

TOWARDS THE MECHANISMS OF "DYNAMIC APHASIA"

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Several years ago one of the present writers (A.R.Luria, 1947, 1948, 1962, 1963) described a special form of speech disorder, which followed focal lesions of the anterior part of the left hemisphere, and which he called "dynamic aphasia". The syndrome of this form of aphasia, very close to the "Adynamie der Sprache" mentioned by earlier authors (Kleist, 1930, 1934, Pick, 1905 and others), could be described as follows: the patient preserved sensory and motor speech; he could easily name objects and repeat words and even sentences. But he was unable to "propositionize" and his active speech was severely<sup>2/</sup> disturbed. In cases of most massive brain destruction the patient was unable even to construct a simple phrase; in less massive cases, severe difficulties appeared when the patient tried to tell a story, to describe-a- describe a situation or even to use his speech for verbal communication. Although his understanding as well as his motor speech were preserved, he did not use his speech for free communication, and remained practically speechless. When asked to describe a picture or to tell a story he only referred: "... yes... and.. how it can be said... Oh, Gosh... I really don't know..." We remember a patient with a gunshot wound in the lower posterior part of the left frontal lobe who tried to give an oral composition "The North.." and after 10 minutes could say only: "There are bears in the North..." and after further stimulation added: "That's ~~over bears in the~~ what I had to see repeat..."

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Another patient with the similar syndrome tried to give an extended composition "The North", failed, and found the solution of the problem by reproduction of a well known M. Lermontov's verse "The North...".

The syndrome of the "dynamic aphasia" remains; but the intimate mechanisms of this syndrome are not yet clear. The purpose of this paper is to make some steps towards the evaluation of the basic disturbances underlying this forms of verbal defect.

### The problem

We shall start by giving some examples of basic disturbances of the active speech in patients with "dynamic aphasia"; only then shall we be able to formulate a hypotheses and present a series of experiments which can prove it.

Patient Mor. (Neuro-Surgical Institute, case 36309), with an aneurism of the left anterior cerebral artery and haemorrhage in the posterior part of the left frontal lobe, was asked to tell the history of his own case.

"Well... oh Gosh... I...oh... no... that's the trouble...  
...no..." (3'35'')

"Will you tell please where are you living, what are you doing, how old are you?" "I'm.. oh...that's the trouble...  
...no..."

If concrete questions are given, and if the psychologist starts the answer, - the patient show to be able to finish!

Where are you working?... "Oh.. yes.." "I'm working.." "I'm working as a horseman". How old are you? "Oh.." I'm... "I'm twenty eight!.." Where are you living? "Living...living... I'm living - I'm living in a village... What do the horses do in the village? "Oh.. yes.. yes..." They are working in "They are transporting... grass.." Who is putting grass in the carriage? "Horses.."

wagon? "Workers". Who is pulled the carriage? "Horses"  
What is in the wagon? "grass.."

It is clear that the patient is unable to construct a sentence but has no marked difficulties in finishing a sentence started by the psychologist.

What kind of a basic disturbance leads to this defect of ~~speke~~ spontaneous formulation of a sentence?

It hardly can be a naming defect: the patient has no difficulties in naming an object; it cannot be a general lack of activity; the patient tries very actively to find the verbal construction he needs, and shows clear symptoms of conflict and disappointment when the verbal structure he needs is not found.

What can be the mechanism of this disturbance?

#### Disturbances of predicative functions

A hypothesis can be formulated pointing to disturbance of the predicative function of speech as the basic deficit in cases of "dynamic aphasia".

As it was mentioned years ago, that process which is initiated by a thought and which ends in an extended phrase has as a transitional link inner speech, abbreviated in its form and predicative in its structure (L.S. Vygotski, 1934). This inner speech is supposed to be a mechanism used by the subject for a transition from a preliminary idea to the extended verbal proposition. We propose that this inner speech with its predicative function, which takes part in forming the structure or scheme of a sentence, is disturbed in cases of "dynamic aphasia".

The first step to prove this hypothesis could be an experiment

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which could answer the question: is it equally easy for patients with "dynamic aphasia" to find names of objects (substantives) and names of actions (verbs) ? If these patients have really a disturbance of the predicative function of speech, - finding of names of actions would be much more difficult than finding the names of objects.

15 patients with dynamic aphasia, and 15 normal subjects took part in this experiment. They were asked to give as many names of objects, and as many names of actions as they could during one minute (with their eyes closed).

Normal subjects did not show difficulties in both tasks, and no marked differences in finding names of objects, and names of actions could be observed.

Patients with temporal (sensory) aphasia had severe difficulties both in naming objects and naming actions, the latter being sometimes even less difficult.

Patients with "dynamic aphasia" could be easily divided into three groups.

The first group - patients with massive syndrome of "dynamic aphasia" were unable to find both objects- and actions - names, and instead of giving a series of names required gave only high fixed verbal stereotypes.

The second group could easily find 9-10 names of objects in one-minute period, but was unable to find ~~eleven~~ even a few names of actions.

The third group of patients, which included patients with a good recovery from "dynamic aphasia", did not show any disturbances in finding names of objects, but had <sup>marked</sup> ~~named~~ difficulties in finding names of actions,

Table 1 gives comparative data obtained in our experiments.

Table 1

Finding names of objects and actions during 1 minute

|                                       | <u>** "</u> Number of names<br>of objects | Number of names<br>of actions |
|---------------------------------------|---|-------------------------------|
| Patients with<br>"dynamic aphasia" 15 | 10.3                                      | 2.7                           |
| Normal subjects 15                    | 30  | 31                            |

Table 2 gives some data obtained in a group of six patients with dynamic aphasia.

Table 2.

Finding names of objects and names of actions in a group of patients with dynamic aphasia

| <u>Names</u>     | Number of names<br>of objects<br>(1') | Number of names<br>of actions<br>(1') |
|------------------|---------------------------------------|---------------------------------------|
| 1. Pim (27237)   | 10                                    | 2                                     |
| 2. Mor.(36804)   | 8                                     | 2                                     |
| 3. Bog.(27715)   | 11                                    | 3                                     |
| 4. Kr. (33957)   | 12                                    | 2                                     |
| 5. Ilm. (33785)  | 9                                     | 4                                     |
| 6. Sklar.(33755) | 12                                    | 3                                     |
| Total            | 62                                    | 16                                    |

We can easily see that in these patients finding of names of actions (verbes) is about 4 times as difficult as finding names of objects (substantives).

Here are several examples from our protocoles:

Pat. Pim. (27237), 29 years old, graduate student of a university

removal of a tumor of the lower posterior part of the left frontal lobe, dynamic aphasia.

Experiment 1. Finding names <sup>of</sup> / object (1 minute period)

"a circle... a camel... a horse.. a cow... a lamb...

green... blue..." You have to tell only names of objects!

"Objects.. a table.. a circle.. sun... sky.. rain.. snow.."

Experiment 2. Finding names of actions (1 minute period)  
 "...Oh.. how ist it... to go... to go by bus.. to start  
 to go..."

Patient Kr. (33957) 45 years old, book-keeper, removal of  
 a tumor (meningeoma) of the left premotor zone, dynamic  
 aphasia.

Experiment 1: Finding names of objects (1 minite period)  
 "Horses.. a dog... a camel... a duck, a tree, an oak..  
 a pinetree... a mapletree... apples, tomatoes.. a cucumbes  
 ... now... earth.... earth... no, I can't..."

Experiment 2. Finding names of actions (1 minute period)  
 "... Oh... (25").. to work... oh, now..(35")... to read..."

Patient Mor.(36309), 28 years old, Farmer...,haemorrhage in  
 the region of the left anterior cerebral arthery, dunamic  
 aphasia.

Experiment 1. Finding names of objects (1 minute interval)  
 "... yes.. a fog.. sky... oh... a window.. a door...a frame...  
 oh, yes a frame.. I can't

Experiment 2.Finding names of actions (1 minute interval)  
 "... Oh... no (20") Oh... no...(30")... oh... I can't..."

The facts we presented show that patients with "dynamic  
 aphasia<sup>2</sup> are slow in finding names of actions, and we can sup-  
 pose the predicative structure of their speech is defective.

Can we <sup>support</sup> that this defect, ~~is~~ one of the most important cause:  
 of the difficulties in the free construction of propositions  
 which, as we have seen, is the most important symptom of the  
 whole picture of "dynamic aphasia"?

To answer this question we have to construct the next hypo-  
 thesis and to prove it in a special series of experiments.

Disturbances in the syntactical scheme of the preposition

... a difficulty in naming actions could

Disturbances in the syntactical scheme of the proposition

As was already shown, a difficulty in naming actions could be supposed to be an expression of a more deep disturbance - that of the predicative form of the inner speech.

One of hypotheses of L.S. Vygotski was that the inner speech abbreviated in its structure and predicative in its function, is an important link between the initial thought and the final extended verbal proposition. If this predicative function of inner speech is disturbed, - a deterioration in "propositionizing" will follow. Is that the case in patients with "dynamic aphasia"?

We can come nearer to the answer by examining a series of possible causes of the deficit of extended active speech in these patients.

As we have already said, it was not a disturbance of initial thought which was the cause of the patient's inability to engage in active extended speech. We could give them a starting idea (by giving them the general topic of the composition - par example "North" or by giving them a picture they have to describe) - and that didn't make their propositionizing easier.

It was not a disturbance of final expressive speech, which was the cause of the defect: patients with "dynamic aphasia" had no trouble in motor organisation of speech nor difficulties of naming objects.

The only trouble we can suppose could be the deficit of the predicative function of inner speech and as a result - a disturbance of the "linear scheme of the phrase", which was needed to find the way from the initial idea to a verbal expression.

It was very probable that patients with "dynamic aphasia"

could not find the scheme of the proposition they needed for a verbal formulation of the initial idea: they were unable to come to a preliminary scheme which contained knowledge of the number and sequence of the verbal elements included in the phrase needed; that is why ~~it~~ they tried to single out separate words from the whole net of verbal connections and failed to find the needed scheme of the sentence. If that was the case, - we could suppose a disturbance of a kind of subjective "generative grammar" - the mechanisms of which are now in the center of interest of the most outstanding linguists (cf. N. Chomsky, 1957 and others). How could we prove this hypothesis ?

Two ways to prove our hypothesis are possible: a negative and a positive one.

The first proof is to give to the patient all separate the words, necessary for constructing a sentence, but not giving him the "linear scheme of the phrase". If that will not help in constructing a proposition, we could conclude that the cause of the difficulties doesn't lay in the lack of needed words.

The ~~first~~ <sup>second</sup> proof is positive: we could give to patient a "linear scheme of the phrase", not giving him a single concrete word. If this test will help the patient - it will be a positive proof that it is the scheme of the phrase which leads to a difficulty of active extended speech.

Let us describe both ~~proofs~~ <sup>tests</sup>.

1. We give to the patient with a syndrome of dynamic aphasia separate words and ask him to construct a whole sentence.

As a rule - he fails, and remains unable to do the task we require. He either tries to repeat separate words, or he finds another way and, instead of constructing a new sentence,

he reproduced some pattern which were already read - made and which he only has to remember.

Pat. Mer. (36309) was given two words: "house" and "hen" and was asked to construct a sentence which included both words. After a long pause with unsuccessful efforts he utters: "House... oh... house... I can't... and hen... house... oh, dear me'.. it is house... and nothing..."

Pat. Bog. (27715) with a meningeoma of the posterior part of the left frontal lobe, a scientist, was given the word "thank" and in another experiment - the word "fly" and was both times asked to construct a sentence, including the word given. During a long period of 5-7 minutes he tried to do so, repeating the word given, but was unable to construct a sentence, and then in the first experiment at once referred a well known part of a poem containing the word "thanks" or - in the second experiment - a nursery rhyme containing the word "fly".

The negative results of these experiments are clear. The patient with "dynamic aphasia" is unable to construct a sentence even if separate words are given to him. The problem doesn't evoke a scheme of the sentence needed, and the patient gives only referances of separate words or turns to the reproduction of well established verbal stereotypes.

2. Let us now turn to what we called a "positive proof". The patient with a syndrome of "dynamic aphasia" is told to construct a phrase, expressing his wish ("I am hungry" or "give me some water") or formulating a simple situation of a picture ("A woman is cutting bread", "A boy is reading a book").

After when he proves unable to express an extended sentence

as it was shown, a series of cues is placed on the table. The cues bear no special meaning (pieces of paper, or buttons, or pebbles can be used); the number of cues in a row reflects the number of words in the phrase required. The patient has to touch every cue, and pronounce the phrase needed.

That kind of experiments provide an external linear scheme of the sentence, not giving the patient any concrete word.

The result of this experiment proved to be striking.

The patient formerly helpless in constructions a sentence, becomes able to fulfill this task, pointing with his finger to every successive cue; when the series of cues is removed, - he becomes helpless and is once more unable to solve the problem. A successive linear scheme of the phrase becomes in many cases a way of compensation <sup>of</sup> for initial defects.

Let us show that in a series of examples.

Patient Mor. (36309) with an expressed form of "dynamic aphasia" could easily name objects, repeat words and short sentences, but was unable to use his speech for free communication. Being questioned he echolalically repeated the question but was unable to find a phrase necessary for an answer. When he was shown a picture of a horse pulling a wagon with hay and asked to formulate the contents he tried to utter: oh... yes... oh, gosh.. a horse... and what else? Oh.... gosh!.."

When three cues (pieces of white paper) were placed on the table and the patient was ordered to point to each piece and to formulate a sentence, - he told at once: "A horse (pointing to the first cue) - is driving..(pointing to the second) - ..a carriage (pointing to the third).

When four cues are placed before the patient and he was asked to tell what farmers are doing in <sup>his</sup> farm, he pointed successively to each cue and told: "Farmers are transporting hay - with horses"..

When cues are removed and the patient was asked to answer the question once more - he became unable to do it and tried to find words needed with no success. He is asked to use cues. He takes separate pieces of white paper, placed five pieces in a row on the table, and pointing to each cue - constructs a sentence: "trucks...take - grain - to - the shed." Then he takes one cue more and adds - "and to the market!"...

He tries to say a sentence about the ~~we~~/ weather<sup>z</sup>, but doesn't succeed: "The weathes ...oh.. what is it.. the weathes<sup>z</sup>... no!" Taking three cues and pointing to them he says: "The weather - to.day - is fine!" x)

The patient was asked to tell the contents of a picture (a boy in the forest). He says: "A boy..(a long pause)..a forest...no.. I can't".

He was given a series of cues. He placed them on the table and pointing to every cue, tells a story: "A boy - went - to the forest - for mushrooms - and was lost... - he cried - and climbed a tree..." etc.

We have shown the restitution of the construction of extended propositions by means of external cues which give the linear scheme of the phrase with one example. We don't need to reproduce observation on other patients with the syndrome of "dynamic aphasia": all patients of our group, in a more or less clearly expressed fason, did show we- the same compensatory role of this kind of help, and

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x) In Russian - this sentence consists of three words; no particles and no verbs ("is", "are") are used.

we can conclude that this experiment was positive proof of our hypothesis.

The basic disturbance in "dynamic aphasia" can be described as a loss of the "linear scheme of the phrase", which, so far we know, can be a result of a deterioration of the inner speech with its abbreviated form and its predicative function.

### Reinforcement of the "Linear scheme of the phrase" and overcoming of perseverations

The recovery of the "linear scheme of the phrase" by means of external cues provides an accessory result we dare not underestimate. It is an important help for overcoming the pathological inertia of verbal stereotypes or of verbal perseverations, typical for disturbances of speech after lesions of the anterior parts of the brain.

As was already mentioned by one of the present author (A.R. Luria, 1902, 1963, 1964) and by a series of animals studies (cf. Mishkin, 1964 s.oth.), - lesions of the anterior part of the brain have a double consequence: They disturb complex programs of actions, and they result in a pathological inertia of complex motor stereotypes.

The same can be seen in the pathology of speech: lesions in posterior parts of the left frontal lobe can result in marked perseverations in the expressive speech, and we have all reason to believe that motor perseverations are one of the most important mechanisms in the so called "efferent" or, "Kinetic" form of motor aphasia (A.R.Luria, 1947, 1963 etc.).

Pathological perseveration can be easily observed in those cases of "dynamic aphasia" when the lesion is located in premotor zones and when subcortical motor ganglia are involved. In these cases which are close to "efferent motor aphasia", troubles of

active propositionizing are combined with perseverations of the words uttered.

It is one of the most important findings that in these cases the method of the restitution of the "linear scheme of the phrase" by means of external cues brings a double result: the restitution of propositionizing and the overcoming of pathological perseverations.

We shall give one example as an illustration.

Patient Oss. (29558), 47, engineer after removal of a tumor of the left premotor zone with a cyst. His movements were disautomatized, his speech was highly disturbed: no spontaneous active speech was observed, he was even unable to give automatized series of words (counting, verbs etc.); he could give echolalic repetition of one or two words, and when a larger series of words was given, he was unable to repeat the series because of perseverations of the first word.

Active speech was impossible; the patient was unable to give ---externa extended answers to questions, although his understanding of these questions remained unimpaired.

Please tell me your complaints. "Oh.. yes.. that's so... oh, gosh... yes..." What work are you doing? Oh.. yes.. that's so... oh... no...

A pen was shown to the patient, and he was told to ask someone to give him the pen... "Oh... zd.. da... zdar.. z darushku" /a contamination: instead of telling "daite ruchku" - "give me the pen" - the patient uttered contamination of both words/

External cues (two pieces of white paper) were given to the patient; there were placed on the table 15 cm apart. The patient was told to point to each cue and to say the phrase. The patient uttered: "Dai.. ruchku!" (Give me the pen"). No perseverations

or contaminations was seen. External cues were removed, and the patients was told to repeat the same proposition.

"...Zdarushka... oh... no... oh, dear me ... Zdarus<sup>k</sup>...  
... Oh. <sup>f</sup>osh..."

There pieces of white paper were placed on the table - each 15 cm apart)

The patient poits each cue and says:

|         |           |         |
|---------|-----------|---------|
| Daite   | Rushka    | me      |
| (give ) | (the pen) | (to me) |

He is very happy and smiles.

In this case external cues yield the double result we mentioned: they bring about a restitution of the scheme of the phrase, and simultaneously they help to overcome pathological perseverations.

We have here an example of the reorganizing role of the external cue and of the indirect (instrumental) organization of behavior which one of the present writers has shown long ago in a series of experiments (A.R.Luria, 1932, 1948).

#### Some steps toward a physiological analysis

We have shown the role of external cues in the restitution of the "linear scheme of the phrase" lacking in patients with "dynamic aphasia" as well their role in overcoming pathological inertia in the verbal system. Can we now take some steps towards a physiologic analysis of the facts mentioned as well towards an analysis of the mechanisms undelying "dynamic aphasia"?

Let us re-consider the mechanisms of speech disturbances in the cases of this peculiar form of aphasia.

As was already said we have every reason to believe the disturbance of inner speech and its predicative function to be the basic mechanism of "dynamic aphasia". We could even suppose that it was the transition of the initial idea to the "linear scheme of the

phrase" which suffered in these cases. Couldn't we prove it in a more direct way? Could we really show that the transition to a verbal processing was disturbed in this form of aphasia? Further experiment were needed to prove this assumption and to come nearer to its physiological mechanisms. Therefore we conducted some physiological experiments.

It is well known that every intention provides a preliminary preparation for action, and that a preliminary set is needed to make the action successful (Usnadze, 19 Anokhin, 1957). In cases when of preparation for verbal activity - such a preliminary set can be seen as a change of the electromyogram of the speech apparatus: The pre-starting changes of initial background of the electromyogram of the tongue and lips in the period of preparation to the speech was shown by a group of authors (Bassin and Beyn, 1957, et al.).

Could we use this technique for our purpose?

Couldn't we show whether the disturbances of transition of the initial thought to the verbal propositionizing "located" in-the-meter we have seen in cases of "dynamic aphasia" are physiologically "located" in the motor outlet of the speech or in-the whether there is a kind of blocking of the process in some earlier links, where no transition to a verbalization of the initial <sup>y</sup> thought can be seen?

Couldn't we show, what kind of changes can be registered when we use thy external cues we described above and when the external restitution of the "linear scheme of the phrase" opens roads towards the verbalization of the initiative thought?

A technique already described by earlier authors (Bassin and Beyn, 1957) was used. Electromyograms of the lower lip

(which proved to be representative for the transition from inner to external speech) was registered in patients with "dynamic aphasia". This was done in both situations already described: when patients proved to be unable to construct verbal propositions, and when they did overcome this difficulty by means of external cues of the "linear scheme of the phrase".

The patient was asked to be ready for a verbal answer, not giving aloud the proposition required; and the EMG of the lower lip was recorded in both cases by means of the Alvar-~~Electro-~~encephalograph with an ink-pen write<sup>2</sup>ent.

The results are shown in Fig.1 (a, b) and ~~c~~.

We can clearly observe that in cases where a patient with "dynamic aphasia" tries to formulate a verbal expression - no changes in the EMG background are seen (Fig.1, a): that proves that the disturbances in these patients are "located" not in the motor link of verbal expression itself, but that a ~~bee~~ blocking of verbal impulses at a preliminary stage is observed.

The type of EMG changes entirely when the second situation - that of external cues with a restitution of the "linear scheme of a phrase" is used.

In that case (Fig.1, b) and ~~c~~) the intention to say a ~~sent~~ sentence (which is blocked by the instruction to remain silent) results in a total change of the EMG background: an expressed increase of the ~~verb~~ voltage of the EMG takes place, and even separate bursts of EMG activity related to the components of the phrase prepared are seen.

It is clear, that external cues don't<sup>o</sup> only recover the "linear structure of the phrase", but open roads to the innervatory of impulses to the motor apparatus of verbalization.

The data we have mentioned show that an important step towards a physiological evaluation of the mechanisms of "dynamic aphasia" is possible.

It becomes possible to suppose that a distortion of inner speech with its predicative function is typical for "dynamic aphasia"; that this distortion results in a disturbance of the mechanism of transition from the initial thought to the "linear scheme of the phrase"; that this disturbance makes it impossible to evoke the preliminary sets of innervations of the motor apparatus of speech; and that the defect of active propositionizing is a result of such disturbances.

A century ago Hughlings Jackson formulated human speech as "propositionizing", and a half a century ago (German neurologists) he made their first statement about the "Adynamie der Sprache".

Up to now, "dynamic aphasia" was supposed to be one of the strangest forms of speech disorders, a kind of a "aphasia without aphasia", as this syndrome could be described.

Only now - a combination of Neuropsychological, linguistic and physiological analysis can propose ~~make~~ the first steps in the description of its mechanisms.

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## SUMMARY

Lesions of the anterior parts of the "Speech zones" of the left hemisphere result in a specific disturbances of speech which can be designated as "dynamic aphasia". These patients preserve their understanding of speech and have no troubles in the articulation of words; They can easily name objects and repeat isolated words and even short sentences. But they cannot use their speech for communication, and are unable to construct sentences.

During many years the mechanisms of this disturbance of "propositionizing" remained unknown.

The present authors try<sup>to</sup> make some steps towards the mechanisms underlying "dynamic aphasia".

They show that patients of this group can easily name objects but have marked difficulties in naming actions and that the predicative function of their speech is disturbed. That leads to a hypothesis that the basic factor of this form of aphasia is connected with the disturbance of "inner speech", abbreviated in its structure and predicative in its function.

This basic disturbance leads to the deterioration of the "linear scheme of the phrase" and to ~~the~~ a blocking of the transition from the initial thought to the extended sentence. The hypothesis is proved with an experiment where external cues giving a "linear scheme of the phrase" are presented to the patient and result in a restitution of "propositionizing". Electromyographic records prove that this method results in a restitution of verbal processing necessary for active propositionizing.

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