BRAIN FUNCTION AND SECOND LANGUAGE LEARNING

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ABSTRACT

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This thesis attempts to draw inferences for Second Language Learning and Teaching from research into brain function. The brain operates by means of electrical signals, and meaning is interpreted according to which cells receive and pass on these signals. In human beings, the left and right hemispheres are differentiated for handedness and language as well as for modes of functioning. In the adult, language production, much language comprehension, and the ideation on which they are dependent, are usually left hemisphere functions. The right hemisphere, however, has some participation in language, greater creativity, and works spatially with a gestalt, parallel processing.

The thesis examines several mthods of teaching second language; the Audio-Lingual Method, Congitive-Code Learning, the Situational Method or the Semantic Approach, and also Community Language Learning and Suggestopaedia. By insisting on automatized responses at an early stage, the Audio-Lingual method seems to run counter to normal acquisition of programs, and to overload auditory gestalt mechanism. Cognitive-Code Learning seems to emphasize left hemisphere precision to the almost exclusion of right hemisphere function. The Situational Method seeks to develop competence by maximal exposure to and meaningful use of language in experiential settings. Activities suitable for younger children gradually cede their place of preference to more

intellectual projects and readings for older students. Since this approach encourages optimal use of both hemispheres at various stage the present state of knowledge seems to indicate that this method might be the better one for second language teaching.

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INTRODUCTION

The year 1957 may be regarded as a watershed date for second language learning. In that same year appeared Skinner's Verbal Behavior and Chomsky's Syntactic Structures: the one was an application to the field of language of entrenched and accepted stimulus-response behavioral psychology; the other was an invitation to new ways of thinking and to a revolutionary new understanding of language.

Linguistic or psychological theory has no immediate link with the second language classroom; and yet method should be based as closely as possible on what we have learned concerning human learning and human language. In the 1950's and 1960's, teachers were content with the various methods of the audio-lingual type, which used perception, mimicry, repetition, and variation of patterns of speech, and, in high school, a Skinnerian-type teaching machine, the language laboratory. Concerned over mediocre results, and perhaps sensitive to the changing psychological climate (with cognitive psychology, and 'third force' psychology, Maslow and others, challenging Behaviorism), teachers later sought better means for teaching. Various new methods were suggested: Total Physical Response, the Silent Way, Counsellor Second Language Learning, Suggestopaedia, and so on. In September 1977, Gloria Paulik Sampson could state that

> the two major controversies that have erupted in the past ten years are:
>
> (1) the audio-lingual habit theory versus the cognitive code learning theory (Chastain 1971) and

> (2) the manipulative drill versus the communication competence debate (Prator 1972; Paulston and Bruder 1975). (TESOL Quarterly, 1977, p. 241)

These methods and controversies stem from a search for better ways of teaching second language.

Thus second language teachers attempt to base their methods on what is known of language and learning; linguistic theory, psychology, and psycholinguistics can help a teacher to teach better. There is another more basic area of knowledge, unknown to many teachers, which underlies and links the previously mentioned areas of knowledge. An understanding of the human brain and its functioning may provide insights into how to teach second language more effectively. Over the last thirty years enormous strides have been made in our understanding of some of the complexity of brain processes and of language function. This should not be ignored in our search for better teaching.

In the chapters that follow, I will outline what is known of the brain and its functioning insofar as it may be of interest to second language learning. I will discuss children's possible lateral plasticity for language, and their possible superiority for learning second language. Lastly, I will consider the usefulness of previous and present methods of teaching second language in the light of what has been outlined.

CHAPTER 1

Capacity for language is one of the differences between the other primates and ourselves. Although a chimpanzee can be taught to manipulate coloured plastic triangles and to form with them meaningful messages, and to communicate with hand signals, he is unable to talk: this is partly because he does not have the necessary apparatus in throat and mouth to make the fine distinctions required in speech sounds, and partly because his brain is not as developed as man's, and therefore does not permit the acquisition of oral language.

Steven Rose lists some of the advantages of homo sapiens:

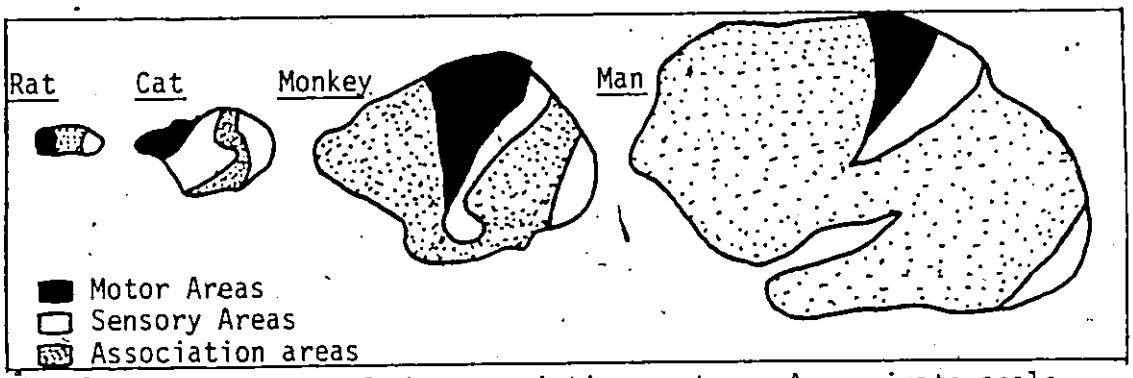
> a somewhat larger brain size in proportion to body weight, a hand structure which makes the operation and manipulation of tools vastly easier than for even a chimpanzee, vocals cords which, unlike those of the apes, permit clear articulation of sounds and a capacity to live in social groups. (Rose, 1976, p. 31)

It is speech which has made possible the accumulation of knowledge and such social groupings as schools, colleges and universities.

A bird is relatively advanced along the evolutionary scale and has a forebrain, but lacks a cortex. Reptiles have a thin, single layer of cortical cells. (Rose, 1976, p. 16) Cortex means simply 'bark' and it is the layer of grey matter, heavily convoluted, around the two hemispheres of the vertebrate brain. As vertebrates evolved,

there has been a "steady increase in size and complexity of cerebral cortex from the most primitive to the most advanced" (Rose, 1976, p. 29). The most simple started with a cortex only one cell thick: the most advanced, man, now has several distinguishable layers of cortex, each layer many cells thick.

In the rat, the cortex was already quite well developed. A strip of association cortex had appeared between the motor areas and the sensory areas. The neurons of this last area to appear 'talk' only to each other or to neurons of the other cortical areas. They do not connect directly to the outside world, but receive information only after several stages of neuronal mediation. (Rose, 1976, p. 170) As can be seen in the accompanying diagram from Rose, the small strip of association areas appearing in the rat's cortex, enlarges to both sides of the sensory areas in the cat's, spreads out around the motor and sensory areas in the monkey's, and in man's, leaves only a thin central strip of motor and sensory areas together with a small area at the back.



Diag.1 The emergence of the association cortex. Approximate scale drawing of the cerebral hemispheres of four mammals. Note both the absolute and relative increase in the size of the area of association cortex (Rose, 1976, p. 170)

Rosenberger notes that the higher the species on the phylogenetic scale, the thicker will be the cortical layer but also the less dense will be the cell count per volume. He suggests this may be due to "greater complexity of interneuronal connections" (Schiefelbusch, 1978, p. 17). which will be the mark of the higher order cortex: the more associations, the more connections needed.

Thus it is easily understandable that "the role of systems responsible not for the reception, but for the coding (analysis and synthesis) of incoming visual information, is considerably increased in man by comparison with his antecedents on the scale of evolution" (Luria, 1973, p. 113). Then again, the secondary zones of the auditory cortex are "the fundamental apparatus for the analysis and synthesis of the sounds of speech, the quality which distinguishes human hearing from the hearing of animals" (Luria, 1973, p. 132). Man posesses a phoneme analyser which the dog, for example, does not. The dog may be taught to perceive the gestalt 'sit' or 'come', but he is unable to separate it into human speech sounds or phonemes. The young child, however, without tuition, can do just this. Luria also notes the existence of tertiary zones, "the zones of overlapping of the cortical ends of the various analysers as ... specifically human structures" (Luria, 1973, p. 73). These integrating structures are perhaps, as we shall see later, at the basis of 'naming' in a generalizing sense. These various structures are then specific to humans.

There is for language an even more important feature of the human brain which sets it apart from those of animals, and this is differentiation between the two hemispheres. Animals of course, also possess two hemispheres, but they seem to be equipotential in all animals except man. Lateral preference can be found "in a wide variety of animals including flatfish, parrots, cows, rodents, cats and, especially, the apes" (Dimond and Beaumont, 1974, p. 92), and chaffinch song, wired-in from birth, seems to be located in one hemisphere; but whereas ape preference is task-specific or modality specific, human handedness is not. A given rat or a given dog may show a preference for own paw rather than the other, but not for a species-specific paw: some use the left more often, others the right. Man has a decided preference for the right hand.

Probably the first words in man were accompanied by a movement of this same right hand. There can be no proof of this, but even now when a policemen says "Stop" he raises his right hand; when we say "down!" to a dog, we motion with our right hand; when the minister gives the blessing, he holds up his right hand.

The right hemisphere of the brain controls the left side of the body and the left hemisphere controls the right side. It would seem that expressive speech and motion, which probably from the early years of speech development were cognate functions, also probably shared the same hemisphere, the left one. Where, in the animal, the hemispheres are equipotential, in man the left hemisphere is usually dominant for speech and right-handedness. The hemispheres are also differentiated

in other ways, such as sequential or parallel processing, the first of which is essential to language.

Not only does the left hemisphere control speech, but particular parts of the associative area subserve language function:

> We have previously established two facts, one that inequality of the two cerebral hemispheres in regulation of speech activities is a typical feature of the human brain, and, the other, that a specific area can be distinguished in the dominant hemisphere which contains those structures that regulate speech . (Maruszewski, 1975, p. 88)

Geschwind indicates that:

> the Sylvian fossa which is the extensive space lying within the depths of the Sylvian fissure represents the greatest single expanse of cortex in the brain which is not visible on the outer surface. The Sylvian fissure and its borders are of course of particular interest to the student of higher functions since the major speech areas lie in its banks (Dimond and Beaumont, 1974, p. 11).

Geschwind and Levitsky measured various brains and found that "the posterior margin of the Sylvian fissure was angled backward more sharply on the left in 57% of the cases, on the right in 18%, with approximate equality in 25%" (Dimond and Beaumont, 1974, p. 15). In France, Lemay and Culebras had found the imprint of the Sylvian

fissure on both sides of a Neanderthal skull, dating back thirty thousand years: "The right side is angled upward more sharply" which although inconclusive, does suggest that:

> the asymmetries in the hemisphere in the region of the Sylvian fissure, which probably underlie cerebral dominance for speech, were present thirty thousand years ago, and that man at that period may already have had the capability for auditory language . (Dimond and Beaumont, 1974, p. 19)

Geschwind also notes that in foetal development, which usually mirrors the development of the species ~~over~~ time, "Cunningham found that the left Sylvian fissure migrated to a more horizontal position than the one on the right" (Dimond and Beaumont, 1974, p. 19). Schnitzer reports a larger temporal planum and frontal operculum by the twenty-ninth week in foetuses, with the left "larger than the right in approximately 90% of both adults and infants (or foetuses) examined" (Paradis, 1978, p. 152).

Although among vertebrates there has been a progressive increase in cortex from the simplest creature to the most advanced, which is man, yet overall brain weight, or brain weight relative to body weight, do not set man in a totally superior position. Maruszewski notes that the whale's brain weighs about seven kilograms, the dophin's 1.7 kilos, and man's about 1.4 kilos. The marmoset monkey and the house mouse have relatively larger brain to body weight ratio than has man:

> It would seem to follow that the decisive factor for the language capacity lies in the morphological features and functional organisation of the human brain... exclusively specific to man... the functional differentiation of the cerebral hemispheres and the dominance of one of them in respect to speech. (Maruszewski, 1975, p. 68)

Thus, it is hemisphere asymmetry and the internal arrangement of the brain, including greater associative areas and more interneuronal connections, that set man off from the animal and grant him the superiority of language. It is language that has permitted culture, knowledge and social evolution unparallelled in the animal world.

We have learned much about the brain by one of two methods: when one section is removed because of tumour or disease, subsequent behaviour can be studied to see in what way it deviates from normal behaviour; or when the brain is open for operation, the cortex can be stimulated and the resultant behaviour studied. Language is a complex process, and

> speech... is the function of the whole insofar as all structures play some role, and it is the function of certain structures in the sense that the latter serve specific functions in speech regulation ... (Maruszewski, 1975, p. 37)

A great deal is now known concerning the parts that function in the whole. Pliny explained by a blow on the head the fact that a

certain Athenian gentleman was no longer able to read: the locus of damage can now be determined in such a case of alexia. We are not much nearer, however, to understanding how the whole language system functions: "Despite our relatively good knowledge of the elements composing the functional system of speech production, we do not yet possess a good understanding of the functions of this system as an integrated whole". (Maruszewski, 1975, p. 123) Although the brain is unlike a car or a television inasmuch as removal of one part does not bring the whole to a grinding halt, nevertheless "damage always deranges the activity of an entire system, and not any single function". (Idem, p. 58). One must therefore be careful in interpreting changes in behaviour due to local damage or local stimulation.

The body also frequently compensates for loss fairly rapidly. When both hands are full, we may hold a third item with the teeth, or push a door with the foot. When one group of brain cells are put out of action, another group may be called upon to do the same job in a different way. The older one becomes, as we shall see later, the less adaptation may be possible. A newt has a specified brain structure, and if he loses a leg, he is able simply to regrow another. Man cannot do this, but his brain is less specified and more plastic: he can thus direct adaptation of the body for loss of some non-vital part, or if the injury is to the head, call upon another group of cells: "After insult, a reordering occurs perhaps over months but often over days or hours which enables the patient with a damaged brain

often totally without awareness, to make the best use of what capacities remain." (Dimond and Beaumont, 1974, p. 5) This capacity for compensation also renders difficult the study of behaviour after loss of a specific part, and this behaviour becomes even more difficult to interpret in humans where the wound or tumour may affect more than one part or be on the borders of some area. Bearing this in mind in interpretation of findings, a great deal of information concerning the various functions which somehow work together to permit the system of language to function has been discovered, particularly over the last thirty years.

CHAPTER 2

We have seen that the ape hemispheres are equipotential, although there is some lateral preference, whereas man's hemispheres are differentiated as to function. A Neanderthal skull showed the Sylvian fissure angled more sharply upward on the right. In 1949, Dart discovered an ancient den used by a clan of Australopithecus, an ancestor of man, together with a heap of baboon remains. The baboon skulls showed that the deliberate blow which killed the animal had been dealt by a weapon wielded in the right hand. Now the left hemisphere controls the right side of the body and the right hemisphere the left. Thus these ancient men were mostly right-handed.

As man needed cooperation from his companions in order to capture or kill animals faster or fiercer than himself, he developped a capacity for strategy and language. His words were probably accompanied by gestures, and these gestures may have been directed by the words. Thus motor action and words tended to go together: "There is little doubt that the origins of primitive language must have been gestural communication, which in turn suggests a link with sophistication of lateral specialisation of hand use." (Dimond and Beaumont, 1974, p. 99) In modern man, the majority are right-handed, and expressive language function also depends on the brain hemisphere which controls the right hand.

We know that this hemisphere is dominant for language because when damage occurs heavily to the language area on that side, aphasia results, whereas when the right is similarly damaged, aphasia rarely results. Furthermore, this is true, even for many left-handers: "Permanent aphasias in left-handers are more likely to result from left rather than right hemisphere lesions. (Luria, 1970). On the other hand, while aphasia almost never occurs with right hemisphere lesions in right-handers, there is good evidence to suggest that left-handers become aphasic, if only transiently, with lesions of either hemisphere." (Dimond and Beaumont, 1974, p. 8). Rosenberger states that 4% of the normal population have language dominance in the right hemisphere, 10% are left handed, and only 1% have right language dominance allied to right hand use. (Schiefelbusch, 1978, p. 20) Thus, right hand preference (left hemisphere) and speech dominance in the left hemisphere are the rule for the majority. Of the about eleven percent left-handers, some have right speech dominance (speech and hand preference on the same side) but just over half still have the left hemisphere dominant for speech: "The left hemisphere is dominant in the vast proportion of dextrals, but only in a small majority of left-handers." (Dimond and Beaumont, 1974, p. 122). Thus speech does seem to be left hemisphere dominant for most.

Since twins, epileptics and mentally retarded have a greater incidence of left-handedness, and since there is also greater evidence of brain damage among this group, it may be that brain damage has caused a transfer of motor control with or without language, depending on

whether the language area was also touched, into the right hemisphere. (Idem, p. 134). This group of left-handers would be a non-familial group. There is a further group who inherit left-handedness from their family. Jerre Levy tested a group of left-handed Caltech students and found that they had a very high verbal I.Q. compared to right-handed students, but a lower Performance I.Q. He suggests that perhaps they use part of the right hemisphere for language as well as the left hemisphere. This may confer some special advantage upon them as planners perhaps, and thus the human race supports a small number of them. Although melody is a right hemisphere feature, analysis of music seems to be a left hemisphere function. Levy found that "Caltech sinistrals are superior to dextrals on the verbal factor extracted from the W.A.I.S. and that 18% of law students and 16% of musicians are sinistrals." (Dimond and Beaumont, 1974, p. 173). Speech, then for the great majority is left hemisphere dominant. Of those very few who become aphasic after injury to the right hemisphere, some may be familial left-handers, and some may be suffering injury for the second time.

In order to understand some of the functions of this left hemisphere, such as production of phonemes, we will look for a moment at the brain itself. The brain contains billions of neurons. These nerve cells have dendrites at one end, which collect information from other cells connected to them. When these impulses reach a certain level, the cell fires down its axon to a synapse which connects with the dendrite of another cell. This is something like electricity going

along a wire; and indeed the axons in the white matter of the brain and in the nerve tracts which go to the periphery of the body are heavily myelinated to prevent short-circuiting and mixing of messages: "Each nerve cell consists of four major parts, the dendrites on which other cells synapse, the cell body, the axon down which the messages accumulated at the cell-body pass, and the synapses at which the cell communicates with others." (Rose, 1976, p. 69).

A nerve-cell or neuron either fires or does not fire. The message is simple:

> In the case of nervous system receptors, the different types of information may be interpreted as 'something is sticking into my foot' or 'I can smell roast meat' or 'I can see a blue motor car' depending on which cells in the spinal cord or the brain the impulses arrive at.... A common language operates throughout the nervous system, and the interpretation of a message depends on the address to which it is dispatched. (Rose, 1976, p. 117).

The brain has been compared to a telephone switchboard and to a computer, although it is more complex than either. In the case of neuronal messages, we might say that a telephone operator knows, because of the way her switchboard is wired, that when a given lamp lights up, the call originates in Edmonton. The neurons and

sets of neurons seem to be wired in according to a pre-arranged pattern or design. Thus, Rose notes that there is need "not merely of the sets of inputs and their codes, but also at least one set of 'comparator' cells deeper within the nervous system, which can actually read and interpret the codes". (Rose, 1976, 124)

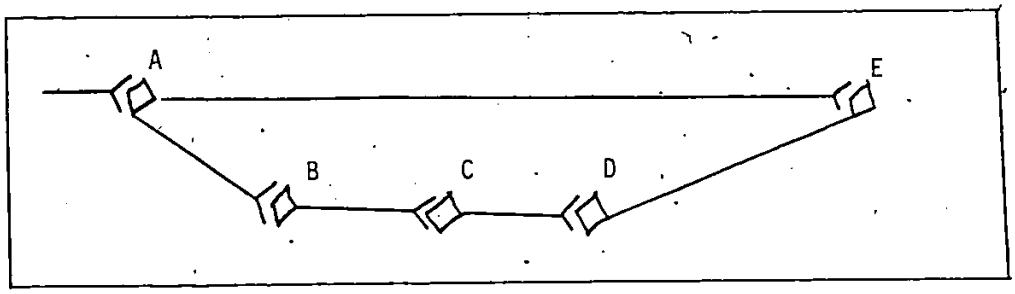


Diagram 2. A simple neuronal comparator mechanism using synaptic delays. Neuron E received two inputs deriving from A: one direct, the other by way of interneurons B, C and D. Because synaptic delays are much greater than axonal transmission times, the input via B, C and D takes longer to arrive at E than input direct from A. Thus, two synapses on E present the neuron with information about the state of A, one arriving direct, and one arriving via B, C and D, giving the state of A a few milliseconds earlier. Changes in the state of A can thus be monitored. (Rose, 1976, p. 125)

Let us now consider the articulation of phonemes, and the messages that must be sent, by firing neurons, to the muscles of the throat, larynx, mouth, tongue, nose and lungs:

> The rate of speech production per minute is about 210 to 220 syllables, including hesitation pauses, while for shorter utterances, the rate may be as high as 500 syllables per minute (Miller, 1951a, b; Lenneberg, 1967)... An English speaker produces about 14 phonemes per second. During speaking, about 100 different muscles belonging to the phonative-articulatory systems must be coordinated... during the act of speaking several hundreds of separate muscular adjustments must occur each second with very precise order of timing. (Maruszewski, 1975, p. 96, 97)

Speech to us seems to be an automatic and simple act. Inasmuch as all the commands necessary to utter one word are below the level of consciousness, this is true. Man can only attend consciously to a few things at once. We may watch television and knit; or listen to the weather on the radio, while preparing supper; listening for a bell to ring and wondering where the boy has got to. We are consciously aware of these things, but we are rarely conscious of directing our air intake, and rarely conscious of directing our speech output. If we say the wrong word or pronounce the right word incorrectly, we back up and seek to put it right with our conscious mind. But even then, the actual commands to lips, tongue, etc., remain below the level of consciousness.

The remarkable part of articulation is that some phonemes take longer to prepare than others, because of the number of muscles involved, or the varying distance from the brain of the part involved. So not only does the coordination centre have to fire hundreds of signals per second in the right order so that the word starts, continues and ends correctly, but some sounds must be started earlier or later than others because of longer or shorter time needed for production:

> The speed at which neuronal impulses travel depends both on the length of the nerve and on the diameter of the nerve fibre... the difference in the time it takes to innervate the different muscles involved in articulation may be thirty milliseconds. It becomes reasonable to assume that the firing order of the central neuronal impulses initiated in cerebral structures may differ in its timing from the order of innervations of the peripheral organs.
> (Lenneberg, 1967, quoted by Maruszewski, 1973, p. 97).

The question may be raised as to whether we do not rather store the whole word as an auditory gestalt and "replay" it when we speak. People can indeed parrot back what they hear, even without understanding, but only if the sounds are those of a language which they know well. If one attempts to repeat a word from a language one does not know, however, a foreign accent will almost certainly result.[1]

Some English Canadians have trouble with French names, and some French Canadians with English names. Thus a simple name like 'Trudeau' gets the stress on the first syllable, and an English 'u'. We hear word sounds according to a store of phonemes already set up in our brain during early childhood. A sound heard checks in as similar to a given phoneme of our language, and in an approved sequence. We can then produce that phoneme according to articulatory patterning already set up. An English person can hear a Frenchman say correctly "pas du tout" [pasdytu] but he perceives it and repeats incorrectly as [pasdutu]. Jerre Levy states that:

> the left hemisphere.... can analyse a spoken input into its phonetic components and that these components can be translated into articulatory components which are synthesised into an output in accordance with the rules of the native language. The mispronunciation of a foreign word would be due to the fact that rules for phonetic analysis which have been established during the course of learning the native language are inappropriate for the foreign language. Such mispronunciations show that the input signal is not simply stored as an auditory gestalt which then triggers a matching articulatory gestalt. (Dimond and Beaumont, 1974, p. 160, 161).

Thus we have previously coded the sounds of our language during our childhood, and it is by matching input to these phonemes that we are able to articulate, by mechanisms also set up in childhood, and below the threshold of consciousness. Luria states that:

> the sounds of speech or phonemes are organized into a particular sequence which depends on the phonemic system of the language, and that in order to distinguish these sounds of speech it is necessary to code them in accordance with this system, to pick out the useful phonemic (or meaning-distinguishing) features and to separate them from the unimportant features which play no part in the differentiation of word meanings and which are known as 'variants'.(Luria, 1973, p. 134).

In 'pas du tout' mentioned above, /y/ is a phoneme in French but does not exist in English, so an English person does not perceive it and cannot produce it. The two 'ls' in English 'little' are different sounds but do not distinguish meaning and are therefore perceived as the same sound: they differ in sound only because of their position in sequence and the influence of other adjacent phonemes. Luria states:

> It is an essential fact that the secondary zones of the temporal cortex --- and, because of the law of progressive lateralisation, the temporal

> cortex of the dominant (left) hemisphere --- are especially adapted for the analysis and synthesis of the sounds of speech, or, in other words, for qualified speech hearing. (Luria, 1973, p. 134).

Peter Eimas, (1971) found an ability to discriminate voiced from unvoiced speech sounds practically at birth. (Halle, Bresnan and Miller, 1978, p. 302) Jerre Levy also finds that "the left hemisphere is dominant for phonemic matches (and is)... both faster and more accurate in identifying verbal stimuli." (Dimond and Beaumont, 1974, p. 148). It seems that steady state vowels (not diphthongs) are more rapidly identified by the right hemisphere, but the consonants are superiorly recognised by the left hemisphere: "The dominance of the left hemisphere for linguistic processes may reside in its capacity to analyse phonemic units whose signal characteristics are highly encoded." (Idem, p. 148).

We need a phonemic analyser in order subsequently to produce phonemes:

> Broadly speaking, lesions of the posterior third division of the superior temporal gyrus of the dominant hemisphere (Wernicke's area) cause disintegration or derangements of the acoustic patterns of speech sounds and words without which correct production is impossible. This explains the frequent symptom that patients speak in

> stereotyped expressions (fixed articulatory habits) producible without auditory feedback afferentation. (Maruszewski, 1973, p. 118).

We need to perceive correctly not only to produce the sounds but also to produce the written form: "The patient who makes errors in articulating the sounds of a word will also misrepresent a word graphically." (Idem, p. 103).

Writing is, in principle, the setting down in graphic symbols of the sounds of speech. Ways of speaking change over the years and writing or spelling is notoriously slow to change accordingly. Yet reading in English can still be taught in its major lines phonetically. It is not surprising therefore, that we find the left hemisphere, which alone possesses a phonemic analyser, also being the most rapid for the identification of written letters. (Dimond and Beaumont, 1974, p. 44, 185) The right hemisphere on the other hand, does indeed recognise whole words, both in speech and writing. Rosenberger quotes the case of a youth with left hemisphere lesion unable to read a single letter, but able to read three letter words. (Schiefelbusch, 1978, p. 23) We must remember, however, that speech production depends on the left hemisphere. In order to speak normally, we must use the central articulation mechanism which sends impulses to hundreds of muscles to produce the necessary movements for phoneme based speech. The right hemisphere, however, helps in recognising whole words. When we first learn to read, we can imagine a laborious letter to phoneme analysis carried on in the left hemisphere; we sound out each

letter until we have a word we can recognise by sound. A rapid adult reader, however, uses his right hemisphere to recognise the whole shape of the word: one can scan a paragraph without even sounding out the words. A new word requires once more the old process. The first time we meet the word 'Maruszewski' we have to work out how to pronounce it using our left hemisphere to translate letter to phoneme, and then putting it together as one word. When we come across it for the tenth time, however, the whole word springs to mind as soon as we see the over-all shape.[2] In the same way, the right hemisphere recognises words with meaning in the continuous flow of phonemes analysed by the left hemisphere. The right hemisphere stores the whole auditory gestalt and permits a more rapid and efficient process. If we had learned to read by the global method, we might not have been able to work out how to pronounce "Maruszewski' and might have had to wait for someone to tell us; later we would have stored it as an auditory gestalt. Levy suggests "that an illiterate adult who loses his left hemisphere would be contrained to use the 'whole word' method if ever he learned to read." (Dimond and Beaumont, 1974, p. 162).

This leads to interesting findings concerning the right hemisphere, for why do we need a left hemisphere to produce speech if the right hemisphere can recognise words?

> The right hemisphere abilities may rely on entirely different mechanisms, namely a matching of complete auditory patterns (words) with auditory Gestalts in long-term memory. If normal language

> production depends on sequential activation of an articulatory code governed by the output from a phonological analyser, then the right hemisphere, by the model suggested, would lack the mechanisms for going from word phonologies in long-term memory to articulations... it would appear that whatever phonologies are possessed by the minor hemisphere, they serve the functions of allowing some simple speech to be decoded with respect to meaning and have not interconnections between themselves. The right hemisphere may know, in other words, that 'cat' means a furry, small pet with claws, but it does no know that 'cat' rhymes with 'rat'. (Dimond and Beaumont, 1974, p. 149)

It is probable that the left hemisphere works in a sequential manner, whereas the right hemisphere takes information in parallel and searches for all aspects at once. Thus left, c-a-t = "cat", but right 'ca' =  . Gazzaniga suggest "that the right hemisphere is active in the recognition of written language with a mechanism that operates prior to any semantic processing". (Idem, p. 374) In one experiment, the bilaterally symetrical words 'deed', 'sees', and 'noon' were separated in two down the middle and put into mixed pairs. One half was shown to the left visual field, and the other half was shown to the right visual field. Then the subjects were asked which of these three words they had been shown. In 93%

of cases the subjects chose the left field stimulus, the left being processed of course by the right hemisphere. When a more sophisticated test was devised where meaning was necessary to determine which word had been seen, there was a dramatic shift to left hemisphere superiority. It would seem therefore that it is pattern and shape which permits rapid recognition by the right hemisphere. (Dimond and Beaumont, 1974, p. 163)

Although the right hemisphere does not normally initiate speech or writing, it can do so when the speech or writing has become engrammed as a pattern after constant use. Thus patients with left lesions were unable to write from dictation or letter by letter but were still able to sign their name. (Dimond and Beaumont, 1974, p. 118) There is a

> process in which the change to writing a highly automated engram (such as a signature) ceases to depend on analysis of the acoustic complex of the word or the visual form of its individual letters, but begins to be performed as a single 'kinetic melody'... In the course of such development it is not only the functional structure of the process which changes, but also, naturally, its cerebral 'organisation'. The participation of the auditory and visual areas of the cortex, essential in the early stages of formation of the activity, no longer is necessary in its later stages, and the

> activity starts to depend on a different system of concertedly working zones. (Luria, 1973, p. 32).

Thus a patient who used his left hemisphere to learn to write his name, now no longer needs it to do so, because it has become an engrammed program or gestalt in his right hemisphere. Maruszewski also notes that "in some forms of aphasia the patient cannot utter a word at the doctor's request but can produce complex expressions, as in swearing, when emotionally aroused".(Maruszewski, 1975, p. 57) "Characteristically the intonational and melodic aspect of speech as a rule remains intact." (Luria, 1973, p. 140) Thus the right hemisphere controls the melodic aspects of speech, and

> the fact that totally aphasic patients can recite well-known verses, sing simple familiar songs, and emit curse words suggests the presence of whole auditory Gestalts in the right hemisphere, particularly in view of the fact that such patients cannot recite verses or sing songs unless they start at the beginning. (Dimond and Beaumont, 1974, p. 161).

Reading in the West is dependent on phonetic decoding since a letter represents a sound. Chinese writing, however, uses a great many ideographic symbols, and the concept or meaning is recognised as a whole. The Japanese use both phonetic symbols and also ideographs borrowed from the Chinese. While all languages seem to

use the same areas for speech production or understanding, reading uses different areas depending on the type of writing used. The left parieto-occipital region is an area related to analytic and synthetic processes dealing with visual data, and when Chinese patients had been injured in this area they were unable to read. When Westerners had suffered damage to the temporal lobe, and therefore to phoneme representation, they consequently became unable to read: Japanese injured in the same area, were unable to read their phonetic symbols, but could read their ideographic symbols. (Maruszewski, 1975, p. 61)

It seems that this left parieto-occipital region, injury to which disturbs the reading of Chinese ideographs, is part of a cross-modal association area which, if it exists in animals, is "incomparably more evolved in humans". Maruszewski quotes Geshwind's conclusion that an anatomically determined capacity for cross-modal associations underlies the human ability to name:

> It is thought to be a relatively new phylogenetic development, since this area matures late in ontogenesis (at three or four years). It is particularly significant that this area lies at the junction of the cortical projection areas for the three major modalities (visual, auditory and somesthetic), and can therefore serve as the anatomical substrate for associations across the three perceptual channels, in other words, cross-

modular associations. (Maruszewski, 1975, p. 168).

Luria describes the experiment of a monkey who had been trained to put out a small fire with water from a barrel in order to obtain the fruit from behind it. Subsequently, the monkey was taken out into a lake full of 'water'. He was set on one raft with the fruit, the fire and a jar; the barrel of water was set on another raft with a small connecting plank between the two. The monkey went across the plank with his jar, filled it, brought it back to the fire; it was not quite enough so he went a second time; then he retrieved the fruit. He knew that 'water in a barrel' could put out fire, but he was unable to generalise to 'water', of which there was plenty in the lake. He had only to dip his jar over the side. A human child of six or seven would have made this association between the two.

Some patients injured in this area may begin to use nouns only specifically, 'the black dog', 'the large book' etc., and consider just plain 'dog' or 'book' to be incorrect. There seemed to be

> the loss of the power to extract the general and essential attributes of objects and phenomena and therefore to deal with objects as members of a category, or conceptual class... words... remain merely sound sequences correlated with concrete objects." (Maruszewski, 1975, p. 29).

With lesions of the secondary zones of the left temporal region, the patient can lose production of nouns entirely. The following is the description by such a patient of a shell exploding, himself

losing consciousness, and regaining health slowly: "suddenly... now this... bang!... and then... nothing... nothing... and since... little by little... better still... quite... and now... do you see?" (Luria, 1973, p. 140).

Loss of naming occurs with lesions towards the back of the language area and the cross modal association areas. The opposite occurs with lesions towards the front of the language area. Here verbs are missing, and are often replaced by gestures and physical actions, to accompany the nouns which are used in 'telegraphic style'. "Here front... and then... attack... then... explosion... and then... nothing... then... operation... splinter... speech... speech." (Maruszewski, 1975, p. 108). Whereas in a normal Polish sentence nouns take case endings, here the nouns were all in the subject case. When a lesion occurs in the frontal lobe, just in front of Broca's area (the front part of the language area which is related to production of speech) both nouns and verbs occur, but with three to four times as many nouns as verbs. (Idem, p. 112)

The left hemisphere may be specialised for syntax, possibly linked to Broca's area and the production of language. When Wernicke's area is intact, comprehension seems to be good; but fails when a patient with a lesion in Broca's area, must rely on syntax, rather than on semantic clues, for understanding. (Halle, Bresnan and Miller, 1978, p. 232) These patients have difficulty using grammatical morphemes and "substitute numbers for plural markers, adverbs of time for tense markers". (Idem p. 229) Nor do they seem to process articles. Presented with black or white squares and circles,

as for example: ■ ○ ● , and asked to press the white one, the patient will press appropriately. When asked to press the black one, he will press a black one. A normal person will see that there are two black, but a choice also between two circles, and hence will press the black circle. (Halle, Bresnan and Miller, 1978, p. 235) This inability to process function words at a lexical, nonsyntactic level may be indicative of an autonomous syntactic processor. It is noteworthy that: "the Broca's aphasic with telegraphic speech not only omits grammar and connector words, but he also cannot even repeat them on command nearly as well as he can repeat nouns and other more substantive words." (Schiefelbusch, 1978, p. 26).

Total aphasia results only when the dominant hemisphere is severely damaged in the language area. Loss of nouns or of verbs due to posterior or anterior injury also occurs only with reference to the left hemisphere. It would seem that the right hemisphere has some capacity of response to nouns but it is doubtful if it has any verbal capacity. There is communication between the two hemispheres via the corpus calosum, which bridges the two halves. When information is shown to the left field of vision and the right hemisphere is slower to respond, it is difficult to know whether it indeed has capacity, but is slower, or whether the information has been relayed to the left hemisphere which has replied in delayed time due to the transfer. In some patients the corpus callosum has been severed to prevent propagation of excessive epileptic activity from one hemisphere

to the other. In these cases, if a stimulus is shown only to one field of vision, only the hemisphere of the opposite side can initiate the response, if any. These persons are termed 'split brain' patients.

Rose finds that only half of the brain has the naming centre:

> In most individuals, where the left hemisphere is dominant, the speech centres are located in the left hemisphere... in the case of a person with a split brain whose right visual field but not left is shown an object, he can name it properly, because the right half of the visual field connects with the left side of the brain. When an object is shown to his left but not to his right visual field, however, so that the information concerning it is received only by the right hemisphere he is generally able neither to 'say' nor to 'write' the name of the object, though he knows how to use it correctly when holding it. (Rose, 1976, p. 176)

Gazzaniga found

> that the right hemisphere is capable of correctly responding to printed or spoken nouns but not to verbs. It also proved to have little or no capacity for syntax. This data stands in marked contrast to the data from children which suggest that the right hemisphere up to a late age, as

> just mentioned, possesses a rich language capacity involving all aspects of normal language behaviour. (Dimond and Beaumont, 1974, p. 376)

This last sentence will be taken up again in a later chapter. Gazzaniga found that in an attempt to teach language to global aphasics, noun symbols were learned in a few trials, whereas verbs took some weeks. He suggests that it may be that the left hemisphere is specialised for predication. A global aphasic must of course, work with his right hemisphere since his left has suffered the damage which caused the aphasia. Seamon also found that "the right hemisphere is unable to respond accordingly to verbal commands, or to comprehend the semantic aspects of verbs." (Dimond and Beaumont, 1974, p. 187).

It is to be remembered, of course, that this information concerning capacities of left and right hemispheres is obtained by experimentation, and that this is necessarily narrow. A word presented in a test is like a school exercise, and the brain may not respond to it as it would in a normal situation. Normally, all

> our attention is focussed on the semantic aspect of words; only under special conditions does the word lose its meaning, in which case its sound comes into the foreground. In perceiving a linguistic sign, we do not automatically become aware of its material form. (Maruszewski, 1975, p. 125).

One reason for the production of speech becoming established in the left hemisphere may be that the left hemisphere works sequentially, whereas the right hemisphere works in parallel on gestalts:

> One of the most striking differences is that reported by Levy-Agresti and Sperry (1969) who suggested that the hemispheres proceed by different modes, the left by sequential analytic procedures and the right with synthetic Gestalt apperception. This difference was taken to be one of sequential processing by Cohen who has provided evidence that response time for the right hemisphere did not increase among increasing numbers of alternative letter stimuli. (Dimond and Beaumont, 1974, p. 74).

When the number of stimuli for comparison with a given word were increased in the right visual field going to the left hemisphere, the time needed to give the response increased accordingly. Increased numbers of items in the left visual field did not increase the time required for response by the right hemisphere. This does seem to indicate a parallel scanning by the right hemisphere, processing more than one item at a time. Kimura and Durnford also found that if, in a visual test to both fields they used only three types of lines --- horizontal, vertical and oblique --- the left hemisphere took over the processing and responses as these three types could be verbally mediated. When the number of lines and the slope were increased, the right hemisphere took over processing and was equally efficient. (Dimond and Beaumont, 1974, p. 35)

The left half field of each eye goes to the right hemisphere, and the right half field of each eye goes to the left hemisphere.

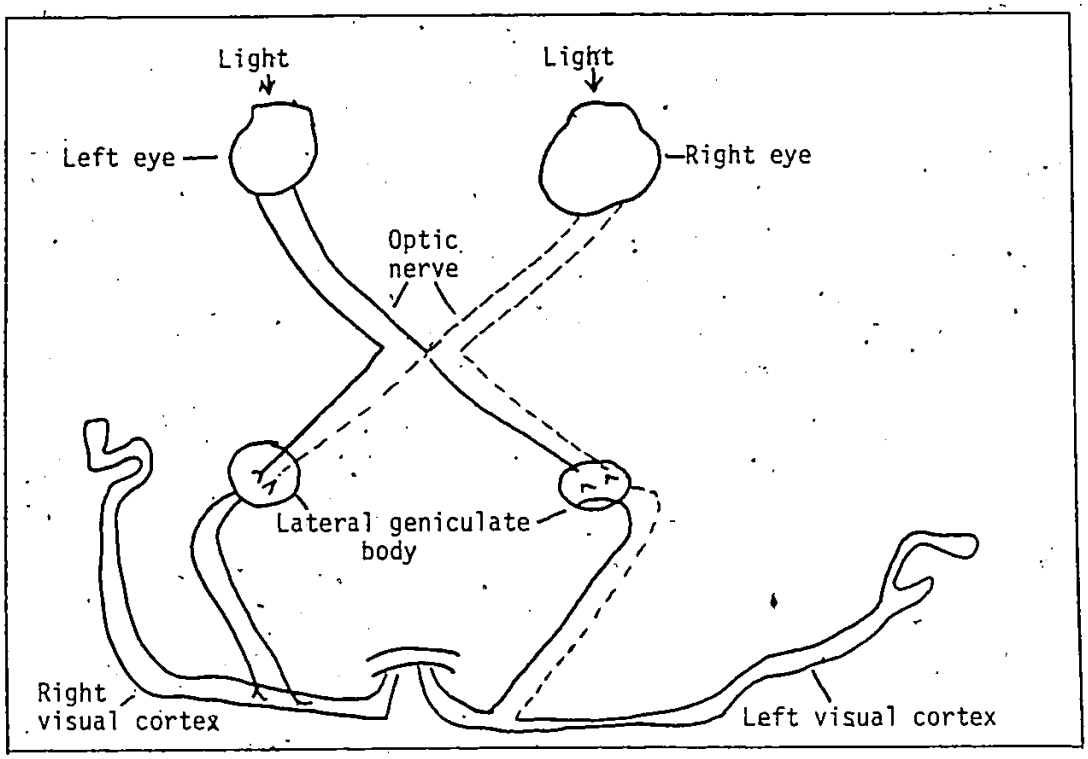


Diagram 3. The visual system of the human. Note the crossing over of the pathways. (Rose, 1976, p. 103)

A further proof of single serial processing on the left was found, when stimuli flashed to one channel created slowing of response due to fatigue. When stimuli were then switched to the other channel, response time suffered from the same fatigue. It was the reverse however, for the right hemisphere. When one channel showed fatigue response, and stimuli were switched to the second channel, response

time was once again rapid and alert:

> It is not surprising that transfer of fatigue was not evident because fatigue accumulated in one channel would not be expected to generalise to another parallel channel. (Dimond and Beaumont, 1974, P. 64).

It does seem then that the work of the left hemisphere is sequential. This is important for language since language is essentially linear --- it goes from left to right and is processed in that sense. 'The dog chased John' and 'John chased the dog' include exactly the same words, but express two different meanings only because of different word order. It is true that some languages have case endings which makes word order less important; but even in these languages there is a natural word order in childhood and an order of style among adults. For understanding and producing speech a sequential processor is needed, and thus language becomes dominant in the left hemisphere which works sequentially.

Physical recognition tasks seem to be better performed by the right hemisphere. We recognise a person by the way he walks, although we might have difficulty explaining the exact movement. Some people whom we can recognise easily, we may not be able to describe. When our son-in-law came to see us, I knew he looked somehow different, but did not realise that he had shaved his moustache until he told me so. When in an exercise book, however, we see Mr. and Mrs. Jones, their children John, Peter and Mary and their friends Genny, Laurie and David, it is hard to remember which is which. We can then search

for detail: Peter has glasses, David has short hair, John resembles a shaggy goat:

> The left hemisphere's learned associations between names and faces depended on the identification and labelling of unique facial features. It appeared that the overall form of a face could not be remembered by the left hemisphere. (Dimond and Beaumont, 1974, p. 155).

Somewhat similar results were found with blocks of various shapes. Levy-Agresti and Sperry found that "the speaking hemisphere consciously analyses the details of each block, while the mute hemisphere synthesises the block gestalt and visualises it." (Dimond and Beaumont, 1974, p. 52). The same task was given to a group of Caltech students who only performed at chance level on the hardest of the sets. They described their technique by saying "well, it had six equal surface, so it was a cube. There were two contiguous rough surfaces". When asked whether they used other methods they replied that there were none:

> It was pointed out that they could have simply visualised the whole stimulus, at which they manifested surprise and said that this strategy had not occurred to them. One gets the suspicion that eighteen or so years of formal schooling in the sciences may functionally ablate the right hemisphere. However, it must be kept in mind that the

> descriptions these students have of their mental function were controlled by the left hemisphere. (Dimond and Beaumont, 1974, p. 153, 154).

We have to bear in mind that the left hemisphere produced the description of the mental function, but we must remember also that these were normal students, not patients. Sperry found, with split-brain patients, that

> the right hemisphere will not uncommonly generate emotional reactions of displeasure under conditions in which 'the minor hemisphere, knowing the correct answer but unable to speak, hears the major hemisphere making obvious verbal mistakes'. (Dimond and Beaumont, 1974, p. 267).

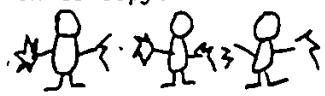
In a normal person, the right hemisphere certainly has input to what is expressed in speech. Thus it seems indeed true that students carefully trained in scientific, verbally couched, methodology, may let fall into disuse part of a natural gestalt function, which they could not explain, and which would therefore be suspect.

The right hemisphere also has its own areas of superiority. We have already seen that the right hemisphere more readily recognises faces. The face is seen as a pattern or gestalt, as are other patterns and visual wholes. The right is superior for the location of articles in space, and also for depth perception. The latter is dependent on binocular vision, but it would be expected that the hemisphere specialised for visual processing would also be superior for judging

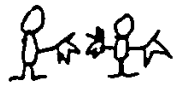
depth. The right hemisphere made a superior number of right judgements as to whether a first rod was closer or more distant than a second rod, when both were shown to one visual field. (Dimond and Beaumont, 1974, p. 55) The right hemisphere was also superior to the left "both in the direction of motion and in the discrimination of orientation of lines, arrows, and two-dimensional objects in space...." (Dimond and Beaumont, 1974, p. 167). "Rapid scanning of stimuli for enumeration" (Dimond and Beaumont, 1974, p. 44) was also a right hemisphere superiority, perhaps due in part to parallel processing rather than sequential. It is interesting that location of dots flashed upon a field was superior for the right hemisphere in both males and females, but more so for the males: "Kimura suggests that the differentiation of the right and left hemispheres with respect to visuo-spatial ability may be greater for males than for females." (Dimond and Beaumont, 1974, p. 55).

The general perception of one's own body seems to be based in the right hemisphere. Luria found 'anosognosia', or absence of perception by the patient of his own defects, with right hemisphere lesions. If the patient was affected by paralysis due to a right hemisphere lesion, he did not notice this paralysis. He was unaware of the left side of space and did not notice these deffects. (Luria, 1973, p. 167) A

patient was given three men to copy.



and he produced these



as a perfect copy. He seemed unaware of the left side of the sheet. Perhaps our orientation of ourselves in space depends upon our right hemisphere.

It has been considered that the left hemisphere was superior for logic, which depends on sequential thought, and also for calculation. Test responses have usually been verbal, and therefore mediated by the left hemisphere. In a task of addition or subtraction when the correct response had to be indicated by hand, "the number of correct responses was greater in the right hemisphere." (Dimond and Beaumont, 1974, p. 73). The only solution as to "why performance in the right hemisphere should be superior... is to suggest a right hemisphere basis for calculation in the human brain". (Idem, p. 73). The right hemisphere was also found to be "superior in the identification of digits, and that in matching digits, more signals were missed at the left than at the right or both hemispheres." (Dimond and Beaumont, 1974, p. 79). Dimond suggests that "the capacity of the right hemisphere in dealing with spatial events may be related to the capacity for calculation or numerate abilities." (Dimond and Beaumont, 1974, p. 74).

The left hemisphere has been considered the logical, reasonable one, without which sensible, rational behaviour would not be possible. Although the right seems to have a different kind of consciousness, it is nevertheless more efficient than the left when in control, more efficient but not verbally expressive:

> Under the special testing conditions designed by Levy et alia (1972), to evoke 'leading' activity in the minor hemisphere, it is possible to observe patients reacting under right hemisphere control for appreciable intervals of time... [they seem to move] into a somewhat dreamy state, speaking little, if at all, and sometimes actually failing to respond when addressed by name. For some time thereafter, the patient may remain quiet or speak without modulation of the voice and with impoverished vocabulary. To an onlooker it is difficult to avoid the impression that there has been some subtle change in the 'quality' of the subject's consciousness, though it should be borne in mind that the 'efficiency' of his performance is actually higher when the task is executed under right hemisphere control. (Dimond and Beaumont, 1974, p. 273).

Again we find the right hemisphere deficient in expressive language capacity, with the "virtual inability of the right (or minor) hemisphere to express itself in either speech or writing. (Dimond and Beaumont, 1974, p. 266). Few persons become aphasic after right brain damage, and for those that do, most tend to recover rapidly. (Maruszewski, 1975, p. 71) With split-brain patients it was found, however, that "the right hemisphere had a high level of comprehension of spoken language and could also read at least nouns. There appeared to be no receptive aphasia of the right half-brain." (Dimond and Beaumont, 1974, p. 148). Gazzaniga experimented with normal patients, and found that

> some patients who have had perceptual objects shown to them while their left hemisphere was anaesthetised, were later unable to recall the objects previously shown to them, but were able to recognise them by picking them out of a display. This might imply that information cannot be re-coded between processing systems after a delay." (Dimond and Beaumont, 1974, p. 201).

Thus, the right side had stored a visual image of what it had seen, but was unable to code it linguistically, since the left hemisphere (to which it could have passed the information via the corpus callosum) was out of action. Seamon subsequently suggests that our early childhood memories may be available in the visual system, but are not accessible through the verbal system. Zangwill adds to this information, that

> there is no evidence that the right hemisphere is incapable of the storage and retrieval of recent experience, only that it cannot formulate and communicate this experience. The right hemisphere may be mute but it is certainly not amnesic. (Dimond and Beaumont, 1974, p. 271).

Maruszewski also concludes that although the left hemisphere is clearly dominant for speech, "the possibility cannot be excluded that the nondominant, subordinate hemisphere participates, at least to some extent, in the regulation of speech." (Maruszewski, 1975, p. 83).

Perhaps, however, the right hemisphere does more than merely participate at a fairly low level. Eisemon noted that "lesions in the right nondominant hemisphere, while not leading to aphasia, impair 'high-level language functioning' as exemplified in the sentence completion test, especially involving the use of abstract words." (Maruszewski, 1975, p. 80). In another test, four letter words for the Kent-Rosanoff Word Association Test were used, and the patient asked to respond. Response time was equal for left or right hemisphere, but "the left hemisphere produced associations which were significantly more common." (Dimond and Beaumont, 1974, p. 75). Among the non right handed group "the difference between the hemispheres manifest in more varied and less common associations produced by the right hemisphere was significantly greater" (Idem), so the effect was not due solely to language factors. Thus the right hemisphere seems to be dominant for the creative aspects of thought, and

Dimond sees this role as "concerned with the more inventive, exploratory and improvisatory aspects of mental ability." (Idem, p.75). Again perhaps the sequential or parallel aspect of processing comes into play. The left must look at one association at a time, whereas perhaps the right can see a nexus of possible associations in the same time, and choose a less common one. Bogen and Bogen conclude that: "there are two different modes of thought, propositional and appositional which tend to dominate the activities of the right and left hemispheres respectively." (Dimond and Beaumont, 1974, p. 74).

Jerre Levy suggests then that:

> the right hemisphere synthesises over space, the left analyses over time. The right hemisphere notes visual similarities to the exclusion of conceptual similarities. The left hemisphere does the opposite. The right hemisphere perceives form, the left detail. The right hemisphere codes sensory input in terms of images, the left hemisphere in terms of linguistic descriptions. The right hemisphere lacks a phonological analyser, the left lacks a Gestalt synthesiser. (Dimond and Beaumont, 1974, p. 167).

Seamon expresses some of the same opinions thus:

> A verbal processing system, which is specialised for speech and abstract information, may be primarily a left hemisphere function, while a visual processing

> system, which is more adept at handling non-verbal spatial and concrete information, appears to be associated with the right hemisphere. (Dimond and Beaumont, 1974, p. 185, 186).

Not only is the left hemisphere clearly superior for verbal expressive behaviour, but it seems that it also directs the right hand and complex motor activities:

> one hemisphere, as a rule the left, exercises a prepotent role in the acquisition of speech and probably also in the initiation of voluntary motor activity... 'the presence of speech, writing, calculation, the bulk of language comprehension, and the ideation dependent on all these, along with the motor and sensory representation of the dominant hand, would strongly favour the left as the leading hemisphere'. (Sperry, et. al., 1969, p. 285; quoted in Dimond and Beaumont, 1974, p. 272).

Here again the left may lead in guiding the right hand and complex motor actions because these have to be prepared as a program sequentially and do not happen in parallel, as a gestalt simultaneous ordering. Trevarthen finds that "the dominant hemisphere is the centre for expressive behaviour, as in the special voluntary uses of the dominant hand (Oldfield, 1969), because the programme of intention must be conceived as a serial patterning of linked acts that are projected onto

an appropriately compliant external medium." (Dimond and Beaumont, 1974, p. 255).

Man is the only animal with differentiated hemispheres. He is also the superior animal. We have been considering the capabilities of each hemisphere separately. Normally of course, the two hemispheres work together. Depending on the skill required, two signals both arriving at the same hemisphere would be responded to faster by the hemisphere dominant for that skill; but if one of the two signals was flashed to each hemisphere, the response time was shortened. (Dimond and Beaumont, 1974, p. 59). When one word was flashed to each hemisphere, the number correctly reported increased over the number when two words were flashed to one hemisphere. It seems that each hemisphere first processes the information that it receives before sharing the results of analysis. The fastest hemisphere can therefore initiate action, and since both are usually at work on the same problem, results can be cross-checked according to two different systems. (Dimond and Beaumont, 1974, p. 60). It is as if there were two computers, working differently,

> sitting side by side, each interacting with the world, providng a surface on which information can be received, each proceeding with analysis of the information and checking off its findings against the other, ultimately linking or cross-comparing the products. By this means the paired organ system of

> the brain provides an advantage to the individual by extension of his capacities and makes him, considered as a whole, a more efficient and productive member. (Dimond and Beaumont, 1974, p. 58, 59).

We are unaware that we have two differential processing systems working for us in our brain, and because the left is more overtly logical and vocal, we may come to rely more heavily on its type of process. Only when we are using both hemispheres optimally, however, do we achieve "the diversity and finely tuned actions of normal human behaviour" (Dimond and Beaumont, 1974, p. 84).

CHAPTER 3

In order for language to develop, both social interaction and genetic inheritance are necessary. A human baby has a brain wired in for language as a species specific capacity. If this baby is not nurtured in a human setting and if he does not hear language used around him and with him, then despite his language capacity inheritance, he will not speak. Maruszewski states:

> The fact of language as a unique phenomenon in the animal world speaks only for man's extensive possession of a special equipment necessary for acquisition of language; in this sense, these functions are dependent upon mechanisms and are biologically determined. As already established, this specific 'equipment' is to be sought primarily in the brain's anatomical and physiological properties. At the same time, the dependency on social conditions of language acquisition and on opportunities of contact with other speakers shows that this biologically and organically determined language equipment cannot be activated autonomously but must be 'programmed'. The condition for 'programming' is contact between the individual and the objective system (as earlier defined). This contact allows for the

> rules of the language to be 'coded' into given neuronal structures, that is, speech performance rules which must be adhered to for effective communication with the environment. (Maruszewski, 1975, p. 12)

What is meant by "neuronal structures' and 'speech performance rules'? Chomsky suggests that "the language user (speaker hearer) possesses, as cerebral equipment, a highly abstract system of grammatical rules which enable him to generate and decode utterances (linguistic competence)." (Maruszewski, p.40). Chomsky found it surprising that the child, with still developing cognition, could also develop language at an early age (sentences by two and a half years) and become a functional user of the language by the time he enters nursery school. He felt that only genetically inherited mechanisms could permit him to speak grammatically so soon. Already, before starting on production, he must have made sense of phonetic input, which must have been as Chinese would be to us when he first heard it.

What we actually say and hear is deemed by Chomsky to be 'surface structure'. He posits also a necessary 'deep structure'. His now famous sentence "Flying planes can be dangerous" must obviously come from one of two underlying deep structures --- either "Planes fly. Planes can be dangerous." or "Men fly planes. This can be dangerous." Transformation rules operate on deep structure in a hierarchical fashion in order to create the surface structure which we actually speak.

Transformation rules seem to be universal, or required in every language. The sentences "The boy hit the ball.", "Did the boy hit the ball?", "Was the ball hit by the boy?", "What didn't the boy hit?", etc. are evidently related. They have one underlying simple form (deep structure) already marked for the particular transformations, which will carry the needed meaning.

> A transformation is an operation which converts one phrase structure into another. This is accomplished by such simple operations as substitution ("what" for "the ball"), displacement (preposing of "what"), permutation (of subject and auxiliary) and a few others. Such operations are linguistic universals, characteristic of all known human languages. (Slobin, 1971, p. 17)

Once these transformations have been completed, the deep structure has become surface structure and carries in speech the meaning intended. This can now be decoded by the hearer into deep structure which again gives the base sentence plus markers of intention; this can be decoded by the brain system so that the meaning is understood. The presence of deep structure can be logically demonstrated, but we may only guess at the neuronal mechanisms involved.

Sounds of speech or phonemes are themselves universals of language. Every human child must perceive the phonemes of his mother tongue before he can learn to produce them.

> Apparently the child begins with a simple and global distinction between vowels and consonants, not attending to differences between sounds within those two classes. With development, these classes are divided and redivided as new contrasts enter the system. All along, the child uses the universal principle of distinguishing classes of sound by distinctive features, but it takes several years for him to arrive at the full complement of features employed distinctively by his native language. (Slobin, 1971, p. 63)

Phonemes may differ somewhat from language to language, but all languages must make use of phonemes. A French person learning English may use approximately the phonemes of his own language for most words, but must add /ɪ/, /ʊ/, /ʌ/, /h/, /tʃ/, /dʒ/, /θ/, /ð/, and three diphthongs. A Frenchman may say "ope" for "hope", and and Englishman may say [pai] for [pʰai] when speaking Thai. In Thai there are two words of different meaning, distinguished only by an aspirate after the "p". English does not use an aspirate after "p". Despite some differences, French, English, Thai, and indeed all languages, employ phonemes with distinctive features.

This universality is true also of grammatical structure. One word utterances already frequently express wider meaning. "Mummy!" may mean "There's Mummy!" or "I'm hungry, Mummy!" or "Come here, Mummy!". With two word utterances, the child enters fuller semantic intent, although the context is needed for understanding.

Bloom (1971) noted that "Mommy sock" occured twice in one recording session but in two different contexts. In the first it meant "Kathryn picking up Mommy's sock", and in the second "Mommy putting Kathryn sock on Kathryn". Two-word utterances most frequently express subject-object, subject-verb, and verb-object strings. Noun phrases come later. A child learns "throw block" or "baby block" before "big block" or even "blocks". Children seem to learn "the syntax of language - the arrangements of words in sentences - before they learn inflections of nouns, verb, and adjective forms." (Ferguson and Slobin, 1973, p. 438).

The reality of subject-predicate in longer constructions has also been attested in such taped expressions as "Want that... Andrew want that." which "indicates a layered build-up, and that the verb is primordial. "Stand up... cat stand up... Cat stand up table." "clearly expresses several grammatical relationships" (Slobin, 1971, p. 48) and indicates the probable processes of adult speech. Kenan (1969) and Blount (1969) have studied Samoan and Luo children respectively and have "demonstrated striking cross-linguistic universals in the early forms and functions of child speech." (Slobin, 1971, p. 46).

Semantic universals also exist. All languages seem to use opposites, for example: "day-night", "hard-soft" and so on.

> "Osgood has found that antonyms break into three major, universal categories of affective or connotative meaning: evaluative (represented by

> dimensions such as good-bad, happy-sad, beautiful-ugly) potency (e.g. strong-weak, brave-cowardly, hard-soft), and activity (e.g. fast-slow, tense-relaxed, hot-cold)." Slobin, 1971, p. 84)

The Whorfian hypothesis that language controls our way of thinking about things is indeed in its strongest form false. We know perfectly well that the world moves around the sun although we continue to say "le soleil se lève", "le soleil se couche". Because it does carry meaning, language can of course influence our thinking. "Bloody Frenchie" or "Maudit anlais" will not assist rational understanding, but someone who hears the expressions is not therefore irrevocably bound by the type of underlying 'thinking', if such one can call it. Thus "the striking differences between languages are not so much in what they are 'able' to express, but in what they habitually do express and are required to express." (Slobin, 1971, p. 129). An Arab may have four words for 'camel' and an Eskimo may have six words for 'snow'. This is simply because language mirrors experience:

> Presumably the basic dimensions along which linguistically-expressed categories vary are universals of human cognition. And probably the same basic functions are performed by all languages --- making and negating assertions, asking questions, giving commands, and so on. Certainly the basic 'form of human language

is universal." (Idem)

These universals of language must 'fit' somehow with the neurological networks or "neuronal structures" mentioned by Maruszewski. Chomsky suggests that the universals themselves are wired in:

> What initial structure must be attributed to the mind that enables it to construct such a grammar from the data of sense?... Suppose that we assign to the mind, as an innate property, the general theory of grammar that we have called 'universal grammar'.... [This] then, provides a schema to which any particular grammar must conform." (Chomsky, 1968, p. 68, 76).

There must be some a priori organisation which causes all humans to be able to learn language, and which causes all languages to use universals. Whether these universals are dependent on this organisation or whether they are themselves a "given" in the brain, it is impossible at this stage to know. Rose (1976) would prefer a larger base which determines the universals. Specificity he feels leads to the rigid patterning of the insects, and he would "take a stand against a neo-Cartesian position on the status of language as a wired in property of the brain." (p. 59). He prefers a broader developmental epistemology to a wired in, totally prepared mechanism which needs only the natural maturational process in order to develop --- as does the genetic epistemology of Piaget.

Such a rigidly unfolding mechanism would make the environment and experience unuseful, though necessary, and I think that Rose misunderstands both Chomsky and Piaget. He states that:

> if all languages have a similar deep structure, the implication must be that aspects of this structure are therefore in some sense wired in to the brain, that within the cortex certain connections are programmed in such a way as to make the emergence of language inevitable and part of the essence of being human. (Rose, 1976, p. 175).

The emergence of language is inevitable in a normal child without physical speech impediment, and growing up in normal nurture: it is not inevitable, in fact will not take place, without normal nurture which includes the environment and experience.

Oatley (1972), on the other hand, sees possibilities for understanding other brain functions, using the analogy of Chomsky's theory of competence:

> The idea of competence, what we must in some sense know to be able to act in some way, can be separated from the idea of performance which involves questions of how in particular the knowledge is represented in the brain and what mechanisms produce behaviour on the basis of it." (Oatley, 1972, p. 164)

This underlying knowledge should be expressed in the most neutral way possible for it would "be difficult or impossible to understand performance correctly if our idea of the underlying competence were basically wrong." (How true this is for second language methodology, although for Chomsky performance does not include, at least in linguistics, how it is represented in the brain.) Oatley (1972), states:

> There is a sense in which each child does work out the grammar, inducing general rules from small numbers of specific instances. But it seems clear that to be able to do this he must inherit very strong biases as to what kinds of inductions to make. He must possess foundations of a very specific kind, waiting as it were, to receive any particular language, English, Chinese, or whatever. On the basis of what might therefore be called a universal grammar which we all inherit, the specific grammar of our native language can be built.
>
> If auditory and visual data had to be learned about in all their possible arrangements, it seems unlikely that any individual within his lifetime would acquire a self-consistent set of mental operations to underlie perception, language and thought. (Oatley, 1972, p. 169).

Vision is a very complex process involving billions of cells. There are 130 million receptors in each eye, and each one receives light from a particular point on the visual field. Cells on the periphery respond to movement, but without any information concerning that movement becoming available. The head must be turned to identify the source of movement, but at least the alert has been sounded for possible danger approaching from the wings. Some receptor cells carry information to the optic nerve; others spread laterally to coordinate information or to inhibit action of cells. Some cells respond only to movement in a particular direction; thus if they fire, the message can be interpreted as "something coming in from the left". Some respond to spots or curves; others only respond to line segments. Some cells respond to a spot of bright light, but if another spot is flashed near it, other cells will inhibit their action and so the response will be lessened. Some cells respond to red, some to yellow, some to blue; and because of their greater or lesser response, we are able to see colour as we do over the whole spectrum.

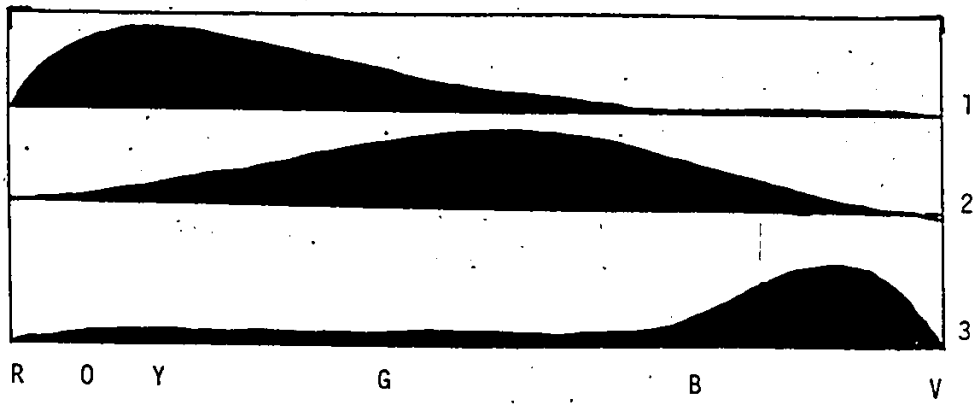


Diagram 4. Helmholtz's development of Young's theory of colour vision is still the basis of our understanding of colour. His diagram shows how three types of cell (1, 2, and 3) each respond over the whole spectrum from red (R) to violet (V), but that each has a maximum in a particular place. (Oatley, 1972, p. 81)

Thus vision is not just a question of a picture being reflected on a field, which we can then inspect with 'our mind's eye', but is rather a matter of millions of cells responding to light in various ways, and sending impulses to the visual cortex, which recreates as a coded picture, which the brain can 'read', that which has been received as light:

> One of the most important things we have to understand about the brain is how networks of nerve cells detect patterns, and interpret them as arising from significant events or objects in the environment. (Oatley, 1972, p. 67)

Without this intricate, wired in system for vision, we would be unable to interpret, only with the help of experience, the light impinging on our eye, as a tree or a person. We must of course touch and taste and experience in order to allot meaning from the outside world to the lines and spots and colour coded by the wired in mechanism. We must also cooperate in communication situations with people in order to store and use the meaningful symbols of that particular language: but that which permits the acquisition of that language is a wired in system which prepares for reception of stimuli (a phonological analyser) and some schemata or universal scheme which permits the generation of deep structure, and so via transformations to surface structure. Vision possesses the visual cortex, where, spread out on either side, the visual scene can be recreated in code, which the brain can read. Language also possesses a language area in the brain, where sentences coming in as electrical signals can be spread out in code (structure) to interpret meaning. The reverse must also be possible for language; the brain must be able to code meaning into a structure which leads to speech (via the hundreds of signals sent to muscles of mouth, lips, throat, etc.). If from a strait-jacket we had only ever seen the walls of a blank cell, then despite our intricate visual system, we would be unable to interpret the outside world if suddenly taken into it. A normal baby touches and tastes what he sees in order to be able to set up a model of the world he experiences within his brain. In the same way then, a child brought up by wolves, and despite his innate

language processing area in the brain, would be unable even to learn to speak if suddenly brought within man's society and communication system, after reaching a certain age.

The brain is not a conglomerate of differently driven mechanisms --- some hydraulic, some electric, some steam-driven and so on. There is one message system throughout the brain, and indeed the body: electrical current passes through the synaptic cleft from the axon of one cell to the dendrite of another. (This system is supported and fed by chemical changes within the cell and to the membrane.) If the visual system helps us to understand how language may work, then language may help us to understand how thinking may work. Oatley sees Chomsky's model of competence as possibly illuminating for thinking. In order to speak or 'perform', we must have a certain knowledge or competence in the brain. How it all works as a system we do not yet know. Yet,

> Logical thought, as distinct from grammatical correctness, may well depend upon the same innate mechanisms which Chomsky has called the universal grammar... If we put together Craik's idea of mental processes modelling or symbolically representing reality [the child tastes and touches and sees, and the 'world out there' gets coded in the brain] with Chomsky's idea of competence, then a means for finding out about some fundamental mental operations begins to

suggest itself." (Oatley, 1972, p. 173, 74).

Just as Chomsky looks at speech or surface structure and deduces logically the necessary deep structure, and from that the underlying necessary knowledge or competence; so we can look at what we see in the world around us and at their interrelationships, and ask what a model of the world would need to represent:

> In order to make interpretations of any kind the interpretative structure clearly needs to contain some knowledge of what interpretations are possible, what the world is like, what kinds of things happen and what kind of relationships can exist... the concept corresponds to Craik's idea of the model which reflects the workings of the world, to Chomsky's notion of competence, or to Piaget's postulates of the logical concepts which each child seems to grasp." (Oatley, 1972, p. 193)

Chomsky's competence leads to performance. By stating the rules of transformational grammar, he is able to move from deep structure to surface structure, or the reverse. Oatley realizes that:

> The model is however not just knowledge, but includes the idea of mechanism. It has a metaphysical handle which can be cranked to make this internal representation actually work to produce predications, or behaviour, or perception. (Idem).

Chomsky has stated that his model is theoretical, and in no way specifies brain mechanisms, yet insofar as all languages use universals, and "all languages are so constructed as to conform to the requirements imposed upon them by cerebral language-data processing mechanisms." (Maruszewski, 1975, p. 41). Chomsky's competence does lead towards those mechanisms. Rose notes that Wilder Penfield was able to locate a number of cortical regions which are primarily concerned with conceptualisation, naming, the motor activities of lip and tongue movements in speech etc. He suggests that:

> Perhaps some of these areas may in fact be not so much concerned with speech but with the problems of general communication, associated with the wiring of Chomsky's 'deep structure', while others may be concerned with the generation of surface structures from deep structures." (Rose, 1976, p. 176).

Oatley reminds us that "we have no consciousness of, or private access to, many lower brain processes. We have no internal system of inspecting patterns on our retina for instance; they are transferred at each stage of the analysis and interpretation process. We have no internal view of the organisation of motor networks that allow us to ride a bicycle." (Oatley, 1972, p. 198). Neither do we have a way of inspecting internally the program which sends hundreds of signals to our phonatory muscles. We see trees or

persons because we have retinas, millions of cells reacting and a visual cortex operating: we speak and comprehend because the various language areas and ideation areas are present in the brain to receive and work on whatever language experience presents. Our visual experience may permit us to recognise a platypus: our language experience may permit us to speak Samoan.

CHAPTER 4

Aphasia results, among other causes, when an adult suffers severe damage to Broca's area of the left (dominant) hemisphere, and generally an adult does not recover. Pettit and Noll (1972), however, have found that after lesions of the left temporal lobe, the efficiency for language of the left ear increases during the period of recovery. (Schiefelbusch, 1978, p. 21) The usual advantage for verbal information is to the right ear which connects with the left hemisphere. The fact that patients having suffered lesions of the left hemisphere, move towards a left-ear advantage during recovery in hospital, indicates that even with adults, there is some take-over of verbal function by the minor hemisphere.

For a child, however, the situation is somewhat different. It seems that at birth the hemispheres are both useful for language, and that up to about eight years old, the child lays down engrams in both hemispheres for language and other perceptions. (Dimond and Beaumont, 1974, p. 376) Up until five years of age, injury to one side does not seem to provoke aphasia, from five to eight years injury to either side may provoke mild and transient aphasia, from eight to fourteen years injury to the left (dominant) hemisphere will provoke aphasia which usually clears up within a year. Maruszewski feels that the emergence of dominance may not occur until eight or nine years old, and notes that full dominance is not always the case for adults either; for there are some in whom both hemispheres share

in speech regulation.

Penfield (1965) noted that children under ten or twelve years of age could become aphasic after injury to the left hemisphere and remain a year dumb. Thereafter they would begin to speak again. It was as if the brain had taken that time to program cortical areas of the right hemisphere to take over some of the language tasks of the left hemisphere. After this age, however, he found children unable to start language all over again as if the areas in the right hemisphere, which might have been used for speech, were now already programmed for perception. It has indeed been found that: "the earlier left hemisphere lesions occur, the better is subsequent verbal function as compared with perceptual function, and the later left hemisphere lesions occur the better is perceptual function relative to verbal function." (Dimond and Beaumont, 1974, p. 169). This does seem to indicate the use of some possible perceptual areas of the right hemisphere for transference of language function.

Whitaker (1978) suggests that the brain has reached eighty to ninety percent of its adult values by four or five years of age: "Biochemical, electro-physiological, and morphological criteria all point to the same conclusion." Concerning the electrical activity of the brain, Rose notes that from normal birth, when an E.E.G. pattern is well-developed compared to a premature birth, the pattern "gradually approaches that of the adult. The final emergence of the adult pattern appears between the eleventh and fourteenth years." (Rose, 1976, p. 191). This does not necessarily invalidate the

eighty to ninety percent for language, but does remind us that maturing continues after four or five years of age. In an experiment with ten adults and eleven children of four to eleven years, electrical activity of left or right hemisphere was measured by electrodes placed over the scalp. Most subjects showed a greater left hemisphere activity when speech stimuli were presented, and a greater left ear activity when non-verbal stimuli were presented. (Molfese, Freeman and Palermo, 1975) This seems to indicate that lateralization is already present in children of four years of age and upwards, at least in reception. Krashen (1972) tested children from four to nine years for differences in right or left ear advantage and found none. Butterfield and Cairns (1974) found specific changes in infant's behaviour in response to specific verbal utterance within the first months of life. We are again considering reception only. It is probable that a phonological analyser is part of the wired in equipment with which man is born. This analyser is situated in the left hemisphere. Therefore a tiny baby reacts more to speech than noise. (It could be simply that he reacts more to human noise than noise.) Processing of speech heard could be complete by age five. This does not necessarily mean that speech production is established in the left hemisphere by age five. One would have to measure electrical activity of one and the other hemisphere during speech production in order to ascertain this.

It seems to me that lateralization of speech production and lateralization of complex motor patterns, both within the left hemisphere, are closely linked. Although lateral preferences are shown at birth and before, with neck flexed left or right and correlated with later handedness, yet "consistent hand preferences are not finally established until the child reaches the age of about six to nine years." (Dimond and Beaumont, 1974, p. 90). This may be a preventive measure in case of injury, which is more likely to happen while the child is young. Vision has a complicated dividing of pathways: half of the left field goes to the right hemisphere and half of the left field goes to the left hemisphere, and the same with the right eye. Thus, if a blow creates damage in one hemisphere, the child is still able to process some vision from both eyes with the intact visual cortex of the other hemisphere. Perhaps a general pattern of the brain obtains for complex motor activity and speech production. Both of these depend upon sequential processing, which is a feature of the left hemisphere, and therefore both are normally found in this left hemisphere. Plasticity of the brain during youth would be a measure to prevent incapacity should damage occur. If the complex motor area is damaged, transferral can be made to the right hemisphere although language remains on the left. If the language area is damaged, language can be transferred to the right although complex motor patterns remain on the left. Below age five or six, therefore, a simple take-over, since lateralization is not yet complete, would be possible. After six or

so, when lateralization has just been accomplished, transfer would be possible but more difficult: see Penfield's ten year olds with a year's delay. Past this age, neither language nor complex motor function would be able to be transferred - hence irreversible disturbed complex motor function, or aphasia. Dennis and Whitaker (1976) note that children who had had a left hemisphere removed before four months of age and who were ten years old at the time of testing, matched normal children of this age on I.Q. scores, auditory-verbal skills and semantic tests. They were deficient, however, in syntactic skills and processing sentences where word order was important. The children, while suffering damage to one hemisphere, had been able to lead fairly normal lives by using the other hemisphere. Hemisphericity not only provides two differentially working precision instruments, but also serves to prevent damage from incapacitating the organism.

Dennis and Kohn (1975) and Whitaker (1976) noted that language acquisition was inferior in those children who had suffered operations of the left hemisphere before five months old. Thus transfer of language is possible in young children, but language capacity may never be as good as when both left and right hemispheres are intact. It seems to me that if the right hemisphere is intrinsically a parallel processor, it may use its spatial, synthetic superiority, instead of the analysis over time of the left hemisphere. Thus, although the right hemisphere may be able to produce speech, it may be using different processes with differing results - we can

close a door with our foot when both hands are full, but the door may slam. When the right hemisphere takes over language function after aphasia, it may not involve "transfer" of language capacities, but special development of other areas in terms of right hemisphere capacities. The village cobbler becomes proficient at shoe-making and uses leather and tools: as the left hemisphere uses a phonological analyser and syntactic processor for language. If the shepherd finds himself alone in the hills, he can still make himself a suitable foot-covering, although lacking the polish of the cobbler's art: the isolated right hemisphere, while still adaptable, can learn to produce speech with some deficiencies and with the use of different strategies.

A normal child in the classroom possesses full language capacities, but a brain which is more plastic and adaptable than the adult's, depending on the age of the child. It is possible that in learning a second language, the child makes use of right hemisphere strategies as well as left, and that as the language becomes more established, it becomes more of a left hemisphere function. Obler (1978) has noted right hemisphere participation in Israeli children learning Hebrew or English as a second language. We know that it is true that children learning first language use both hemispheres since damage to one hemisphere causes no aphasia below five years of age. High verbal I.Q. children with right hemisphere damage experienced difficulty learning a second language, and the reverse was also found, learning disability children joining French

Immersion classes in St. Lambert, succeeded well in French. It seems that gestalt procedures are highly useful in the early stages of language learning. This applies equally well to the graphic form. The best way to tackle a Latin unseen passage, is to read it through slowly from beginning to end. One thus gains a general idea of what it is about. Subsequently one returns to the first sentence and studies word endings to find a verb, subject of the verb and so on. Appropriate meanings can be chosen for words according to the general context, and the final translation is superior to the one studied word for word without a preceeding overall global reading. Right hemisphere strategies would be useful in the early stages of first language learning also.

The differences between children and adults learning language have been exaggerated. Children greet most experiences in life, including language, as adventures to be gained from. Consider learning to swim. Six-month old babies have been taught to swim at the Y. in Montreal, and our toddler daughter took to the water like a duck. At six years old, a child may be afraid of trusting his own muscle power, though as he gains confidence he will be anxious to learn. An adult is inhibited: he is used to doing all he does reasonably well, and he does not like finding himself "looking silly". I lived by the sea, and so I swim and feel comfortable in water: but I never learned to crawl. Now, I would like to learn, but I would also like to have the pool to myself, so that other people do not watch my first

uncoordinated efforts - hence I do not learn. Yet I have arms, legs, lungs as when I was younger. No one would suggest that my body now is less able to learn to swim. I am possibly less adaptable, but above all, I am reluctant.

This same reluctance hinders adults who try to learn a second language. Certainly the phonemes and syntax of a first language are already well established, but this does not prevent acquiring the phonemes and syntax of a second language. Language is no longer a part of life experience to be welcomed, but is now to be interpreted in the light of past experience as something new and different. A host of motivational factors enters in. The adult sometimes does not want to lose his "foreign" accent for he sees it as a mark of his own individuality of the past. The major difference will be whether the adult must use this second language for work, for enjoyment, for conversation and for living. If it is merely useful for work, or for a month's vacation, or merely as an exercise, then we do not have to search the brain for a developed incapacity for second language as opposed to first language. The full environmental necessity and joy of the first language is not present, and thus motivation for this second language will not equal the natural drive to learn the first. Concepts, learning and the fullness of life itself depended on acquisition of a first language. At the very most, second language permits communication and some additional learning.

A doubt remains as to whether there is room in the human brain for second language. If take-over of first language by the right hemisphere affects language and perception, then what happens if you stack another language into the normal brain? It would seem that usually bilinguals use the same areas for second language as for first. Penfield and Roberts (1959) contended that: "basically the same mechanisms subserving a single language also subserve several languages." There is one semantic system which serves both languages and separates only at the level of production. A functional bilingual understands speech regardless of which of the two languages he hears. Obler (1978) states that patients with anesthetized right hemispheres, make inappropriate switches of language use. Thus although both languages are in the left hemisphere, choice of language must be a right hemisphere function.

Aphasic bilinguals, when they recover, usually recover languages to a similar degree or at a similar rate. (Paradis, 1977) In about ten per cent of cases, however, one language remains severely impaired. In a few cases one language begins recovery and then fades as another starts to recover, or one recovers before the other. The reasons for these latter cases, do not seem to be separate lodging of second language, but rather, emotional and motivational factors attached to one language rather than the other, a consideration of which language was learned through writing, or how well the second language had been learned.

Further evidence for left hemisphere dominance for both languages was a test carried out by Hamers and Lambert (1974) with right handed bilinguals. Words in French or in English were flashed to the right or to the left visual field. Both for French and English, most though not all subjects gave more rapid response to the right field stimulus. Concepts are at a level deeper than words and consequently: "it does not make sense to say that a bilingual can think in one or the other language." He does not "think" in either language, but is able to go directly from concept to speech production in second language also, whereas a non-functional bilingual must pass from concept to first language and then, via translation, to second language. Bilinguals acquire concepts in one language or the other and are able to use them at the service of both. There seems to be room and to spare in the brain for one or two or more of these coordinate languages. Bilinguals abound and polyglots are not rare in some countries.

CHAPTER 5

Over these last decades we have gained great knowledge concerning the human brain and we are drawing nearer to an understanding of thinking. We know that the hemispheres of the brain are two-fold mechanisms which are enormously complex, and that language itself is a complex function tied to developing intelligence. No method is needed to teach a child his native language. The brain's mechanisms work efficiently as the child listens to input which can at first carry no meaning for him, for he starts with few concepts if any, and no experience to which to link this language. Bit by bit, as concepts build up, the child works to code them in language, first to understand and later to speak. Gestalt apperception of a whole situation gives way to finer and finer analysis. In language also human noise becomes vowels and consonants, which become differentiated vowels and groups of consonants, until the full range is perceived and produced. Thus a child starts with right hemispehre gestalt apperception, and as items are mastered, they pass to left hemisphere analysis and production. Slowly a mass of human communication becomes words and sense.

A second language cannot be more strange to an older child than the first is to the tiny baby. The child has by now coded many concepts and has linked them symbolically with words. An immigrant child playing on the block with his French or English speaking friends, uses the same old strategies that served him so well as a

baby. He looks and listens, touches, tastes, smells and attempts to take part in activity. He needs the words which will let him have fun with the others. He soon picks up expressions here and there and uses them in similar context. If he does not pronounce them correctly, the children laugh, so he tries again for he wants very much to be one of them, to be "in", and to be "in" you must sound "like". Soon he is fluently bilingual and may even let fall into disuse his native tongue which does not help him in the world he now lives in.

The child in school is different. If he is an immigrant, he may wish to learn the second language, but he is self-conscious, for the other children are doing work with language which he is as yet unable to do, and the teacher treats him differently and teaches him. The natural efficiency of the twin hemispheres is jeopardized, for he thinks now of a worksheet to be coped with, and irrelevant meanings. The young child is concerned only with relevance as he learns his first language. Daddy and Mummy talk about retiling the roof, and he continues his game; Daddy mentions ice-cream in the refrigerator and the child chips in with "Me get it, Daddy!". The teacher may be concerned with size and how to express it. "Here is the elephant. He is big. Here is the mouse. He is smaller than the elephant. Here is the ant, he is the smallest of all. Which one is smaller than the elephant?" "Oh! Oh! I think I am expected to say something now. What was teacher saying?"

First language springs from experience and is used when there is something to express. I noticed in a supermarket a small child with her father who had just bought candy. She jumped up and down and emitted a string of what to me were nonsense words. "You want some gum?" said Daddy. "Yes!" came the decisive and clear answer. Meaning, understanding and the will to speak precede the ability to speak. Luria's five-year old, semi-autistic twins understood each other when they played; only when separated and sent to different kindergartens did each begin to develop more normal speech. Second language, however, when it is taught in school, frequently concerns things that are not only irrelevant but also uninteresting: it becomes merely one more school subject one is expected to learn. For the little girl in the store, striving after form was only in order to express desire: in the classroom, meaning is frequently of less account than the acquisiton of form.

Several methods are in use, in the schools, for teaching second language. In the light of what we know concerning brain functioning, we will now look at some of these methods. Teh best established in North America in the late sixties and early seventies in the audio-lingual approach. During the second world war, descriptive linguists, backed by the learning theory of the behaviorists, created the methods used in the ASTP: "linguists came along with a scientific approach, and created methods of mjmicry, memorization, and pattern drill for the Army Specialized Training Program in World War II" (Diller, 1971, p. 3). Because of the

seeming success of these courses, the same techniques were applied to the schools, with again behavioral psychology and descriptive linguistics as guiding lights: "The influence of descriptive linguistics and behavioristic psychology were at their peak during the years in which the foundations of the audio-lingual approach were being laid." (Chastain, 1971, p. 65)

The behaviorists considered all behavior to be conditioned by stimulus, reward and punishment from the environment. Watson considered that, given a small child, he could make of him a thief or a musician as he willed. All that man does is a response to stimuli, and this applies equally to language: "Language too is composed of conditioned responses. The only difference is that the responses are verbal rather than physical." (Chastain, 1971, p. 65) Language was speech, and speech was simply a set of habits acquired by practice. Rules were not something that brought about utterances in a particular form, but simply summaries of what speakers were observed to do: "The rule is a description of a habit and nothing more." (Diller, 1971, p.15) Only the concrete and observable was considered to have reality: all that could be observed in language was that which could be taped or put on a spectograph - speech. Sound or phonology thus came to be of major importance.

If language is a set of habits and rules are merely summaries of behavior, then the best way to teach language is to imitate and memorize the speech of native speakers, and to vary its use in minimal step pattern drills. A mistake constitutes the beginning of a bad habit, and so mistakes must be avoided at all cost:

> choral recitation of responses by the class after the teacher before individuals are called on to recite; drills and exercises in which a minimal change has to be made; question and answer procedures in which the student's response involves, for the most part, repetition of materials contained in the question; and the use of memorized dialogue material in recreations of everyday situations. Such procedures insure that the students repeat aloud a great deal of foreign-language material with a very low probability of error. (Rivers, 1964, p. 61)

In the pattern drill the example and stimulus must be so clear as to guide the student to the one correct and acceptable response.

A good pattern drill works on a structure already encountered, and this structure is drilled in repetition drills through six to eight cue-response items. Changes then introduced must advance by minimal steps. The items must be short and vocabulary kept to a minimum, so that the student can concentrate his thinking "at the point of teaching" (Rivers, 68, p. 103). The structure has been presented in the preceding dialogue.

Since one learns one's native language by listening, speaking, reading and writing, in that order; and since speech is language; the dialogue is introduced orally. It is chosen to resemble closely the speech of native speakers (no literary bias). It

supplies the students with genuine language for imitation:

> The clichés of the language are embedded in typical acts of communication instead of being learned artificially as isolated phrases and sentences... a dialogue lends itself ideally to chorus repetition with sections of the class taking roles and responding to each other's cues. (Rivers, 1968, pp. 168-169).

In the recitation of the first whole class memorization, the pace must be smart, with the teacher modeling by backward build-up, in order to preserve natural intonation, e.g., "to buy bread", "to the store to buy bread", "John goes to the store to buy bread".

The descriptive linguist has noticed that speech acts always happen in set patterns, and according to behaviourist theory, they wish the student to imitate, repeat, and vary within these set patterns. Rivers states:

> What appears to be ignored in teaching is the fact that certain elements of language remain in fixed relationships in small closed systems, so that once the system is invoked in a particular way a succession of interrelated formal features appears. Fluent speakers are able to make these interrelated adjustments irrespective of the particular message they wish to produce. The elements which interact in

> restricted systems may be practiced seperately in order to forge strong habitual associations from which the speaker never deviates (this applies to such elements as inflection of person and number, agreements of gender, fixed forms of interrogation or negation, and formal features of tense). These elements do not require intellectual analysis: they exist, and they must be used in a certain way in certain environments and in no other way. For these features, drill is a very effective technique. They may be inductively learned by the students without more than an occasional word of explanation by the teacher when there is hesitation or bewilderment. In structured classroom practice their use may be extended, by the process of analogy, to other utterances with different combinations of lexical items. (Rivers, 1968, pp. 78-79)

At this drill level, the student must concentrate on manipulating the structure, and "changes [in meaning] brought about by the drill make little impression on the student's mind." (Diller, 1971, p. 49) (By the use of the word "mind", we see immediately that Diller is not an exponent of this method.)

Rivers sees two levels of language learning. The first is one of repetition and drill when the student is conditioned in the use of patterns, and the second is "at the level of communication, where he will learn by experience in selection to apply what he has learned to new situations." (Rivers, 1964, pp. 78-79). It is however the drill which facilitates learning:

> It is evident that higher level choices cannot be put into operation with ease if facility has not been developed in the production of interdependent lower level elements, and so learning by induction, drill, and analogy will be the commonest feature of the early stages. (Rivers, 1968, p. 80).

Rivers finds in practice that students trained in automaticity of response do not express well their own meaning:

> Those who share Skinner's view that 'ideas' are explanatory fictions and prejudicial to a discussion of verbal behavior, will immediately reject this suggested level as an unscientific concept, as misleading and extraneous to the discussion as the concept of 'meaning' and will maintain that manipulation of language cues and responses is sufficient. (Rivers, 1964, pp. 73-74)

Diller states that the behaviourists "refuse to go so far as to talk of 'knowledge' or of 'mind' - for them the human being is essentially a machine with a collection of habits which have been molded by the outside world." (Diller, 1971, p.6).

We have seen earlier that just as man transforms the image impinging on his retina into a coded image in his visual cortex, so man also transforms into code a model of the outside world built up through his experience with it. This code is then associated with language via other coding processes. Words do not flash whole through the brain any more than pictures of trees remain as visual images painted on some inner wall. All must be reduced to a binary coding in order to be processed. Sound is wavelengths and is reduced to electrical signals in order to be recognized according to an inner model. The sound does not travel along a tube like an echo.

Man is able to repeat human sound, even if it has no meaning. It can be decoded by a phonological analyzer and recoded for instructions to be sent to the phonatory muscles. Thus a student is able to practice a pattern with a minimum of understanding or even none. He can repeat:- 'I eat candy: candy:' "I eat candy", 'butter': "I eat butter", 'bread': "I eat bread" 'Mary': "I eat Mary", without blinking an eyelid. John Lamendella at the Mexico City Tesol Conference stated that:

> two clinical syndromes: Conduction Aphasia and Echolalic Aphasia... point out the functional autonomy of the speech circuit from higher level language processing, and the special status of imitation, repetition, and certain forms of substitution as distinct types of speech behavior separate from propositional speech. It is argued that during pattern practice exercises, many learners disengage the speech circuit from higher level language processing systems (and from the language acquisition process) as an efficient means of performing a repetitious task not related to communicative interactions. (Tesol, 1978, p. 73).

When I was quite young I had first a budgerigar and later a canary. I was able to imitate and repeat their songs. I have never used them for meaningful communication, since I did not learn them in situations of meaningful communication, but only as a pattern. Language learned in this manner likewise may have little applicability to useful communication. Rivers states: "That students are unable to express themselves in unstructured situations has been a major complaint about the audio-lingual methods, with their emphasis on repetitive learning and 'over-learning' or 'automatization of responses'." (Rivers, 1964, p. 72-73).

Chastain sums up the method by suggesting that: "The basic task boils down to one of establishing automatic, non-thoughtful responses to language stimuli." (Chastain, 1971, p. 70) Unfortunately, behaviorists considered that this was how a native speaker proceeded when speaking; rules were summaries of behavior: "There is no possibility that the linguist's rule of grammar might be a description of some sort of mental rule by which (perhaps without conscious thought) a speaker might form sentences," (Diller, 1971, p. 15), and the same author writes on page 6:

> Descriptive linguists have affirmed that the normal use of language is either mimicry or analogy; grammatical rules are merely descriptions of habits, and in normal fast use, they say, a person has no time to apply rules as recipes for sentence formation.

We know, however, that we have two precision instruments, working differentially, sitting side by side - the left and the right hemispheres. Conscious use of rule takes time to work out. Unconscious use of rule is processed at speed by a syntactic analyzer. A computer can complete in half a minute a calculation that would take a man half a day. If the control area for speech production is sending hundreds of signals for the enunciation of speech to the phonatory muscles, then it seems reasonable to suppose that the syntactic analyzer and related command centre are coordinating and organizing structures also at the speed

requisite for speech. In fact it may take longer to locate and use a stored pattern than to create it at need, because the brain is made to decode and encode and is equipped with a phonological analyzer and syntactic analyzer for use at the speed of speech. There are some patterns which have become engrammed as a "signature" through frequent use, but these are few: patients are left with swear-words, simple songs and verses, and some frequent, simple expressions; but certainly not the endless succession of patterns of the audio-lingual approach.

We also know that the right hemisphere has a capacity for gestalt apperception in parallel; it can take in many stimuli and recognize pattern within a mass. Rivers notes that at first sight the audio-lingual approach seems to be consistent with Gestalt psychology. She says that instead of a

> piecemeal grammatical approach, in which the language is taken apart, the parts are studied separately, and the student is expected to put them together again in a form as closely related to the original as possible... the audio-lingual method of learning by analogy through pattern drill proposes to present complete structures to the student to be learned as 'wholes', and

> language-learning becomes, as Politzer says, 'the perception of a 'gestalt'; an awareness of a pattern or configuration of patterns'. (Rivers, 1964, p. 121)

She sees, however, that this is an over-simplification of the Gestalt position. It is not only a question of 'wholes' but of 'the whole', and this requires analysis. The students must see "that these patterns are structurally related to the whole language, and that within them there are separate, functioning parts." (Rivers, 1964, p. 122). The students learn, in effect, unrelated middle bits, half-way between words and complete meaning units. They do not gain a feeling for the language.

We know, also, that the more modalities involved in information reception, the better will be the processing and subsequent memory. A split brain patient who saw a word or an object in his left visual field could not name it, but when he was given the object to hold in his right hand, the information rapidly reached the left hemisphere and he was able to name it. (Rose, 1976) In the normal person, the more cross-modal the imput, the better the processing. We must not confuse audio-lingual and audio-visual. Rivers makes quite clear that they are not synonymous:

> The term 'audio-lingual' applies to a particular teaching method with a clearly elaborated theoretical basis and an accepted set of techniques.

> The term 'audio-visual', on the other hand, cannot be identified with on specific method. (Rivers, 1968, pp. 174-175).

Chastain regrets the use of only listening at the beginning of language learning in the audio-lingual method. Students listen and repeat. We did indeed learn our first language this way, but where reading and writing are already acquired skills, it seems a pity to deny students the use of both ear and eye in learning.

It seems that the student must 'forget' his own language in order to learn another because contrastive linguistics show us how different all languages are and thus how interfering. Yet all languages make use of similar basic structure - the human brain. The brain imposes universals of language at the deep structure level, (please see preceding pages 49-53) although languages may vary considerably at the surface level. Diller suggests that:

> When Bloomfield says 'the sounds, constructions, and meanings of different languages are not the same...', he is implying that all languages do have sounds, constructions, and meanings, even if the second half of his sentence states that '...to get an easy command of a foreign language one must learn to ignore the features of any and all other languages, especially

one's own'. (Diller, 1971, p. 20)

Has the audio-lingual approach provided 'an easy command of foreign-language' to its students? The Pennsylvania Report of 1968, despite drawbacks due in part to size of operation, came up with some surprising results. Traditionally taught students exceeded or equalled 'Functional Skills' students in all measures. The Language Laboratory (a Skinner-box for humans) as used twice weekly had no discernible effect. Student opinion of foreign language study declines throughout instruction, independent of teaching strategies employed. (Chastain, 1971). He also states:

> Many believe that the only way to teach speaking is by means of the audio-lingual method. This is simply not true. Many students were learning to speak languages long before the inception of audio-lingual techniques; many students are not learning to speak now, even though audio-lingual practices are wide-spread. (Chastain, 1971, p. 358).

Rivers regrets that a students is plunged back into practicing strange sounds and words "in an unreal world where you say not what you want to say but only what can be concocted from the few foreign language forms you know, no matter how infantile or how irrelevant to real life affairs it may seem." (Rivers, 1964, p. 91-92). Yet, she says, you can make your lessons interesting by use of a variety of techniques even though they "may not, theoretically, be as

efficient as drills and memorization." Thus variety outside the method will maintain student enthusiasm within the method: "The students will be rewarded [like rats] at short intervals by the satisfaction of achieving momentary goals, goals which are relevant to their own needs and interests, and they will be kept working toward the more distant goal of language mastery." (Rivers, 1964, p. 58). This is indeed to admit that the method is irrelevant to the students' goals and interests. Surely language has its own present goal - that of expression or communication of self. As Chastain says: "Students learn to do what they do, and therefore the approach which makes possible more activities resembling 'real' language contexts should be the one in which the greater achievement is possible." (Chastain, 1971, p. 360).

The goal of cognitive-code language learning is the same as for the audio-lingual approach - to develop the student's ability to use the language. Apart from that, the two approaches differ considerably. The student is considered to be a thinking human being, and "learning is the acquisition, organization, and storage of knowledge in such a way that it becomes an active part of the individual's cognitive structure." (Chastain, 1971, pp. 88-89). Language is not the set of habits of the behaviorists, but a rule-governed system, which the student actively acquires: "Cognitive theory stresses perception of experiences, and organization of knowledge. The mind is not a plastic glob to be molded by environmental forces, but an active and determining agent in the acquisition

and storage of knowledge." (Chastain, 1971, p. 85). Far from the development of automatic, unthinking responses, the student is encouraged to question and to think, in order to relate what he is learning to what he already knows:

> By his teaching, the teacher should demonstrate to the students that he does not expect rote learning in order to return a verbatim regurgitation of the material... Periodic application sessions... are basic to ensuring that the information is functional and can be utilized to solve problems and to further additional learning." (Chastain, 1971, p. 92).

This sentence refers of course to the cognitive psychologist's view of learning in general, but second language is also learning. The student does not in some way alter as he steps through our classroom door.

The cognitive psychologist considers second language learning in the classroom to be a conscious process. The audio-lingual proponent points to the first language speaker, who speaks with ease and automaticity. This seeming ease, however, may be the result of conscious effort and practice:

> They [cognitive proponents] feel that the fact that a habit is an action which can be performed without conscious thought in no way negates a process of conscious, continued application in

> developing the skill. For example, the fact that a man ties a tie or drives a car without conscious awareness of individual actions in no way signifies that this skill was attained without thinking through each step in the beginning stages of learning. Thus, these instructors place primary emphasis on student comprehension of structure. With further practice, the student can perfect his ability to use these structures unconsciously, leaving his mind free to concentrate on the content of speech. (Chastain, 1969, p. 105)

We do not think of the individual letters as we sign our name because the signature has become routinized from much use, but we did make each letter individually with care when we first learned to write our name. With great difficulty would we have learned our present scrawl, without learning letters first.

Penfield gives us a descriptive passage of the beginning of speech in his book, The Mystery of Mind (1975) pp. 58-59:

> The beginning of speech is important. The first time he hears the sound and imitates it, the sound will be far from his eventual pronunciation of 'dog'. A parrot can imitate, too. But it is not long before the infant takes another step. A dog appears in the stream of consciousness,

whereupon the highest brain-mechanism carries a patterned neuronal message to the non-verbal concept-mechanism. The past record is scanned and a similar appearance recalled through the hippocampal system. The mind compares the two images that have thus appeared in the stream of consciousness, and sees similarity. There is a sense of familiarity or recognition. While all this is still in the stream of consciousness, another patterned neuronal message is formed, made up of the remembered concept modified by the past experience. This message is sent to the speech mechanism and the word 'dog' flashes up into consciousness.

Then he acts. A message is sent to the grey matter in the articulation area of the motor cortex. He speaks the word 'dog' aloud and laughs, perhaps, in conscious triumph. I imagine that the parts of this sequence that have not become automatic are carried out by the highest brain-mechanism under the direction of the mind. I want to point out only that every learned-reaction that becomes automatic was first carried out within the

light of conscious attention and in accordance with the understanding of the mind.

Cognitive-code teachers use graphic or schematic procedures to clarify relationships and they use "the native language, visuals, or demonstrations as a base from which to build conceptualization of meaning and form in the second language." (Chastain, 1971, p. 95). The grammar is explained, set in context, used in exercises, and applied in practice sessions. The teacher must "provide for the establishment of the system and opportunities to invoke the system." (Chastain, 1971, p. 91). Rote learning is avoided "except perhaps in the case of vocabulary". (p. 95). This seems to be a carry-over from the old grammar-translation method.

This approach is immediately more in line with what we know of man's brain function, since it acknowledges that man does have a brain, and that he thinks. The older language student, perhaps because of academic years of background, does like explanations. Rivers (1964, p. 120) had noted that "an important human characteristic which the method of analogy does not seem to take into account is the individual's desire to understand what he is doing: Both Brooks and Politzer admit the existence of this trait but seem to regard it as rather inconvenient and restrictive". The younger child likes to know what he is doing - communicating - but is happy to use language rather than discuss it. Cognitive-code learning might raise questions, the younger child is not interested

in asking.

The older learner does not necessarily wish for grammatical explanations continually. Fairlee W. Carroll (1978) has carried out a dichotic listening study which is reported in the Report of the Tesol Mexico City Conference of 1978, p. 27. Adult immigrants were beginning to learn and also to use English. It was found that the right hemisphere was dominant for English in the initial stages of study, with a shift to left hemisphere dominance at more advanced levels. The right hemisphere is able to take in much information in parallel, to collate and sort it, sensing patterns. Thus it appears that a second language learner can make sense of a second language more readily by using meaningful situations to clarify structure usage, employing his right hemisphere dominantly. As general patterns and understanding emerge, the left hemisphere is more appropriate. Fairlee Carroll (1978, p. 27) suggests that: "Difficulties encountered by adults in foreign language learning are postulated as being due to failure to release from suppression the right hemisphere linguistic processes necessary for natural language learning". We recall studies with Caltech students, cited earlier, and the suggestion that eighteen years or so of schooling in the sciences functionally ablates the right hemisphere. We are accustomed to logically worded explanations and scientific discussion, and ignore our right hemisphere natural abilities.

While the audio-lingual approach emphasizes performance, the cognitive-code language learning emphasizes competence: "Proponents of a cognitive approach have as their goal the development of 'competence' (as the term is used in generative-transformational linguistics)". (Chastain, 1971, p. 97). In first language, this competence is built up simultaneously with understanding and production. The schemata are present and ready to code a given language, and the given language has developed in accordance with brain mechanisms which determine universals. The competence for a given language has still to be built up by hearing and using that language in meaningful situations. Explanations of grammar before meeting the structure in context do not seem to be in accordance with this model.

Learning vocabulary by rote in lists is the only concession made by the cognitive approach to rote learning. Here again, meeting words in meaningful context might be more efficient, for vocabulary rote learning is the most useless of all rote learning. The left hemisphere processes vocabulary words serially, one by one, whereas meaningful context provides the possibility of a nexus of associations. An interactive image "appeared to temporally and spatially unify the information in memory, and this might permit a parallel retrieval process in which each item is examined simultaneously." (Dimond and Beaumont, 1974, p. 188) Diller (1971, p. 66) mentions that "the parts of the body and the items of clothing can be learned very quickly in a foreign language when

they are organized in their natural spatial relationships".

The use of all four language skills with children who already know how to read and write, and the use of diagrams and visual aids of all kinds seems to ensure that cross-modal information is available for language processing, and hence increases retention effectiveness. Motivation is also likely to be higher in the cognitive-code learning class, where the students are expected to question and make relevant the knowledge to themselves. As they are expected to relate skills and knowledge to what they already possess, meaningless learning and boredom should be at a minimum.

The two preceding methods are wide-spread, based upon a main-line psychology - behaviorism and cognitive psychology - well elaborated and well-known. The situational method or semantic approach is less well-known. With these three approaches, however, we progress from an interest in phonology (descriptive linguistics and the audio-lingual approach) to an interest in syntax (generative-transformational linguistics and the cognitive approach) to an interest in semantics, (which is the linguist's present occupation). First of all, it was claimed that children learned by imitation, then children spoke in pivot structures, now "syntax is learned by the child in his efforts to code certain conceptual relations". (Bloom, 1973, p. 437). Learning language is a movement towards coding meaning appropriately; it is not the reverse - acquiring form to which one will somehow attach meaning: "The grammatical

devices of a language are not to be learned as an end in themselves. It is the capacity to express meaning that is the end." (Wilkins, 1974, p. 5).

We can attack language either by putting it to bits, and feeding the component parts to the learner one by one, or we can take "the alternative approach... and let the learner meet a much greater variety of linguistic forms from the beginning". (Wilkins, 1974, p. 73). It is this latter approach which the situational method prefers, and which is also more in accord with what we know of right hemisphere function in beginning language learning:

> The learning mechanism operates through its capacity to formulate rules about the language once the individual has been exposed to it.... The greater the exposure to meaningful language the more effectively the learner can formulate and revise his hypotheses about the structure of the language. (Wilkins, 1972, p. 172).

Thus in the semantic approach "we abondon the principle of grammatical selection in favour of semantic or notional selection". (Carmen Silva, 1976, p. 341). To create the wish to communicate and to encourage active involvement becomes an essential part of the semantic approach.

Younger children can of course play games, sing songs, go on field trips, bake cookies, make stuffed animals, see film strips or films, work on projects -where language is used for communication. All our classes need to be more free and easy and cooperative than the traditional "I know everything. Come here and I'll teach you" ones. The right hemisphere is ready to operate in such situations, and improves learning, which can be formalized later.

As we have moved into the area of interest in meaning in linguistics, so we have moved into the area of interest in the person in psychology. Charles A. Curran (Tesol 78, p. 32) based his counseling learning or community language learning on the psychology of Carl Rogers. Rogers, Alpert, Maslow and others form the phalanx of Humanist psychology. Charles Curran said, then, at Mexico City that a new age of the person had superseded the age of science which is just finishing. This brings a deep regard and commitment to the unique and special quality of each human being. He suggested we limit the problem-solving methodology (a left-hemisphere function!) coming from the scientific model of the past age (again we recall the phrase "functionally ablate the right hemisphere"). The learning relationship is for him one of deep mutual engagement, and in the langauge larning situation there must develop a "deep and trusting communication and shared community rather than isolated competition."

Thus his students form a circle of friendship, they are people who wish to speak with each other. They can talk of whatever interests them. The counselor is outside the circle. As needed, and gently and kindly, he provides the words or phrases the students need to express their meaning. The students recall more readily, because their mind is poised over the meaning to be expressed, and therefore they code more readily the symbol made available. In a classroom it is difficult to combine acquisition of competence with performance, especially when the teacher wants to "teach", and yet "syntax is learned by the child in his effort to code certain conceptual relations". A community of learners desirous of communicating together is a large first step.

Suggestopaedia is the last method we shall consider. It was created by Dr. Lozanov of Bucharest to help adults learn a second language. The students hear a story produced dramatically and with feeling. The third time they hear it against a background of softly played classical music. Each has been given a fictitious character from the story, and now they are asked to relate in their own way part of the story. Success in recall is high. Louis B. Mignault, who uses a similar method in his Summer Language Institute at Scarborough College writes that:

> in an educational system which tends to rely entirely on conscious voluntary attention as if it were the only way to acquire knowledge, students have developed defense mechanisms by

> which they let their mind wander away very rapidly since the faculty to which the teacher appeals exclusively is incapable of sustained effort. (1978, p. 696)

Mignault does not agree with all Lozanov's claims, but he does feel that students are capable of more than they usually give, and that this method is disinhibiting.

Although musical analysis is a left hemisphere function, musical melody is perceived by the right hemisphere. It is possible that a background of soft music, sets the right hemisphere in motion, and it applies itself to language also. We are used to directing language to the left hemisphere, as, in first language, we have reached the advanced level where it is dominant. Listening to music may engage the right hemisphere and encourage right hemisphere language processing. The fact that the atmosphere is relaxed and encouraging may also help.

There remains a question of individual student differences. Hart (1975, p. 134) has suggested that there are two modes of thinking - SSM (for symbol selection and manipulation) and PAC (for perception, analysis and choice). Both of these make use of both hemispheres, but the first is predominantly a left hemisphere processing, and the last a right hemisphere one. Bakan (1969) has demonstrated that the direction of gaze when asked a thought-provoking question, is indicative of left or right dominant thinking. Hartnett (1974) suggests that students

be offered various courses in second language to suit their type of thinking. A single course could include both modes and thus provide an opportunity of success to a greater number of students than at present:

> If we accept that the two hemispheres are equipped for relatively distinct modes of thought, we have to accept that we are educating two different types of organ, each with its own special ways of excelling... Exercising the conjoint activities of both hemispheres may require a further range of educational activities, and it may be only by such means that the individual will ultimately be helped to achieve his full potential. (Lishman, 1977, p. 64).

As an educator, I have of course interpreted the findings of medecine and science, which I have quoted in this thesis with a view to their usefulness for second language learning. They should, however, be useful for learning in a more general sense also. Although Broca's work dates from 1861 and Wernicke's from 1873, both concern only the left hemisphere. A great spate of brain research has taken place in the last thirty to forty years, and we are now approaching a better understanding of the functioning and differentiation of the brain hemispheres. An educator, Alfred North Whitehead, had already realized that there were different phases to learning, although he had not connected them with right or left hemisphere function. He stated that:

> The stage of romance is the stage of first apprehension. The subject-matter has the vividness of novelty; it holds within itself unexplored connections with possibilities half-disclosed by glimpses and half-concealed by the wealth of material (...) The stage of precision also represents an addition to knowledge. In this stage, width of relationships is subordinated to exactness of formulation (...) The final stage of generalization... is a return to romanticism with added advantage of classified ideas and relevant technique. (Whitehead, 1932, pp. 28, 29, 30)

Here we can see first a parallel apperception of a gestalt by the right hemisphere, followed by serial analysis by the left hemisphere, coming to fruition using both the exactness of left and the perception of relationships of right. Whitehead remarks that:

> In our conception of education we tend to confine it to the second stage of the cycle; namely, to the stage of precision. But we cannot so limit our task without misconceiving the whole problem. We are concerned alike with the ferment, with the acquirement of precision, and with the subsequent fruition. (Whitehead, 1932, p. 29)

Both hemispheres must be used optimally.

A later educator and psychologist, Jerome Bruner, does compare the modes of learning of right and left hemisphere, when he speaks of left and right hand. He states that:

> The right is order and lawfulness; 'le droit'. It's beauties are those of geometry and taut implication. Reaching for knowledge with the right hand is science. Yet to say only that much of science is to overlook one of its excitements, for the great hypotheses of science are gifts carried in the left hand... And should we say that reaching for knowledge with the left hand is art? Again it is not enough, for as surely as the recital of day-dreams differs from the well-wrought tale, there is a barrier between undisciplined fantasy and art. To climb the barrier requires a right hand adept at technique and artifice. (Bruner, 1962, p.2)

Hunches and intuition result from right hemisphere function, and they are passed to the left hemisphere for refinement and proving. Yet proof leads to fresh possibilities, fresh relationships, and so to fresh hypotheses and further right hemisphere function.

As educators, we must be mindful of these differences in approach which should be cyclic --- even the adult scientist moves from the one to the other - but we must be mindful also fo the younger child's predominant relicance on right hemisphere function and romance as he forges slowly the cognitive tools of analytic reasoning, and of the

adolescent's greater reliance on left hemisphere functioning, once reasoning is well developped. Yet as Whitehead warns us, he means a "distinction of emphasis, of pervasive quality --- romance, precision, generalization, are all present throughout." (Whitehead, 1932, p. 44) Both hemispheres are operative in schools, but with reliance sometimes more on one and sometimes more on the other, depending not only on age, but also on the task in hand and the moment in time.

CONCLUSION

We have seen that the brain functions by electrical impulses. When the signals from other cells coming in through the dendrites reach a given level, the cell fires down its axon and across the synaptic cleft to the dendrite of another cell. A common language operates throughout the system, and messages are interpreted according to their point of origin. The articulation of phonemes requires the firing of neurons to send messages in order to coordinate about one hundred different muscles of throat, larynx, mouth, nose and lungs. The sound waves of speech are likewise reduced to electrical impulses directed to the auditory cortex. A few patterns are set up for which a particular set of impulses is required. When a patient is injured in the normal speech production areas of the left hemisphere, the right hemisphere may still permit him to use swear words, songs or short poems.

The right hemisphere seems to be a visual, spatial, more concrete processor, while the left hemisphere analyzes in a serial manner over time. The right operates in parallel, perceives gestalt relationships and forms syntheses. Perhaps because language is sequentially programmed and linear, the left hemisphere is normally dominant for language production. The right hemisphere, however, participates in some language comprehension, and provides less common associations in word association tests. The right hemisphere is able, up to about twelve years, to adapt spatial capacities for the mapping of language

production, should the left hemisphere suffer injury.

Several methods of teaching second language have been reviewed in the light of the foregoing data, in order to draw inferences as to the usefulness of some of their methodological requirements. The Audio-Lingual Method was considered. This requires automatization of learned responses. Sound waves, however, must be reduced to electrical impulses. Some auditory gestalts, patterns of impulses, are retained by the right hemisphere: these are few in number -- swear words, songs, verses -- far from the endless patterns to be automatized according to the Audio-Lingual method. The pattern drill is of doubtful usefulness for second language learning, and students trained in automization of response do not express well their own meaning, nor readily take part in conversation. Although in normal speech our attention is almost exclusively on meaning, Lamendella has suggested that such students disengage the speech circuit from the higher level language processing systems in order to be able to carry out a repetitious and uncommunicative task. The student learns unrelated middle bits (patterns) half-way between words and complete meaning units, and thereby are not encouraged to gain an understanding of the language as a whole.

The Cognitive-Code method does recognize the mind's need for meaning and inter-relationships, but emphasizes the precision of analytical reasoning of the left hemisphere to the almost exclusion of newness and wealth of data which calls for right hemisphere function. "Competence" or knowledge of the rules of the language and how it works, is very necessary at the high school level; but it should not exclude

the "romance" and "ferment" of being exposed to larger tracts of language and experience.

Educators need to be mindful of both hemispheres and both modes of learning. The Situational method would expose a child to much language in meanigful situations so that he needs to understand and desires to communicate. Once involved in communication, then how a structure expresses thought or how a change in word form alters meaning can be considered. Thus he would move from right hemisphere apperception, to left hemisphere analysis, and back to right hemisphere generalization with left hemisphere exactitude. This encourages optimal use of both hemispheres and the Situational Method would therefore seem to be superior.

The young child needs more emphasis on "romance", and so will profit from activities and experiential involvement. The high school student will be caught by the interest of the stories or the value of new information in a more linguistically emphasized medium. Involvement will help him to work at control of expression. A child's abilities will be taken into account in teaching. A young child may simply hear and speak the second language in experiential use. Once he has learned to read and write, he will make use of these skills to help him learn the second language. Once he has developped and refined reasoning and analysis, he will analyze more frequently both the structure of language and words and their changes.

An educator takes the child as he is and where he is. Always, the child has two hemispheres working side by side. Slowly the left hemisphere will become more specialized for language production and comprehension, more specialized for reading and writing, more specialized in analytical and sequential reasoning. These capabilities the child will be called upon to use, as they develop, in order to help him learn the second language. Nevertheless, the parallel, gestalt processing of the right hemisphere also improves in function, and exposure to much language, all of which he does not necessarily understand, should increase also with age and capabilities. A high school student who is restricted to pattern drills or to grammar and excercises, soon loses interst. Books from which he can gain concepts and information, as well as stories of interest, should be provided. Any field trip or activity that is feasible should be considered. This challenge to the right hemisphere brings involvement and excitement, as the new territory is mapped in outline, before the left hemisphere sets to work to analyze in detail. Meanwhile, language is learned because it carries meaning worthy of attention. If the brain can find material worthy of its exertion, rather than the parrotted patterns of the Audio-Lingual Method or the restricted precision of the Cognitive-Code Method, then the twin hemispheres will both go to work, one making sense out of a wealth of data, and the other analyzing the structure and components of that data so as to be able to control similar output worthy of the attention of another. Mouthed phrases or precise exercises can remain as inert ideas, and

only engage the students peripherally. It is important to engage the various senses, higher and lower language processes, and both the left and right hemispheres of the students in our Second Language classes. To do this, the Semantic approach of the Situational Method seems to be preferable.

FOOTNOTES

1. The African name "Githaiga" I find hard to grasp orally, easy once I have seen it in print. Maruszewski has the reverse effect: the writing is confusing because of an unusual grouping of letters in English. Once mastered orally, it is simple.
2. Unfortunately, unless we speak Polish, it is a foreign pronunciation that we have worked out, according to an Enlish stock of grapheme to phoneme associations - [mærəzuskī] rather than the Polish [mæruʃɛvski].

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