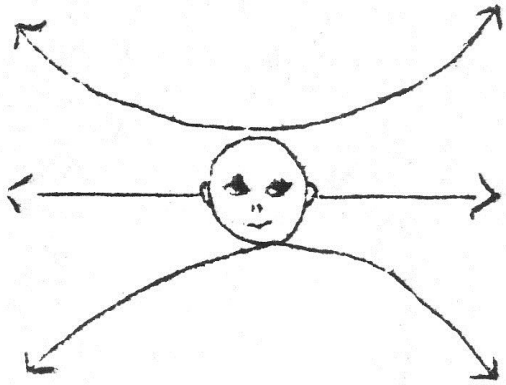
to rhythmic speech or singing as of a nursery rhyme. She was able to produce a small number of vocalised sounds in direct imitation of her mother.

There was less interest in most other sounds but the sound of a spoon stirred against the interior of a cup produced a variety of orally directed responses.

Perceptual activity appears to be fairly well divided into several sensory spheres and also to be vertically arranged in space, rather like a layer cake.

Main sphere of visual interest

Main sphere of auditory interest



Main sphere of haptic interest

Visually attention is almost wholly directed above eye level towards sources of bright light. Listening is largely in the horizontal plane at ear level, whilst tactually only stimulation of the trunk or thighs or upper limbs are likely to elicit a manual localising response and touching the hand itself is the only certain way of producing groping and grasping.

APPENDIX IV

The Evaluation of Hearing in 'Athetoid' or Dystonic Children

Much of the investigation of hearing function has been carried out on young adults with 'normal' hearing and on subjects who had suffered impairment of acuity later in life.

The close correlation between pure-tone audiograms (PTAs) and speech discrimination in such subjects does not imply that the two measurements are mutually dependent neither can it be inferred that the pure-tone audiogram in a

child who has never developed normal and consistent responses to sound necessarily defines the state of his hearing.

I see no reason to suppose that a mechanism which raises the response threshold for a particular acoustic stimulus necessarily raises the threshold to the same level for all other acoustic stimuli. The response thresholds for non-periodic sounds, for example, need not be raised merely because it is found that the PTA is consistently depressed.

Even if such an audiogram were known to record just audible thresholds *for pure-tones* it is not necessarily a satisfactory indication of the just audible thresholds for complex sounds or variations of sounds containing similar frequencies; however, what is more important, do we have any evidence that the responses of young children are to just audible thresholds?

Records made from actively co-operating subjects who have known a prolonged adaptive use of hearing are not directly comparable with those made from young subjects without considerable risk of error.

In a child who for one reason or another has failed to find interest, significance or meaning in sound one might reasonably expect a tendency to ignore all auditory stimulation other than that which compels attention in virtue of certain properties such as fairly high or unusually low intensities, unexpected directions or rhythms, unusual sounds, directly conditioned associations, etc.

As inhibition or adaptation could clearly take place at any of several possible levels of auditory activity it is quite possible that consistent responses to one kind of stimulus might occur at ear intensity levels quite different from those at which responses to a different variety of stimuli take place; or under a different set of conditions, different but internally consistent sets of response levels might be encountered.

A dissociation of responsiveness to different kinds of auditory signal is commonly seen during the early months of life as interest, significance and meaning become tied to some sounds earlier and more firmly than to others.

A dissociation of this kind is particularly likely to be perpetuated in cases of auditory system immaturity or dysfunction, or in situations where experience in exercising listening and/or responding to meaningful acoustic signals has been limited or unusual.

With young children, and even older children with abnormal hearing/listening experience one cannot expect the sophisticated and highly motivated co-operation usually available from the adult with normal hearing/listening experience, and yet this is very often what we do require if the results of tests are to be comparable with standard models.

One might compare the response behaviour of an unsuspecting normal adult listener towards a very familiar and relatively meaningless sound such as a clock ticking, with that towards a meaningful – significant or anticipated – sound of similar acoustic pressure, as a distant baby cry or the sounds of an expected motor car.

The movements of athetoid children vary somewhat in their character and distribution and in the background state against which they occur.

There is some disagreement about the exact nature of the movements even in the most common varieties but my own view is that in addition to variable and intermittent accesses of raised muscle tone occurring in a generally hypotonic (flaccid or floppy) child there is a combination of co-ordination (ataxia) and equilibration (total bodily tone distribution) disorder, of 'cerebellar' origin, which appears as delayed initiation of compensatory adjustment to movement and over-sustained response.

Many athetoid children would appear to come within that category of children whose ears are capable of detecting sounds of widely differing frequencies at intensities within or near to those considered to be the usual limits of hearing yet who do not make normal use of the sounds; of children who are unable to find interest or meaning in sound, or at least who are unable to respond immediately or appropriately to auditory stimulation.

There would appear to be a variety of possible levels at which dysfunction might occur and several ways in which such disorders could come about.

Some children appear to suffer from a congenital disorder of auditory function – a specific inability to make normal use of sounds to which they can under certain circumstances respond. These children are often considered from an early age to be profoundly deaf whilst others respond to moderately raised intensities or to sound within the normal range.

Comprehension of speech may fail completely to develop, develop late, or develop at a reasonable time but in an abnormal manner. Some children develop speech very similar in character to the aphasic conditions met with in adults but I consider it misleading to equate the auditory difficulties of this group of children as a whole with adult aphasia or to refer to them as having 'language' disorders. I prefer to term them auditory dysgnosias to distinguish them from true language disorders in which language learned through routes other than the auditory are equally affected.

Some of the children in addition to having diffuse lesions of the brain, themselves possibly a direct cause of failure in normal auditory function development, have also physical defects which together with adverse environmental influences may induce auditory dysgnosia or dysgnosodyspraxia.

When dealing with disorders of speech and hearing too often the attention is focussed on the ears and the 'auditory system' and the priority of postural and movement development and the tactual, proprioceptive and visual senses in the development of interest in, and use of, sound is forgotten.

My own observations lead me to the view that effective use of hearing only follows the regular and ready location of the sources of the sounds. Such source localisation normally depends on an early attainment of the vertical postures from which to explore the environment tactually – primarily orally and manually – and visually.

It would appear that for an interest in sound to develop normally in the first instance perceptual associations are required to be built up between the sounds and the objects or operations which appear to be their sources.

For a relatively few sounds under exceptional conditions direct associations may be set up without any active process of searching for or locating the source – as in the early weeks of life the sounds of food preparation in preceding the appearance of the food commonly leads to the anticipation of the approach of mother and satisfaction of the appetite.

However, more usually it is necessary that the child find the source of the sound, its meaningfulness being dependent upon its relationships with other already meaningful perceptions.

Presumably experiencing passive handling, making active movements and manipulating objects – at first fortuitous and haphazard, later intentional – leads to the development of bodily self-awareness and the structuring of immediate space in terms of the various sensibility modalities.

Finding objects with the hands, or other parts of the body, becoming linked with the developing visual perception normally results in the ability to turn from the vertical and to subjectively measure the deviation to either side from the normal, presumably in terms of twist or torque of the trunk, head at the neck and conjugate deviation of the eyes, thus making it possible to record the degree of rotation and to locate a nearby object with the hand or eye.

Any postural or movement disorder which interrupts or obstructs this process may modify or even prevent the adaptive use of sound.

Such anomalous auditory development is readily to be seen in the young amblyopic or blind child, in the posturally disordered and in the child with other severe sensory or perceptual defect.

To focus our attention on the child who has suffered diffuse or scattered cerebral and possibly cochlear damage, presumably from the deposition of unconjugated bilirubin or the effects of neonatal anoxia, and has developed a postural dystonia, there would appear to be a number of possible factors

involved. The arguments at present must remain theoretical or rather speculative but are not, I feel, preposterous.

If we might for a moment ignore the possible effects of damage to the mechanisms involved in the processing of auditory signals at cochlear level, to local cochlear habituation activated at cellular level or by feedback from the CNS, to inhibition or interference with auditory attention, with auditory discrimination, with intersensory association and auditory memory, with auditory symbolisation, temporal sequencing, etc., and consider only the extra-acoustic factors, we find several mechanisms which might produce an appearance of auditory impairment and a failure to develop speech.

The young jaundiced baby is not infrequently very ill for several days or longer and is likely to have had exchange and top-up transfusions. He is often a very floppy baby and not only very late in supporting his head and sitting but also very difficult to prop up in a semi-recumbent position during the early months. He is often a very quiet "good" baby when he may be left to sleep or lie by a grateful mother, or being relatively unresponsive to stimulation his parents may quite naturally and unconsciously tend to decrease the amount they stimulate him; or, if an irritable child, initial attempts to quieten and comfort him by picking him up being unsuccessful will be abandoned and the child left to cry.

As the strength of the hypotonic baby increases, intermittent accesses of tone will disturb the postures to produce irregular and disorganised, possibly spontaneous (although I have personally never been convinced of this), movements so that the upright postures are not only attained late but are also achieved as a fairly diffuse probability cloud of relatively vertical positions rather than definite upright postures. Individual movements, often including those of the eyes, are ataxic and accompanied by violent associated movements which are inhibited very late and only partially.

Unlike the normal child, who from an early age steadily and progressively assumes the vertical, from which he may turn and co-ordinatedly move his limbs at well-fixated joints, to manipulate, explore, and visually locate distant objects, the athetoid child is slow in learning to locate objects, including the sources of sounds, at first with his hands and later with his eyes. The restricted nature of his organised movements and exploration of his own body and its movements, together with limited tactual stimulation by parents or nurse lead to an imperfect and tardy formation of a concept of bodily self-image, a necessary prerequisite, one would imagine, for adequate structuring of surrounding space and the location of external images by reference to or relative to himself.

In addition to these various factors, which themselves are quite capable of adversely influencing the development of adaptive auditory function, the athetoid child may be so limited in his ability to make his responses sufficiently immediate so to use them in an adaptive manner that unaided he may fail to make readily observable and interpretable responses regularly even when he

hears and finds interest and meaning in the sounds. Sounds are so temporary and fugitive that the athetoid child might well find that his clumsy and slow turns to sounds are rarely crowned with the success of finding the source during the time that it remains meaningfully associated with a sound.

A further point which may well be relevant and although likely to reflect a primary dysfunction within the CNS seems to be related to the last point: I have observed in many athetoid children a distinct delay in initiating responses of various kinds - what appears to be an inertial delay which reminds me of that encountered in adult cases of post-encephalitic Parkinsonism. This slow initiation of response, which may represent a dyspraxia of movement, may sometimes be seen during tests of hearing when a child responds fairly consistently with some conscious activity to the *second* of two signals, identical in quality, duration and intensity, but separated in time by a second or two. Such a phenomenon may sometimes represent preliminary arousal in a condition of diminished auditory awareness but, in other cases I am thinking of, resembles more the overcoming of static inertia or the gathering of resources.

If these processes are in fact important in preventing athetoid and other children from finding interest and meaning in sound or in impeding his efforts to respond effectively to sounds he does find meaningful, they do also suggest the means of overcoming the difficulties of both examination and education.

Examination of hearing

On the assumption that despite appearances to the contrary, hearing thresholds in athetoid children might be normal or near-normal I devised a simple method of free-field distraction testing for such children.

Keeping intensities low, the qualities varied and rhythms and directions changed frequently to prevent too rapid adaptation, the test sounds are used sparingly and only at times of high response probability.

Testing first with the child's movements unrestricted, any responses are made more definite and immediate by impressing the test signals at a moment when he is facing some 30-40 degrees the other side of the normal. This manoeuvre imposes considerable restriction on the direction of the initial component of the movement and facilitates the child's swing across to the other side.

Clearly it is necessary always to demonstrate unequivocally that such turns are only continued to the point of visual location of the sound source following an acoustic stimulus.

Following this procedure the child is further tested under conditions of complete restriction of the bodily movements other than the head. This method reduces the distracting effects of redundant movements and allowing the child to

concentrate on his head movements alone promotes ease in turning quickly and accurately to localise the sound source.

The use of such methods has produced results that strongly suggest that athetoid children are frequently able to hear and to locate the sources of a wide range of high and low frequency complex sounds or noises impressing intensities at the ear of the order 35 dB. and below.

Findings like these do not prove that auditory acuity is normal but they do cast considerable doubt on the value of pure-tone audiometry in some cases where consistent audiograms indicate serious overall loss of hearing which conflicts with the free-field results.

Education

This needs to be started as early as possible and directed towards enlarging the child's experience as a whole by encouraging the active use of the motor skills and the senses.

The strong temptation to stress auditory training and to apply amplified sound should be restricted until it is quite certain that there is an impairment of auditory acuity. Sound and speech should not be neglected of course but used as with a normal young infant and child in the early stages.

In an older child it may be necessary to emphasise or highlight sound and speech to some extent but always in as unartificial a manner as possible.

Various ways of establishing associations between sounds and their sources, between sounds and other sensations, and between sounds and ideas may be devised. Having decided what associations one requires to build up, the child's attention and expectation is engaged by various means and the sensations and perceptions to be associated evoked by appropriate stimulation in statistically high concentration and in suitable chronological and spatial relationships under conditions of low channel noise (i.e. perceptual distraction), and low equivocation (as represented in this case by sensory loss, etc).

Active and passive meaningful movements of various kinds should be regularly engaged in to improve and consolidate the formation of postural and kinaesthetic engrams generally, together with maximal physical and social contact in play with the parent, siblings and others.

I further favour the physical restriction of the trunk and limbs at times to aid the child's concentration on certain specific activities.

The burdensome and potentially destructive movements resulting from excessive compensatory modifications of postural tone and due to malfunction of the righting and postural reflex mechanisms are usually very distressing to the child. Furthermore the haphazard profusion of incoming sensations from these recalcitrant bodily parts must be considered to be largely "noise" from the

information point of view and hence eminently liable to mask other and more useful sensations.

Inhibition of the excessive and entirely useless associated activity of limbs not in voluntary use, in limiting the physical license of these bodily parts, enlarges the liberty of voluntary movement as a whole. You will notice how often older athetoid subjects themselves spontaneously engage in such restrictions by manoeuvres as hooking their feet under the cross-struts of chairs and clamping an unengaged hand between the knees during manipulation with the other.

I consider such restriction entirely analogous with those restraints to natural ebullience and unbridled enterprise which overtly or unobtrusively are essential features of any learning system; and with the required obedience to the rules or laws of society on which depends the freedom of the individual in a community.

Physical restriction requires to be very gentle and only for short periods at first until the child recognises the increased freedom it brings.

As associational learning frequently requires that a child sit in one place for various periods of time this may often be combined with physical restriction.

An arrangement which I have found useful in the past is a chair with a pair of sandals screwed to the foot board and wide straps for the knees and *either* wrist. A large tray fitted with walls at least 5" high and with a slot cut out to fit the upper chest both prevents excessive movement of the upper trunk and the too ready loss of play materials as a result of violent movement of the unrestricted hand or hands.

SUMMARY

A failure to attend to sound in children with postural, visual and other perceptual disabilities is often interpreted as due to deafness – impairment of auditory acuity.

In particular the 'athetoid' children, those who have limited movement or whose mothers contracted rubella during early pregnancy have frequently, and quite understandably, come to be assumed deaf when in fact a certain proportion, perhaps a fairly high one, have little or no cochlear impairment.

The functional precedence that perception involving tactile, position and movement sensibility takes over visual, and visual over auditory perception, in the building up of a concept of self-awareness and a knowledge of the properties and dispositions of the environmental elements, is frequently not remembered (or recognised). As a result a child with dystonia or limited movement, satisfactorily tended and protected in many ways, may be deprived of the necessary opportunities to gain the basic perceptual experience normally

acquired during the early months of life, upon which higher adaptive functioning and intelligent behaviour must depend.

The very reasons which make it so difficult to determine the latent and potential abilities of the dystonic child are also those which prevent his readily acquiring fundamental perceptual experience or exercising a responsiveness to stimulation appropriately or within a suitable time limit.

How much greater is the athetoid child's difficulty in repeating a successful activity so reinforcing perceptual association; how much more limited his opportunities to respond appositely to a stimulus he finds meaningful.

The child who needs extra practice over a more than normally extended period is likely to encounter even fewer chances within an even shorter duration. It would seem likely that only the child with a potentially superior intellect whose handling has quite fortuitously been suitable, is capable of satisfactorily overcoming the natural impediments to progress.

The successful examination of the athetoid child's hearing requires that he be given adequate opportunity to respond without undue effort and excessive emotional reaction. This is best achieved, not by conditioning him to respond to meaningless and disembodied sounds but by reducing unnecessary activity and supplying him with postural (as well as moral) support so allowing him to turn to *and localise the sources* of the sounds.

Auditory training should by no means be directed only towards encouraging listening and fostering an interest in sounds and speech but, as any auditory dysgnosia may be secondary the postural disabilities and the concomitant perceptual inexperience, should be make more general.

This is only accomplished by regular and concentrated therapy in which passive stimulation of the senses and exercise of movement is coupled with promotion of learning through active effort brought about by increasing positive experience and raising the chances of success whilst reducing the distracting influences. Normally such treatment must be carried out by the child's parents under regular and adequate supervision.

Geoffrey Waldon