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## RIGHT HEMISPHERE VERSUS LEFT HEMISPHERE: WHAT IS WRONG WITH THE TEACHING OF READING SCIENTIFIC LITERATURE?

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**ABSTRACT.** New findings in the investigation of the functional asymmetry of the brain shed light on many problems of human cognition. Reading in a foreign language (L2), being a kind of cognition, is subject to its laws. The experiments show that by processing verbal information the left hemisphere applies the analytical strategy and the right hemisphere the holistic one. The probabilistic structure of the world makes the holistic way of processing information very efficient; this strategy corresponds to the principle of least effort. But working with descriptions of highly probable events and thus having the possibility of using the holistic strategy at the first stages of learning L2, the students fail to master the formal grammatical means of the foreign language and are not able to use the analytical strategy where it is necessary: while dealing with scientific texts whose contents is predictable only to a small degree. The analytical strategy, as running counter the principle of economy, is very difficult to develop. A method, aiming at achieving this goal, is proposed.

*However powerful a linguistic analysis may be, it cannot account for all aspects of linguistic performance any more than one predict linguistic performance without knowledge of linguistics.*

*N. Geschwind. Biological Foundations  
of Language and Hemispheric Dominance*

The paper "Muttersprachliches gleich fremdsprachliches Lesen?" (Karcher, 1987) in the Journal "Zielsprache Deutsch" states: little has been done so far to clarify the specific character of processing written information in L2. Consequently, much is yet to be done about it.

In the present paper I put forward a hypothesis which, if proven true, might, as it seems, considerably diminish the amount of the unknown in the said problem.

To attain the goal I use the method widespread in contemporary scientific research work: many a time important inferences were drawn by means of comparison of theoretical ideas and experimental data, obtained in different fields of investigation.

I shall make use of some important revelations obtained during the last two decades by the scientists investigating the cerebral hemisphere asymmetry (on patients with the so-called "split brain" and the hemispherectomized subjects, on left-hemisphere-damaged patients, on patients undergoing the unilateral electroconvulsive treatment, and normal subjects tested under special conditions), of some ideas of cognitive psychology, and the general theory of processing information by man.

At the end of the 60's the first results of the experiments on patients with the "split brain"<sup>1</sup> were published. They were striking. Professor Rodger Sperry from the California Technology Institute was awarded the Nobel Prize. The researchers investigated diverse properties of the "two consciousnesses" of the patients (R. Sperry, 1985).

But in this paper I will only dwell on findings concerning the problem of processing verbal information by the disconnected hemispheres, or, to put it more exactly, on processing verbal information by the *right* hemisphere (RH).

As it is sometimes the case in science, the former Cinderella quite unexpectedly became the focus of attention. The hitherto almost neglected "minor", "non-dominant" hemisphere, contrary to all expectations, was found to possess linguistic abilities (Searleman, 1977; Hebes, 1979; Wapner et al., 1981; Zaidel, 1985).

True, it was shown that the linguistic competence of the RH was in many ways inferior to that of left counterpart.

True, the RHs of the commissurotomy patients (though varying to some extent from individual (Sidtis, Gazzaniga, 1983; Zaidel, 1985)) proved not to possess the ability to speak (Zaidel, 1983b).

True, the number of lexical units the RH has access to is smaller than the general storage of the lexicon (Hebes, 1978; Zaidel, 1985).

True, its syntax is limited (Zaidel, 1983b; Zaidel, 1985). But the RH *can* participate in processing verbal information. And that is in itself the fact that counts.

But of still greater impact on further investigations is another fact. The RH has *its own way of dealing with the verbal message* it receives. They call it

---

<sup>1</sup> That is the patients after dissection of the corpus callosum, which normally connects the two hemispheres of the brain.

synthetic, simultaneous, holistic, template matching and the like (Searleman, 1977; Springer, Deutsch, 1985; Paivio, 1986; Zaidel, 1983a; Zaidel, 1985). For the non-specialist these names seem a little vague, and perhaps the word "vague" itself is one of the appropriate definitions of the RH's way processing information.

But to demonstrate it, let us have a look at his activities.

The very first experiments showed the RH's ability to comprehend concrete nouns. The subjects who were asked to blindly retrieve with their left hand the objects after corresponding names were flashed in their left visual field, easily performed the task (Searleman, 1977; Hebes, 1978; Bloom et al., 1985). Later on, experiments converged on the conclusion that (though large variability across subjects must be taken into consideration), the RH possesses the auditory vocabulary of a 12 to 16 year old child and the visual vocabulary (the latter being a subset of the first) of a 7 to 10 year old child (Zaidel, 1985). But not so much the quantity as the quality of the RH vocabulary is of great interest. It turned out that the RH does fairly well at comprehending concrete nouns, then come verbs, adjectives, and adverbs. It is also adept at understanding spatial prepositions, but it is very poor at comprehending abstract part of speech: conjunctions, numerals, and so on. (Zaidel, 1985). In the associative experiment the RH produces paradigmatic associations, mostly using the names of objects that are found together in the objective reality (Deglin et al., 1983).

*The lexical preference of the RH show its openness towards the outer world, which is imageable, and its weakness at dealing with linguistic elements, which are so to speak "body-void".*

Let us turn to the syntactic abilities of the RH. The research yielded very interesting results.

Hemispherectomides patients could not find mistakes in the sentences like the following:

I paid the money by the man.

I was paid the money to the lady.

(Dennis, Whitaker, 1976; cited by Bloom et al., 1985).

During the unilateral electroconvulsive treatment the intact RH cannot discriminate between the sentences (1) and (2):

(1) Петя побил Ваню

(2) Петю побил Ваня

(the inflexions express the relations between the agent and the patient: (1) Pete beat Vania vs. (2) Vania was beaten by Pete).

Being shown the pictures, the commissurotomed patients cannot say which is correct:

The boy is kissing the girl

or

The girl is kissing the boy.

The dogs jump over the fence.

or

The dog jumps over the fence.

The girl is drinking the milk.

or

The girl will drink the milk.

(Gazzanig, Helliard, 1979).

Deprived of the aid of the left hemisphere, the RH is not able to discriminate between the positive and the negative sentences.<sup>2</sup> (Balonov et al., 1985).

*As to the syntactic structures, the RH is very poor at revealing the relations expressed in them by the linguistic means: it just knows the external world, its qualities and its relations.*

Now I will briefly describe some other experiments which demonstrate the same phenomenon of vague strategy of the RH but from another angle.

One experiment in particular is worth mentioning.

A subject with a partial callosal section being shown in his left visual field a certain word could not read the word but gave the description either of the object itself "Knight": "I have a picture in mind, but can't say it... Two fighters in a ring. Ancient wearing uniforms and helmets... on horses... trying to knock each off... Knights?") or of its surroundings (the word "stove" elicited a description of his aunt's kitchen: the word "onion" a description of a family garden (Siddis, Gazzaniga, 1983).

Patients suffering from the so-called "deep dyslexia" show a very similar sort of behaviour. It is quite natural: many anatomical and psychological evidence pointing to a relationship between brain asymmetry and dyslexia have been reported recently (Geschwind, 1983; Zaidel, 1983; Springer, Deutsch, 1985). A patient tries to read the word "enemy": "I know it... something... different countries fighting together... spy". (Jones, 1985). Another patient is asked to read the word "Holland": "I know it, I know it... this is a country... not in Europe... not Germany... no... a small country... it was occupied... Belgium; It's Belgium:" (Velichkovsky 1985).

In all three experiments the subjects are equally unable to immediately attain the goal. They are somehow beating about the bush.

<sup>2</sup> The contrary opinion expressed by Gazzaniga and Helliard (1979) is most probably due to the misinterpretation of the facts. The authors write: "The only "higher" grammatical dimension tested that was understood by the right hemisphere was the affirmative vs. negative. When a picture of a girl either sitting or not sitting was followed by the spoken alternatives "The girl is sitting" and "The girl is not sitting", the correct one was selected. Both (tested -M.K.) subjects performed almost perfectly on these positive-negative discriminations, despite their complete failure with the other aspects of language". But to all likelihood the patients discriminated not between "sitting" and "not sitting" but between "sitting", "standing", "lying", and so on. This kind of discrimination has nothing to do with grammar. It is discrimination between the actions.

The third important inference is like the two previous ones. *The RH knows the external world quite well. But having received a verbal message about it, it contents itself with creating a vague picture of the corresponding piece of reality.*

Thus, different kinds of experiments yield practically the same results.

A very provocative question arises. If the RH processes verbal information without taking much trouble about doing linguistic analysis, just using its good knowledge of the reality, is this strategy not made use of by normal subjects when they have to deal with the messages about this reality?

One of the most prominent specialists in the field of cerebral asymmetry E. Zaidel holds that "the evidence for the right hemisphere involvement in normal language is becoming increasingly prominent" (Zaidel, 1983b). But compared with the number of experiments on the isolated hemispheres, the tests on the intact brain are very few in number. The proofs of the involvement of the RH in language processing, the dominant hemisphere having equal possibility of processing information with the RH, are rather hard to obtain.

I tried to get evidence of RH activity in processing information by normal subjects using the RH's strong side (see italicised statements above): its knowledge of the external world.

One of the main features of the world is its probabilistic structure. Knowledge of the world includes knowledge of the probability of the events. There are events whose occurrence in reality in certain circumstances is near to 1. If we find such events and then, using linguistic means, produce a message in which the rough, vague picture is the same as in the probable event but whose probability is almost zero, then, if the message is processed by the RH, the processor of this hemisphere would be trapped.

I dictated to the subjects (all of them – students of the university) some sentences with the instruction to memorize them.<sup>3</sup>

The sentences were as follows:

- (1) В классе учитель дал ученику задачу.
- (2) В детской комнате мать дала ребенку игрушку.
- (3) На выставке поэт подарил художнику картину.
- (4) В столовой клиент принес официанту бифштекс.
- (5) На улице старушка помогла девушке перенести сумку.
- (1) In the class-room the teacher gave the pupil a task.
- (2) In the nursery mother gave her child a toy.
- (3) In the exhibition the poet presented the painter with a picture.
- (4) In the canteen the visitor brought the waiter beefsteak.
- (5) In the street an old women helped a girl to carry a bag.<sup>4</sup>

<sup>3</sup> There are some other versions of the test that yielded rather interesting data too, but for this paper this simplest version is quite sufficient.

<sup>4</sup> The first two sentences were given as distractors.

The English version of the sentences reflects only their sense but cannot serve as an adequate illustration of the experiment: in Russian as in a highly inflexional language the agent and patient are marked with special morphemes.

The theoretical supposition came true. The overwhelming majority of the subjects exhibited a *holistic* apprehension of the message. In their interpretations "the *painter* presented the poet with the picture", "the *waiter* brought the visitor beefsteak" and so on.<sup>5</sup> The linguistic markers were ignored. The rough, vague, matching strategy was used. But this is the strategy that the RH applies.

In my experiment the RH erred. But this is the cost that it has practically never to pay. The possibility of something almost impossible can be neglected. In return it can use the strategy which is by far more economic than analytical processing. And because economy is one of the leading principles of the vital activities of all life, it is highly improbable that possessing an instrument capable of applying an economic strategy, the organism would not make use of this instrument.

To sum up everything that has been said, we can formulate the statement: *The messages about the regular events in the objective reality are most probably processed in a holistic way, by means of a matching strategy, without linguistic analysis.*

That is already 50% of the answer raised in the title. Indeed: What does a compiler of a L2 text-book begin with? He/she begins with the "texts". The texts are like the following:

Unser Lehrer ist Herr Fix. Wir haben Unterricht, wir lernen Deutsch. Herr Fix zeigt Bilder und erklärt die Vokabeln und die Grammatik. Wir verstehen die Grammatik. Wir bilden Beispiele. Er korrigiert die Fehler und wir wiederholen die Sätze. (Deutsch. Ein Lehrbuch für Ausländer, 1979).

Lexical and grammatical means are taught at the same time. There are special "grammar" exercises in the text-book. But the students do not need grammar to comprehend the text. Laws of the world, the probability degree of the events plus grammatical redundancy spare them the trouble of analyzing the relations between the root morphemes.

Indeed, "Wir haben Unterricht" but not "Der Unterricht hat uns" (We have lessons" but not "The lessons have us"); "Er korrigiert die Fehler" and not "Die fehler korrigieren ihn" (He corrects mistakes" and not "The mistakes correct him"). In "haben" the ending "en" is redundant because number is one of the relative categories of the verb; the same holds for "t" in "er korrigiert".

The easiness of decoding sentences without any grammatical clues by no means promotes their mastering. As long as the student reads about Ann and Peter visiting friends or playing baseball, in too many cases these clues can be

<sup>5</sup> The fact that not 100% of the subjects misinterpreted the message, may be explained by the well-known individual differences in the profile of the asymmetry of the brain.

ignored. The RH-strategy turns out to be quite sufficient. Still most non-philologists learn languages "for special purposes", the scientists learn languages to be able to read scientific literature. This is the social demand of today. But the scientific texts differ from the everyday stories not only in the vocabulary and in the complexity of grammatical structures. *The main difference between these two kinds of texts that has never been the focus of attention of the linguists, is the degree of the predictability of the contents of these texts.* The description of the surroundings of man on the one hand and a scientific work on the other, are on the opposite sides of a predictability scale. The contents of a scientific work is unpredictable per definition. Science investigates the unknown, its world is just emerging from non-existence. The relations between the objects described in a scientific work can but only to a small degree be correctly guessed, they must be reestablished by the reader by means of grammatical clues. Here the switch to another strategy of reading must take place, the switch from holistic processing to the analytical priming approach. Such a switch from one strategy to another often place in the brain of man by the regulation of diverse processes, e.g. by regulation of the motions. We must assume that by reading in the mother tongue the switching mechanism works automatically; it regulates the rate of participation of both strategies in the encoding process. And as the native reader possesses the grammatical system of his language utterly – it is an integrate part of his language competence – he/she can use the force – consuming analytical strategy when the holistic strategy fails him/her.

But in L2, after the preliminary work at everyday topics is over, the grammatical clues, hitherto so often not needed, *are not assimilated*. Even people, who speak a foreign language fluently, often do not reach the degree of automatic use of grammatical means, for example omitting the "s" in the third person of English verbs (Krashen, 1981).

Thus, being faced with the non-predictable contents and possessing only a small ability to apply an analytical strategy, the students construct more or less verisimilar statements. They apply the rough strategy but now under *not adequate conditions*.

Where is the way out?

We cannot extirpate the RHs out of the brains of our students, when they learn L2, to make them use their not economic, analyzing left hemispheres. And being intact, the RH turns out to be stronger because it enables the reader to apply the principle of least effort.

Still, there is a way out. We can neutralize the RH. If the RH operates almost exclusively on root morphemes, we must find a means to somehow do without them, making the grammatical clues as such targets of learning.

Indeed, why do we not use the fact that there are two *separate* subsystems in the system of each language: the subsystem of lexical units and the

grammatical subsystem, which are *relatively independent*? There is a great difference in the way the two of them are treated by foreign language teachers: while the elements of the first are always drilled in dozens of sophisticated exercises, the second always comes short, never being an object of separate training, its means ever fixed to the units of the first. But even elementary linguistics says that the grammatical means have meanings of their own, and as elements of a system they obey definite laws, which can be studied. The grammatical means can be compared as members of paradigms, they can be examined as links of a syntagmatic chain. But comparison and revealing the laws of combination of the elements is pure analysis. And analysis is the *prerogative of the left hemisphere*. The RH cannot interfere in such an activity with its guesses drawn from the objective reality. Thus, for some period (its duration depends on the structure of a given language) the RH can be stilled.

There can be dozens of various tasks addressed to the left hemisphere. I shall confine myself to a few examples from Russian and from German.

## I. Russian

1) We are given the ending of a noun "-a". Can it be preceded by the ending of adjective "-oro"? If the answer is "yes", is this ending the only one possible? (Answers: yes; yes, if "a" is not the ending of the possessive case).

2) We are given the ending of a noun "-a". Can this noun be preceded by an adjective with the ending "-ой"? (The answer is "yes" if it is the nominative case masculine gender).

3) We are given the ending of a "-o". Can this noun be a member of a paradigm where the other endings "-y", "-ой", "-амн"? (Answers: yes; no; yes).

## II. German

1) Can the omitted letter(s) be univalently restored?

vo...den Berechnungen

vo...dem Zeichen

au...der Seite

au...den Kreis

au...dem Bild

vo...die Klammer

(Answers: no; no; no; yes; no; yes)

2) Are the following grammatic means in the NP possible?

der...-nis

der...-tät

dem...-ung

einer...-schaft

ein...-ling

eines...-tur

(Answers: yes; yes; no; yes; yes; no).

3) One of the four constructions given below is often used, one is possible, but under certain conditions (what conditions?), the remaining two are impossible.

Which is which?

1. Man/...t/.../.../...
2. Man/...n/.../.../...
3. Man/wird/.../.../...
4. Man/...end/.../.../...

(Answers: 1 is often used; 2 and 4 are impossible; 3 is possible if the last word in the sentence is infinitive and impossible if it is participle III).

The two main goals of the exercises of this kind are: first, to make the students *realize* the fact that the grammatical means have a meaning of their own, and second, to make them *master* these linguistic devices. When roots come on the scene, the main aim is to show the *importance of these devices for the adequate understanding of the message*.

Two examples from German:

- 1) *Is there any difference in the meaning of the following parts of the sentences?*  
Die Übung fehlt...  
Der Übung fehlt...
- 2) *Who is the host and who is the guest?*  
Besucht Sie heute Ihr Freund?

Thus we force the analytical mechanisms of the left hemisphere to be involved in linguistic processing. To put it another way: *we form the analytical strategy of reading*. And when it is formed, the correct understanding of the relations of the objects described in the scientific work can be safeguarded. But it is just what we need.

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