THE MECHANISM OF 'DYNAMIC APHASIA'

Several years ago one of the authors (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 aphasia, resembling the 'Adynamie der Sprache' mentioned by earlier authors (Kleist, 1930, 1934; Pick, 1905; and others), could be described as follows. The patient had 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 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 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 tell a story he said: "...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 on attempting to give an oral composition on 'The North' could only say after 10 minutes: "There are bears in the North..." and after further stimulation added: "That's what I had to report...". Another patient with a similar syndrome tried to give an extended composition on 'The North', failed, and found a solution by reproducing M. Lermontov's well-known verse 'The North...'. Yet, the mechanisms of 'dynamic aphasia' are not clear. The purpose of this paper is to take some steps towards describing the basic disturbances underlying this form of verbal defect.

1. THE PROBLEM

We shall give some examples of the disturbances of speech in patients with 'dynamic aphasia'; we shall then try to formulate a hypothesis and present experimental results to support it.

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

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"Well...oh gosh...I...oh...no...that's the trouble...no..." (3′35″).
"Will you please tell us where you are living, what you are doing, and how old you are?" "I'm...oh...that's the trouble...no..." When concrete questions were posed, and when the psychologist started the answer, the patient was able to finish it.
"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 wagon?"* "Workers." *"Who pulls the carriage?"* "Horses..." *"What is in the wagon?"* "Grass..."

It is clear that the patient is unable to construct a sentence but has no great difficulty in finishing a sentence started by the psychologist. What is the basic disturbance leading to this defect of spontaneous formulation of a sentence? It can hardly 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 forthcoming.

2. DISTURBANCES OF PREDICATIVE FUNCTIONS

The basic deficit in cases of dynamic aphasia seems to us to be a disturbance of the *predicative function of speech.*

It has been suggested years ago that the 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 (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 hypothesize 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 would be an experiment which could answer the question whether it is equally easy for patients with dynamic aphasia to find names of objects (substantives) and names of actions (verbs). If these patients really have a disturbance of the predicative function of speech, finding names of actions should be much more difficult than finding the names of objects. Fifteen patients with dynamic aphasia,

and fifteen normal subjects took part in this experiment. With their eyes closed they were asked to give as many names of objects and of actions as they could during one minute.

Normal subjects had no difficulty in either task, 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 in naming actions.

Patients with dynamic aphasia could be divided into three groups. The first group consisted of patients with a massive syndrome of dynamic aphasia. They were unable to find either object or action names, and instead of giving a series of names, they only gave verbal stereotypes. The second group could find 9–10 names of objects in one minute, but was unable to give names of actions. The third group, which included patients with good recovery from dynamic aphasia, had no disturbance in naming objects, but marked difficulties in finding names of actions. Table I gives comparative data obtained in our experiments.

TABLE I

Finding names of objects and actions during one minute

		Number of names of objects	Number of names of actions
Patients with dynamic aphasia	15	10.3	2.7
Normal subjects	15	30	31

Table II gives some data obtained in a group of 6 patients with dynamic aphasia.

TABLE II

Finding names of objects and names of actions in group 2 of patients with dynamic aphasia

	Number of names of objects (1′)	Number of names of actions (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 see that in these patients finding of names of actions (verbs) is about 4 times as difficult as finding names of objects (substantives).

Here are several examples from our protocols:

Pat. Pim. (27237), 29-year old, graduate student of a university, renoval of a tumor of the lower posterior part of the left frontal lobe, dynamic aphasia.
Experiment 1. Finding names of objects (1 minute period), "a circle ... a camel ... a horse ... a cow ... a lamb ... green ... blue ..." *"You have to give only names of objects!"* "Objects ... a table ... a circle ... sun ... sky ... rain ... snow ..."
Experiment 2. Finding names of actions (1 minute period), "... Oh ... how is it ... to go ... to go by bus ... to start to go ..."

Pat. Kr. (33957). 45-year old, bookkeeper, removal of tumor (meningioma) of the left premotor zone, dynamic aphasia.
Experiment 1. Finding names of objects (1 minute period), "Horses ... a dog ... a camel ... a duck ... a tree ... an oak ... a pine-tree ... a mapletree ... apples ... tomatoes ... a cucumber ... 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 ..."

Pat. Mor. (36309), 28-year old, farmer, hemorrhage in the region of the left anterior cerebral artery, dynamic 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 presented here show that patients with dynamic aphasia are slow in findings names of actions, and we propose that the *predicative structure of their speech is defective*.

We must now ask whether this defect is the most important cause of the difficulties in the free construction of propositions and, if so, the most important symptom of dynamic aphasia. To answer this question we have to construct a hypothesis and to test it in a special series of experiments.

H. DISTURBANCES IN THE SYNTACTIC SCHEME OF THE PROPOSITION

As noted, a difficulty in naming actions could be supposed to reflect a deeper disturbance – that of the predicative form of the inner speech.

One of the hypotheses of L. S. Vygotski was that 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, for example 'North', or by giving them a picture they have to describe) and that did not 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 organization of speech nor difficulties in naming objects. This leaves as the only candidate 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 original idea to a verbal expression.

It seems to us 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 they tried to single out separate words from the whole net of verbal connections and failed to find the needed scheme of the sentence. Hence it would appear that we are dealing with a disturbance of a kind of 'subjective grammar', the mechanisms of which are now in the center of interest of the most outstanding linguists (cf. Chomsky 1957, and others). How could we prove this hypothesis?

Two ways of proving our hypothesis are possible: a negative and a positive one. The first test is to give to the patients all separate words, necessary for constructing the sentence, but not giving him the 'linear scheme of the phrase'. If that will not help him in constructing a proposition, we could conclude that the cause of the difficulties does not lie in the lack of needed words. The second test is positive: we could give to the 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 tests in greater detail.

(1) The patient with a syndrome of dynamic aphasia is presented with separate words and is asked 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 reproduces some ready-made pattern which he only has to remember.

Pat. Mor. (36309), with a tumor on the posterior part of the left frontal lobe, 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 meningioma of the posterior part of the left frontal lobe, a scientist, was given the word 'thanks' and, in another experiment, the word 'fly', and was both times asked to construct a sentence, containing the given word. During a long period (5–7 minutes) he tried to do so, repeating the given word, but was unable to construct a sentence. He then suddenly referred, in the first experiment, to a well-known part of a poem containing the word 'thanks', and, in the second experiment, to 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 when separate words are given to him. The problem does not evoke a scheme of the sentence needed, and the patient gives only references 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") describing a simple situation in a picture ("A woman is slicing bread", "A boy is reading a book").

After he proves unable to express an extended sentence as it was shown, a series of cues is placed upon the table. The cues have no specific meaning (pieces of paper, or buttons, or pennies can be used); a number of cues in a row reflects the number of words in the phrase required. The patient has to touch each cue, and pronounce the phrase needed.

That kind of experiment provides an *external linear scheme of the sentence*, not giving the patient any concrete word. The result of the experiment proved to be striking. The patient, previously helpless to construct a sentence, is suddenly able to accomplish this task, pointing with his finger to each successive cue; when the series of cues is removed he becomes helpless again and is unable to solve the problem. A successive linear scheme of the phrase becomes in many cases a way of compensating for the original defects. Let us show this in a series of examples.

Pat. Mor. (36309), with a pronounced 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 upon the table and the patient was ordered to point to each piece and to formulate a sentence, he said at once: "A horse (pointing to the first cue) ... is driving (pointing to the second) ... a carriage (pointing to the third) ..." When four cues were placed before the patient and he was asked to tell what farmers are doing on their farm, he pointed successively to each cue and said: "Farmers are transporting hay ... with horses." When the cues were removed and the patient was asked to answer the question once more, he was unable to do it, and tried to find the needed words, with no success. He was then asked to use the cues. He took separate pieces of white paper, placed five of them in a row on the table and, pointing to each cue, constructed a sentence: "Trucks ... take ... grain ... to ... the shed." Then he took one more cue and added: "and to the market!" He tried to say a sentence about the weather, but did not succeed: "The weather ... oh ... what is it ... the weather ... no!" Taking three cues and pointing to them he said: "The weather ... today ... is fine!"[1] The patient was asked to describe the contents of a picture (a boy in the forest). He said: "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, told a story: "A boy ... went ... to the forest ... for mushrooms ... and was lost ... he cried ... and climbed a tree ...", etc.

We shall not reproduce observation on other patients with the syndrome of dynamic aphasia, since *all* patients of our group showed in a more or less clear fashion the same compensatory role of this kind of help. We can conclude, therefore, that this experiment was a 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 as we know, can be due to a

[1] In Russian, this sentence consists of three words: no particles and no verbs ('is', 'are') are used.

deterioration of inner speech with its abbreviated form and its predicative function.

IV. 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 important help for overcoming the inertia of verbal stereotypes or of verbal perseverations, typical for disturbances of speech after lesions of the anterior parts of the brain. This is an additional result of great significance.

As was already mentioned by one of the authors (Luria, 1962, 1963, 1964) with regard to a series of animal studies, 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 reason to believe that motor perseverations are among the most important mechanisms in the so-called 'efferent' or 'kinetic' form of motor aphasia (Luria, 1947, 1963, etc.).

Pathological perseverations 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 related 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 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.

Pat. Oss. (29558), 47, engineer, after removal of a tumor with a cyst in the left premotor zone. His movements were disautomatized, his speech was highly disturbed; no spontaneous active speech was observed, he was even unable to produce automatized series of words (counting, verses, etc.); he could give echolalic repetition of one or two words, but when a longer series of words was given, he was unable to repeat because of perseverations of the first word. Active speech was impossible; the patient was unable to give 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 ... darashku" (a contamination: instead of saying "daite ruchku" – "give me the pen" – the patient uttered a contamination of both words). External cues (two pieces of white paper) were given to the patient; they 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 were observed. External cues were removed, and the patient was told to repeat the same proposition. "... Zdaruchku ... oh ... no ... oh, dear me ... Zdarusk ... oh, gosh ...".

Three pieces of white paper were placed on the table, 15 cm apart. The patient pointed to each cue and said:

Daite	ruschku	mne
(give)	(the pen)	(to me)

He was very happy and smiled.

In this case external cues yield the double result we mentioned: they bring about a restitution of the scheme of the phrase, and simultaneously the 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 demonstrated long ago in a series of experiments (Luria, 1932, 1948).

V. SOME STEPS TOWARD A PHYSIOLOGICAL ANALYSIS

We have shown the role of external cues in the restitution of the 'linear scheme of the phrase' which was lacking in patients with dynamic aphasia, as well as the role of these cues in overcoming pathological inertia in the verbalization. Can we now take some steps towards a physiological analysis of the facts mentioned as well as towards an analysis of the mechanisms underlying dynamic aphasia?

Let us consider the mechanisms of speech disturbances in the cases of this particular form of aphasia. As was already said, we have every reason to believe that the disturbance of inner speech and its predicative function is 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. Could we not prove it in a more direct way? Could we really show that the transition to *verbal* processing was disturbed in this form of aphasia? To come nearer to its physiological mechanisms 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. In cases of preparation for verbal activity, such a preliminary set can be seen as a change of the electromyogram of the vocal tract. The pre-starting changes of intitial background of the electromyogram of the tongue and lips in the period of preparation for speaking has been shown by a group of authors (Bassin and Beyn, 1958).

Could we use this technique for our purpose? Could we not show whether the disturbance of transition of the initial thought to the verbal propositionizing that we have seen in cases of dynamic aphasia are physiologically 'located' in the motor outlet of speech, or whether there is a kind of blocking of the process in some earlier links, where no transition to a verbalization of the initial thought can be seen? What kind of changes can be registered when we use the external cues we described above and when the external restitution of the 'linear scheme of the phrase' makes possible the verbaliziation of the initiative thought?

A technique already described by earlier authors (Bassin and Beyn, 1958) 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 overcame 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-Electroencephalograph with ink-pen. The results are shown in Figure 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 (Figure 1b). This proves that the disturbances in these patients are 'located' not in the motor link of verbal expression itself, but that a blocking of verbal impulses at a preliminary stage is present.

The EMG changes entirely in the second situation, that of external cues with a restitution of the 'linear scheme of the phrase'. In that case (Figure 1c) the intention to say a sentence (which is blocked by the instruction to remain silent) results in a total change of the EMG background: a pronounced increase of the voltage of the EMG takes place, and even separate bursts of

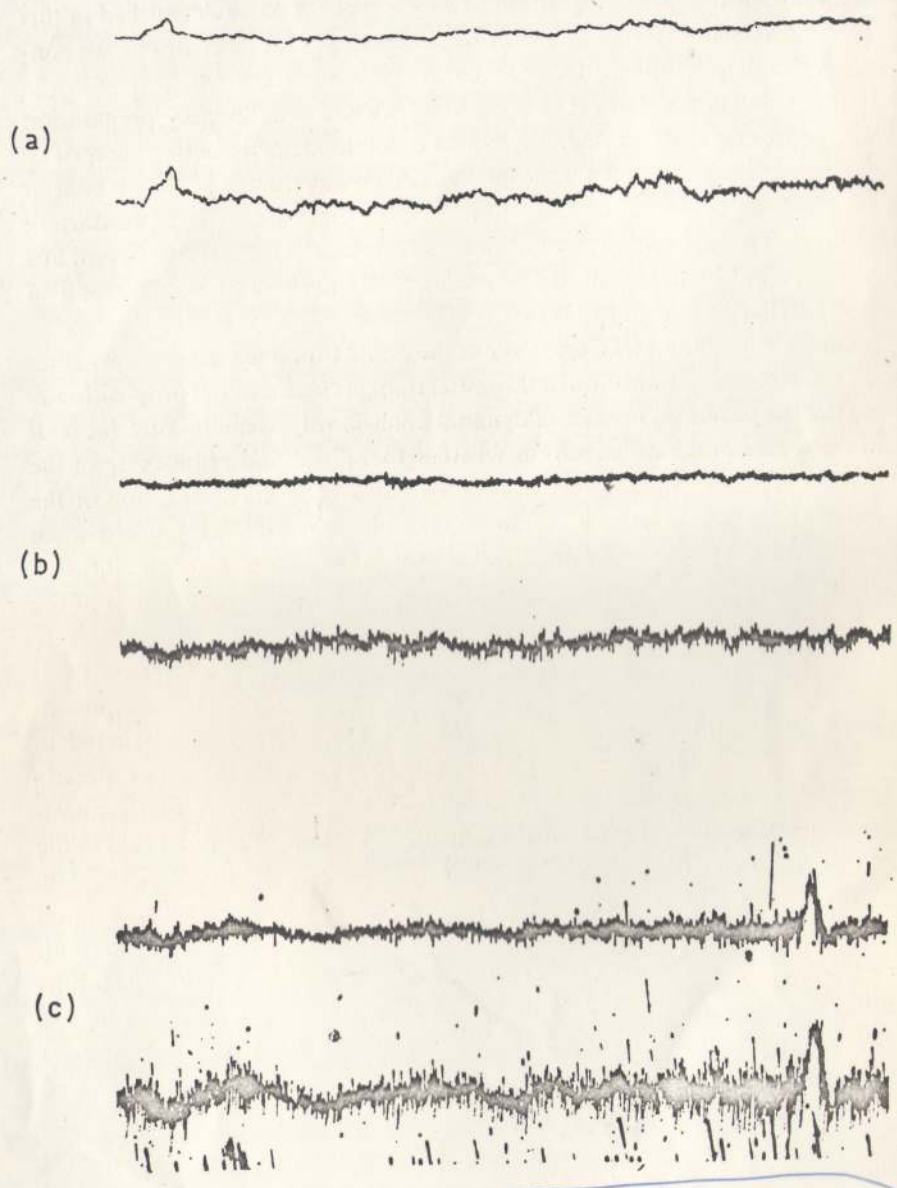

Fig. 1. Electromyogram of the lower lip of patient M. (a) Background (without any speech activity). (b) The attempts to recite a story (no bursts are seen). (c) The same, with a series of aids (paper showing the linear scheme of a phrase). (Active bursts by EEG are seen.)

EMG activity related to the components of the phrase prepared are seen.

It is clear that external cues do not only recover the 'linear structure of the phrase', but also open roads to the innervation of impulses to the motor apparatus of verbalization.

The data we have mentioned show that an important step towards a physiological evaluation of the mechanism of dynamic aphasia is possible. It may now be supposed 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 defined human speech as 'propositionizing', and half a century ago German neurologists 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 'aphasia without aphasia', as this syndrome could be described. Only now a combination of psychological, linguistic and physiological analyses allow us to take first steps in the description of its mechanisms.

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