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## ABSTRACT

In the neurolinguistic approach to the study of the acquisition of reading and writing, language may be used to express thoughts and intellectual attitudes as well as emotions and emotional attitudes. Experimental studies and clinical data suggest that / grammatical rules for spoken language predominantly rely on the left hemisphere of the brain, while the grammatical rules for body language (expressing emotions) rely more on the right hemisphere. The neurolinguistic approach also holds that: (1) in normal children and adults there is a strong relationship between expressive speech ability and reading and writing; (2) dyslexia is related to a left hemisphere lesion or to the absence of left hemisphere dominance for auditory discrimination of speech sounds; (3) speechless persons can develop reading and writing skills; (4) there are some basic abilities that must be available to these persons; and (5) it is possible to support the development of these abilities by using pictorial symbols. (Ten figures are included and 15 references are attached.) (RS)

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Presentation: Speech therapist, phoniatic dpt, special interest - language disturbances, including spoken and written languages, mostly working with aphasic patients and dyslectic youngsters, and since about two years with a project: computerized communication aid for aphasics (PICBOX), and let me immediately tell you that I have practically no clinical experience of multihandicapped children like CP-children.

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Acquisition of reading and writing.  
A neurolinguistic approach.

You can study reading and writing from different points of view and I want to emphasize that what follows is ONE way of doing it.

When two or more people come together and want to communicate they "use" their language. I will not here discuss the meaning and definition of language but merely state that language may be used to express thoughts and intellectual attitude, but also to express emotions and emotional attitudes. In the first case, expressing thoughts, we usually make use of speech. In the second case, expressing emotional attitudes, we use body language. Spoken language and body language both have to rely on socially accepted rules in order to be intelligible. There is a grammar for spoken language and a grammar for body language, grammars that are different for different cultures. From experimental studies and from clinical data there is some evidence that these different kinds of grammar are mediated by different parts of our brain. While grammatical rules for spoken language seem to rely predominantly on the left hemisphere the grammar rules for body language seem to rely more on the right hemisphere. The differences are of course relative and not

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at all absolute. There are people, who are very sceptical about these statements, but I am not - yet - because of my own clinical experiences from my work with brain-injured persons. At least, I am not sceptical, until the next paradigm shift comes concerning brain-behaviour relationship.

So far about close communication. For distant communication different kinds of written languages have emerged. The earliest forms of written language were pictorial, and there are still written languages with elements of pictorial writing. In written Chinese and Japanese there are elements of pictorial writing.

In the early forms of written languages one could find a word like this.

OH 1 (upper half)

This could mean "chicken" or perhaps "bird".....

And here is the same concept written in modern Chinese (taken from different dictionaries).

OH 2

These signs are pictures and refer directly to the content, to semantics. Today, most languages have a script with letters which we usually think of as a kind of visible speech.

Let's look at these two words

OH 1 (lower half):

<chicken>      <bird>      [tciken]      [b :d]

Here we recognize elements from the spoken words, but there is not a total one-to-one correspondance.

/c/h/i/ck/e/n/      /b/i/rd/      3

3

Time is too short for discussions about the relationship between letter script and speech, but from only these words it can be seen that

OH 2:

- one letter may represent one sound, <b> - [b]
- one letter may represent two different sounds in different contexts, <i> - [i] and <i> - [ɪ]
- two letters may represent one sound <ck> - [k]

And so on!

These examples make it clear that there is not a one-to-one-correspondance between speaking and writing.

In order to learn a letter script the child, besides having a language, has to

OH 3:

1. be able to learn the symbols, the letters, as a visual-motor task, which can result in copying of real letters and words.

2. segment the speech chain, to realize that sounds are separable. This stage can result in phonetically correct spelling, like in Swedish

<vij> (we) for <vi>

or

<nij> (you) for <ni>

3. In order to omit the /j/ the child has to find out the phonology of the language, to realize the smallest elements that can change the meaning of the words. This gives phonological spelling, like

<vi>

<ni>

4

4. For a total mastery of written language the child has to find out the relation between spelling and lexicon in order to master lexical spelling.

<bird>

Lots of other and better examples can be found to this point, but this refers to the above example.

There are of course spelling rules for this, but very few people believe today, that all these words with lexical spelling are learned according to such rules. It is instead assumed that the children learn to make an association between the lexical meaning/the semantics and the spelling. It is a script with letters, but where the letters are cognitively handled as a pictorial pattern with direct associations to semantics/to the meaning.

And this makes the lexical spelling of letter script very similar to pictorial script. In a way then, we have a kind of pictorial writing even in these languages that are said not to have.

(For a skilled reader the text is very much processed with this kind of top-down strategy which speeds up reading. Compare here what Lindblom said yesterday about listening. That you listen according to preparatory sets and not according to the exact signal - bottom-up).

It is certainly a mystery that small children are able to learn this!

There are also many who find reading and writing very difficult, which brings us to

Dyslexia,

which means failure to handle the written language. The term means "deficient reading ability" but it is very often used as a general term including reading and writing difficulties as well.

Dyslexia may be studied from different viewpoints and there is research going on in linguistics, psychology, education and different medical specialities.

From linguistic research it seems quite clear that a majority of the dyslectic children have a kind of phonological disturbance. They are not fully aware of the sound structure of their language. For these children it is difficult to take a metaperspective of language. It is a problem for them to separate the form/the sound structure of the word from the content of the word. A classical example is to judge a word like 'train' as longer than a word like 'butterfly', because a train is much bigger and longer than a butterfly. These children may also have trouble with rhyming, with segmentation of spoken words into sounds and phonemes, and with correct sequencing of sounds/phonemes.

Neurolinguistic research refers to studies relating brain function to language in different ways. Put into practice this has come to mean different kinds of studies depending on the researchers original discipline.

Neuroanatomical postmortem studies of brains from persons who have been dyslectic have given a lot of interesting data. Geschwind & Galaburda, and later Sandra Witelson, all in the USA, have found cellular anomalies in the left brain hemisphere and especially in a region called planum temporale.

OH 5

From neuroradiological and neuroanatomical studies we have more data concerning planum temporale. Most people have a larger left planum temporale but among those who are dyslectic it has been shown that planum teporale tends to be of the same size on both sides.

Psychologists, using laterality tests, like dichotic listening, have shown, that many dyslectic children and adults have an atypical hemisphere specialization with an overrepresentation of right hemisphere dominance, or more common, no dominance at all.

In an own study of 87 dyslectic children we found the same thing and we also found that more than half of these children had a combined audio-oral deficiency.

Let us now return to this OH (4).

To learn the letters, to identify them and to write them, we need basic skills belonging to the visuo-motor modalities.

OH 6 put onto OH 4.

7.

To learn segmentation of the speech chain we must rely on basic audio-oral skills and combine them with these visuo-motor skills.

To understand the phonology we must be able to separate form from meaning, an ability usually named metalinguistic ability or more specific in this case 'phonological awareness' and combine this cognitive process with these basic skills.

And to learn the relation between spelling and lexicon we have to rely on complex visuo-semantic and metalinguistic ability. Audio-oral capacity is not needed here.

It is only with the combination 1-2-3 that reading and writing of letter script is possible. It is possible to write to some extent with 1 and 2, and to read to some extent with 4. But for the fully mastery of reading and writing we need all four.

For understanding and use of pictorial signs 1 and 4 seem necessary, i e mastery of symbols and complex visuo-semantic competence.

Given this background let's now discuss

Written language and alternative communication, AC.

AC is a substitute for spoken language which has to be used when speaking is impossible or at least so disturbed that it is of no use for transfer of information. Information thus has to be transferred by some other means.

Since we know that there are those who use writing instead of speech it seems possible to have an audio-oral representation of the speech signal even when one is incapable of speaking.

How is this possible?

For normal children there is a strong relationship between speech development and reading and writing ability. Children with delayed speech development are very likely to become dyslectic.

In a longitudinal study of children we found, that of 226 children who at 4 years of age were delayed in their speech development, 89 were late in reading and writing acquisition, 39 %, and at the age of 13 there were still 54 of the 226 children who were dyslectic.

OH ?

Adults with acquired brain damage to the left hemisphere will typically show both speech disturbances and reading and writing disturbances.

How is it then possible that severely handicapped persons without speech can learn letter script?

We can only speculate about this today.

Would it, for instance, be possible to start the learning process with a visual-semantic approach before getting to phonetics and phonology? Yes, it certainly is. There are normal children who start to read and write whole word pattern before they learn the details and there are special teaching methods using this strategy.

But how do speechless persons master these last steps? Well, perhaps the audio-oral component is not so important? At least not for those who totally lack this component. In normal children speech is more or less automatically tied to letter reading and writing and they seem not to be able to make themselves free from this. For those who have never experienced speaking, this cannot be true.

What is then absolutely necessary for them to master in order to read and write besides having a language?

OH 8

- Mastery of the visual symbols
- To separate form from content
- Segmentation
- Sequencing
- Working memory

What kind of AC would support the development of these skills? (Note that I am now talking about children). First of all sign language which is verbal and very close to spoken language. See for instance Fuller et al, reporting about a multihandicapped boy (CP, deafness, anarthria), who via sign language certainly learned to master written language!

OH 9

But what about picture communication systems? Well, certainly not those that are iconical and depicting

concrete objects and events because here form and content are not clearly separable, there is nothing to segment and sequencing is less important.

To support segmentation and sequencing it is necessary to mark features of concepts and to use grammatical markers.

A picture communication system with these qualities might well result in acquiring of written language, like Bliss.

Moreover, a system which is not iconical will very likely stimulate language development in general (which is a prerequisite for all other steps to follow), whereas iconic pictures may hamper language development because the child is not given the opportunity to create its own association nets and to actively use features of concepts related to lexicon. Iconic pictures may in a way be compared to onomatopoeic "words" in spoken language and can not be regarded as *symbols* but as *signs*.

It has been shown, by for instance Tsvetkova, that there is a relationship between poor lexical development and poor ability to detect visual distinctive features of objects.

Gainotti has shown that aphasic adults with semantic-lexical disturbances of the language have difficulties with visual features.

There is from these and other studies (see listed ref.) clear evidence of a strong relationship between visual perception and lexical-semantic competence.

To summarize:

OH 10

Acquisition of reading and writing,  
a neurolinguistic approach.

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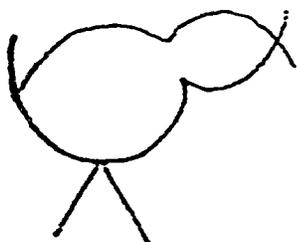
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<chicken>

<bird>

[tʃɪkən]

[bɜːd]

鳥

all creatures  
of the bird  
family

niaan  
(diaan)

鳥

bird

(niǎo)

鳥

ONE LETTER MAY REPRESENT ONE SOUND

<B> — [B]

ONE LETTER MAY REPRESENT TWO DIFFERENT SOUNDS IN  
DIFFERENT CONTEXTS

<I> — [I]

<I> — [ɪ:]

TWO LETTERS MAY REPRESENT ONE SOUND

<CK> — [K]

IN ORDER TO LEARN A LETTER SCRIPT, THE CHILD HAS TO

1. LEARN THE SYMBOLS/THE LETTERS → COPYING

2. SEGMENT THE SPEECH CHAIN → PHONETICAL  
SPELLING

SW. <VIJ> (WE) FOR <VI>  
<NIJ> (YOU) FOR <NI>

3. UNDERSTAND THE PHONOLOGY → PHONOLOGICAL  
SPELLING

SW. <VI>  
<NI>

4. LEARN THE RELATION SPELLING/LEXICON → LEXICAL  
SPELLING

ENG. <BIRD>

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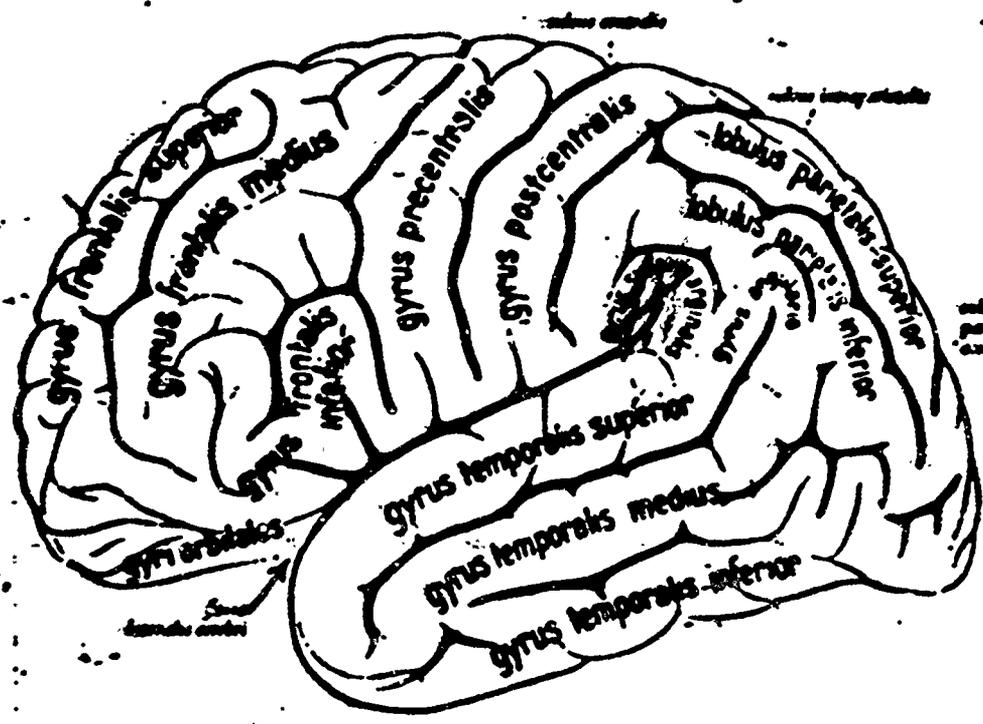


Fig. 207. Linke Seitenansicht des Hirnschenkels, palmar, und seiner Gliederung in Furchen, sulci, und Windungen, gyri (s. Fig. 206).

1.

VISUO-MOTOR

COPYING

2.

AUDIO-ORAL  
VISUO-MOTOR

SOME WRITING

3.

METALINGUISTIC COMPE-  
TENCE  
(AUDIO-ORAL)  
(VISUO-MOTOR)

SOME READING  
AND WRITING

4.

COMPLEX VISUO-SEMANTIC  
COMPETENCE

FULLY MASTERY  
OF READING  
AND WRITING

4 YEARS OLD

226 CHILDREN WITH  
DELAYED SPEECH  
DEVELOPMENT

7 - 9 YEARS  
OLD

89 CHILDREN  
LATE R & W

137 CHILDREN  
NO PROBLEMS

13 YEARS OLD

54 CHILDREN  
DYSLEXIA

- MASTERY OF THE VISUAL SYMBOLS
  
- TO SEPARATE FORM AND CONTENT
  
- SEGMENTATION
  
- SEQUENCING
  
- WORKING MEMORY

Are you looking forward  
to Christmas?

No I am Looking at  
you. I am not

LoO King AT Xmas

TO SUMMERIZE:

- SPOKEN LANGUAGE IS TO A GREAT EXTENT MEDIATED BY THE LEFT HEMISPHERE

- IN NORMAL CHILDREN AND ADULTS THERE IS A STRONG RELATIONSHIP BETWEEN EXPRESSIVE/IMPRESSIVE SPEECH ABILITY AND WRITING/READING

- DYSLEXIA IS RELATED TO A LEFT HEMISPHERE LESION OR TO THE ABSENCE OF LEFT HEMISPHERE DOMINANCE FOR AUDITORY DISCRIMINATION OF SPEECH SOUNDS

- FROM CLINICAL EXPERIENCE WE KNOW THAT IT IS POSSIBLE FOR SPEECHLESS PERSONS TO DEVELOP READING AND WRITING SKILLS

- THERE ARE SOME BASIC ABILITIES THAT MUST BE AVAILABLE TO THESE PERSONS

- IT IS POSSIBLE TO SUPPORT THE DEVELOPMENT OF THESE ABILITIES BY USING PICTORIAL SYMBOLS

.....BUT FIRST OF ALL WE HAVE TO SUPPORT LANGUAGE DEVELOPMENT IN GENERAL!!